WF288 Gateway Application Note

Amp'ed RF Technology, Inc.

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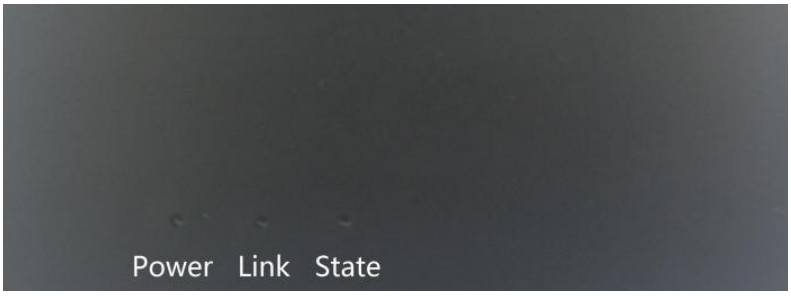
1. WF288 Mesh Gateway

1.1. Overview

WF288 MG is an enclosed gateway product for Wi-Fi Mesh network. This product implements the gateway functionality of a Wi-Fi mesh network and serves as a WAN bridge.

1.2. Product Introduction

1.2.1. Layout



- Power: When powered on, this indicator light will light up.
- Link: When the system is fully started, this indicator light will light up.
- State: Indicates Wi-Fi Mesh network connection status.

- Reset: Reset button.
- Power: Power input.
- LAN: Ethernet socket.

1.2.2. Key Features

- Supports IPV6
- 802.11 a/b/g/n, dual band
- Mesh networking with WF88
- Supports Mesh Gateway
- WPA3 security enabled
- DC5V/1A Input

1.3. Cable Connections

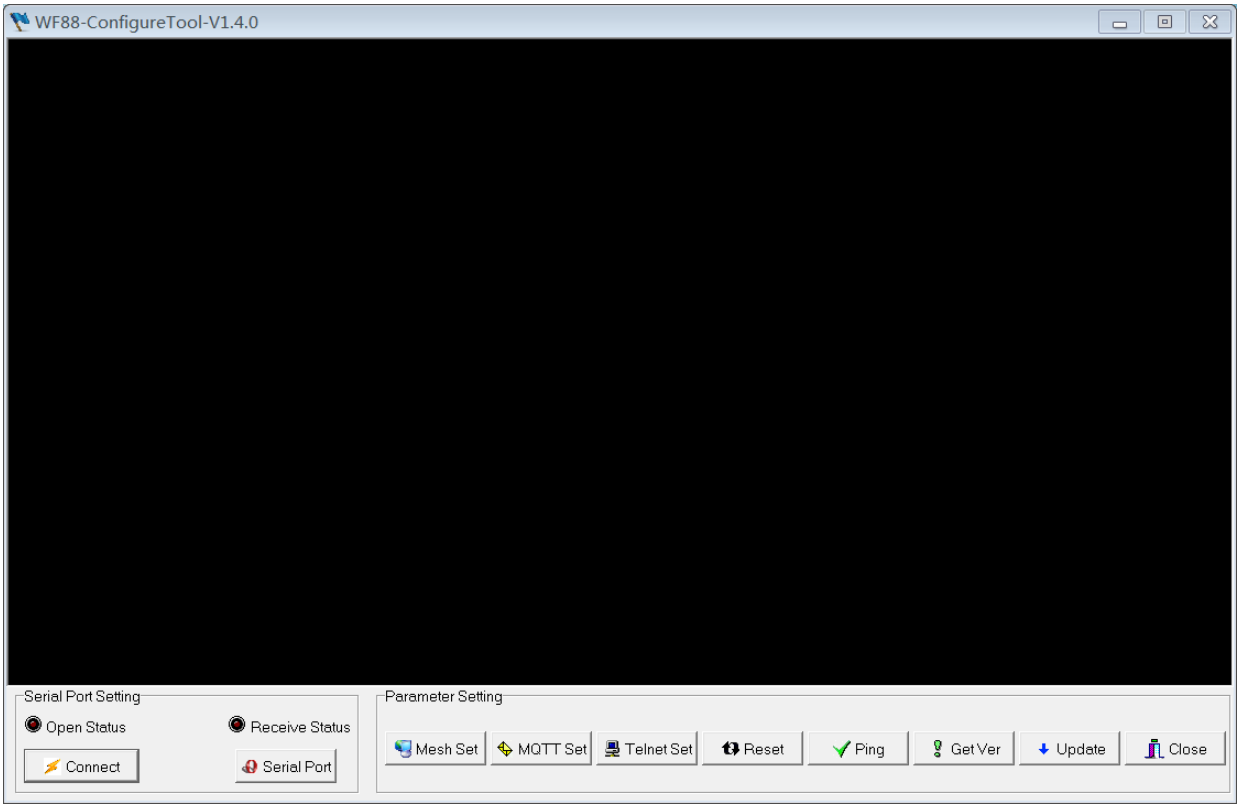
A USB to Type-C data cable provides the voltage input connection. Insert the Type-C connector of the data cable into the Type-C power interface of WF288 MG, and the other end into the DC5V/1A adapter. The “Power” indicator light of WF288 MG is on. Insert the Ethernet cable into the LAN interface of WF288 MG, and the other end into devices such as switches or routers. The yellow and green indicator lights on the Ethernet socket of WF288 MG indicate the network status.

1.4. Parameter Setup

1.4.1. COM Port

Plug the USB to Type-C data cable into the computer's USB interface. The Ethernet cable does not need to be plugged in. In the Windows operating system, under Control Panel -> Administrative Tools -> Computer Management -> Device Manager -> Ports (COM and LPT), find the “Silicon Labs CP210x USB to UART Bridge (COMx) “ device.

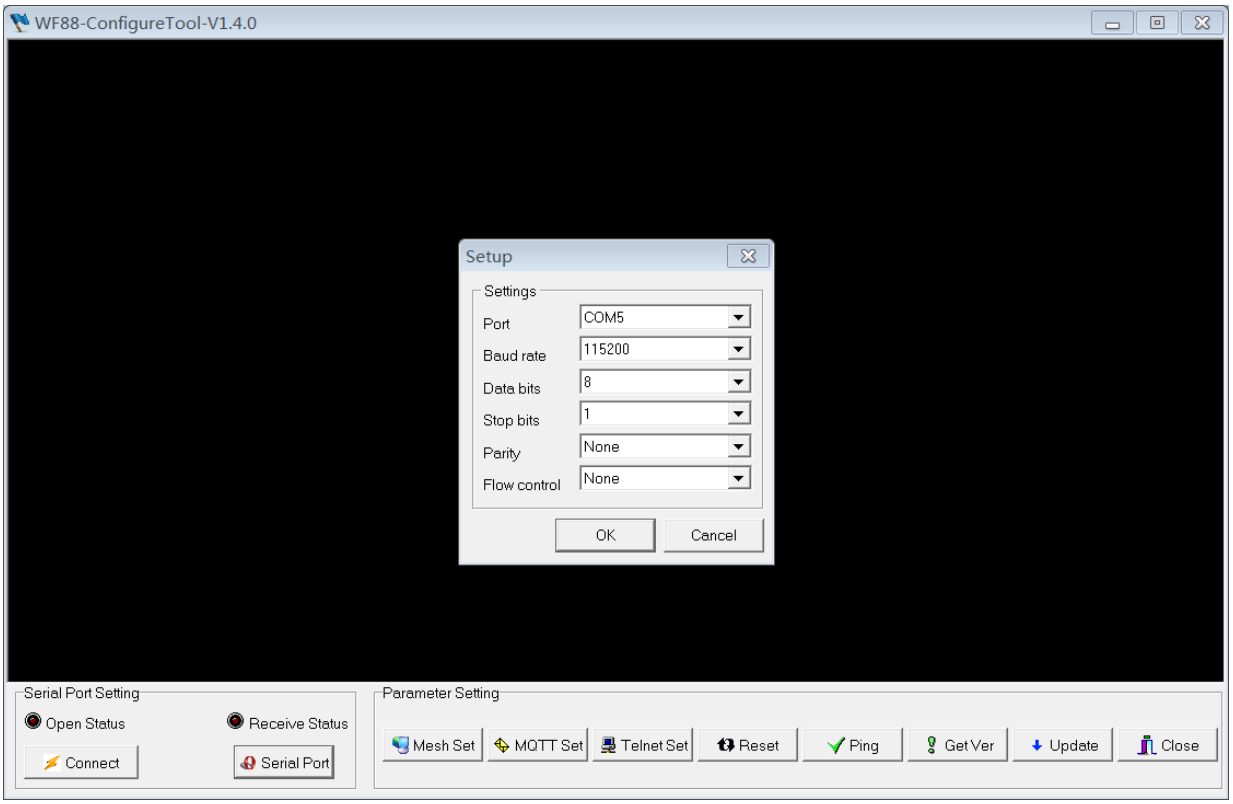
1.4.2. Run “WF88-ConfigureToolPro-Vx.x.x.exe” configuration tool software, as shown below:



