GSM PPP

Application Note

GSM/GPRS Module Series

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About the Document

History

Revision	Date	Author	Description
1.0	2013-04-28	Wythe WANG Jelly WANG	Initial
1.1	2015-04-08	Wythe WANG	Added applicable modules.

Contents

Table Index

1 Introduction

This document gives a brief introduction to PPP function of Quectel standard module, including recommended procedures for PPP set-up, UART mode for PPP connection, special handling and AT commands for PPP.

This document is applicable to all Quectel GSM modules.

2 Application Mode
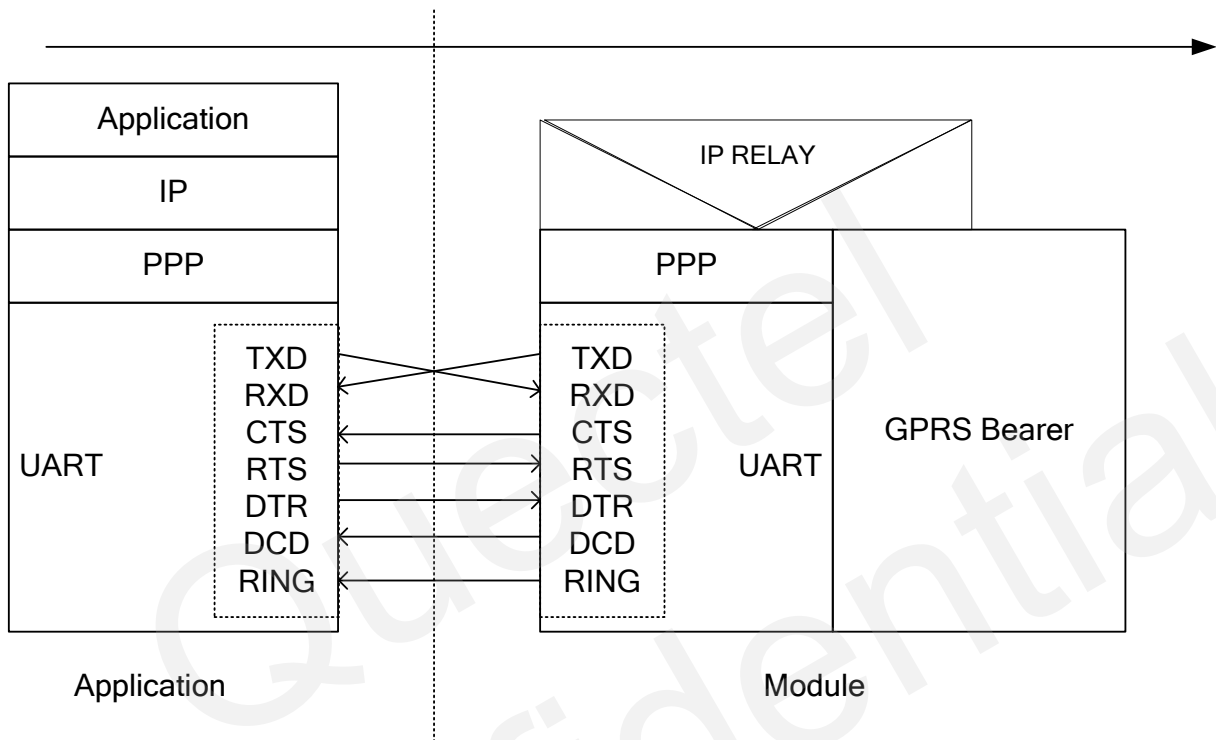
Figure 1: PPP Application Mode

The usage of PPP (Point to Point Protocol) can be described as Figure 1. Module provides a PPP server to application, and application side provides PPP client to module. Besides PPP, 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 include existing application to set up PPP connection, it is very important to develop a useful 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
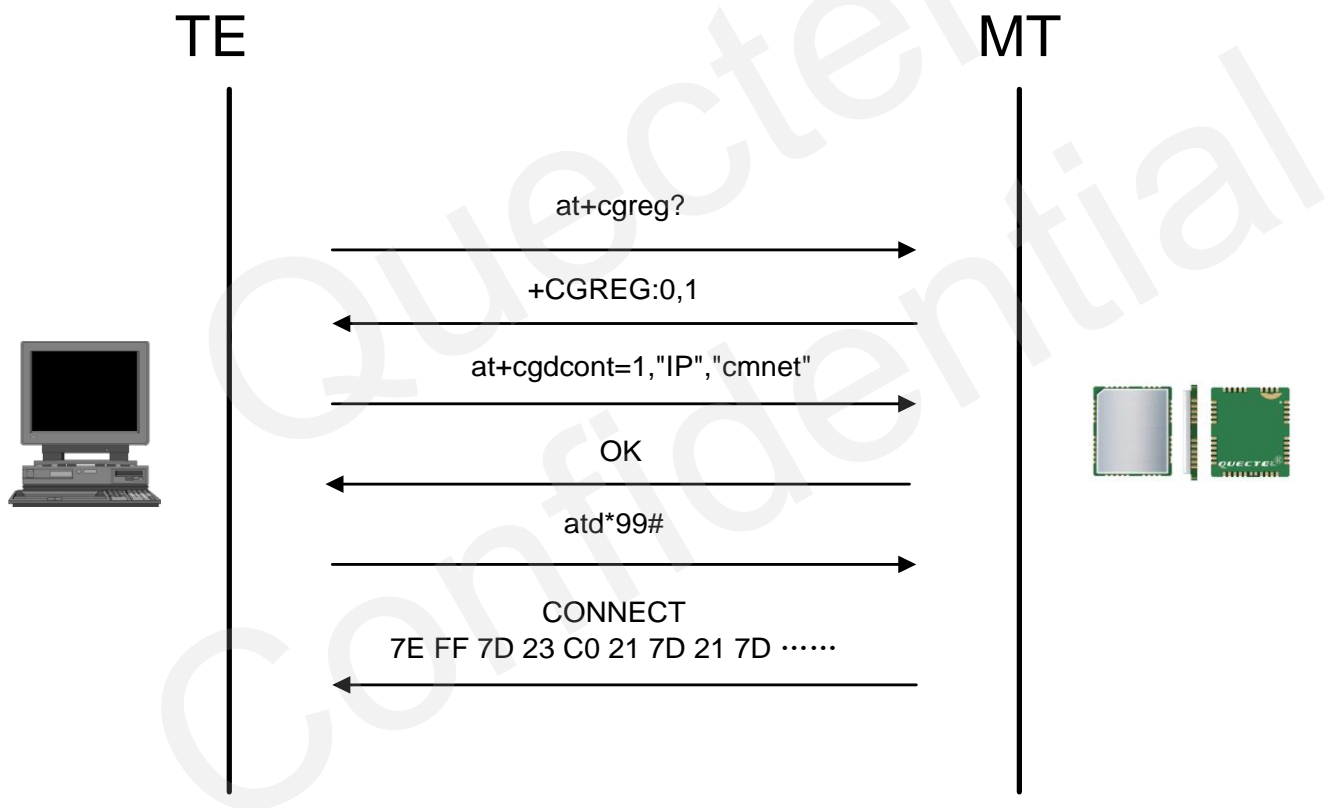
Figure 2: General Procedure of PPP

After module has registered to the GPRS network, the following step is to set APN for PPP by AT+CGDCONT and start PPP setup by command of ATD*99#. When ATD*99# is executed, module enters 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 within 1s.
3. Pull Power Key back to high when finishing Power OFF or Power ON.

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

GSM Network：
1. It indicates that module has registered to GSM network when AT+CREG? returns 1 or 5.
2. Reboot the module if it failed to register to GSM network in 30s.

