

BG95&BG77&BG600L Series

PPP Application Note

LPWA Module Series

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Quectel Wireless Solutions Co., Ltd.

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: info@quectel.com

Or our local offices. For more information, please visit:

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About the Document

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-	2021-07-30	Sherlock ZHAO	Creation of the document
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1 Introduction

This document provides a brief explanation of the PPP functions of Quectel BG95 series, BG77 and BG600L-M3 modules, including PPP application modes, setting procedures, connection modes, termination steps, and dialing examples.

The Point-to-Point Protocol is designed for simple links which transport packets between two ports. These links provide full-duplex simultaneous bi-directional operation, and are assumed to deliver packets in order. It is intended that PPP provides a common solution for easy connection of a wide variety of hosts, bridges, and routers.

1.1. Applicable Modules

Table 1: Applicable Modules

Module Series	Model	Description
BG95	BG95-M1	Cat M1 only
	BG95-M2	Cat M1/Cat NB2
	BG95-M3	Cat M1/Cat NB2/EGPRS
	BG95-M4	Cat M1/Cat NB2, 450 MHz Supported
	BG95-M5	Cat M1/Cat NB2/EGPRS, Power Class 3
	BG95-M6	Cat M1/Cat NB2, Power Class 3
	BG95-MF	Cat M1/Cat NB2, Wi-Fi Positioning
BG77	BG77	Cat M1/Cat NB2
BG600L	BG600L-M3	Cat M1/Cat NB2/EGPRS

2 Application Mode

PPP (Point-to-Point Protocol) use is illustrated in the figure below. Use UART port or USB port for PPP connection. The module provides a PPP server for application, and the application provides a PPP client for the module. In addition, the application must provide protocols such as TCP/IP, HTTP(S), etc. When the PPP connection is established, the IP packet data stream from the application is transmitted to the Internet through the module.

Most standard operating systems (e.g., Windows and Unix/Linux) include the PPP protocol stack. For operating systems that have no available applications for PPP connection, it is necessary to develop application software first.

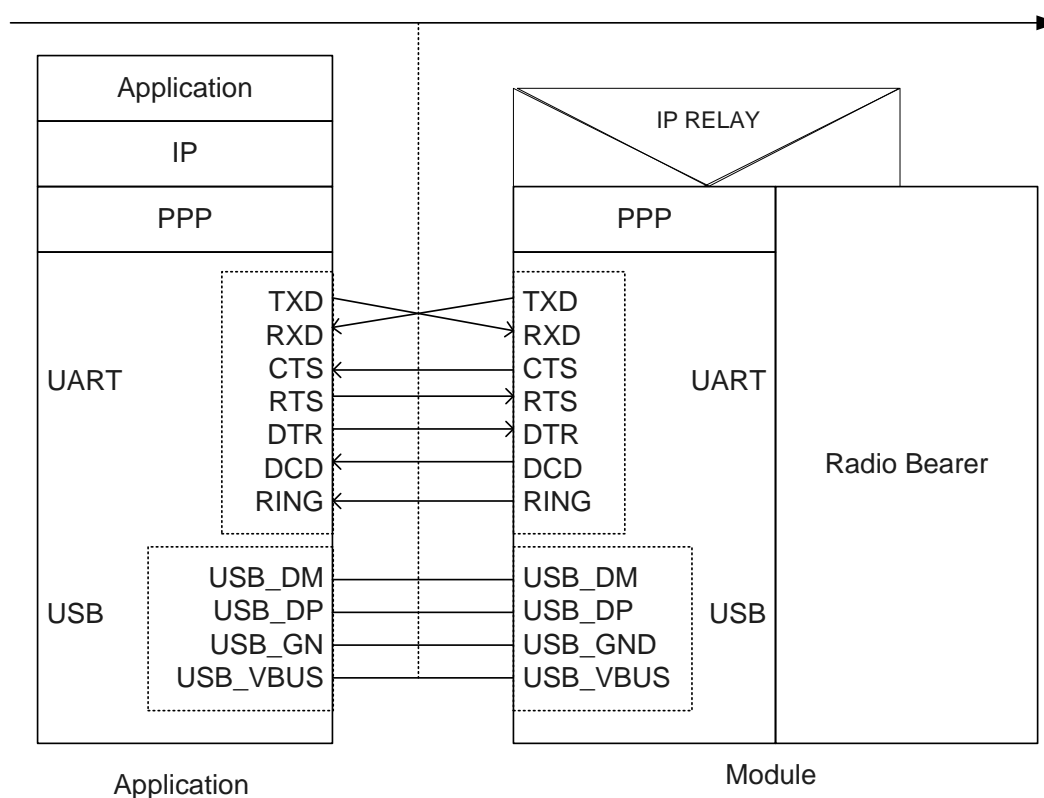


Figure 1: PPP Application Mode

3 Procedures for Setting up PPP

3.1. General Procedure for Setting up PPP

After the module registers on LTE Cat M1, LTE Cat NB2 or GPRS network, it is necessary to set the APN for PPP with **AT+CGDCONT** and to start the PPP with **ATD*99#**. After executing **ATD*99#**, the module enters the PPP frame interaction process, which is based on standard PPP protocol. The module data packet interaction description is shown in the figure below. For more information about standard PPP, see *RFC 1661*.