Configuration tool software main window

1.4.3. Port Setup

click the "Serial Port" button, and a serial port settings dialog box will pop up, as shown below:

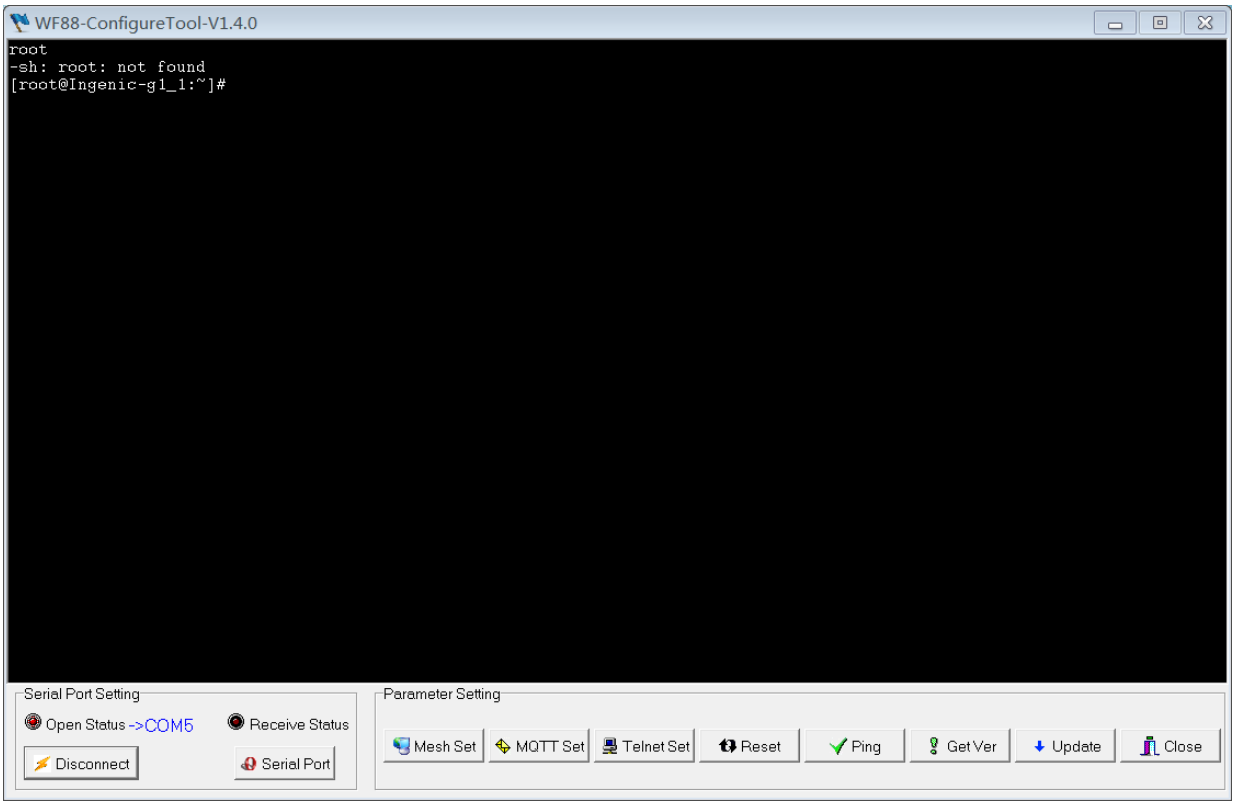


Serial port settings dialog box

In the serial port settings dialog box, Select the corresponding COMx port from the Port dropdown list box, where the COMx port number is consistent with the serial port number recognized in the Device Manager above. Then, click the “OK” button.

1.4.4. Connect

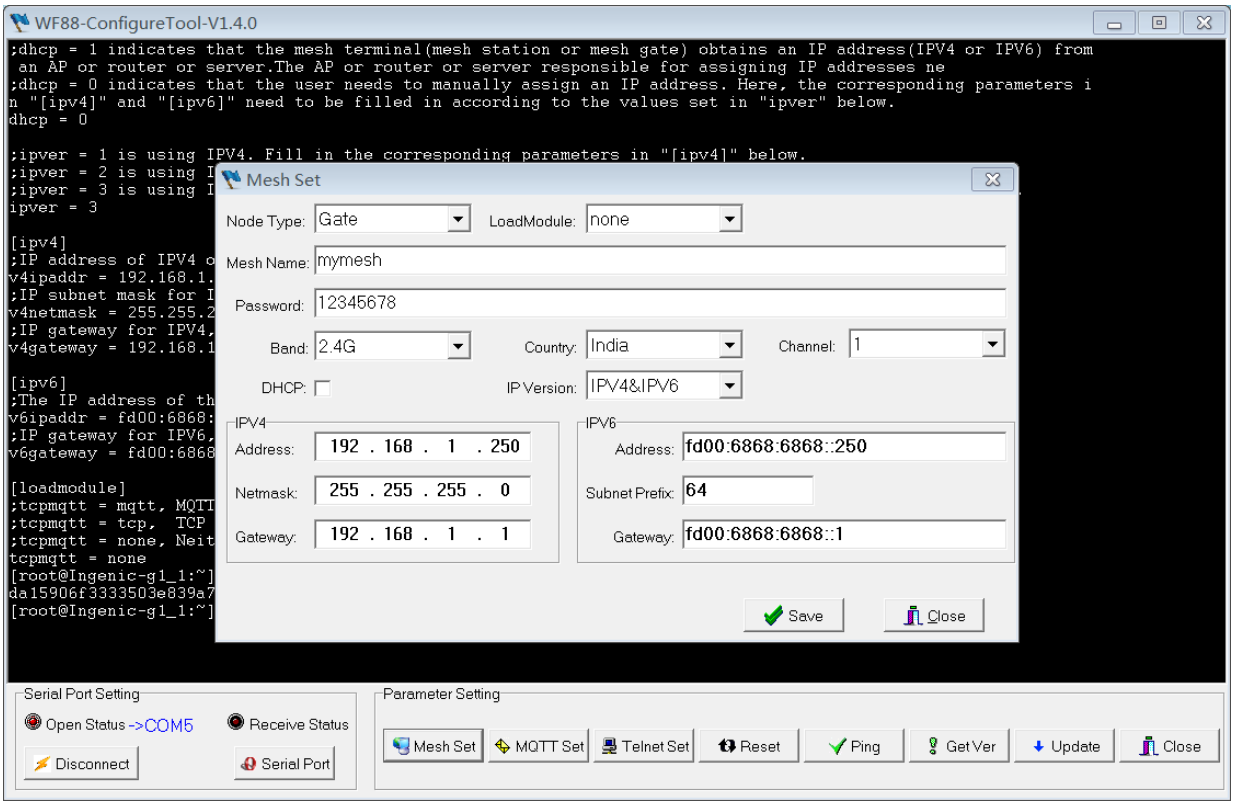
In the main window, click the “Connect” button to open the serial port.



