EC20 PPP

Application Note

LTE Module Series

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About the Document

History

Revision	Date	Author	Description
1.0	2015-06-02	Francis TANG	Initial

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1 Introduction

This document gives a brief introduction to PPP function of Quectel standard module, including recommended procedures for PPP setup, the mode for PPP connection and the example for PPP dial-up in Windows and Linux system.

2 Application Mode
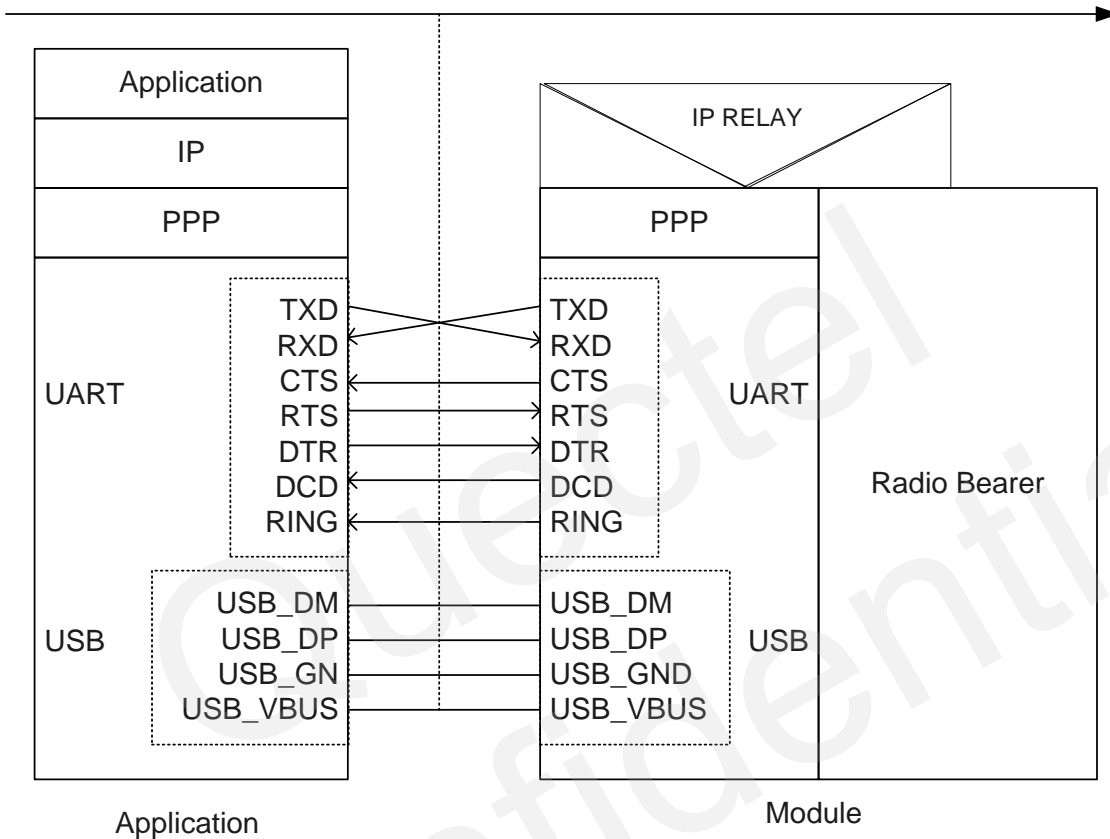
Figure 1: PPP Application Mode

The usage of PPP (Point to Point Protocol) can be described as Figure 1. You can use either UART or USB to realise PPP connection. Module provides a PPP server to application, and application side provides PPP client to module. Besides, application side also has to provide the following protocols: TCP/IP, HTTP, etc. When PPP connection has been set up, the IP packet flow from application side will be transmitted to Internet by module.

Most standard operating systems (e.g. Windows, Unix/Linux) include the PPP protocol stack. For other operating systems which do not have existing application to set up PPP connection, it is very important to develop applicable application software to accomplish PPP connection first.

3 Procedure for PPP Setup

This chapter gives the recommended procedure of PPP setup for Quectel standard module. If you want to develop PPP application software, please read this chapter before programming.

3.1. General Procedure for PPP Setup
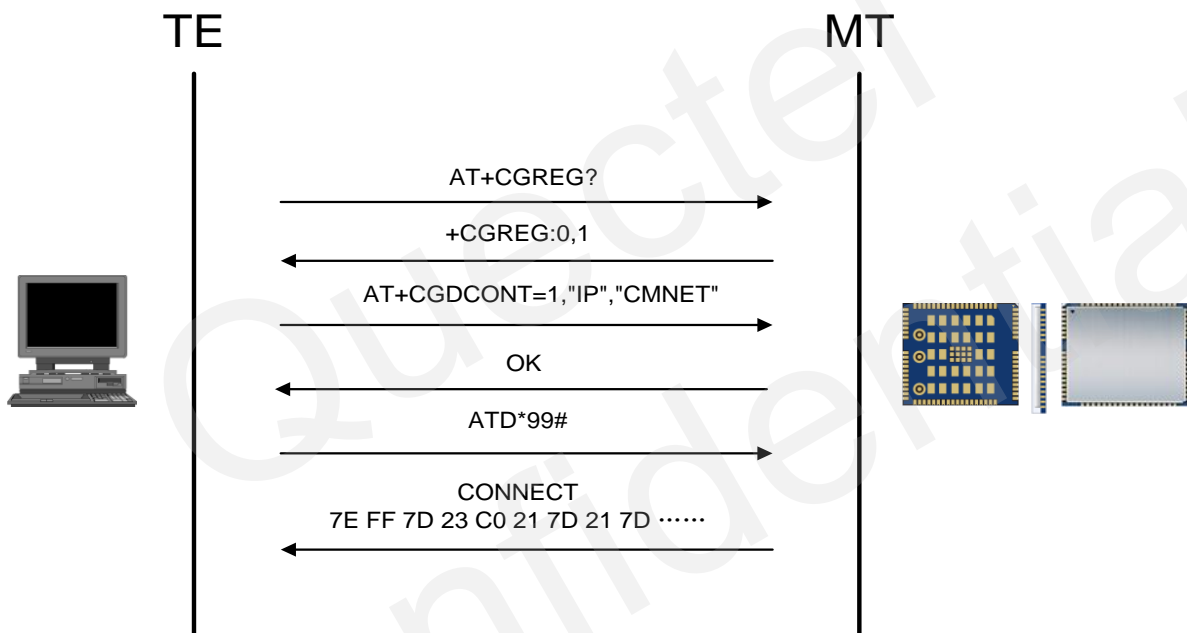
Figure 2: General Procedure for PPP Setup

After module has registered to the GPRS network, you should set APN for PPP by AT+CGDCONT and start PPP setup by command ATD*99#. When ATD*99# is executed, module enters into the procedure of PPP packet interaction. The way of PPP packet interaction which Quectel module uses is on the basis of standard Point to Point Protocol. Description about module's packet interaction is included in Figure 3. Please get more details about standard Point to Point Protocol from RFC 1661.

3.2. Recommended Procedure for PPP Setup

Recommended Power ON/OFF:
1. Power OFF: Pull Power Key from high to low, then cut off power after 12s.
2. Power ON: Pull Power Key to low in 1s.
3. Pull Power Key back to high when finishing Power OFF or Power ON.

Query SIM Card Status:
AT+CPIN. Reboot module if module failed to detect SIM card in 10s with AT+CPIN?.

Network:
1. It indicates that module has registered to network when AT+CREG? returns 1 or 5.
2. Reboot the module if it failed to register to network in 60s.