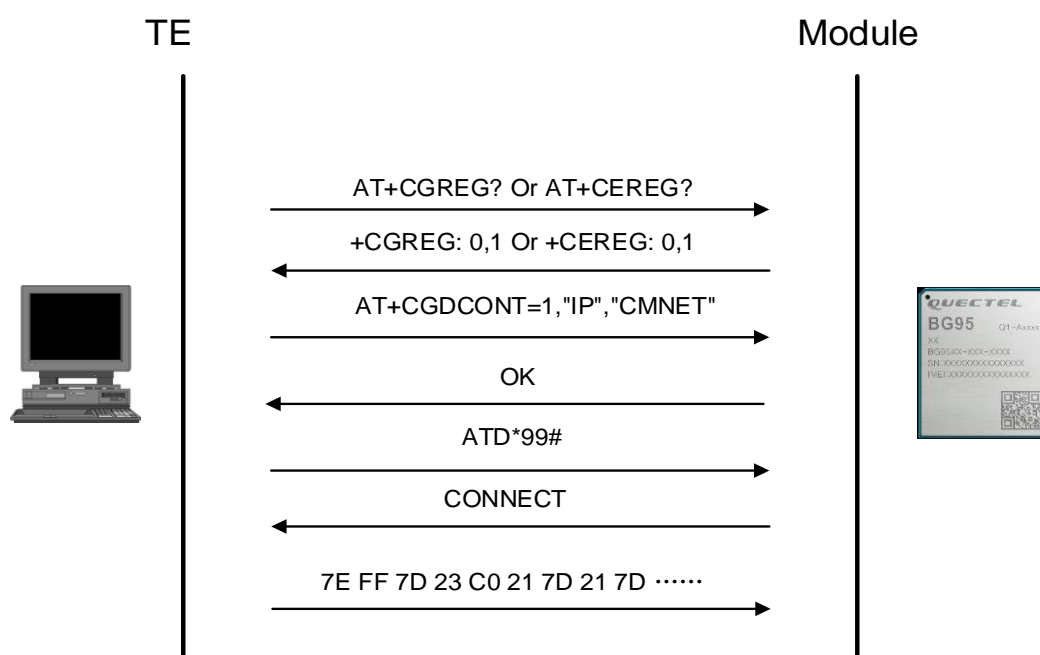


Figure 2: General Procedure for Setting up PPP

NOTE

See *document [1]* for detailed information about the AT commands mentioned in this chapter.

3.2. Recommended Procedure for Setting up PPP

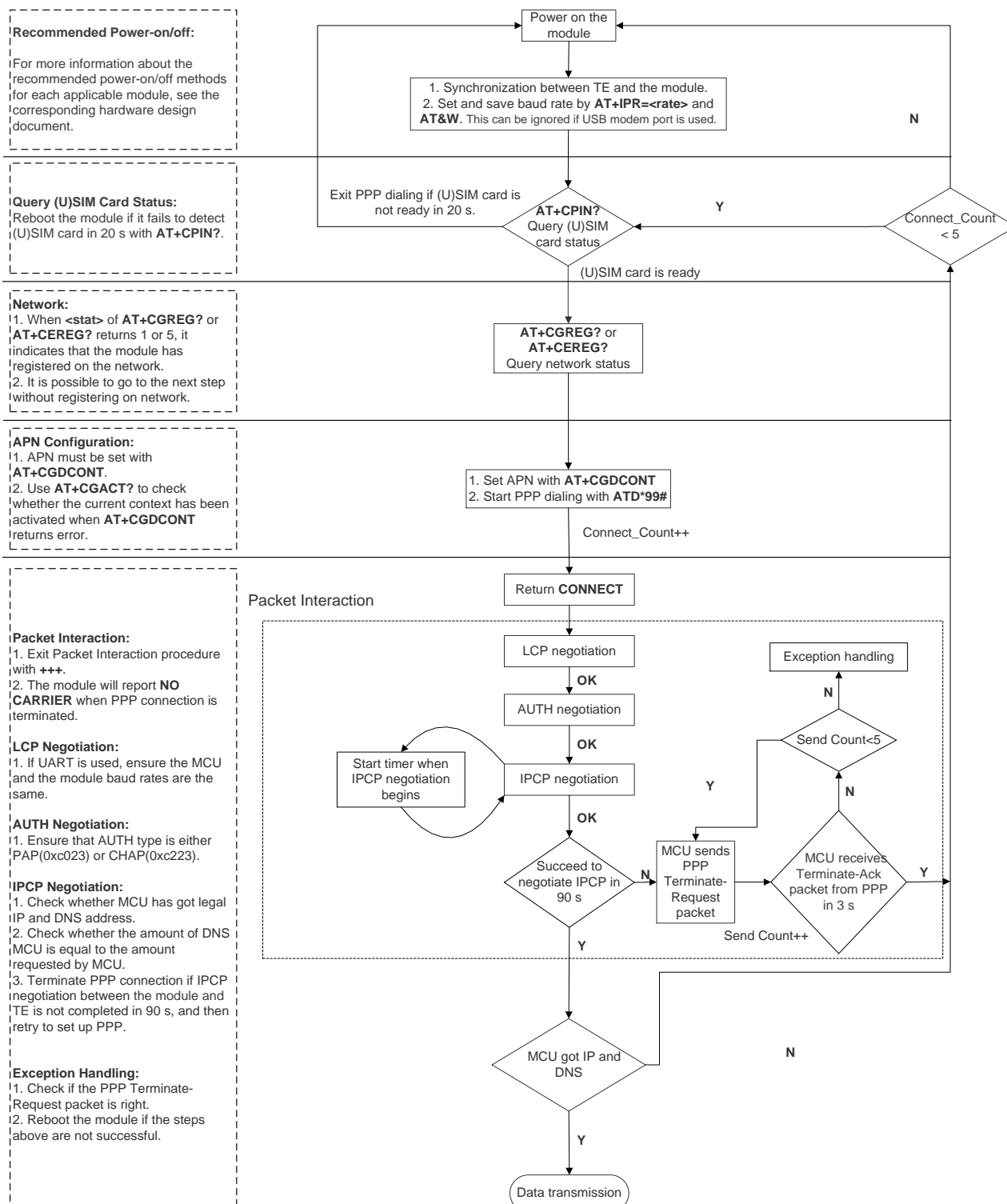


Figure 3: Flowchart of Recommended Procedure for Setting up PPP

When the module is powered on and the main UART is used, set and save the baud rate by executing **AT+IPR=<rate>** and **AT&W**. Before executing **ATD*99#** to set up PPP, you must check the status of the (U)SIM card with **AT+CPIN?**. When the (U)SIM card is ready, periodically check the network registration status with **AT+CEREG?** or **AT+CGREG?** until the network is prepared.