Open the serial port

1.4.5. Mesh Settings

Click the “Mesh Set” button to open the Mesh Set dialog box:



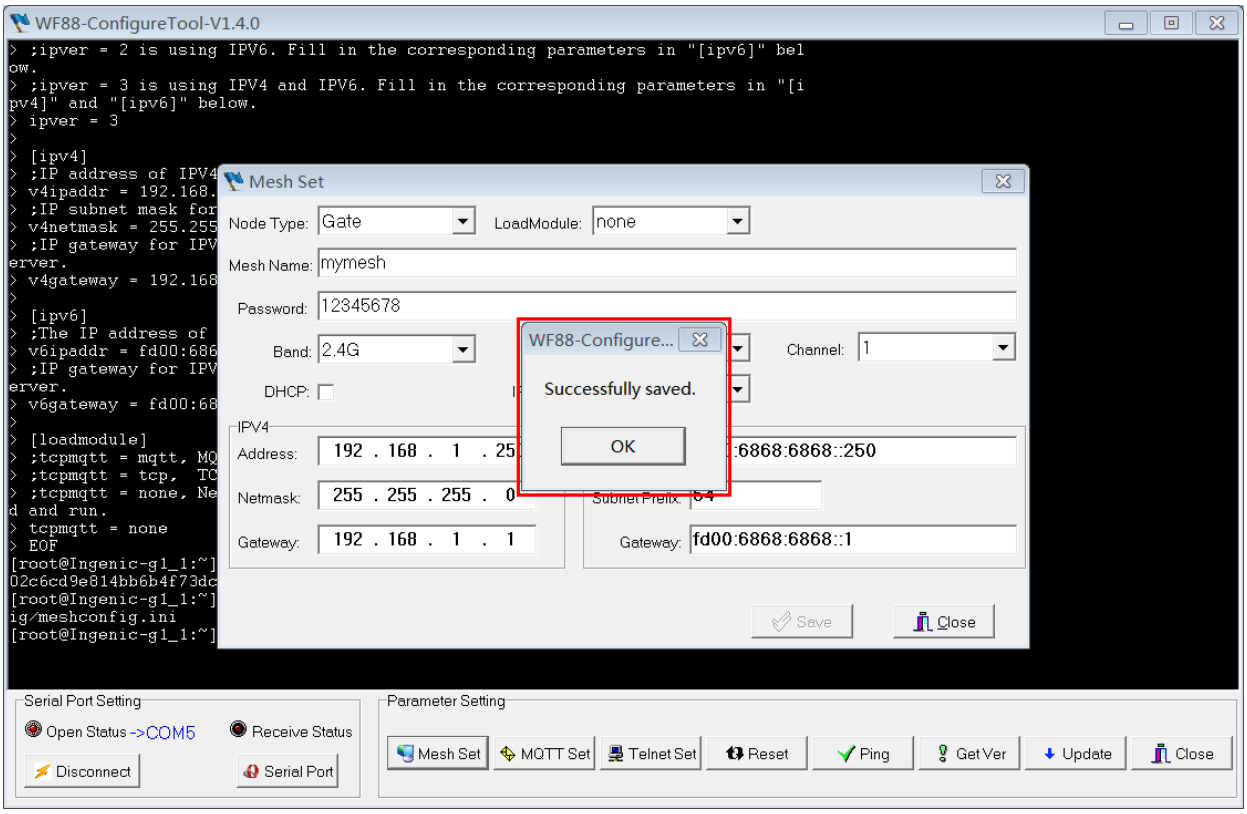
Mesh Set dialog box

For WF288 MG typical settings are:

- Node Type: must select “Gate”,
- LoadModule: must select “none”
- DHCP: optional, does not need to be selected

Other parameters should be filled in according to the actual situation. In general, in a physical Wi-Fi Mesh network, only one WF288 MG device is needed as the Gate. “Mesh Name”, “Password”, “Band”, “Country”, “Channel”, “IP Version” must be the same for all station and gateway nodes in the same network. The IP address cannot be duplicated, but it must be set to the same network segment.

After completion, click the "Save" button to save the settings. The "Successfully saved" dialog box will pop up, as shown below:



In the "Successfully saved" dialog box, click “OK” button, complete parameter settings.

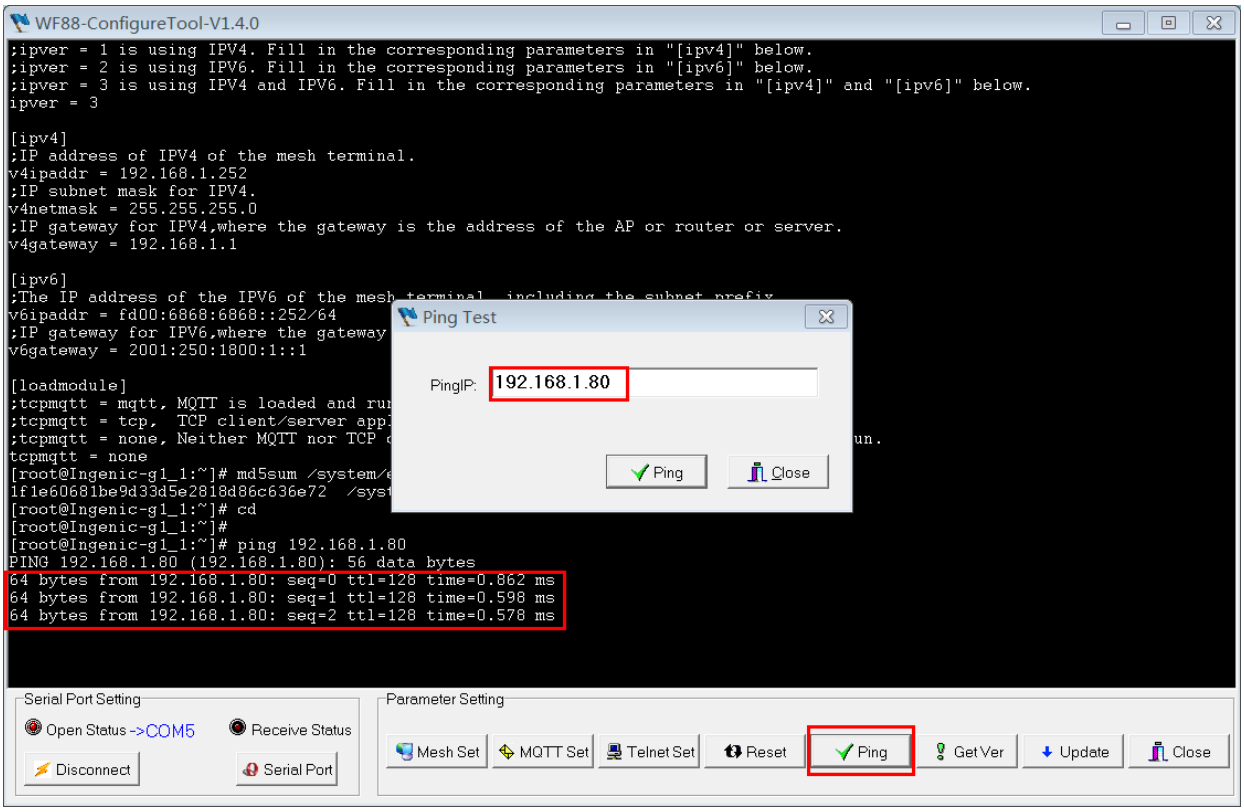
Note: In the main window, click the “Reset” button to restart WF288 MG for the settings to take effect.