PS Network:
1. It indicates that module has registered to PS when AT+CGREG? returns 1 or 5.
2. It is able to go to next step without registering to PS in 60s.

APN Configuration:
1. APN must be set by AT+CGDCONT
2. Use AT+CGACT? to check whether current context has been activated when AT+CGDCONT returns error.

Packet Interaction
1. Exit from the procedure of Packet Interaction by "+++".
2. Module will report NO CARRIER when PPP connection is terminated.

LCP Negotiation
1. If UART is used, ensure the baudrate between MCU and module is the same.

AUTH Negotiation
1. Ensure the type of AUTH is one of PAP(0xc023) and CHAP(0xc223).

IPCP Negotiation
1. Check if MCU gets legal IP and DNS address.
2. Check whether the amount of DNS MCU is equal to the amount requested by MCU.
3. Terminate PPP connection if IPCP negotiation between TA and TE is not completed in 90s, and then retry PPP setup.

Exception Handling
1. Check whether the PPP Terminate-Request packet is right.
2. Reboot module if the steps above do not work.

Power On the Module

1. Synchronization between TE and TA
2. Fix and save baudrate by AT+IPR=xxx&W, if USB modem port is used, this coud be ignored

N

Exit from the PPP dialing if SIM Card is not ready in 10s

AT+CPIN? Query SIM Card Status — Y — Connect_Count <5

SIM card is ready

Exit from the PPP dialing if module failed to register to network in 60s

AT+CREG? Query network

Register to network in 60s

AT+CGREG? Query PS network

1. Set APN by AT+CGDCONT
2. Start PPP Dialing by ATD*99#

Connect_Count++

Return CONNECT

Packet Interaction

LCP Negotiation — OK — AUTH Negotiation — OK — IPCP Negotiation

Start timer when IPCP negotiation begins

OK

Succeed to negotiate IPCP in 90s — N — MCU sends PPP Terminate-Request packet — MCU receives PPP Terminate-Ack packet in 3s — Y

Y

Send Count<5 — N — Exception Handling

Y — N

Send Count++

Exception Handling

MCU got IP and DNS — N
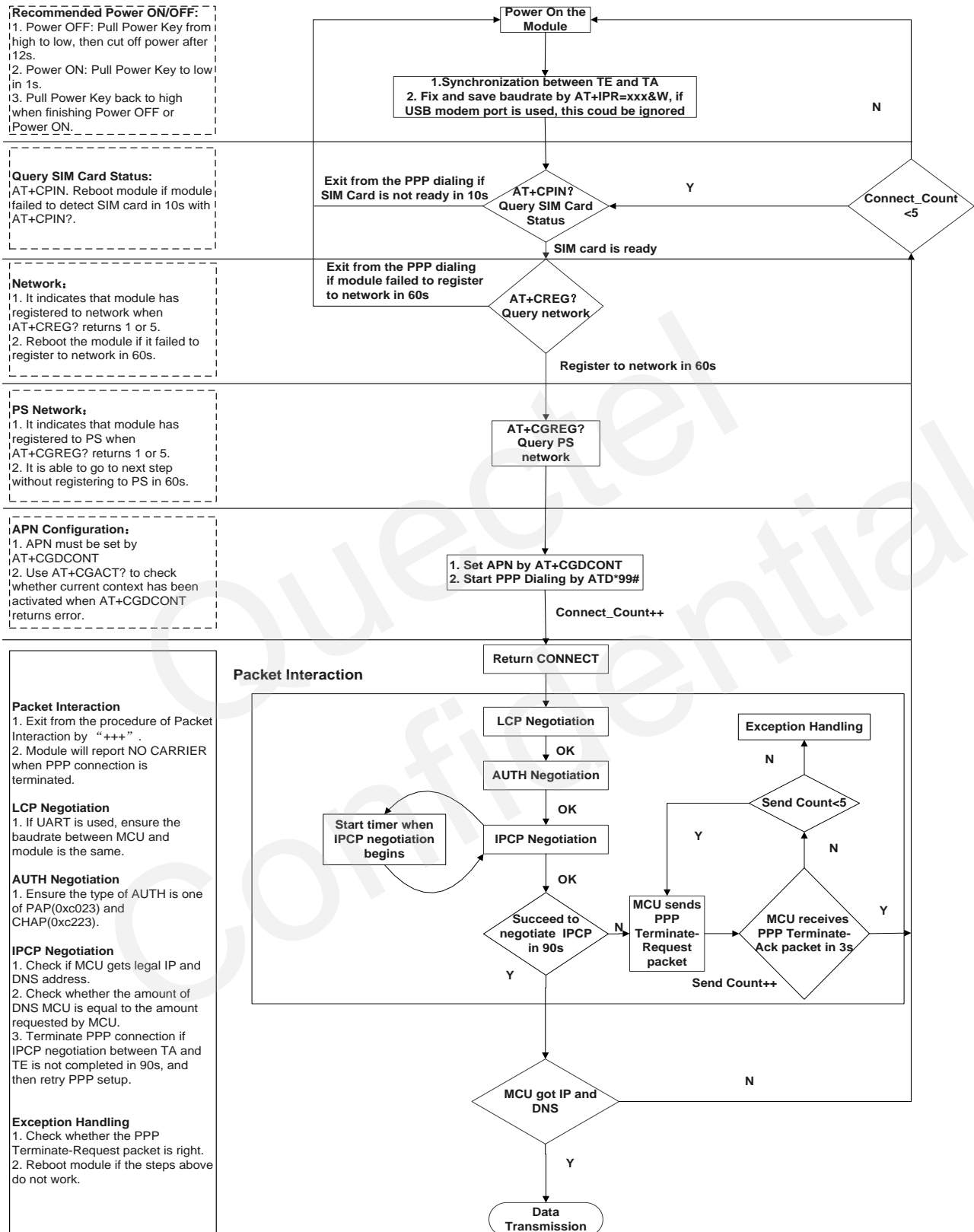
Y

Data Transmission

Figure 3: Flowchart for PPP Setup

When you power on module, if you use the UART, baud rate of the UART should be fixed by **AT+IPR=115200&W**. Before using **ATD*99#** to set up PPP, you must check the status of SIM card with **AT+CPIN?**. When SIM card is OK, you also need to check the state of network periodically with **AT+CREG?** and **AT+CGREG?** until network condition is ready.

NOTES

1. Ensure that MCU and the module are synchronized successfully after rebooting the module. MCU sends "**AT<CR><LF>**" to module every 100ms until "OK" is received from the module. And if the UART is used, MCU fixes and saves baud rate by "**AT+IPR=xxx&W**" after synchronization is successful.
2. Please note that MCU has to wait for the response (for example **OK**, **CME error**, **CMS error**) of the previous AT command before inputting the next AT command. The module can be rebooted if there is no response in 60s.
3. The module cannot be rebooted frequently. When you constantly failed to restart for 3 times, you can restart immediately for the first time after that, if it still fails, you should restart after 10 minutes for the second time, and restart after 30 minutes for the third time, 1 hour for the fourth time, etc.
4. If MCU fails to transmit data to network after PPP connection has been set up, please check the configuration of PPP and the state of network, and then reboot the module.

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4 UART/USB for PPP Connection

4.1. Data Mode and Command Mode

Module communicates information with application by UART/USB port, including AT commands and data. There are two modes for module's port. One is data mode and the other is command mode. Module's port is in command mode before PPP setup, and module can execute AT commands in this state. When PPP negotiating is started, module's port will enter into data mode. Module will be kept in data mode when PPP connection was set up and module cannot execute AT commands in data mode. Quectel standard modules provide convenient methods to switch between the modes.