GPRS Network：
1. It indicates that module has registered to GPRS network when AT+CGREG? returns 1 or 5.
2. It is able to go to next step without registering to GPRS network in 30s.

APN configuration：
1. APN must be set by AT+CGDCONT
2. Use AT+CGACT? to check whether or not current context has been activated when AT+CGDCONT returns error.

Packet Interaction
1. Able to use "+++" to exit the procedure of packet interaction.
2. Module will report NO CARRIER when PPP connection is terminated.

LCP Negotiation
1. Ensure the baudrate between MCU and module is same.
2. If MCU does not want to transfer the character of 0x11 and 0x13, try to use AT+QACCM=0,0.

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

IPCP Negotiation
1. Check whether or not MCU gets legal IP and DNS address.
2. Check whether no not the amount of DNS MCU got equals to the amount MCU requested.
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 or not the PPP Terminate-Request packet is right.
2. Try to use "+++" and ATH to hang up the PPP connection.
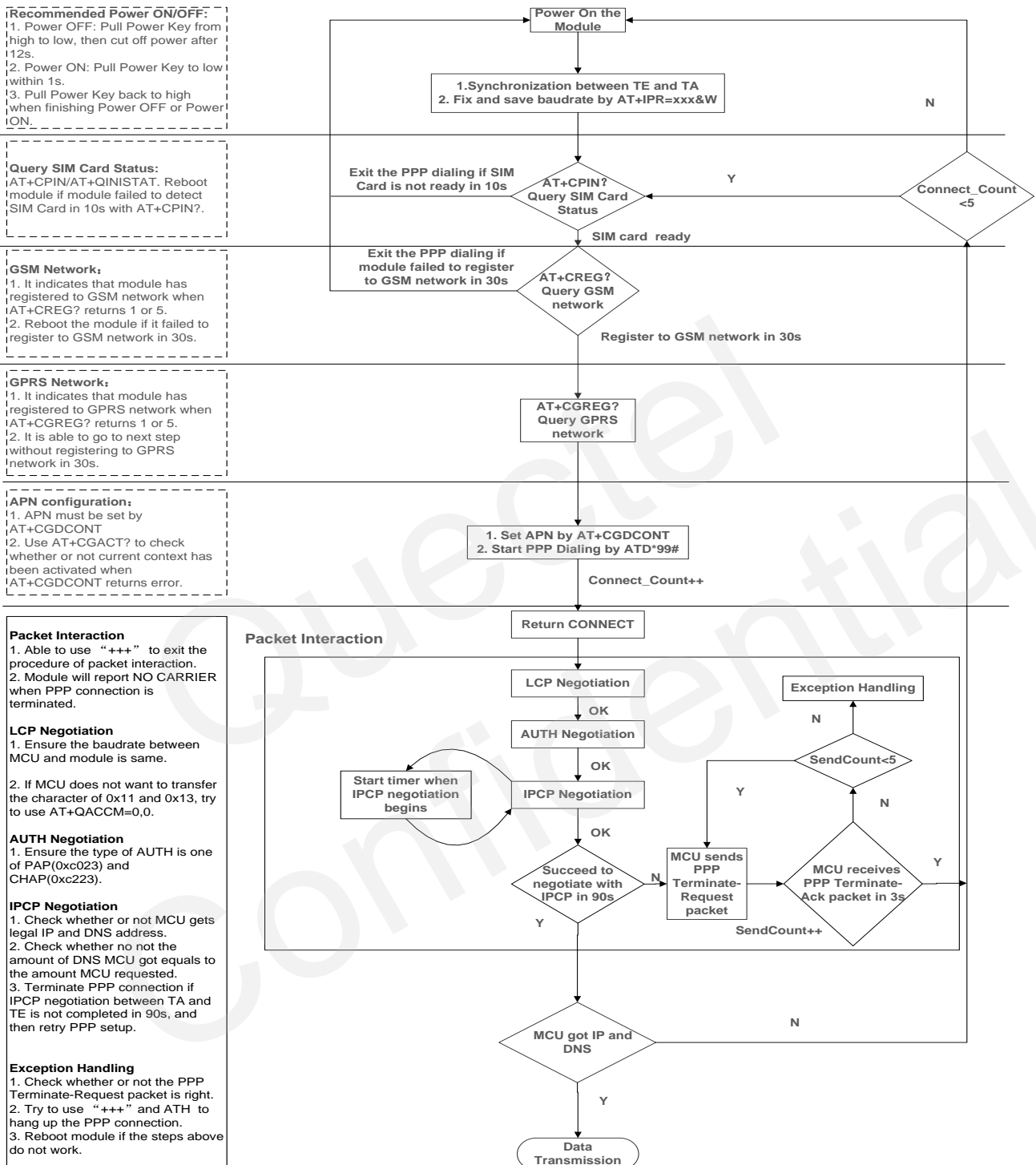3. Reboot module if the steps above do not work.

Figure 3: Flowchart for PPP Setup

When module starts, baud rate of module's UART must be fixed by **AT+IPR=115200&W**. Before using **ATD*99#** to start PPP setup, application must check the status of SIM card with **AT+CPIN?**. When SIM

card is OK, application also needs 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 Receive "**OK**" from the module. And then MCU fixes and saves baud rate by "**AT+IPR=xxx&W**" after synchronization is successfully.

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. You can reboot the module immediately at first, and then reboot the module after 10 minutes, 30 minutes, 1 hour, etc if the module is repeatedly abnormal.

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.

---

4 UART for PPP Connection

4.1. Data Mode and Command Mode

Module communicates information with Application by UART, including AT commands and data. There are two modes for module's UART. One is data mode and the other is command mode. Module's UART is in command mode before PPP setup, and module can execute AT commands in this state. When PPP negotiating starts, module's UART enters data mode. Module will keep in data mode when PPP connection was set up and module can not execute AT commands in data mode. Quectel standard modules provide convenient methods to switch the UART's mode.

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, setting command of **AT&D1** and switching DTR level from low to high can change module from data mode to command mode. 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 UART being misinterpreted as data, it should be preceded and followed by a pause of at least 500ms. The interval time between each "+" must be less than 1000ms. 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 is changed to command mode after accomplishing PPP negotiation, UART 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                          // Indicates that TA has entered the 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 protocol. This method must be operated in data mode.

ATH is the method of shutting down connection with AT command, which closes the data connection, deactivates the PDP context. But it is only supported in command mode.

Example

```
// When PPP connection exists, and module is in command mode
ATH
OK                               // Indicate that the PPP connection has been terminated
```

> **NOTE**
>
> **ATH** disconnects existing connections, such as voice call and PPP connection.

TA also can terminate the connection with switching of the DTR level. At first, set DTR function with **AT&D2**. This method can be operated in both data mode and command mode.

Example

```
// Before PPP connection has been set, module is still in command mode
AT&D2
```

OK

And then set the disconnection delay time with **ATS10**.

Example

// Before PPP connection has been set, module is still in command mode
ATS10=5
OK

When PPP connection exists already, switch the DTR level from low to high, and keep High level for five seconds which is set by **ATS10** as the above example. The data connection will terminate automatically. Module enters command mode after PPP connection is terminated completely.

4.3. Handle URC in Data Mode

Coming call and short message will not be reported to UART during PPP connection. But the level of module's RI pin will change from high to low for 120ms as short message indication. And for coming call, the level of RI pin will be pulled down and keep low until call ends. MCU can process the call or short message by switching to command mode according to the status of RI pin. If coming call or message exists, the URC will be output to UART 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 high level when data carrier exists or PPP negotiation begins, otherwise it will keep low level.