1.5. Update Firmware

In WF288 MG firmware versions later than V1.3.0_20231028, and the kernel version of Linux is “3.10.14__isvp_swan_1.0__ (yangsz@amped) (gcc version 4.7.2 (Ingenic r2.3.3 2016.12)) #58 PREEMPT Wed Oct 25 11:24:14 CST 2023”, then the firmware update of the application partition is supported.

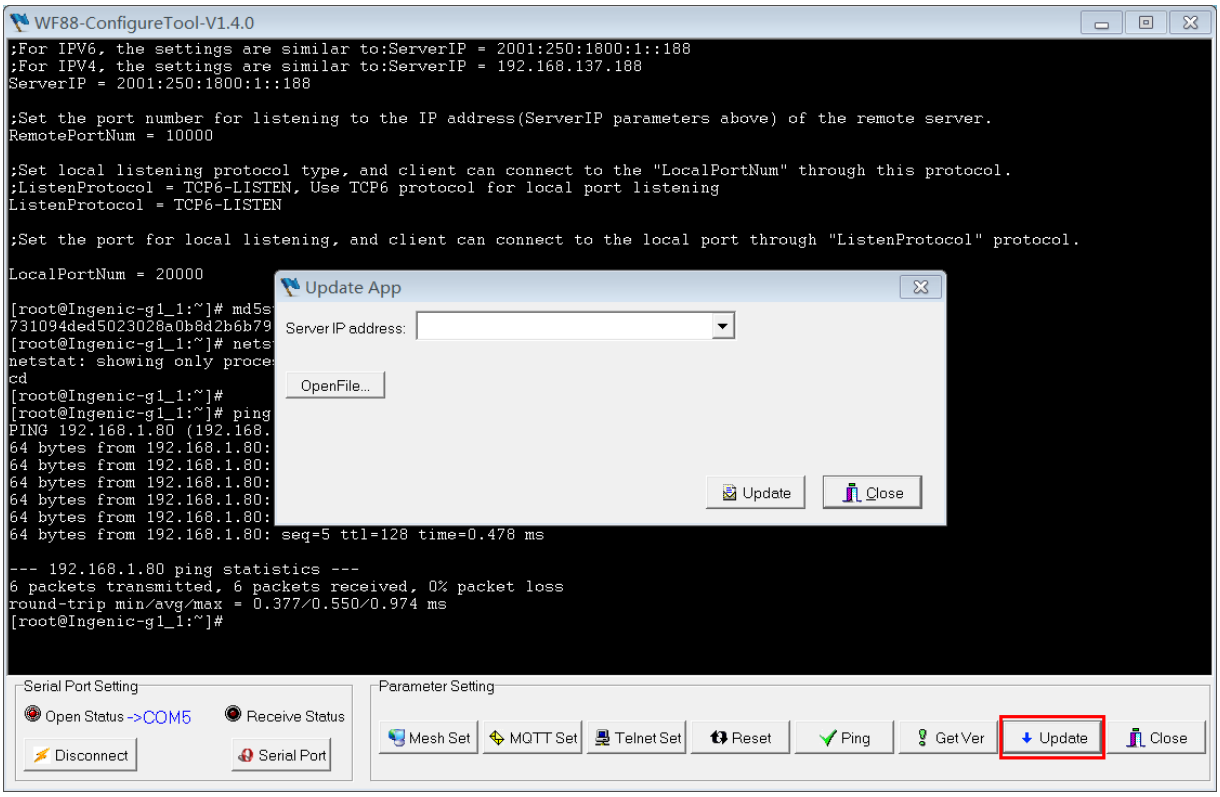
Using a network cable to connect the WF288 MG to the computer used to update the firmware. The cable can be connected directly or through a switch.

Please ensure that the IP address of WF288 MG and the IP address of the computer are in the same network segment. For example, the IP address of WF288 MG is 192.168.1.250, and the IP address of the computer is 192.168.1.80. It can be tested through ping, as shown below:



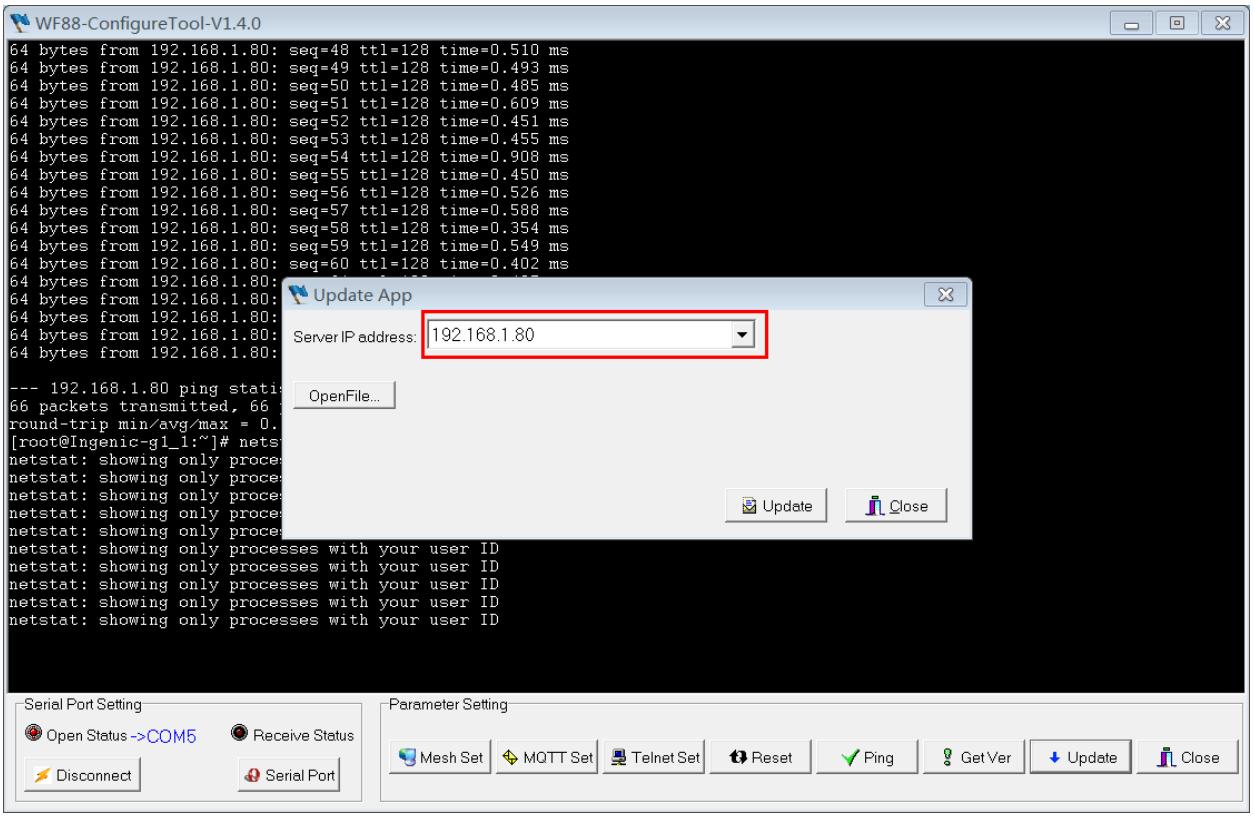
Ping dialog box

Click the "Update" button, and the "Update App" dialog box will pop up, as shown below:



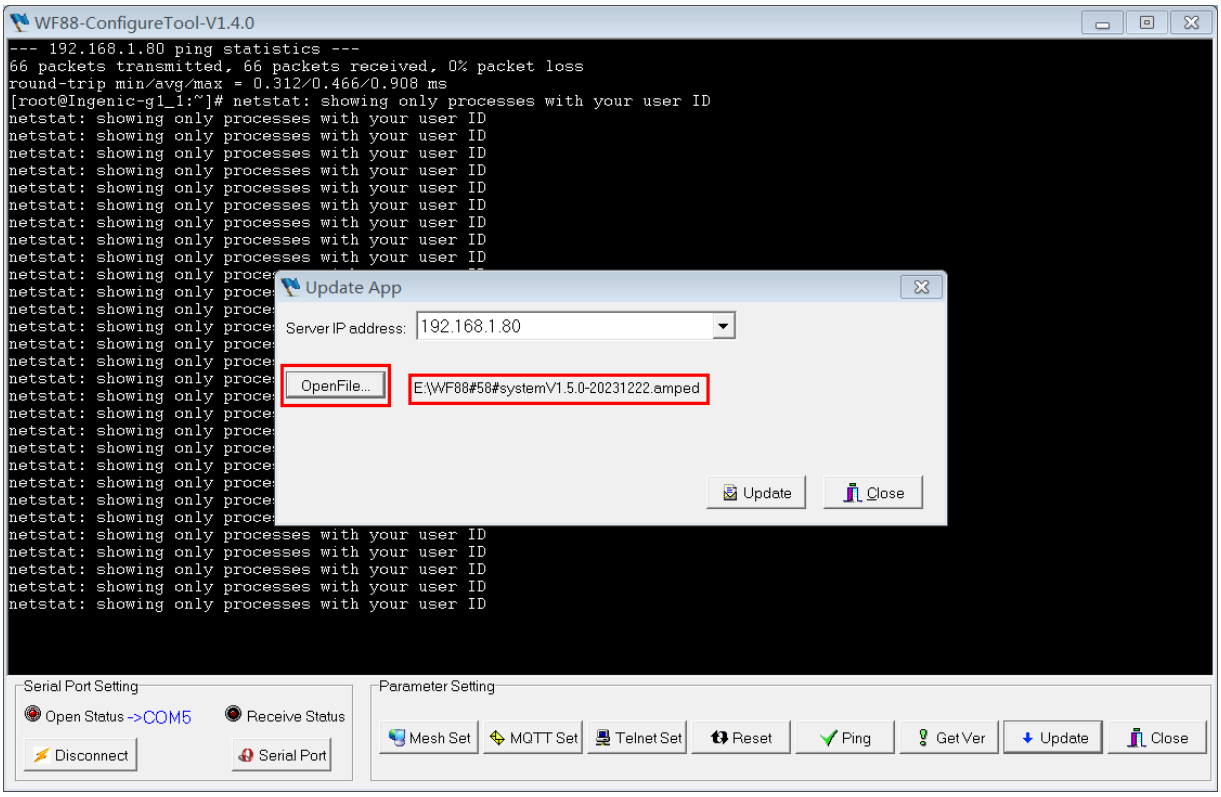
Update App dialog box

Click on the "Server IP address" dropdown list box and select the IP address of the computer that successfully tested communication, as shown below:



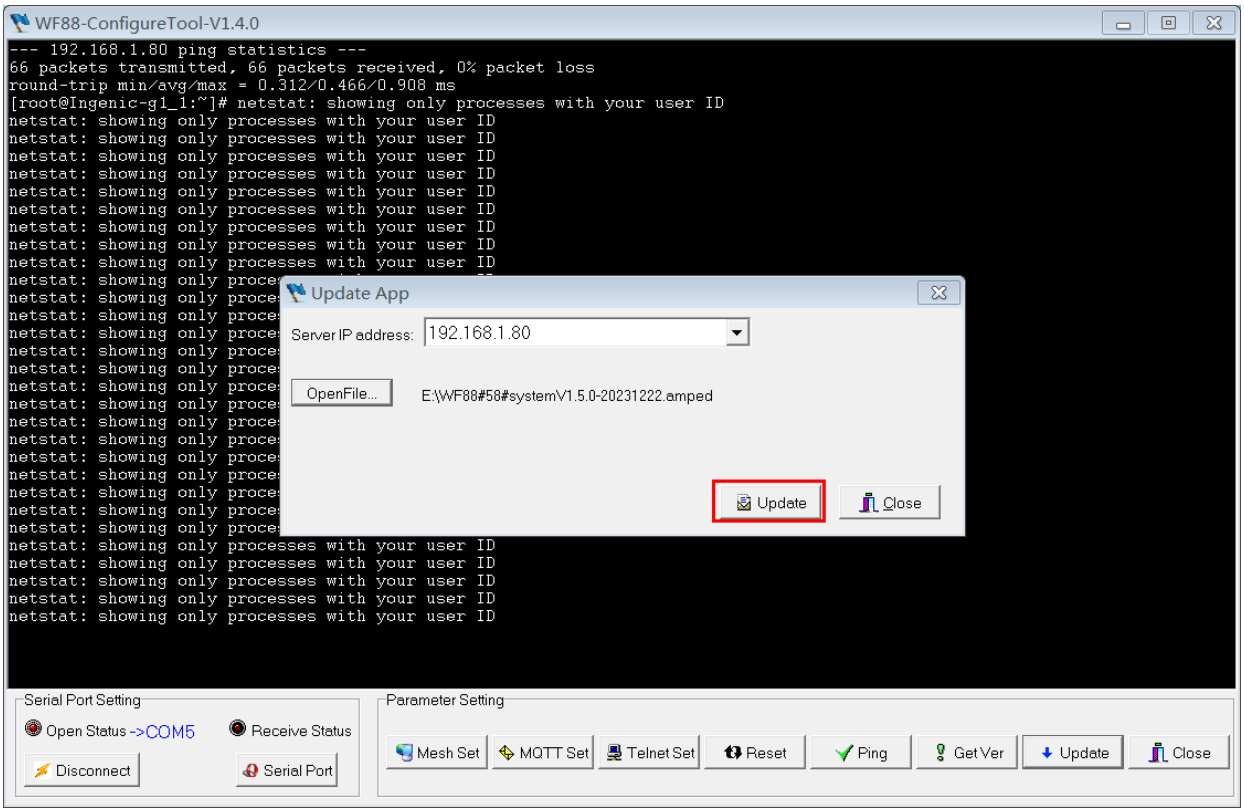
Select Server IP address

Click the "OpenFile" button to open the file selection dialog box and select the firmware with the “.amped” extension that needs to be upgraded, as shown below:



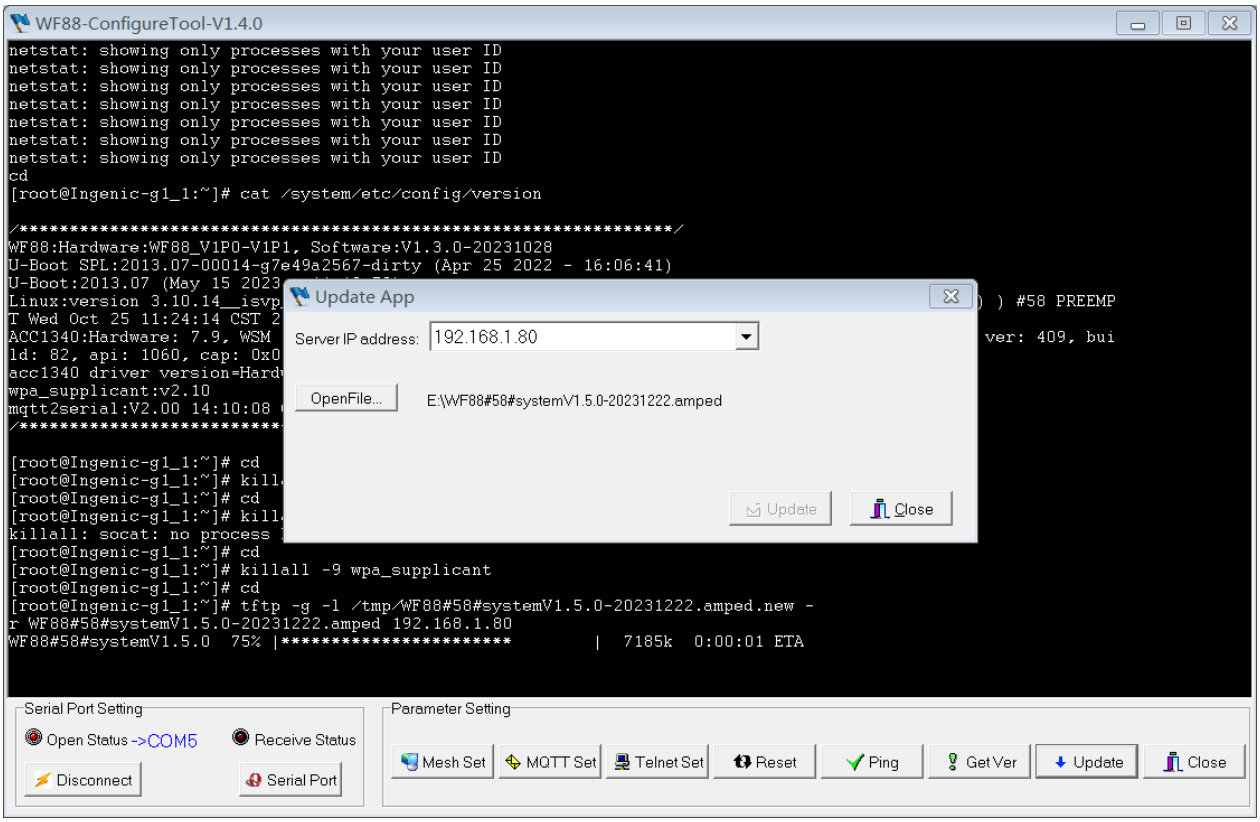
Firmware selection

Click the "Update" button in the Update App dialog box to start downloading the firmware, as shown below:



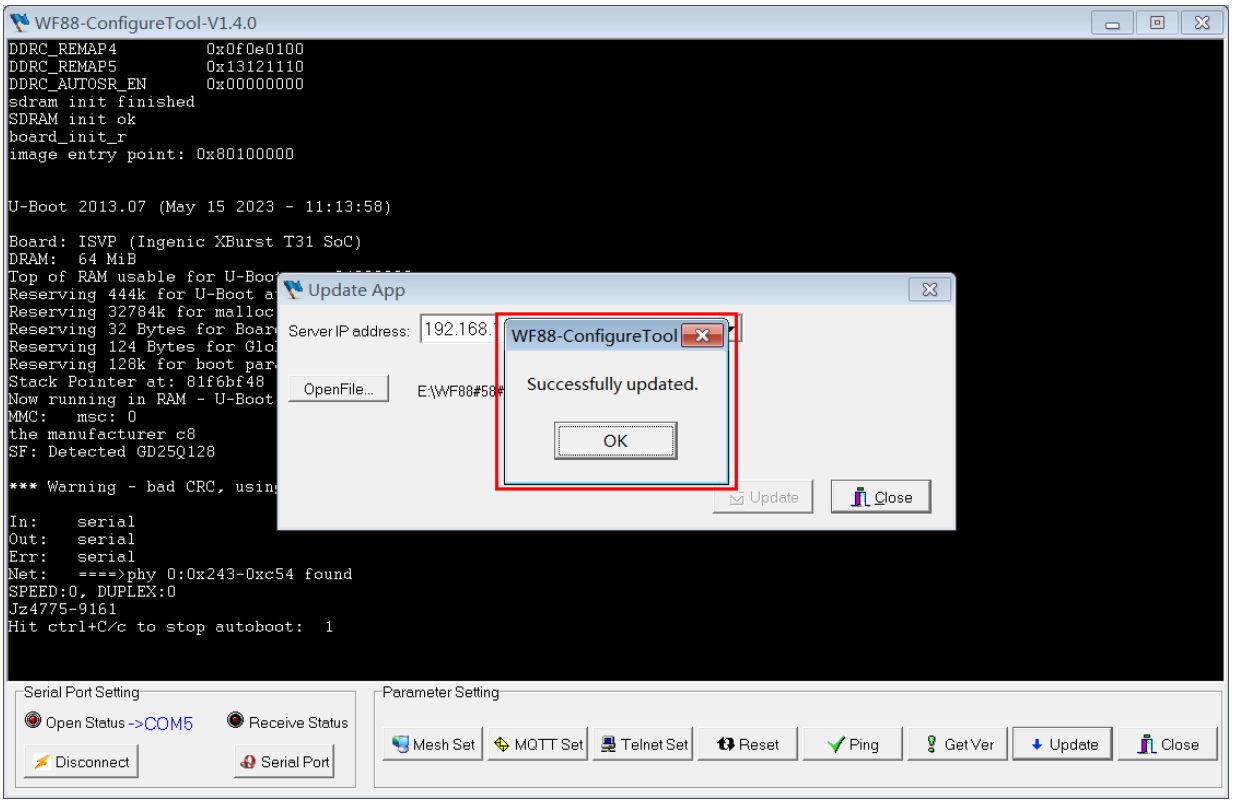
Start updating the firmware

The WF88-ConfigureTool will download and update firmware, as shown below:



Start downloading the firmware

Finally, complete the firmware update, the device will automatically restart, as shown below:



Successfully updated

2. WF288 LoRaNetGateway

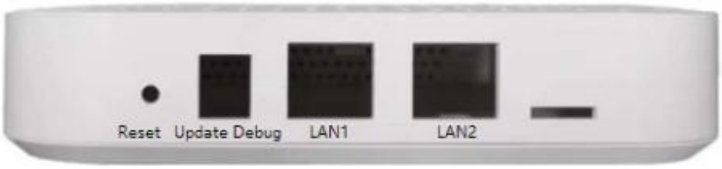
2.1. Overview

WF288 LoRaNetGateway is a LoRa gateway product. This product enables users to remotely control LoRa through the network.

2.2. Product Introduction

2.2.1. Layout

- LoRa: LoRa antenna SMA interface.
- Wi-Fi: Wi-Fi antenna SMA interface.



- Reset: Press and hold for 1 second to reset the system; Press and hold for 10 seconds to restore factory settings.
- Update: System firmware update interface.
- Debug: System debugging, parameter setting interface.
- LAN1: Ethernet socket1.
- LAN2: Ethernet socket2.

Power supply: Both the Update and Debug interfaces can serve as power supply interfaces.

2.2.2. Key Features

- Supports IPV4/IPV6
- 802.11 a/b/g/n, dual band
- Support STA mode connection to AP

- Supports 2 LAN ports
- WPA3 security enabled
- Support TCP client connection
- Support MQTT connection
- DC5V/2A Input

2.3. Antenna Installation

Install the LoRa and Wi-Fi antennas separately onto the SMA interface of WF288 LoRaNetGateway.

2.4. Power Connection

A USB to Type-C data cable provides the voltage input connection. Insert the Type-C connector of the data cable into the Type-C “Update/Debug” interface of WF288 LoRaNetGateway, and the other end into the DC5V/2A adapter. The red indicator light of WF288 LoRaNetGateway is on. After the system startup is complete, the blue indicator light will light up.

2.5. Build a network through Ethernet

A network through Ethernet interface is used to achieve remote control of LoRa.

2.5.1. Network topology diagram

As shown in the network topology diagram in Figure 2-5-1-1. If MQTT Broker supports IPV6, the entire network can be configured using IPV6. If MQTT Broker only supports IPV4, the entire network can be configured using IPV4. In this network, Gate needs to be in the same network segment as the router.

- LoRaNetGateway loads “MQTT” functionality:

  Before establishing an MQTT connection, verify that both the PC and the Gateway can access the Internet. The MQTT Broker in this example is hosted on the Internet, so connectivity must be confirmed first. Since the IP address of the MQTT Broker in the figure (44.232.241.40) may not support ping, use the "ping 8.8.8.8" command to test on the PC and Gate to confirm whether the Internet can be accessed normally. If the IP address of MQTT Broker can accept ping command, then ping its IP address directly is sufficient. Once Internet access is verified, the PC and Gateway can reach the Broker’s physical network, allowing subsequent MQTT connections to be established.