4.1.1. Switch from Data Mode to Command Mode

4.1.1.1. Use DTR Level Switch from Data Mode to Command Mode

When PPP connection already exists and module is in data mode, you can change module from data mode to command mode by setting command of **AT&D1** and switching DTR level from low to high. If module's mode is changed successfully in this way, module will return "**OK**".

4.1.1.2. Use Sequence +++ to Switch from Data Mode to Command Mode

Another way to switch module from data mode to command mode is using sequence +++ when PPP connection has been set up successfully. To prevent the +++ escape sequence from being misinterpreted as data, it should comply with the following sequences:

- Do not input any character within 1s or longer,
- Input "+++" within 1s, and no other characters can be inputted during this time,
- Do not input any character within 1s after "+++" has been inputted.

When such particular sequence +++ is received, module will switch from data mode to command mode and return "**OK**" for this kind of operation.

NOTE

Please make sure above operation is operated after completion of PPP negotiation. If not, above operation will terminate the PPP negotiation and quit from data mode. When UART/USB is changed to command mode after accomplishing PPP negotiation, the data will be treated as AT command and module still remains PPP connection.

4.1.2. Switch from Command Mode to Data Mode

4.1.2.1. Use ATO to Switch from Command Mode to Data Mode

Example

//When PPP connection exists, and module is in command mode.
ATO
CONNECT 100000000   //Indicates that TA has entered into data mode; inputting
                                   commands from UART will be treated as PPP data.

4.2. Terminate the Connection

It is recommended to terminate the connection with LCP Terminate-Request message in PPP. This method must be operated in data mode.

TA can also terminate the connection by switching the DTR level. You should set DTR function with **AT&D2** first. This method must be operated in data mode as well.

Example

//Module is still in command mode before PPP connection has been set.
AT&D2
OK

When PPP connection exists already, switch the DTR level from low to high, the data connection will terminate automatically. Module enters into command mode after PPP connection is terminated completely.

4.3. Handle URC in Data Mode

Incoming call and short message will not be reported to the port in the data mode during PPP connection. The level of module's RI pin will change from high to low for 120ms as indication. MCU can process the call or short message by switching to command mode according to the status of RI pin. If incoming call or message exists, the URC will be output to the port when module is changed to command mode.

4.4. Data Carrier Detect (DCD) Function Mode

DCD function mode is determined by **AT&C**. If **AT&C0** was set, the status of DCD pin will not be used to indicate the data carrier status. And if **AT&C1** was set, the DCD pin will be used to indicate the data carrier status. The pin will hold on low level when data carrier exists or PPP negotiation begins, otherwise it will keep in high level.

NOTE

When switching PPP from data mode to command mode (using **+++**), the DCD state does not change.

---

5 PPP Dial-up in Windows

5.1. Preparation

It is necessary to finish the following steps before establishing a PPP connection.

1. Connect the module to PC and enter the PIN code if the SIM card PIN is locked.
2. Make sure the SIM card can successfully register to the GPRS network.

5.2. Modem Configuration

5.2.1.   Add a Modem

If "**Standard 19200 bps Modem**" has not been installed on your PC, you need to add a standard modem.

1. Click "**Start**"->"**Settings**"->"**Control Panel**"->"**Phone and Modem Options**". Please refer to Figure 4.
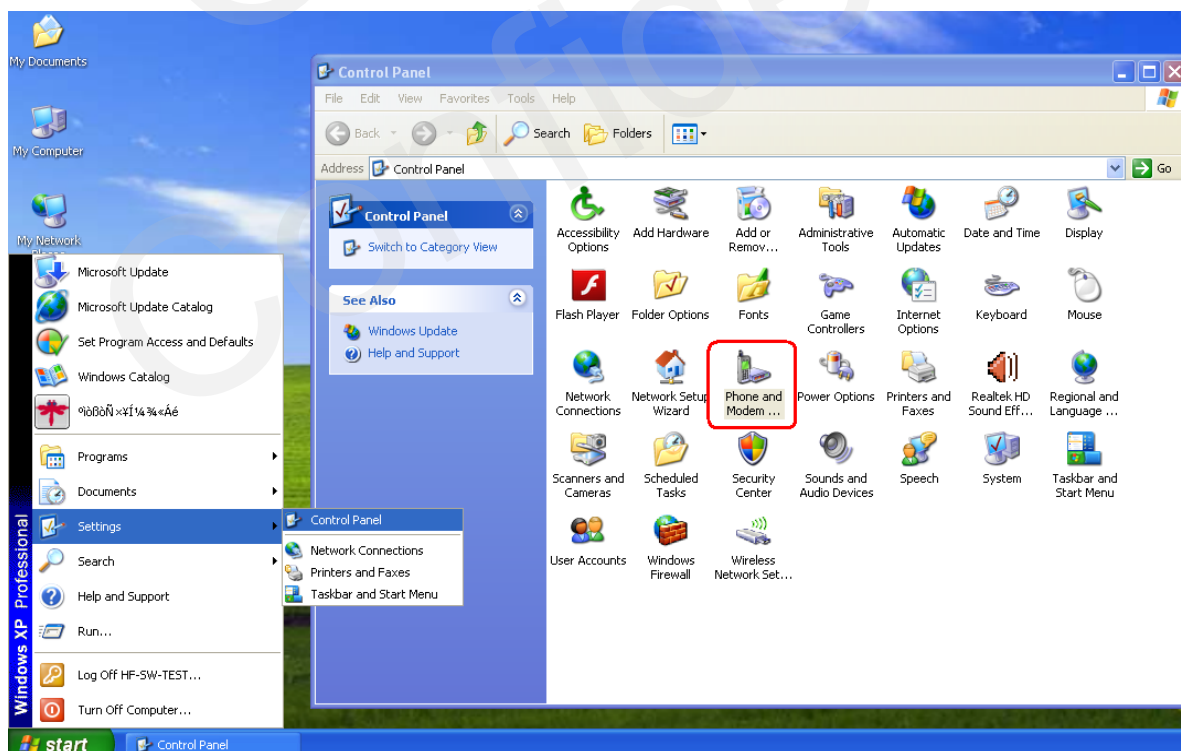
Figure 4: Phone and Modem Options