NOTE

1. Ensure the MCU and the module are synchronized successfully after rebooting the module. The MCU sends **AT<CR><LF>** to the module every 100 ms until it receives **OK** reported by the module. If the main UART is used, the MCU will execute **AT+IPR=<rate>** and **AT&W** to set and save the baud rate after successfully synchronizing the baud rate.
2. Before inputting the next AT command, the MCU needs to wait for the response to the previous AT command (e.g., **OK**, **CME error**, **CMS error**). If there is no response within 60 seconds, the module can be restarted.
3. It is strongly recommended NOT to power on/off the module frequently. If 3 consecutive dialing retries fail, you can immediately power on/off (reset) the module for the first time. After resetting, if the dialing retry fails again, you need to wait for 10 minutes for the second reset, 30 minutes for the third reset, and 1 hour for the fourth reset.
4. If MCU fails to transmit data to the network after establishing the PPP connection, check the PPP configuration and network status and restart the module.
5. See **document [1]** for detailed information about the AT commands mentioned in this chapter.

4 PPP Connection Modes

4.1. Data Mode and Command Mode

The module communicates with an application via USB or UART port (including AT commands and data). USB and UART ports support two types of operation modes: data mode and command mode.

The two ports are in command mode before PPP is set up, and the module can execute AT commands in this mode. When PPP negotiation is started, the two ports enter data mode, and stay in the data mode after the PPP connection is configured. The module cannot execute AT commands in data mode. If the PPP connection is not successfully established, the two ports will remain in the command mode.

Quectel BG95 series, BG77 and BG600L-M3 modules provide convenient methods for switching between the two modes.

4.1.1. Switch from Data Mode to Command Mode

4.1.1.1. Change MAIN_DTR Level to Switch from Data Mode to Command Mode

When PPP connection already exists and the USB/UART port is in data mode, the ports can be switched to command mode by changing MAIN_DTR pin level from low to high (**AT&D1** should be set first). The module will return **OK** after switching to command mode.

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

After the PPP connection is successfully established, you can also switch the USB/UART port from data mode to command mode by inputting **+++**. To prevent the **+++** escape sequence from being misinterpreted as data, the following requirements should be followed:

- a) Do not input any character for at least 1 s before and after inputting **+++**.
- b) Input **+++** within 1 s, and wait until **OK** is returned. After **OK** is returned, the module switches to command mode.

NOTE

Perform the above operations after completing the PPP negotiation, otherwise the above operations will terminate the PPP negotiation and the USB/UART port will exit the data mode. Once the PPP negotiation is completed, when the USB/UART port switches to the command mode, the input data are treated as AT commands, and the module maintains the 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

You can execute **ATO** (see *document [1]* for details) to switch the USB/UART port from command mode to data mode after the PPP connection has been established.

Example

//When PPP connection exists, and USB/UART port is in command mode.

ATO

CONNECT 150000000

//Indicates that the module has entered data mode, and all data inputted from USB/UART port are treated as PPP frames.

4.2. Handle URC in Data Mode

The URC for incoming calls and short messages in data mode will not be reported to the PPP dial-up port during PPP connection. However, the level of module's MAIN_RI pin will change from high to low for 120 ms as an indication of URC for incoming calls and short messages. The MCU can switch the port to command mode according to the MAIN_RI pin status to process incoming calls or short message. After switching to command mode, the URC will be reported to the PPP dial-up port if there are incoming calls or text messages.

4.3. Data Carrier Detection (DCD) Mode

DCD mode is determined by **AT&C** (see *document [1]* for details). If **AT&C0** is executed, the MAIN_DCD pin will not be used to indicate the data carrier status. While executing **AT&C1**, the MAIN_DCD pin will be used to indicate the data carrier status. The pin will remain at low level when there is a data carrier or PPP negotiation begins, otherwise it will remain at high level.

NOTE

When switching module's USB/UART port from data mode to command mode, the MAIN_DCD pin state remains unchanged.

5 PPP Connection Termination

There are two methods to terminate the PPP dial-up connection:

1. Terminate the PPP connection with the LCP Terminate-Request message (the recommended method).
2. The module can also terminate the PPP connection by changing the MAIN_DTR pin level. First, set the DTR function with **AT&D2** when the USB/UART port is still in command mode before PPP connection is established. Then, change the MAIN_DTR pin level from low to high to automatically terminate the data connection. After the PPP connection is terminated, the USB/UART port enters the command mode. Example is presented below:

Example

//USB/UART port is in command mode before PPP connection is established.

AT&D2

OK

NOTE

PPP connection termination procedures can be performed at any time during the PPP setup or connection establishment process.

6 PPP Dial-up Operations

This chapter explains how to establish a PPP dial-up connection in Windows 10. For detailed operation in Linux operating system, see *document [2]*.

6.1. Preparation

It is necessary to finish the following steps before establishing a PPP dial-up connection in Windows.

1. Connect the module to a PC and enter the PIN code if the (U)SIM card PIN is locked.
2. Make sure the (U)SIM card can successfully register on LTE Cat M1, LTE Cat NB2 or GPRS network.