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

5 Special Handling in PPP

5.1. Optimize Speed and Success Ratio for PPP Setup

On most condition of network, the speed and success ratio of PPP setup is fast and steady. But sometimes, when the situation of network is not so good or even extremely bad, it is able to use **AT+QPPPTIMER** to optimize the configuration of module to enhance the speed and success ratio for PPP setup. Please get detailed description of **AT+QPPPTIMER** from next chapter.

5.2. Set Preferred Authentication Type for PPP Setup

Quectel module supports PAP and CHAP in PPP authentication negotiation. The default preferred authentication protocol which will be negotiated with TE in Quectel module is PAP. Quectel module can be set with **AT+QGPAU** to switch preferred authentication protocol from PAP to CHAP. Please get detailed description of **AT+QGPAU** from next chapter.

5.3. Configure ACCM of PPP

Quectel Module takes 0x11 and 0x13 as asynchronous control characters by default. When 0x11 and 0x13 are included in the PPP packet data which will be transferred from TE to module, 0x11 should be transformed as 0x7d31 and 0x13 should be transformed as 0x7d33. On the contrary, when module received 0x7d31 or 0x7d33, module will transform 0x7d31 to 0x11 and transform 0x7d33 to 0x13. In this case, TE can use **AT+QACCM** to disable the transformation relationship. Please get detailed description of **AT+ QACCM** from next chapter.

6 PPP AT Commands

6.1. AT Command Syntax

Test Command	**AT+<x>=?**	This command returns the list of parameters and value ranges set by the corresponding Write Command or internal processes.
Read Command	**AT+<x>?**	This command returns the currently set value of the parameter or parameters.
Write Command	**AT+<x>=<…>**	This command sets the user-definable parameter values.
Execution Command	**AT+<x>**	This command reads non-variable parameters affected by internal processes in the GSM engine

6.2. Related Commands

6.2.1. AT+QPPPTIMER   Optimize PPP Setup Speed and Success Ratio

This command is used to optimize configuration of PPP in module to enhance the speed and success ratio for PPP setup, especially when the situation of network is extremely bad.

AT+QPPPTIMER Optimize PPP Setup Speed and Success Ratio	
Test Command **AT+QPPPTIMER=?**	Response **+QPPPTIMER:** (list of supported **<mode>**s),(list of supported **<timer>**s),**<period>**,**<retrycount>** **OK**
Write Command **AT+QPPPTIMER=<mode>,<timer>[,<period>,<retrycount>]**	Response If **<mode>**=1 and command is successful **OK** If **<mode>**=0 and command is successful **+QPPPTIMER: <timer>,<period>,<retrycount>** **OK**

Reference	

Parameter

\<mode\>	The operation mode:
	0 Read
	1 Write
\<timer\>	The dial-up retry timer or hang-up retry timer
	0 Dial-up retry timer
	1 Hang-up retry timer
\<period\>	The period for the **\<timer\>**,if the mode is 0, this parameter is not needed. The unit is second.
\<retrycount\>	The **\<retrycount\>** for the timer. If the mode is 0, this parameter is not needed.

NOTES

1. The default **\<period\>** of dial-up retry timer is 30s and the **\<retrycount\>** is 5.
2. The default **\<period\>** of hang-up retry timer is 8s and the **\<retrycount\>** is 5.
3. This command cannot be saved, and it needs to be set before **ATD*99#**.

Example

// Configure PPP optimization parameters, as below:
AT+QPPPTIMER=1,0,8,5   // Set the period of dial-up retry to 8s, and the retry time is 5
OK
AT+QPPPTIMER=1,1,6,5   // Set the period of hang-up retry to 6s, and the retry time is 5
OK

ATD*99#   // Start PPP dial-up
CONNECT
......
// Enter PPP (dial-up) negotiation

Example

// Recover default setting
AT+QPPPTIMER=1,0,30,5   // Set the period of dial-up retry to 30s, and the retry time is 5
OK
AT+QPPPTIMER=1,1,8,5   // Set the period of hang-up retry to 8s, and the retry time is 5
OK

// Read Command
AT+QPPPTIMER=0,0

+QPPPTIMER: 0,30,5	// The default period of dial-up retry is 30s, the retry time is 5
OK	
AT+QPPPTIMER=0,1	
+QPPPTIMER: 1,8,5	// The default period of hang-up is 8s, the retry time is 5
OK	

6.2.2. AT+QACCM Set the Async-Control-Character of PPP

This command is used to enable or disable 0x11 and 0x13 as asynchronous control characters during PPP procedure.

AT+QACCM Set the Async-Control-Character of PPP	
Test Command **AT+QACCM=?**	Response **+QACCM:** (list of supported **<tx_cfg>**s),(list of supported **<rx_cfg>**s) **OK**
Read Command **AT+QACCM?**	Response **+QACCM: <tx_cfg>,<rx_cfg>** **OK**
Write Command **AT+QACCM=<tx_cfg>,<rx_cfg>**	Response **OK**
Reference	

Parameter

<tx_cfg>	0	No asynchronous control characters when module sends PPP packet data.
	655360	Enable 0x11 and 0x13 as asynchronous control characters when module sends PPP packet data.
<rx_cfg>	0	No asynchronous control characters when module receives PPP packet data.
	655360	Enable 0x11 and 0x13 as asynchronous control characters when module receives PPP packet data.

> **NOTES**
>
> 1. The default value of **<tx_cfg>** and **<rx_cfg>** are both 655360.
> 2. The result of this command cannot be saved.

Example

// The default value of **<tx_cfg>** and **<rx_cfg>** in module are both 0xa0000. In this way, module enables 0x11 and 0x13 as asynchronous control characters by default.
AT+QACCM?
+QACCM: 0xa0000,0xa0000   // Read current configuration of ACCM

OK

// When user does not want to use asynchronous control characters, user must set AT+QACCM=0,0 to disable the asynchronous control characters on module side before ATD*99#.
AT+QACCM=0,0   // Disable 0x11 and 0x13 as asynchronous control characters
OK

6.2.3. AT+QGPAU   Define PPP Auth Type

This command is used to set the preferred authentication protocol which will be   used to negotiate with TE from module side. The default preferred protocol in module is PAP. But for PPP function, module supports both PAP and CHAP.

AT+QGPAU Define PPP Auth Type	
Test Command **AT+QGPAU=?**	Response **+QGPAU:** (list of supported **<mode>**s),(list of supported **<cid>**s),(list of supported **<is_chap>**s) **OK**
Read Command **AT+QGPAU=0,<cid>**	Response **+QGPAU: <is_chap>** **OK**
Execution Command **AT+QGPAU=1,<cid>,<is_chap>**	Response **OK**
Reference	

Parameter

<mode>	0	Read mode
	1	Write mode
<cid>	PDP Context Identifier. It is defined by **AT+CGDCONT**	
<is_chap>	Negotiation protocol	
	0	PAP
	1	CHAP

NOTES

1. The default value of **<is_chap>** is 0, which means that the default prior negotiation type in module is PAP.
2. This command only defines the priority of negotiation type in module. The final auth type of PPP is negotiated between MCU and the module.