2. Double click "**Phone and Modem Options**", and select "**Modems**"->"**Add…**" to add a modem. Refer to Figure 5.
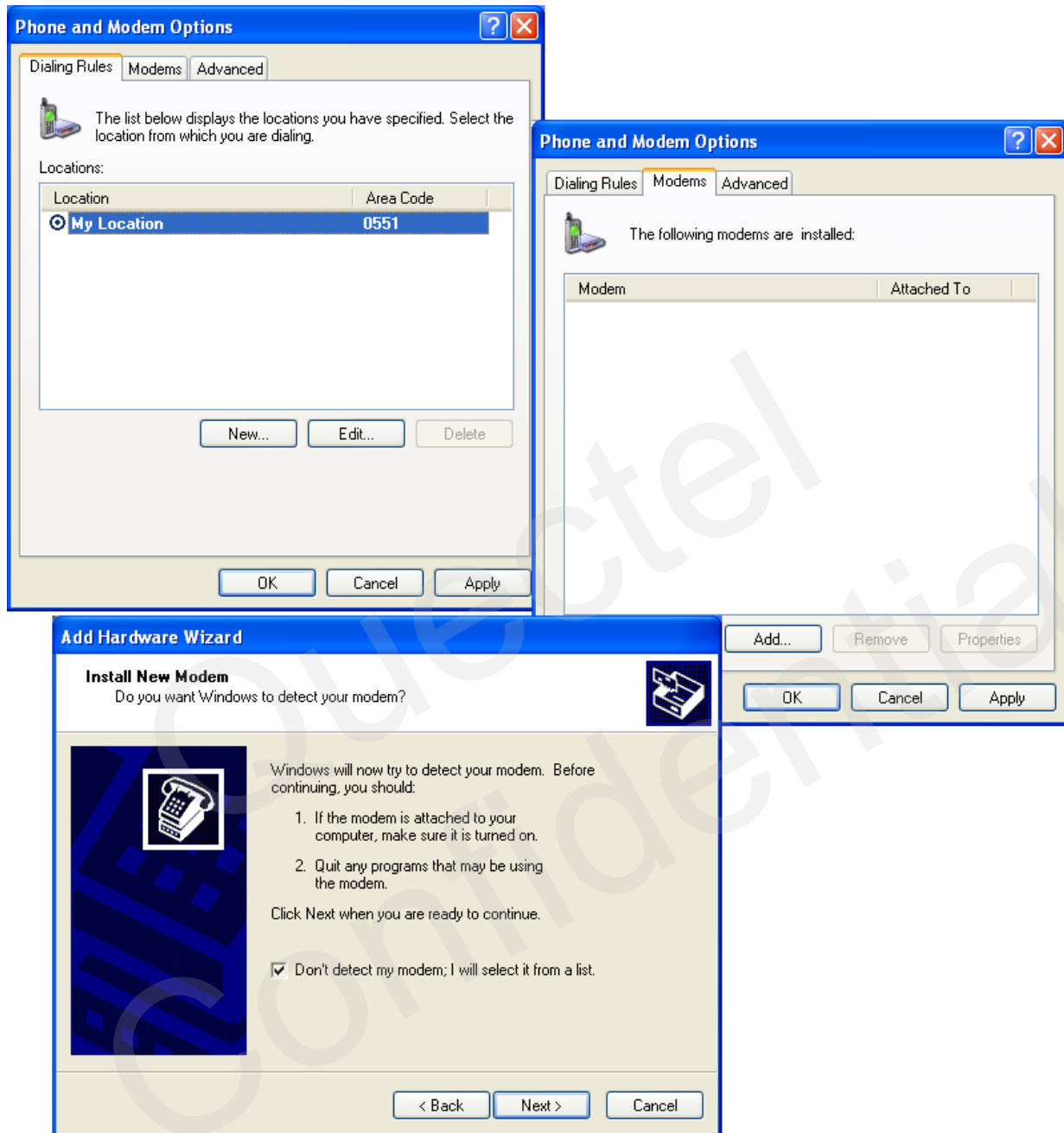

Figure 5: Add a Modem

Install the new modem, refer to the instructions on the screen, select "**Standard 19200 bps Modem**" and click "**Next**" button, a port (COM3) will be installed, then click "**Next**" and wait till the configuration is finished. Refer to the following figures.
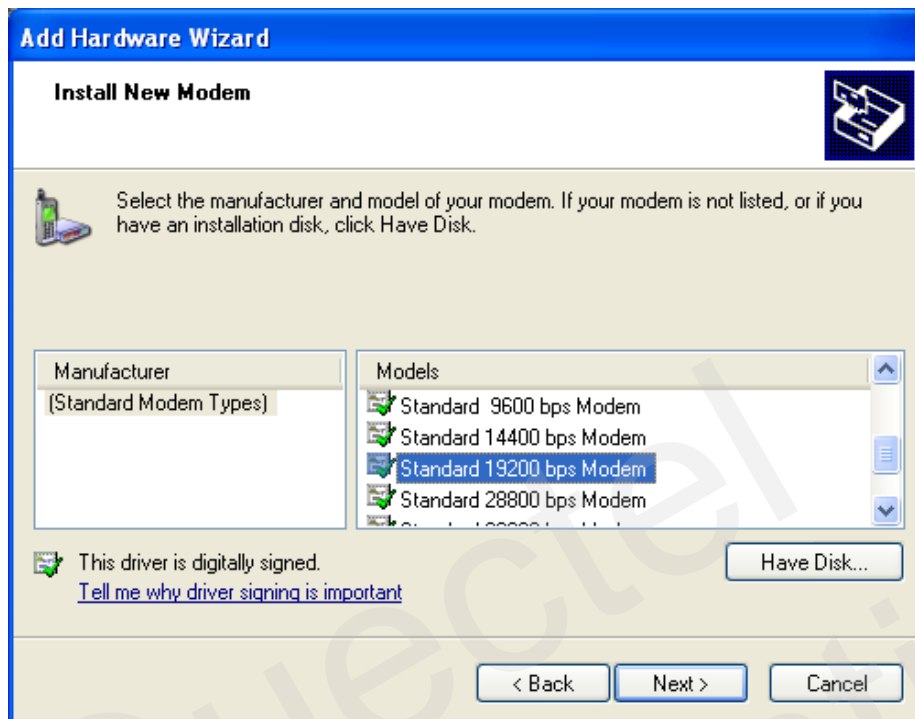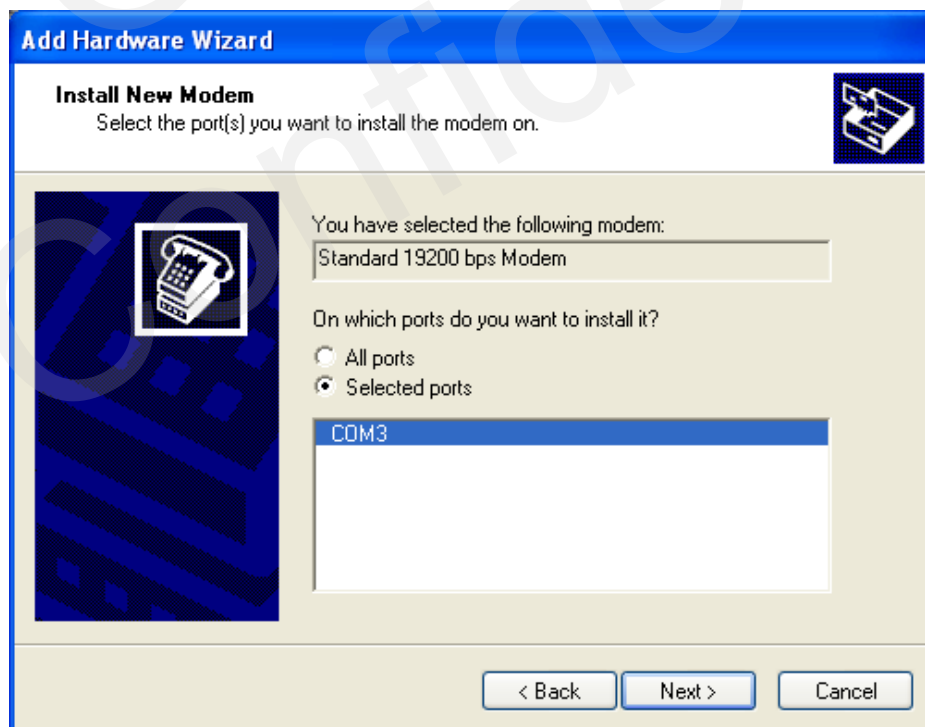