6.2. PPP Dial-up Network Configuration

6.2.1. Add a New Dial-up Connection

If no Windows Dial-up is set up, a new dial-up connection needs to be added to the **"Network & Internet"** section in Windows Settings.

Click **"Start"** → **"Settings"** → **"Network & Internet"** → **"Dial-up"** → **"Set up a new connection"** → **"Connect to the Internet"** consequently. Click **"Next"** and choose **"Dial-up"** in the interface to add a new dial-up as shown in figures below.

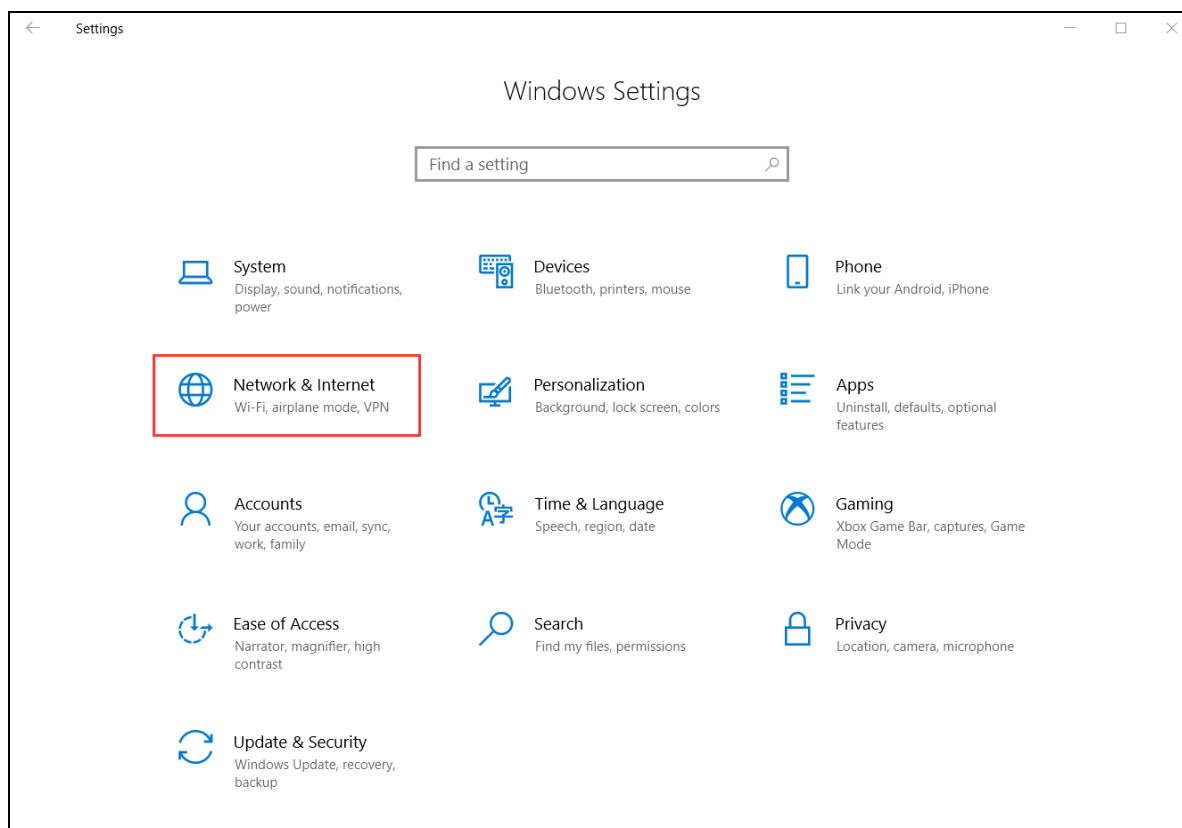


Figure 4: Select "Network & Internet" in Windows Settings

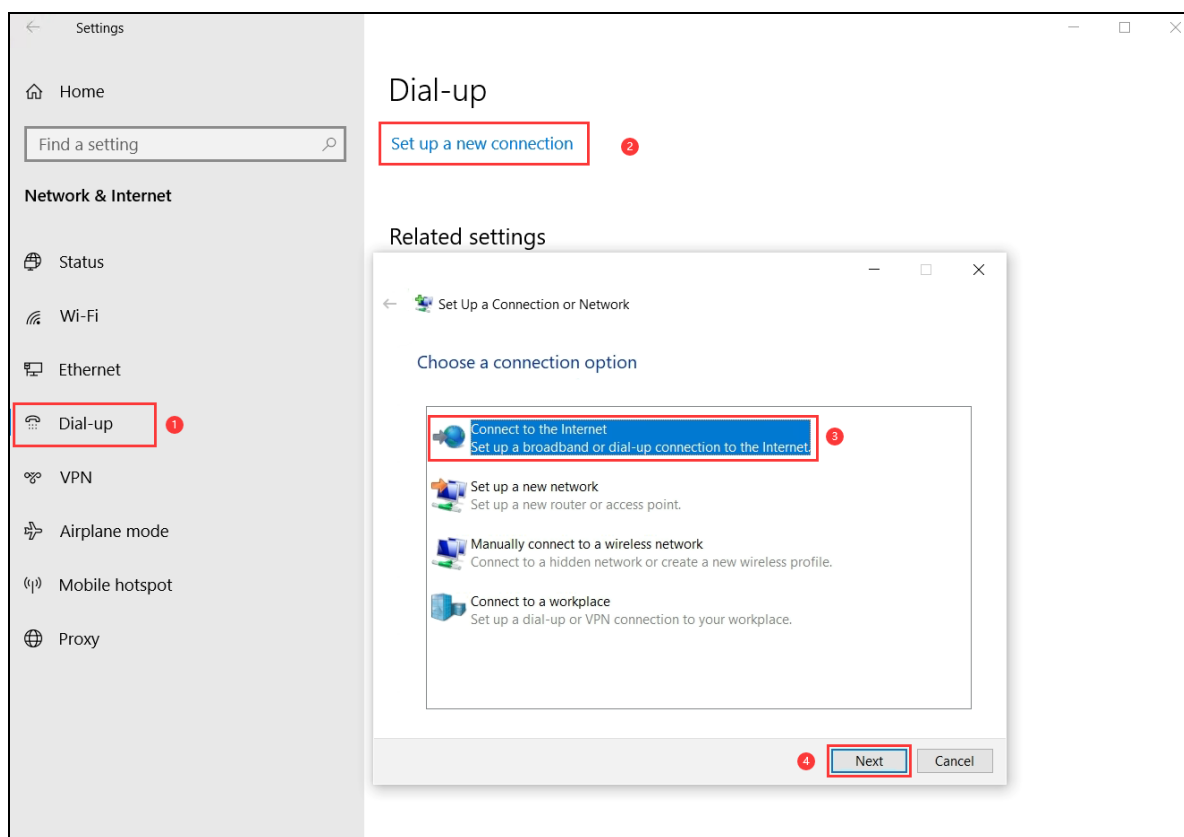


Figure 5: Set up a New PPP Connection

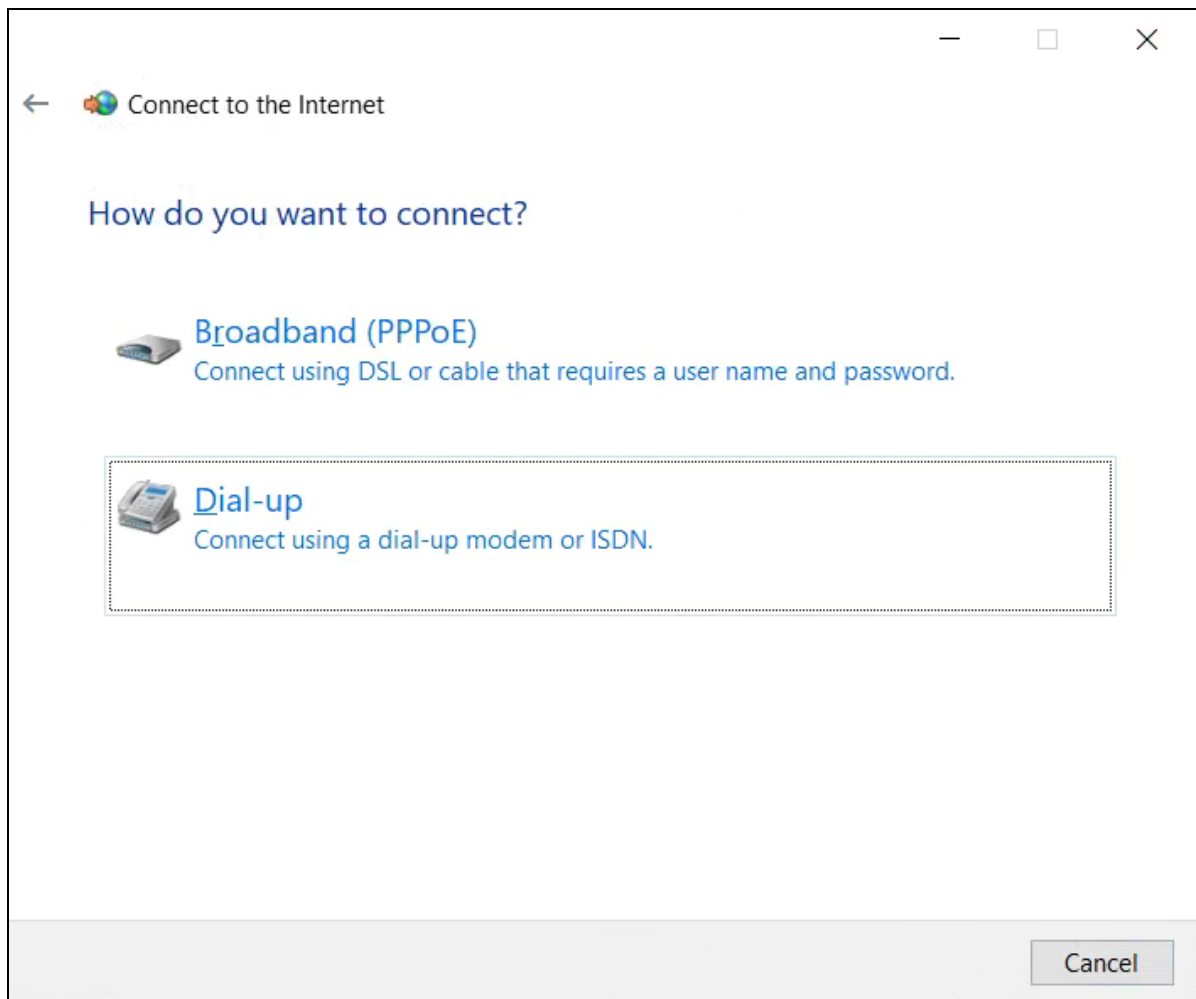
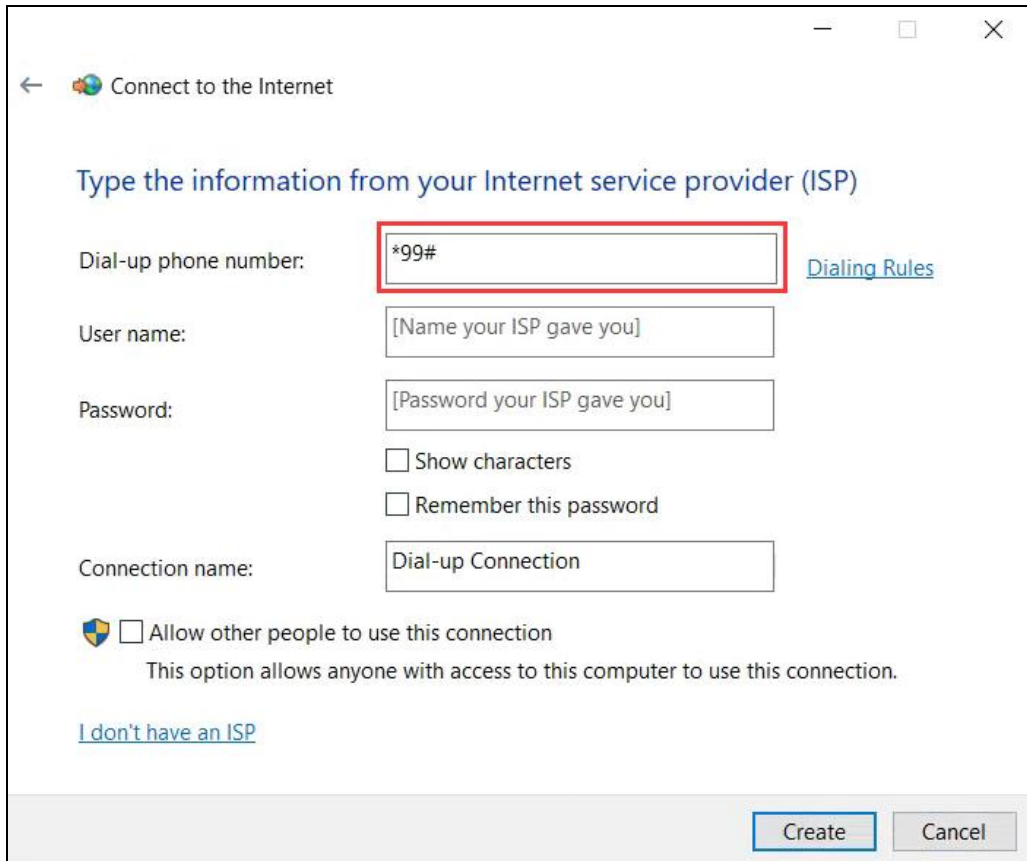