Example

```
// Read Command, the default value is PAP. (0 equals PAP and 1 equals CHAP)
AT+QGPAU=0,1                    // Read priority of negotiation type on PDP context 1
+QGPAU: 0

OK
// Set Command
AT+QGPAU=1,1,1                  // Set CHAP as the preferred protocol to be used to negotiate with TE
OK                                on PDP context 1 in module
```

7 Example of PPP(dial-up) in Windows

7.1. Preparation

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

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

7.2. Modem Configuration
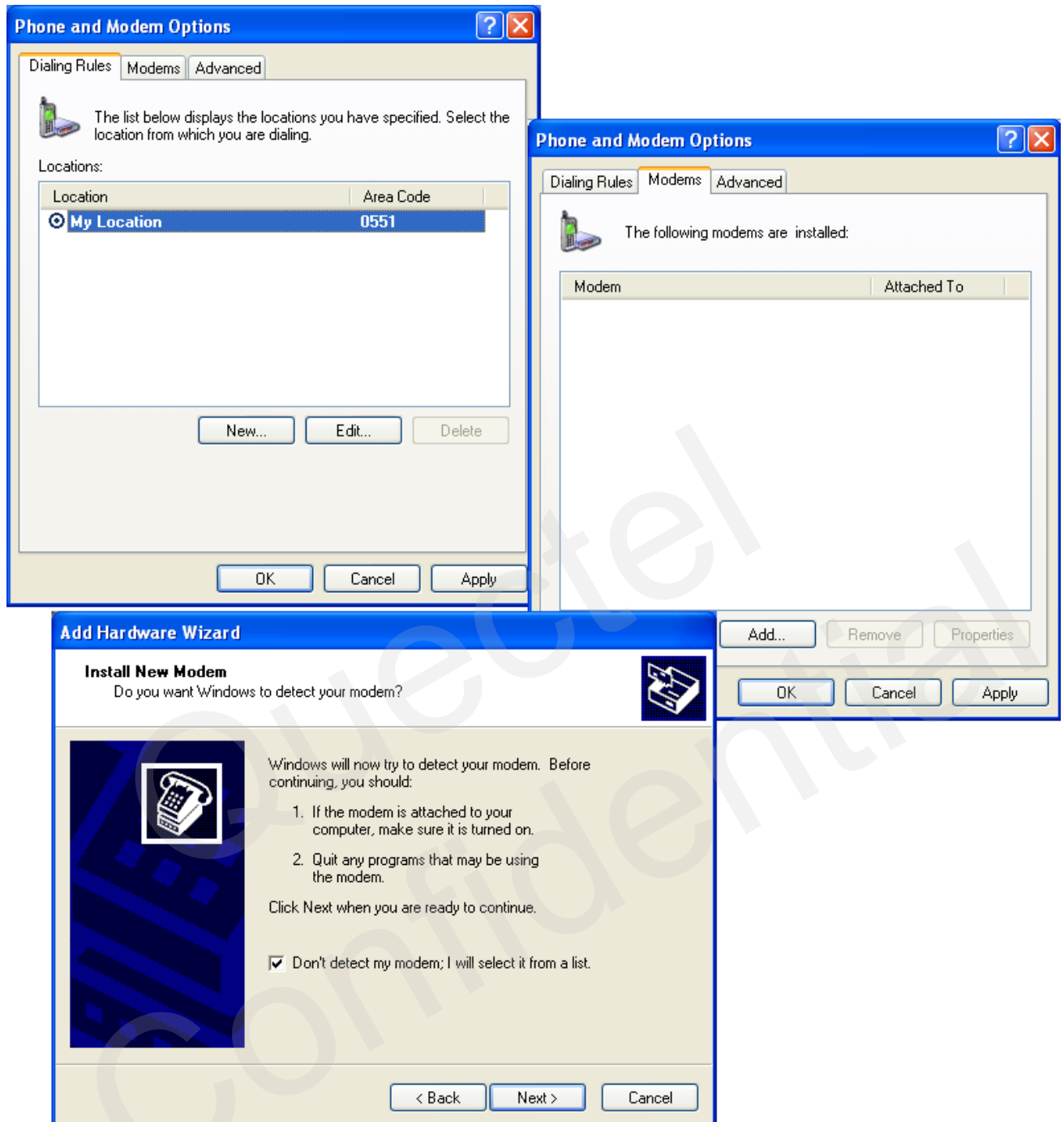
7.2.1. Add a New Modem

If there is no "**Standard 19200 bps Modem**" has been installed, it needs to add a new standard modem to the modem section of the control panel.

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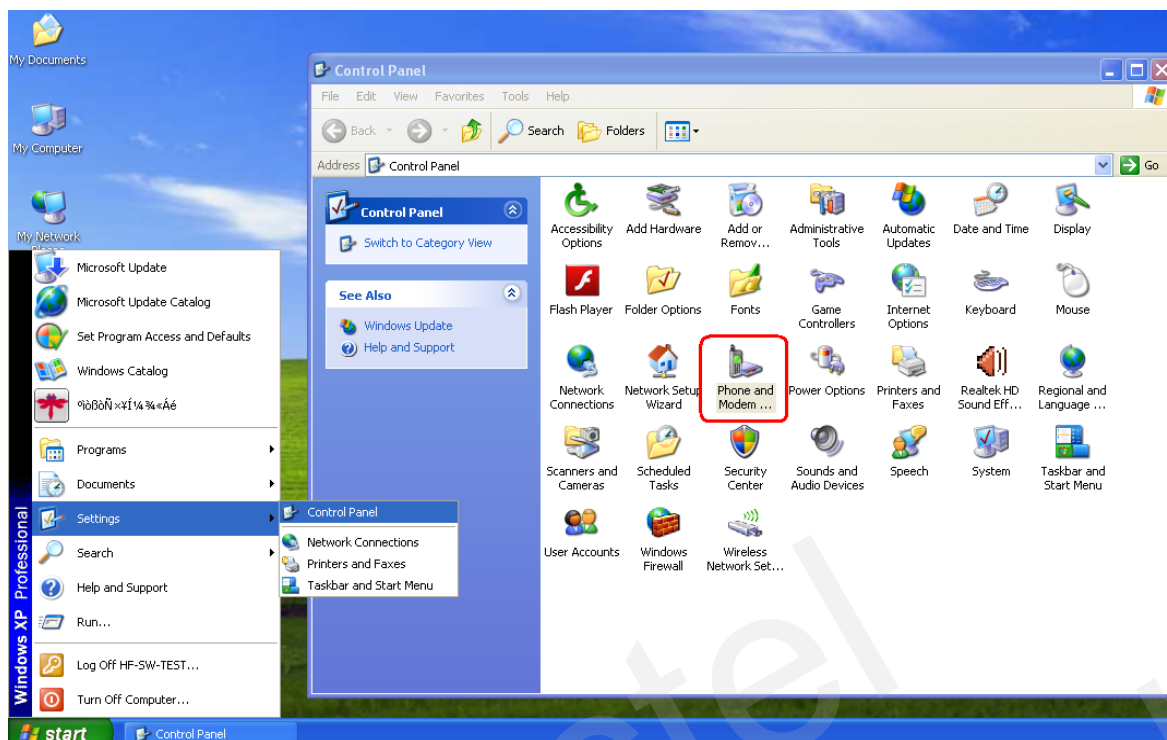
Figure 4: Open the Control Panel