Figure 6: Select Model of the Modem
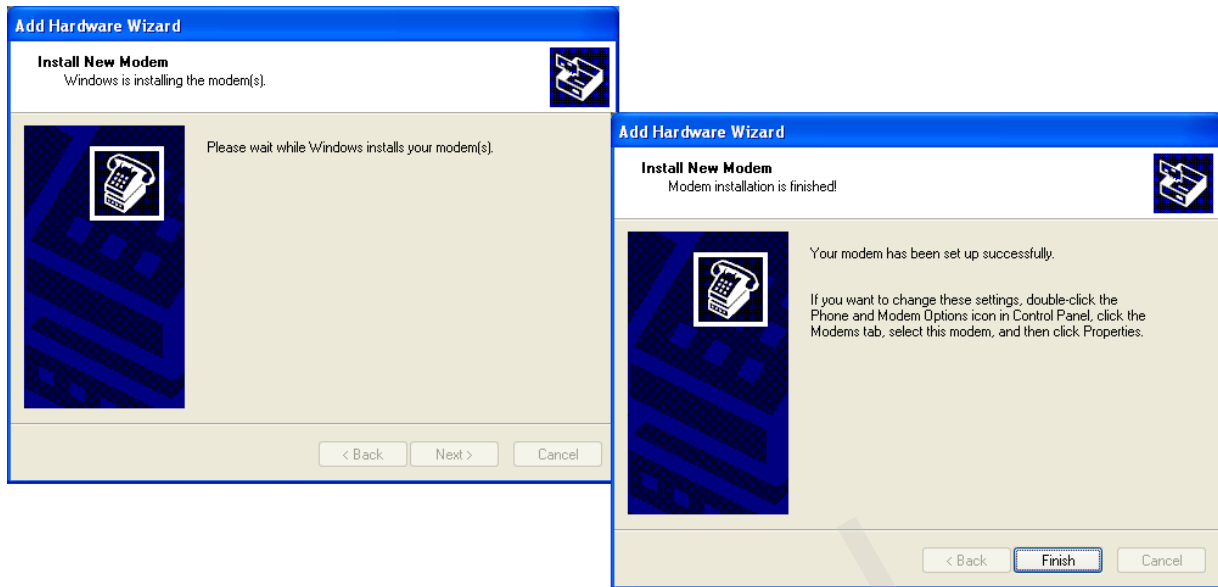

Figure 7: Select a Port

Figure 8: Installed Successfully

5.2.2. Configure the Modem Driver

Select the "**Standard 19200 bps Modem**" which has been installed, click "**Properties**" button, choose "**Maximum Port Speed**" as **115200** (default value), then click "**Advanced**" to configure "**Extra Settings**", input AT command "**AT+CGDCONT=1,"IP","CMNET"**" as illustrated in the Figure 9 below.
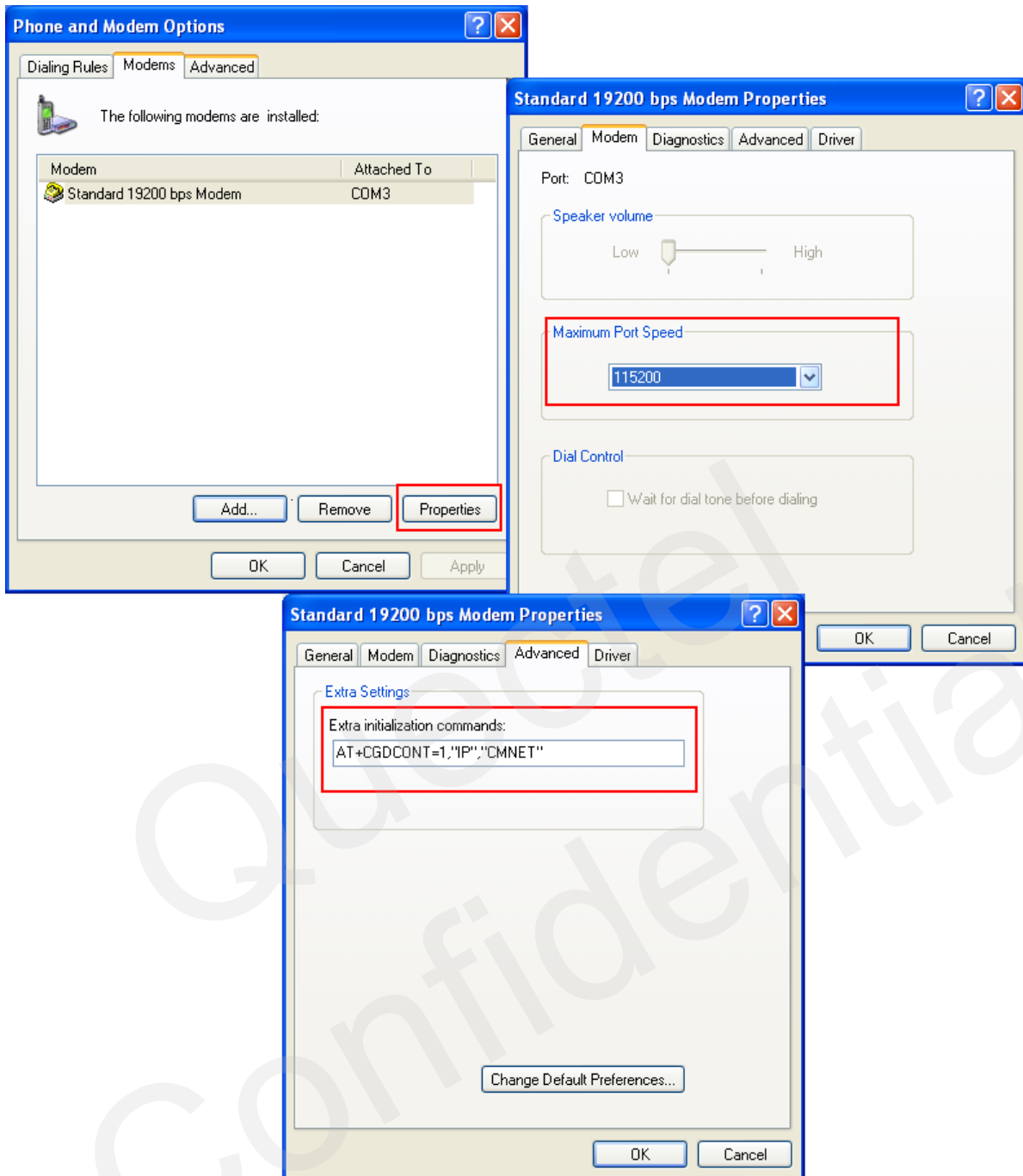
Figure 9: Configure the Modem Driver

NOTE

In the example above, the settings predefine a PDP context whose CID=1, PDP type=IP and APN=CMNET. CMNET is the APN for the network provider China Mobile and it should be replaced with the APN by the network provider.