Figure 6: Connect Using Dial-up

6.2.2. Create the Connection

Enter number (e.g., *99#) in “dial-up phone number”, and then click “**Create**” button, as illustrated below.



←  Connect to the Internet

Type the information from your Internet service provider (ISP)

Dial-up phone number: [Dialing Rules](#)


User name:

Password:

☐ Show characters

☐ Remember this password

Connection name:

 ☐ Allow other people to use this connection
This option allows anyone with access to this computer to use this connection.

[I don't have an ISP](#)

Figure 7: Create the Connection

After that, the interface displays **“Connecting to Dial-up Connection”**.

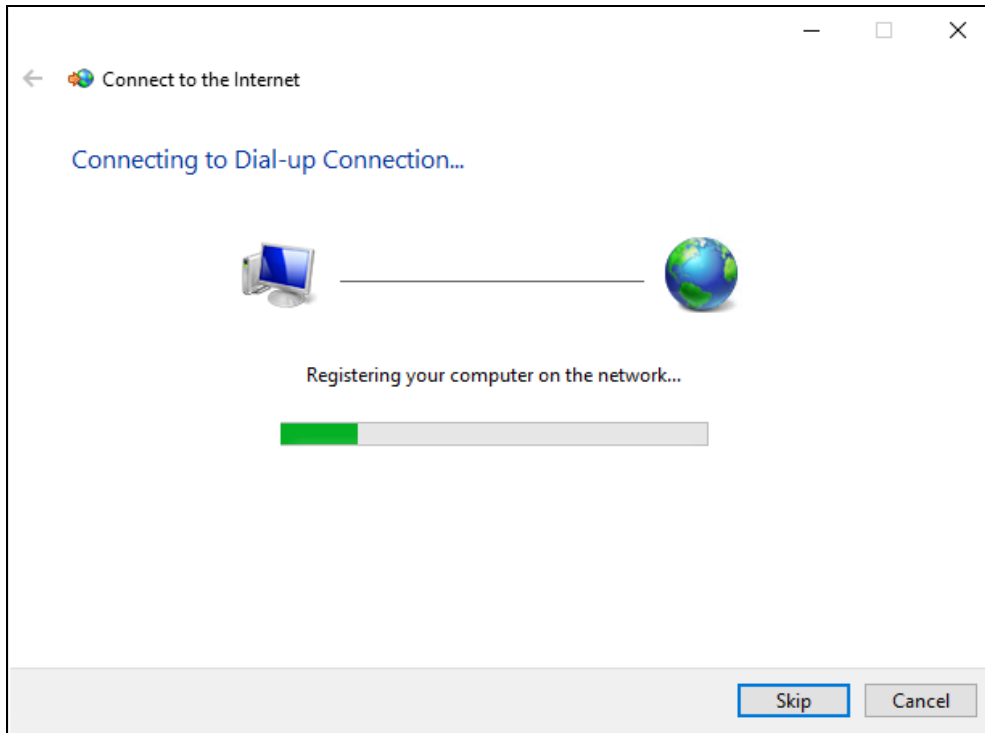


Figure 8: Connecting to Dial-up Connection

And then it displays **"The connection to the Internet is ready to use"** if the connection is successful.