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

Figure 5: Add a New Modem

3. Install the new modem, refer to the instructions on the screen, select "**Standard 19200 bps Modem**" and a port (COM3) which will be installed, click "**Next**" button, till the configuration is finished. Refer to Figure 6, Figure 7 & Figure 8.
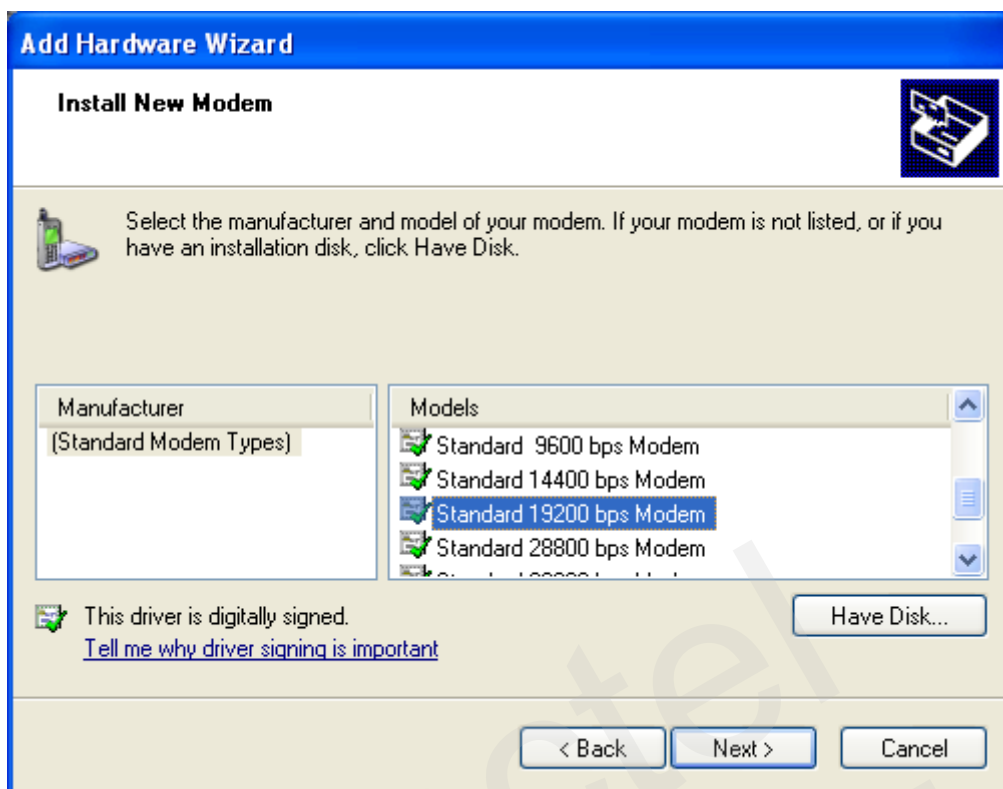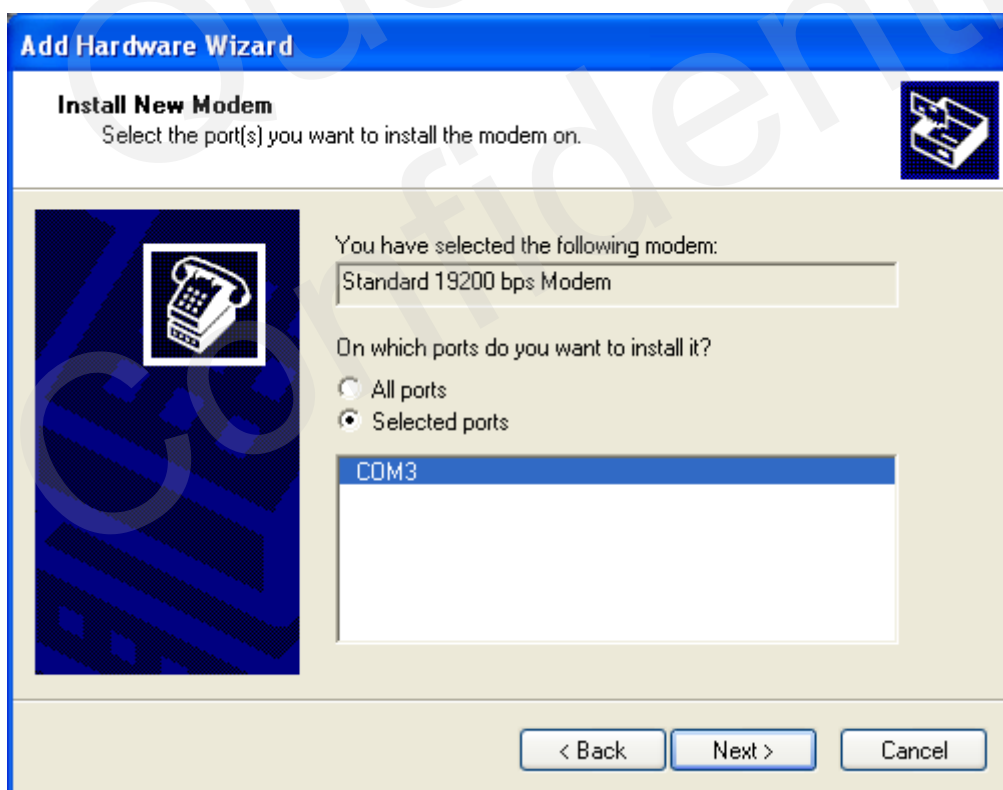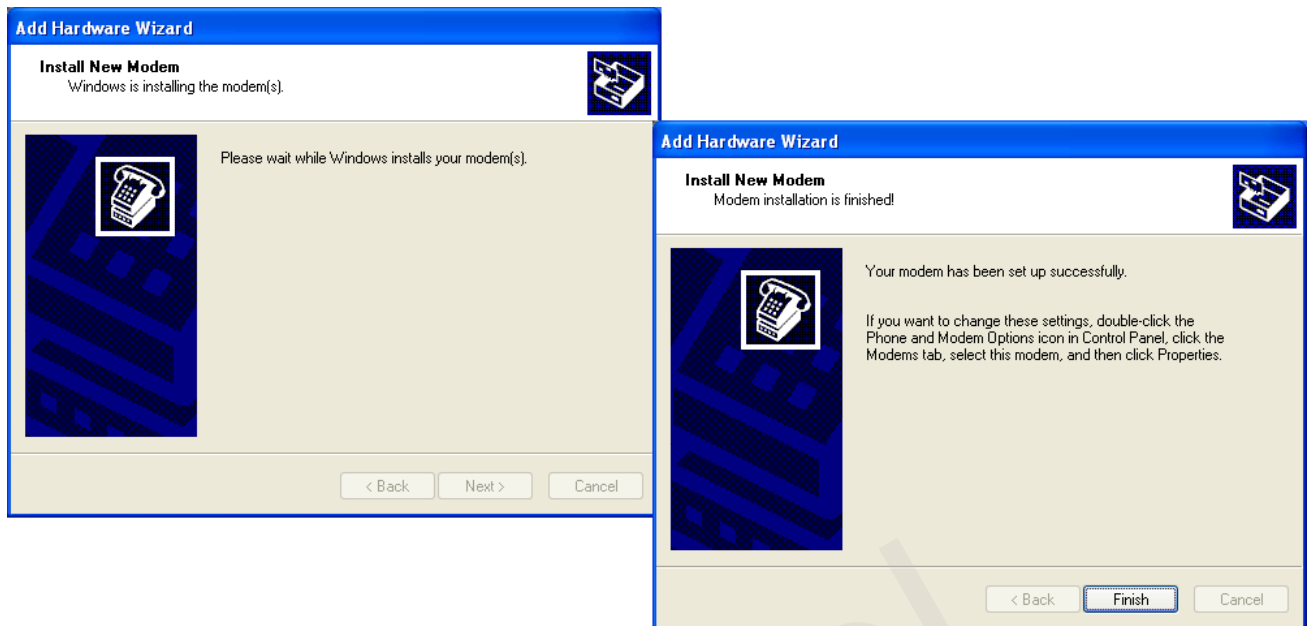
**Figure 6: Select Model of the Modem**