5.3. Dial-up Network Configuration

5.3.1.　Create a New Connection

Open "**Control Panel**" and double click "**Network Connections**", then click "**Create a new connection**" from the right list of Network Tasks. Refer to Figure 10.
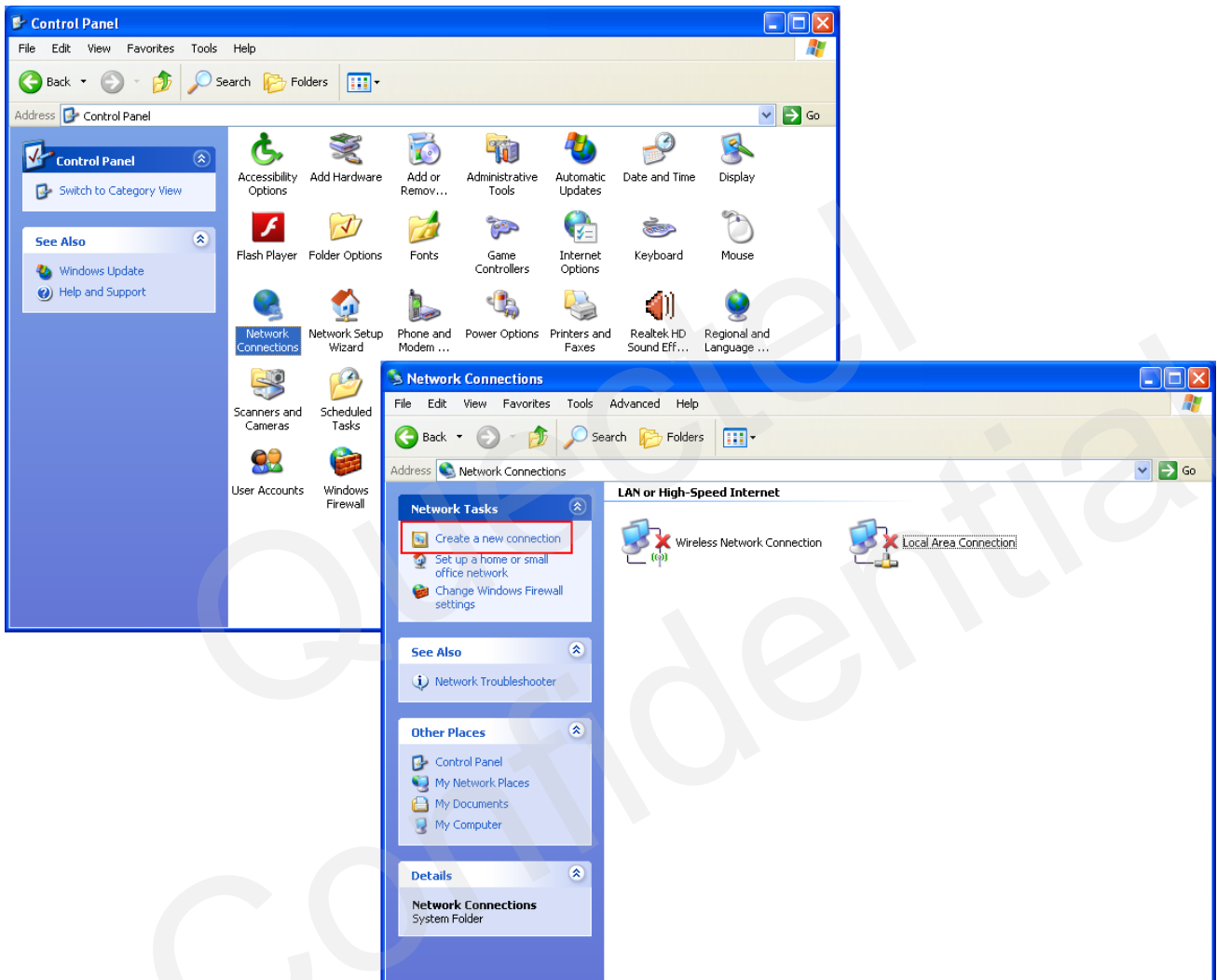

Figure 10: Create a New Connection

Click "**Next**" button, choose "**Connect to the network at my workplace**"->"**Next**", then select "**Dial-up connection**". Refer to Figure 11.
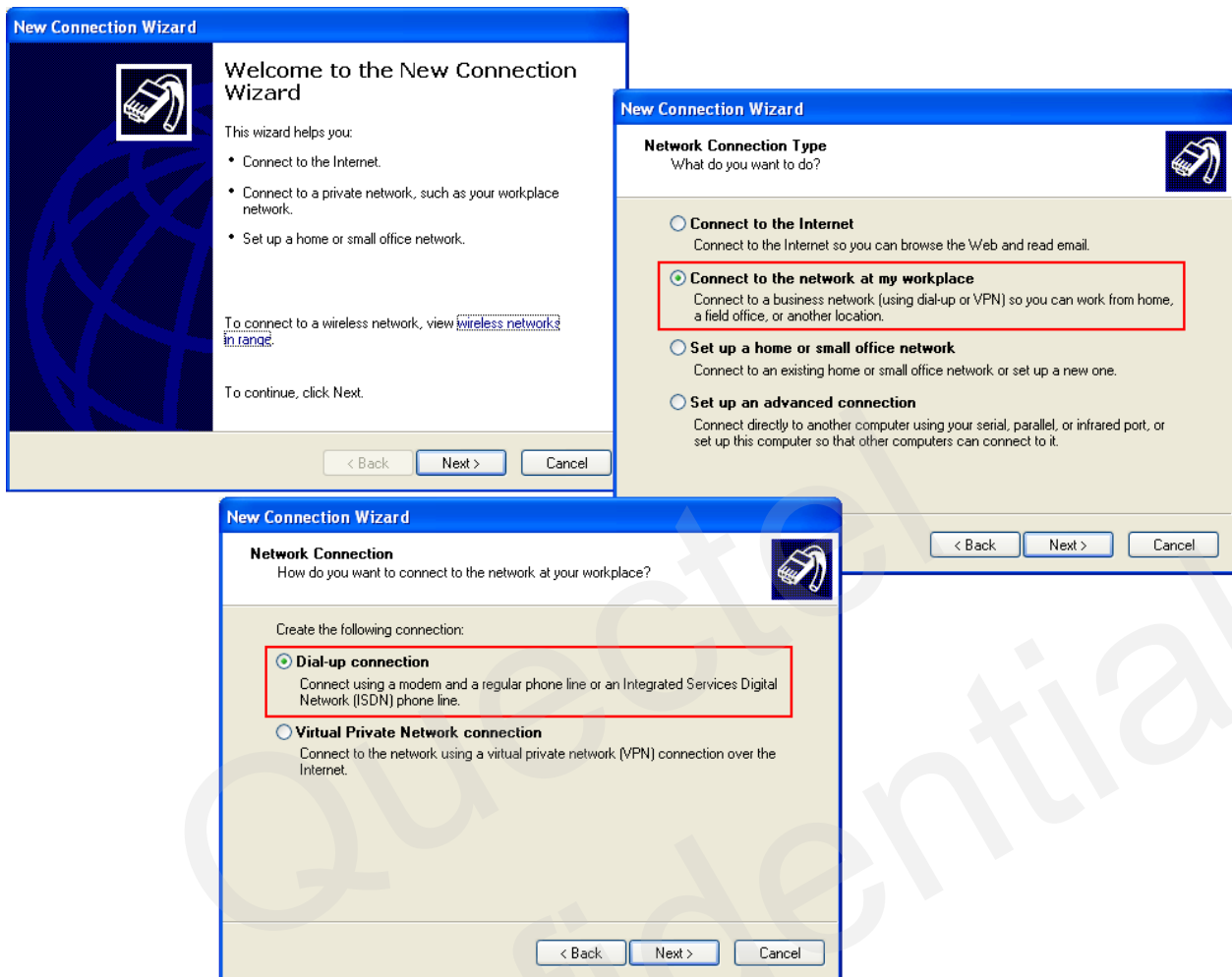