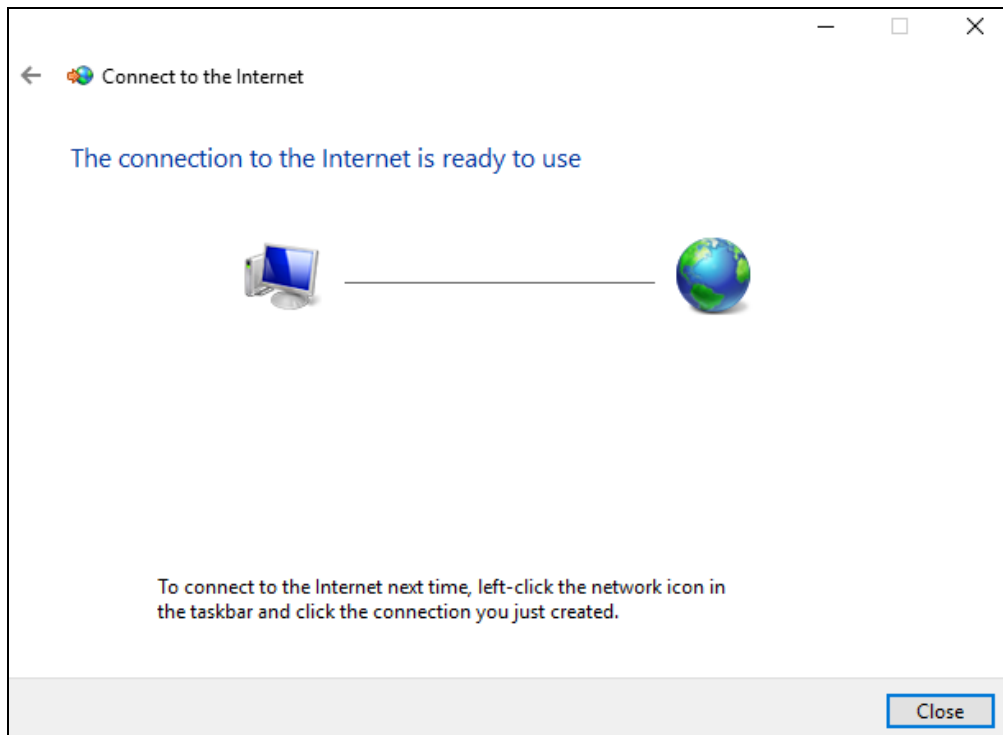


Figure 9: The Connection to the Internet is Ready to Use

6.2.3. Configure the Dial-up Tool

If the Windows dial-up has been set up, you can configure its properties with the following steps.

1. Click **"Start" → "Settings" → "Network & Internet" → "Dial-up" → "Connect"**.
2. Click **"Properties"** button from the popup window.
3. Click **"Configure..."** button to configure the **"Modem – Quectel USB Modem (COM5)"**.
4. Select **"115200"** from the **"Maximum speed"** drop-down list. Click **"OK"** button to finish the configuration.

See the figure below for more information.