Figure 7: Select a Port

Figure 8: Successful Installation

7.2.2.   Configure the Modem Driver

Select the "**Standard 19200 bps Modem**" which have 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.
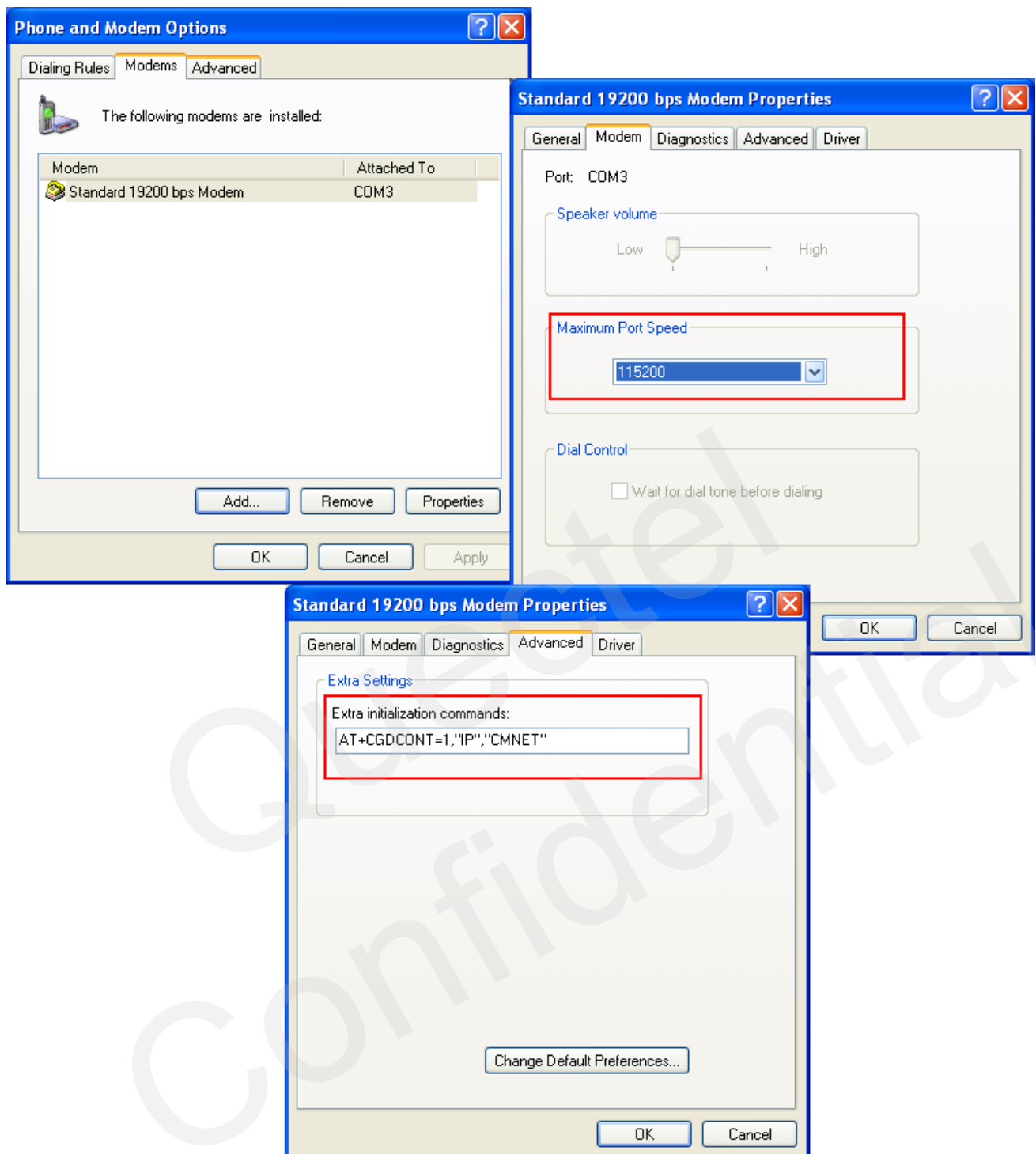
Figure 9: Configure the Modem Driver

NOTE

In the example above, the settings predefine a PDP context where 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.

7.3. Dial-up Network Configuration

7.3.1. Create a New Connection

1. 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.
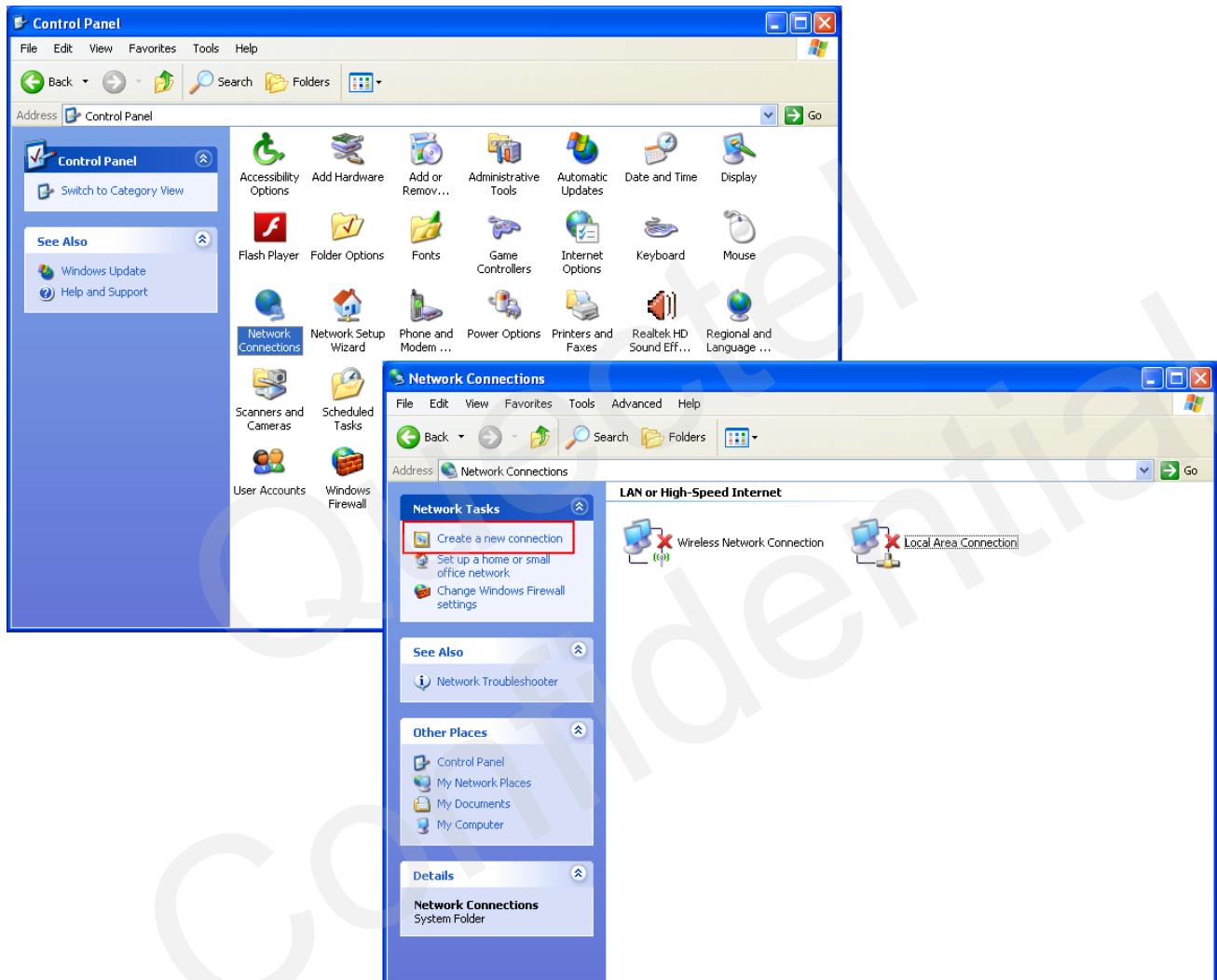