Figure 11: Set up the New Connection

5.3.2.   Configure the Connection

Input "**Company Name**" as the connection name, for example "**Test**", then click "**Next**" button, enter "***99#**" as "Phone number", and click "**Finish**" to configure the connection. Refer to Figure 12.
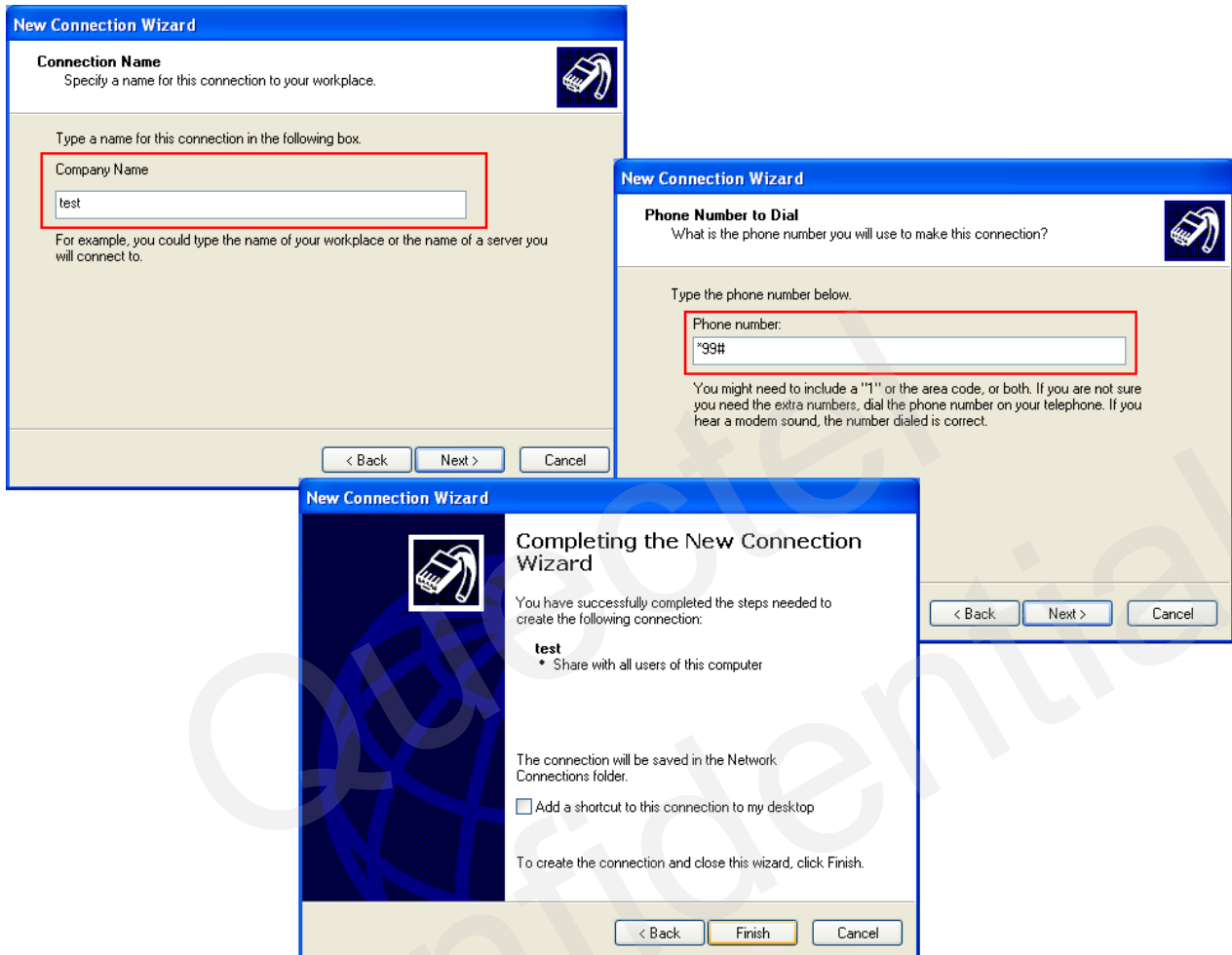

Figure 12: Configure the Connection

5.3.3. Configure the Dial-up Tool

Click "**Properties**" button from the popup box and "**Configure…**" button to configure the "**Standard 19200 bps Modem**", select "**115200**" from the drop-down list of "Maximum speed". Click "**OK**" button to finish the configuration. Refer to Figure 13.
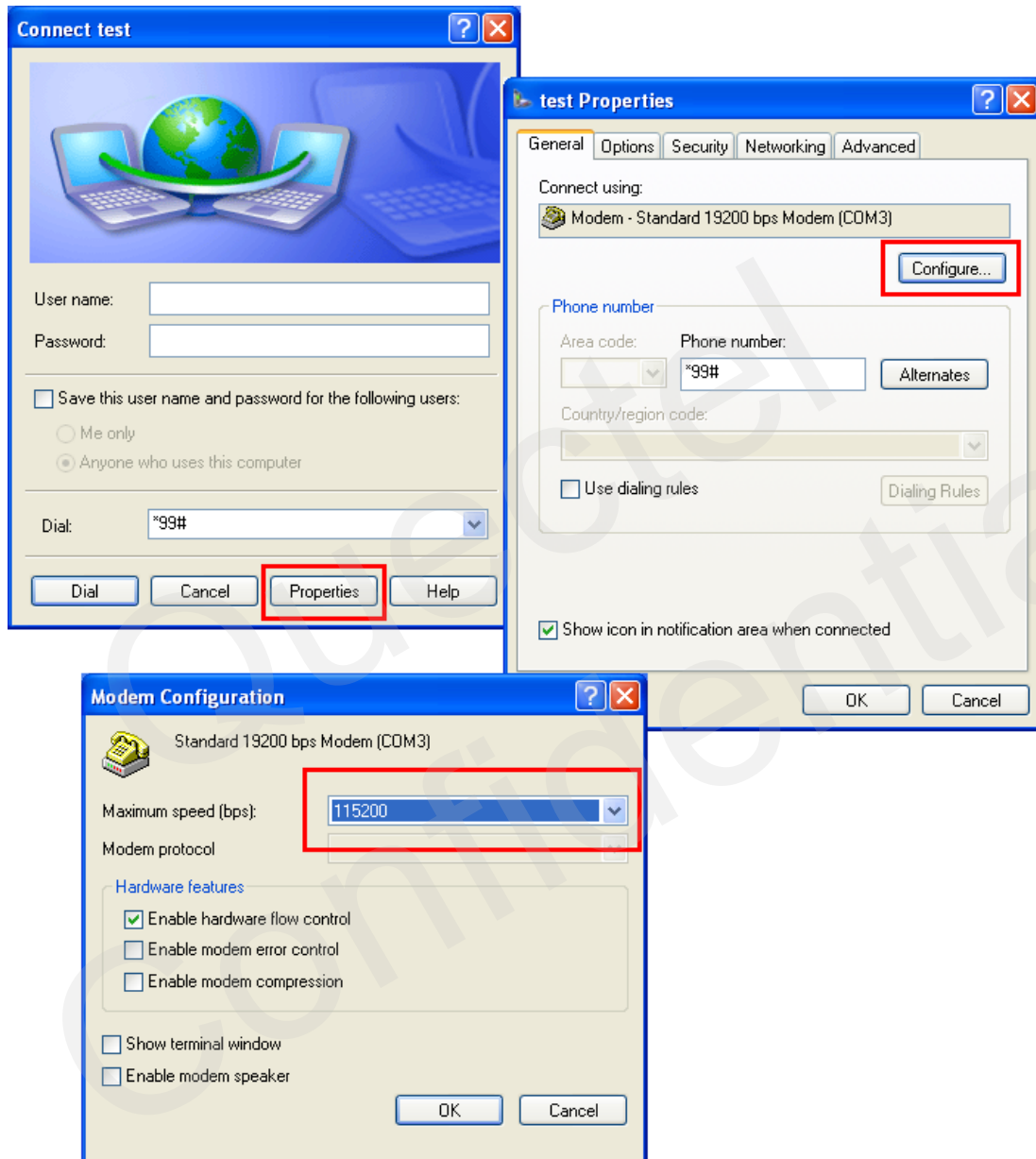