- LoRaNetGateway loads “TCP” functionality:

  PC can access Gate, and router may need to NAT the port that Gate listens on.

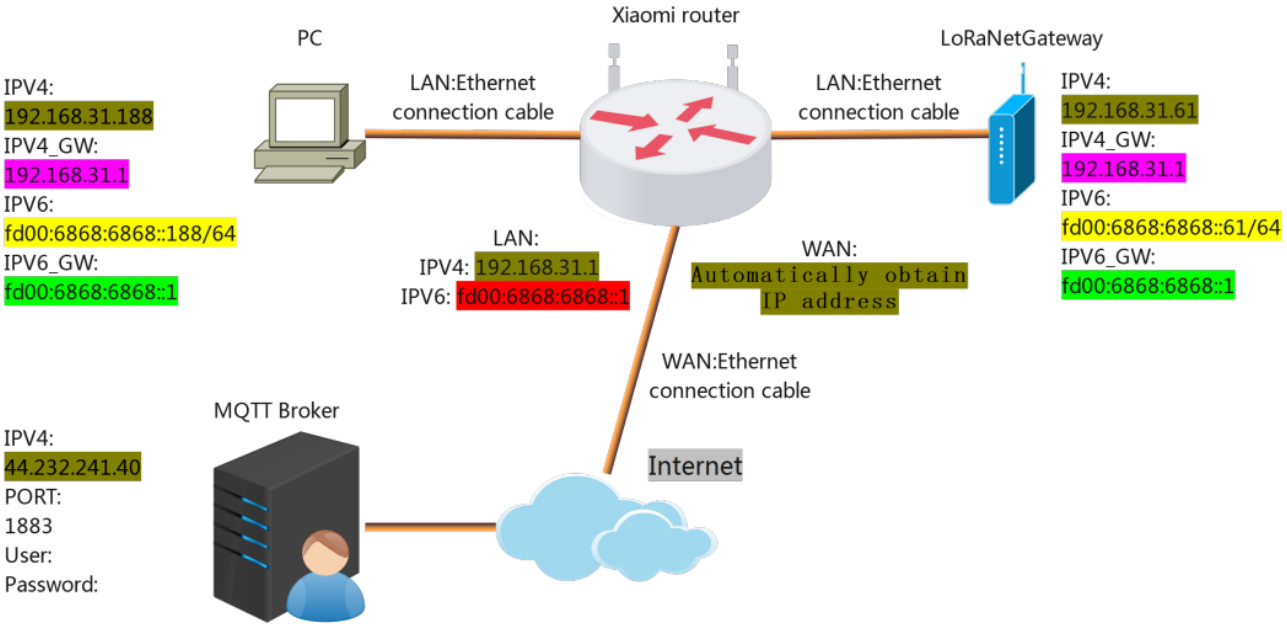


Figure 2-5-1-1. Network topology diagram

2.5.2. Configure the parameters of Gate for MQTT

Use the WF88 configuration tool to configure the parameters of Gate for MQTT.

(1) Start the WF88 configuration tool, as shown in Figure 2-5-2-1.

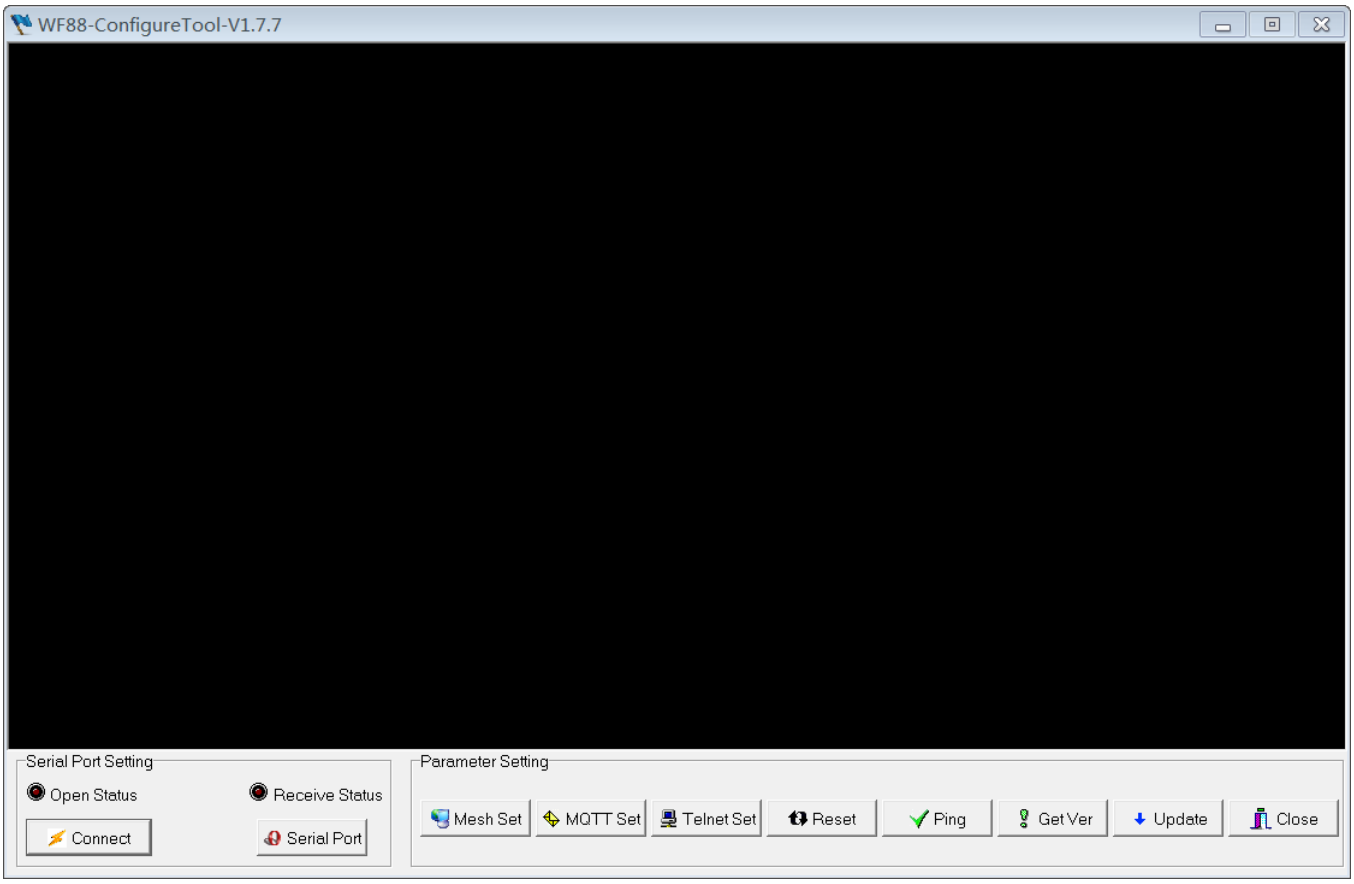


Figure 2-5-2-1. WF88 configuration tool

(2) Clicking the "Serial Port" button will bring up the "Setup" dialog box. Select the serial port number of the PC connected to the Gate “Debug” port from the "Port" drop-down list in the dialog box, and click the "OK" button. As shown in Figure 2-5-2-2.