Figure 10: Create a New Connection

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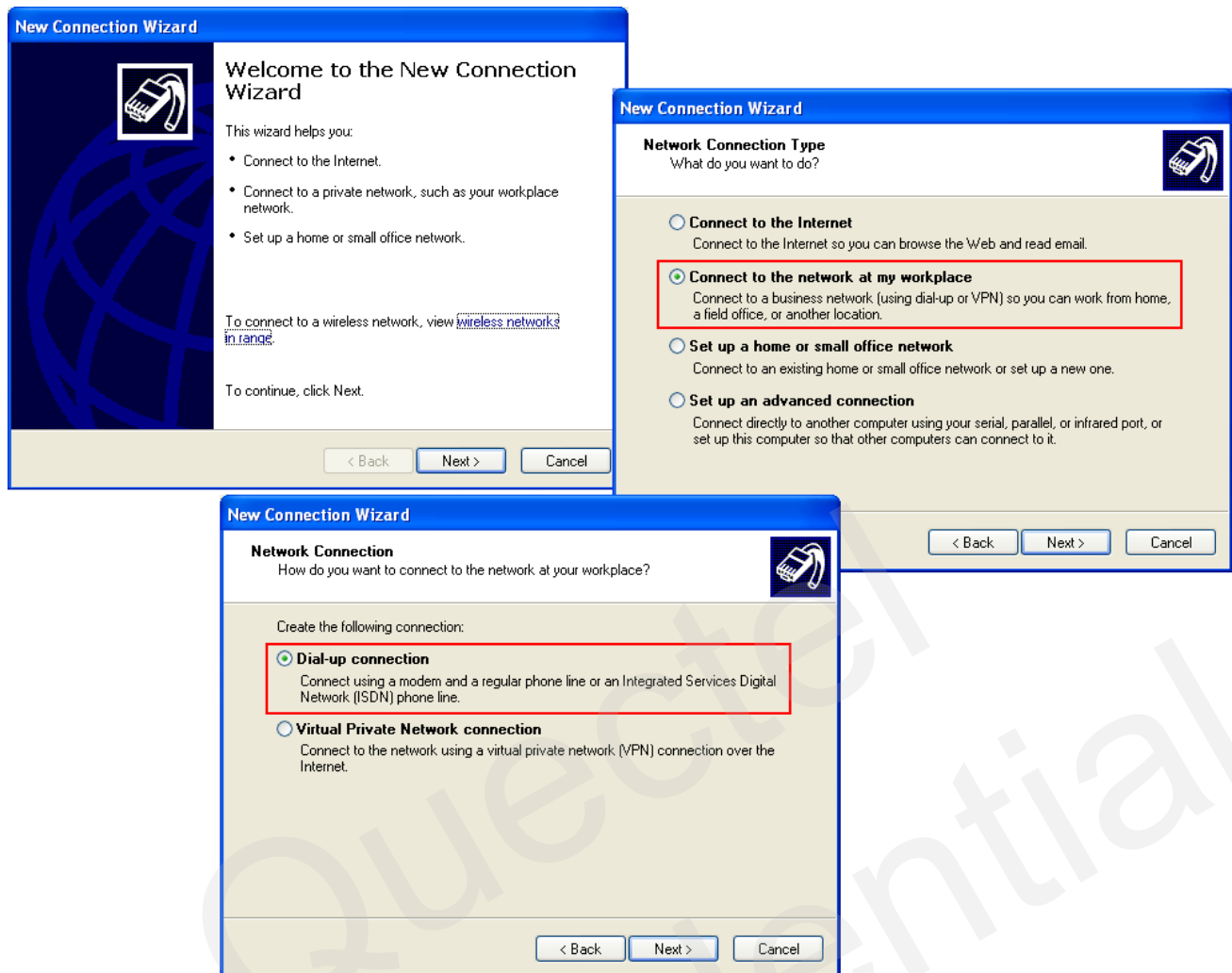
Figure 11: Set up the New Connection

7.3.2. Configure the Connection

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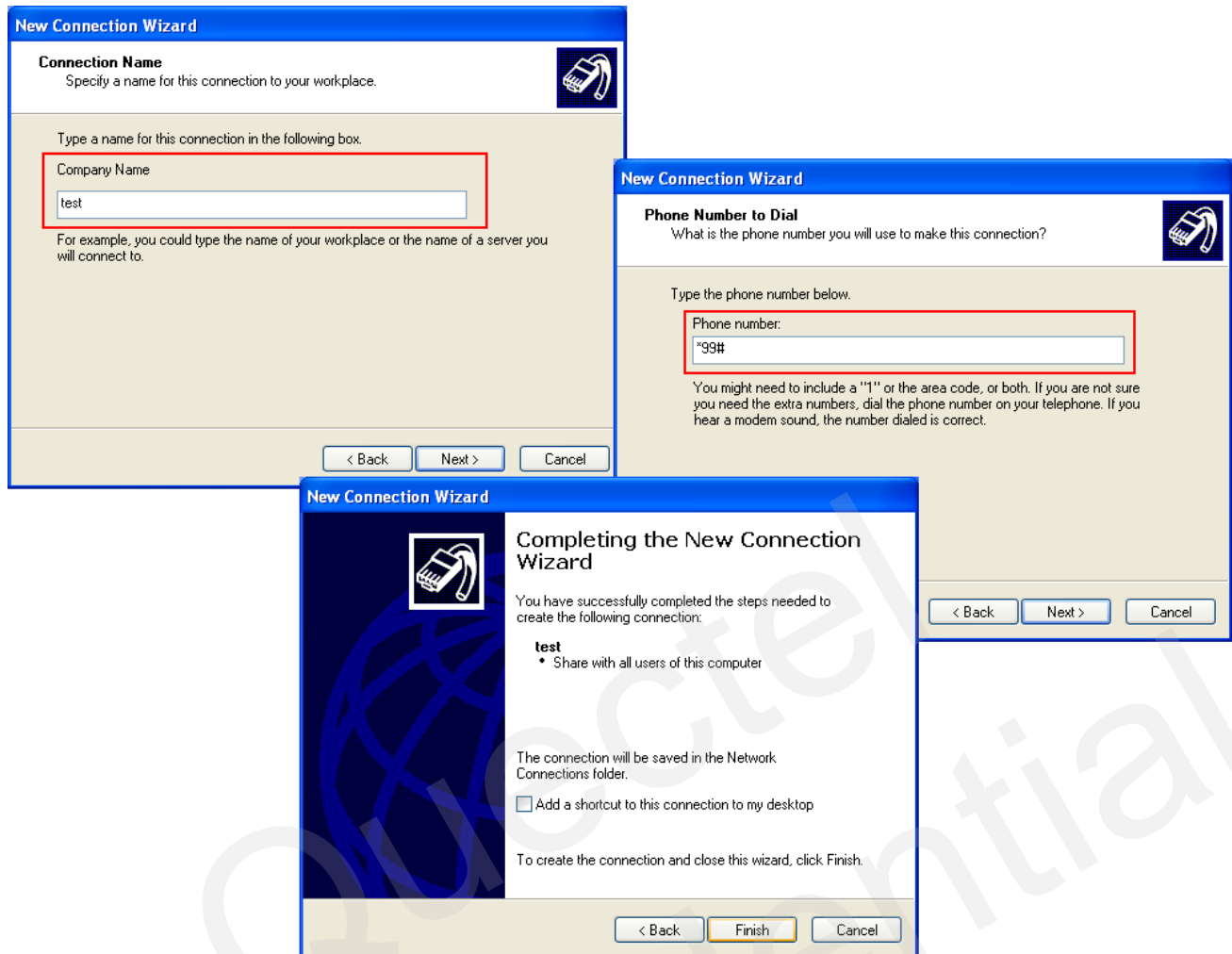
Figure 12: Configure the Setting