Figure 13: Configure the Dial-up

5.3.4. Establish the Dial-up Connection

Right click "**Test**" which was created as the new connection and click "**Connect**"->"**Dial**" from network connections. It is successful to establish the dial-up connection when a prompt box "**test is now connected**" is popped up. Refer to Figure 14.
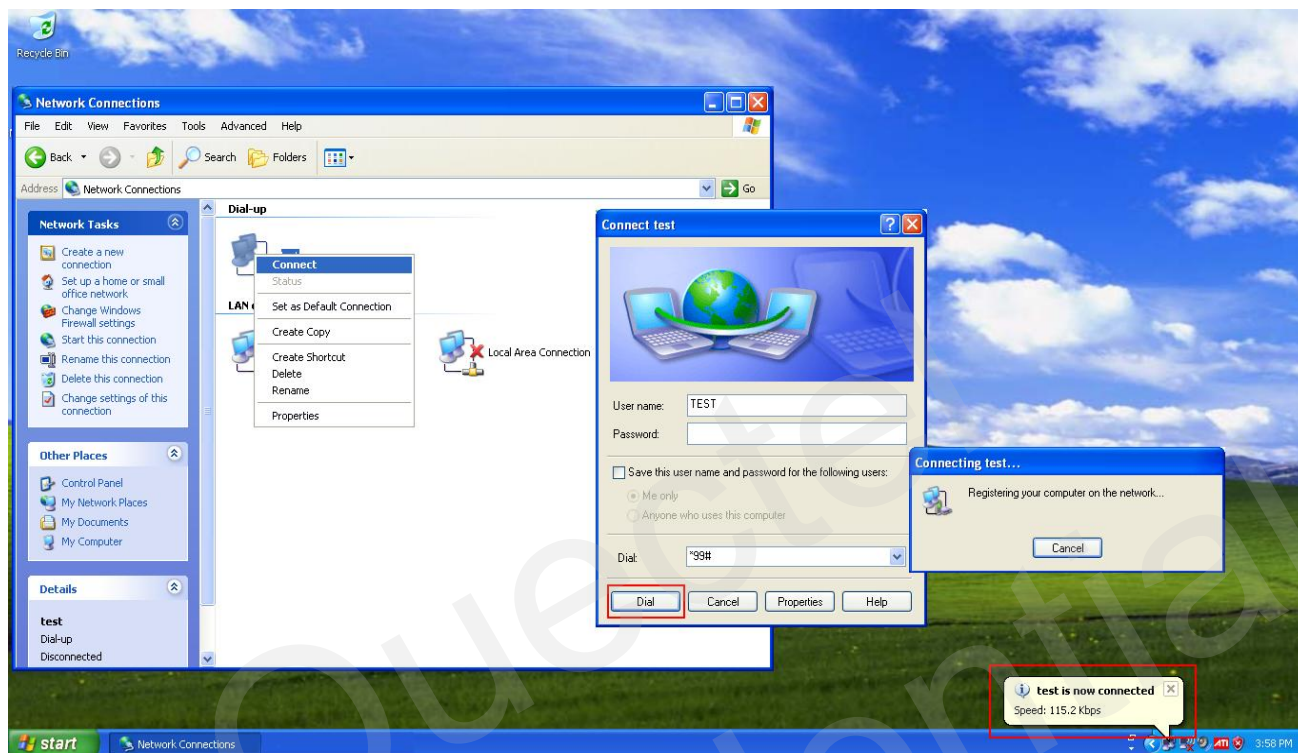

Figure 14: Establish the Dial-up Connection

6 PPP Dial-up in Linux

6.1. Prepare PPPD and CHAT

In Linux system, PPP dial-up is implemented by PPPD and CHAT, it's necessary to install PPPD and CHAT before establishing PPP connection.

6.2. Create Script Files

Create three script files, which are named as "lte", "lte-chat-connect", "lte-chat-disconnect" in "/etc/ppp/peers" directory. The content of these three files are shown below:

The content of the file "lte" is shown as below:

```
nodetach
nolock
/dev/ttyUSB3          //Must be your own device descriptor for EC20 USB Modem Port.
115200
user ""               //Modify your user name here if necessary, it's null in example.
password ""           //Modify your password here if necessary, it's null in example.
nocrtscts
modem
hide-password
usepeerdns
noauth
noipdefault
novj
novjccomp
noccp
debug
defaultroute
ipcp-accept-local
ipcp-accept-remote
connect 'chat -s -v -f /etc/ppp/peers/lte-chat-connect'
disconnect 'chat -s -v -f /etc/ppp/peers/lte-chat-disconnect'
```

The content of the file "lte-chat-connect" is shown as below:

```
ABORT 'NO CARRIER'
ABORT 'ERROR'
ABORT 'NO DIALTONE'
ABORT 'BUSY'
ABORT 'NO ANSWER'
'' AT
OK ATE0
OK ATD*99#
CONNECT ''
```

The content of the file "lte-chat-disconnect" is shown as below:

```
ABORT   OK
ABORT   BUSY
ABORT   DELAYED
ABORT   "NO ANSWER"
ABORT   "NO CARRIER"
ABORT   "NO DIALTONE"
ABORT   VOICE
ABORT   ERROR
ABORT   RINGING
TIMEOUT   12
""   \K
""   \K
""   \K
""   +++ATH
""   +++ATH
""   +++ATH
""   ATZ
SAY "\nGoodbay\n"\
```

NOTE

Please create these three files and write the content of script manually in Linux system.

6.3. Set up PPP Connection by PPPD

Switch to root account, and type command "pppd call lte" in terminal. If PPP dial-up is established successfully, you can see the new network interface with command "ifconfig".

ppp0	**Link encap:Point-to-Point Protocol**
	inet addr:10.156.235.241 P-t-P:10.64.64.64 Mask:255.255.255.255
	UP POINTOPOINT RUNNING NOARP MULTICAST MTU:1500 Metric:1
	RX packets:6 errors:0 dropped:0 overruns:0 frame:0
	TX packets:4 errors:0 dropped:0 overruns:0 carrier:0
	collisions: 0 txqueuelen: 3
	RX bytes: 134 (134.0 B) TX bytes:58 (58.0 B)

7 Appendix A Reference

Table 1: Related Documents

SN	Document Name	Remark
[1]	Quectel_EC20_AT_Commands_Manual	AT Commands Manual for EC20

Table 2: Terms and Abbreviations

Abbreviation	Description
PPP	Point-to-Point Protocol, The Point-to-Point Protocol is designed for simple links which transport packets between two peers. These links provide full-duplex simultaneous bi-directional operation, and are assumed to deliver packets in order. It is intended that PPP provides a common solution for easy connection of a wide variety of hosts, bridges and routers.
UART	Universal Asynchronous Receiver Transmitter. Integrated circuit which works with serial ports converting incoming serial data from a serial port into parallel form and parallel data to serial form when sending out data through a serial port (Computers, Electronics).
APN	Access Point Name
CHAP	Challenge Handshake Authentication Protocol
DNS	Domain Name Server
DTR	Data Terminal Ready
RI	Ring Indicator
DCD	Data Carrier Detection
GPRS	General Packet Radio Service
GSM	Global System of Mobile Communication
IP	Internet Protocol

IPCP	IP Control Protocol
LCP	Link Control Protocol
MCU	Micro Control Unit
MS	Mobile Station
PAP	Password Authentication Protocol
PDP	Packet Data Protocol
PIN	Personal Identification Number
SIM	Subscriber Identity Module
TA	Terminal Adapter
TE	Terminal Equipment