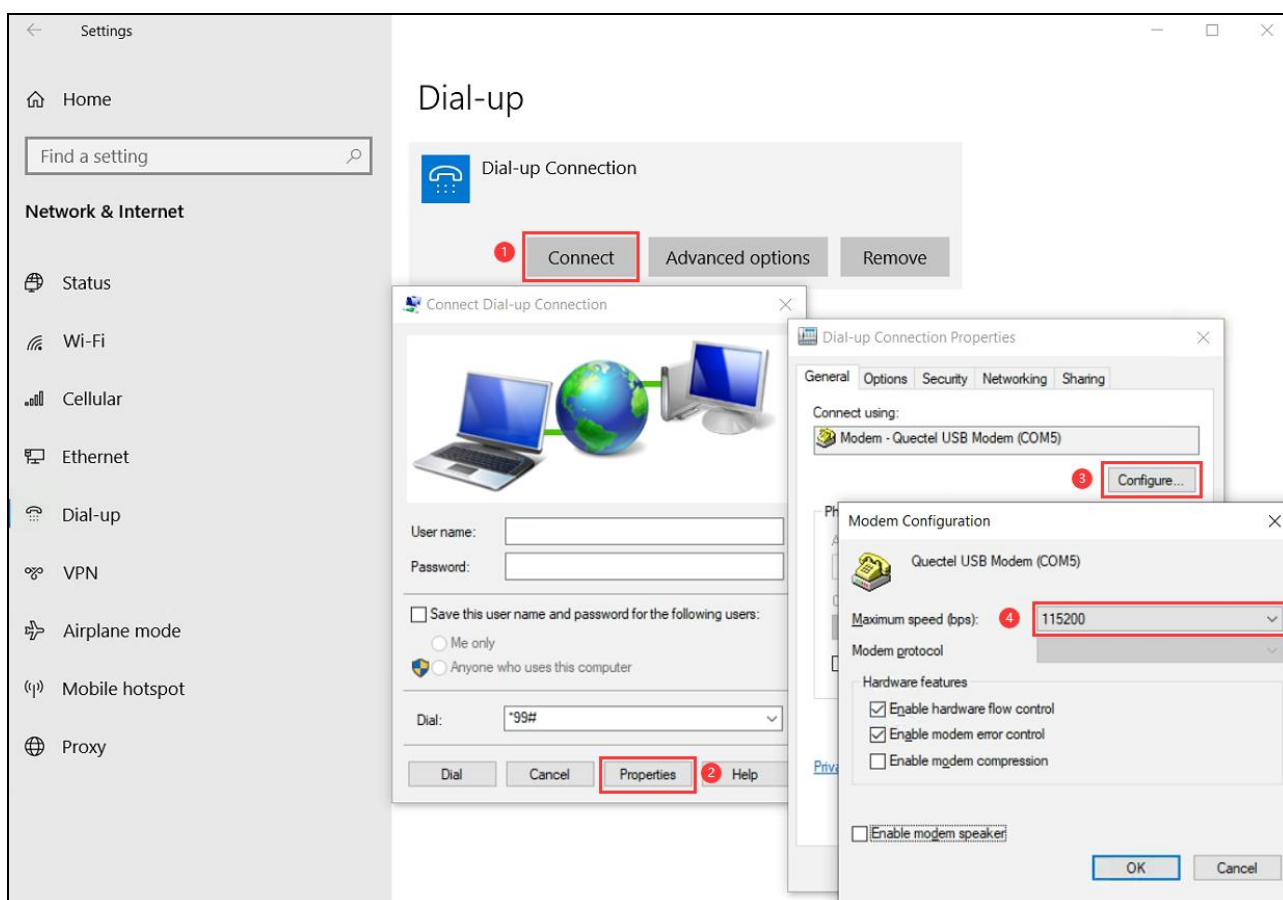


Figure 10: Configure the Dial-up Tool

6.2.4. Establish Dial-up Connection

After the above operations, click the **"Dial"** button from **"Connect Dial-up Connection"** pop-up window and the interface will pop up a prompt box **"Registering your computer on the network"**. Wait for the computer to register on the network successfully. See the figure below for more information.

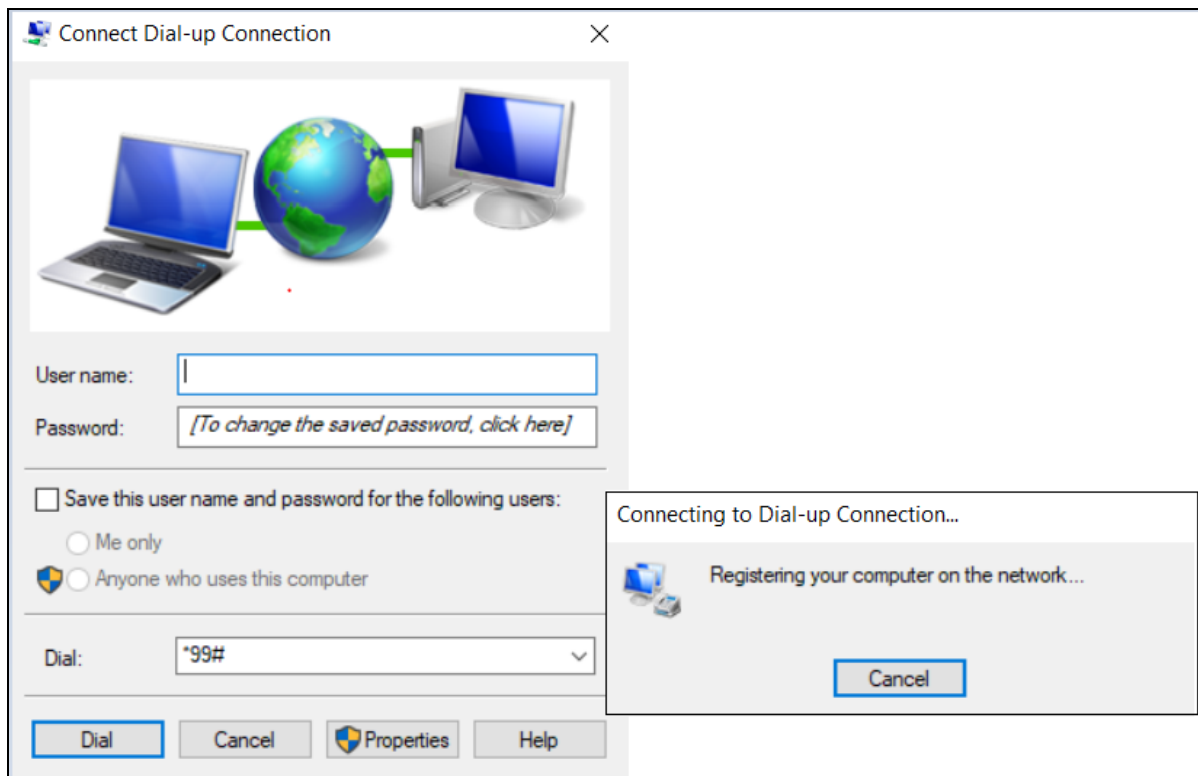


Figure 11: Establish Dial-up Connection

7 Appendix References

Table 2: Related Documents

Document Name
[1] Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual
[2] Quectel_WCDMA<E_Linux_USB_Driver_User_Guide
[3] Quectel_BG95_Series_Hardware_Design
[4] Quectel_BG77_Hardware_Design
[5] Quectel_BG600L-M3_Hardware_Design

Table 3: Terms and Abbreviations

Abbreviation	Description
APN	Access Point Name
CHAP	Challenge Handshake Authentication Protocol
CTS	Clear To Send
DCD	Data Carrier Detection
DTR	Data Terminal Ready
EGPRS	Enhanced General Packet Radio Service
GPRS	General Packet Radio Service
HTTP(S)	Hypertext Transfer Protocol Secure
IP	Internet Protocol
LCP	Link Control Protocol
LPWA	Low Power Wide Area

LTE	Long-Term Evolution
MCU	Micro Control Unit
PAP	Password Authentication Protocol
PIN	Personal Identification Number
PPP	Point-to-Point Protocol
RI	Ring Indicator
RTS	Request to Send
RXD	Receive Data (Pin)
TA	Terminal Adapter
TCP	Transmission Control Protocol
TE	Terminal Equipment
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module
Wi-Fi	Wireless Fidelity