7.3.3. 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 maximum speed of the drop-down list. Click "**OK**" button to finish the configuration. Refer to Figure 13.
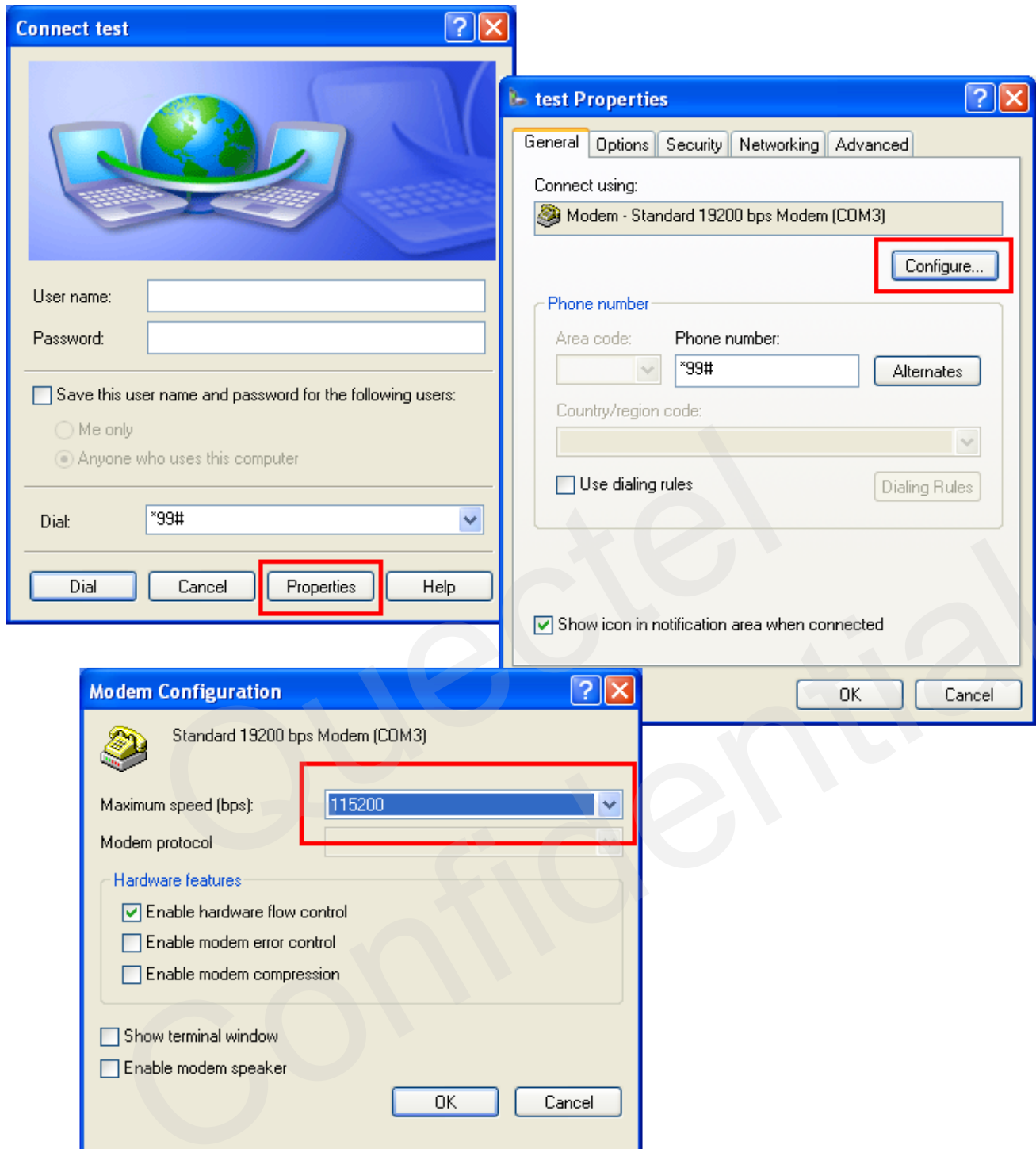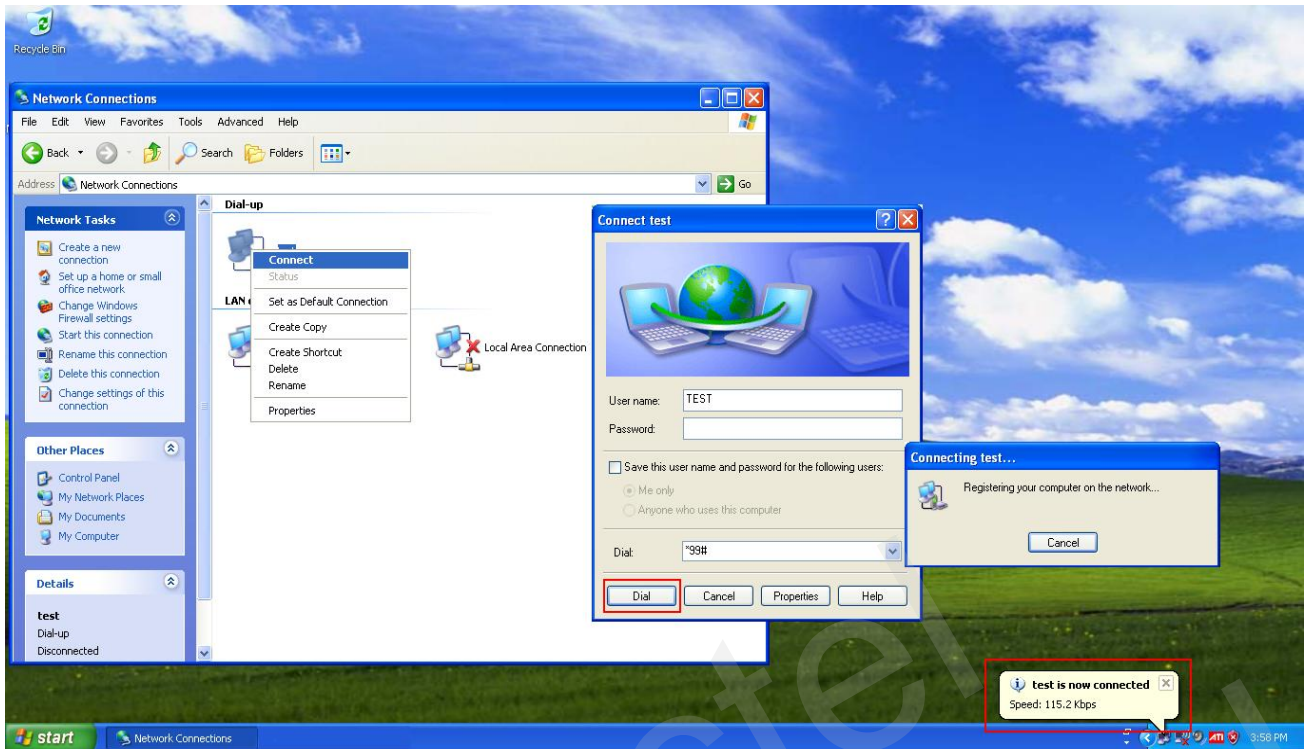
Figure 13: Configure the Dial-up

7.3.4. Establish the Dial-up Connection

Right click "**Test**" which was created 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**" popped up. Refer to Figure 14.

Figure 14: Establish the Dial-up Connection

8 Appendix A Reference

Table 1: Related Documents

SN	Document name	Remark
[1]	Mxx_AT_Commands_Manual .pdf	AT Commands Manual for Mxx

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