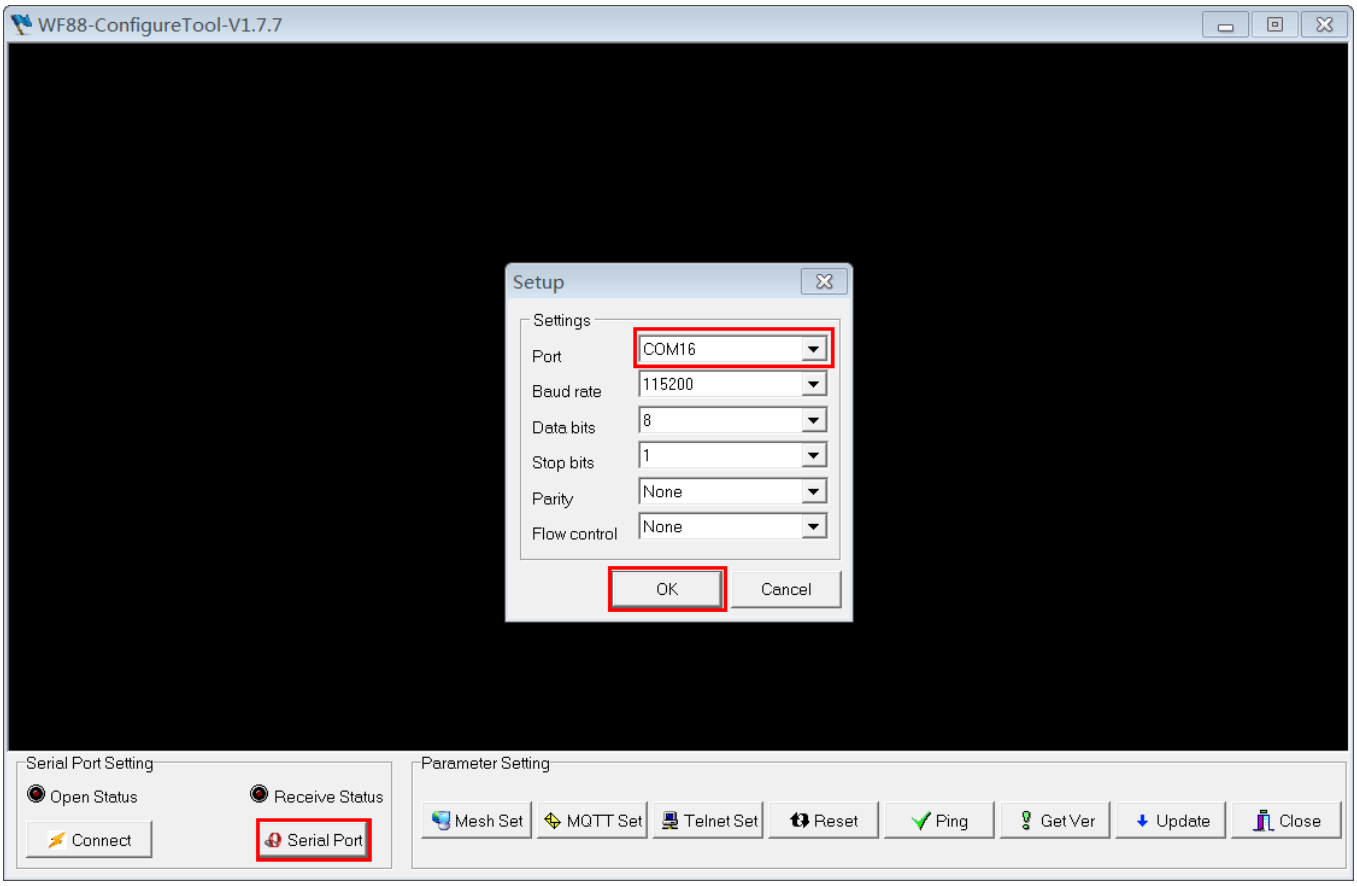


Figure 2-5-2-2. The serial port configuration

(3) Click the "Connect" button to open the serial port, as shown in Figure 2-5-2-3.

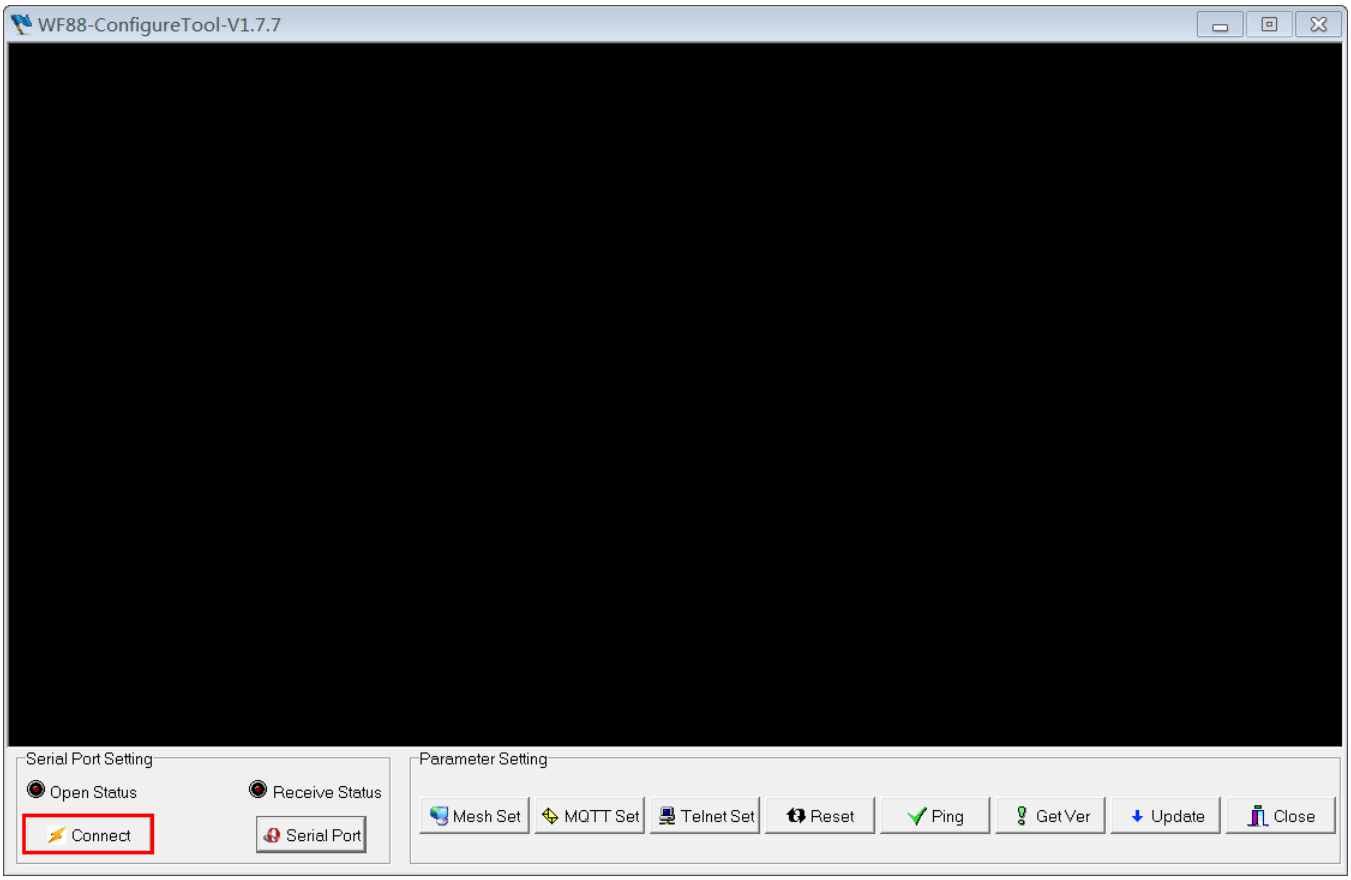


Figure 2-5-2-3. Open the serial port

(4) Click the "Mesh Set" button to bring up the "WF288 LoRaNetGateway Set" dialog box. Select "Ethernet" from the "Connection mode" drop-down list. Select "MQTT" from the "LoadModule" drop-down list. Select the corresponding IP version based on the user's network support in the "IP Version" drop-down list, and enter the IP address in the corresponding IP version below. Finally, click the "Save" button. As shown in Figure 2-5-2-4 and Figure 2-5-2-5.

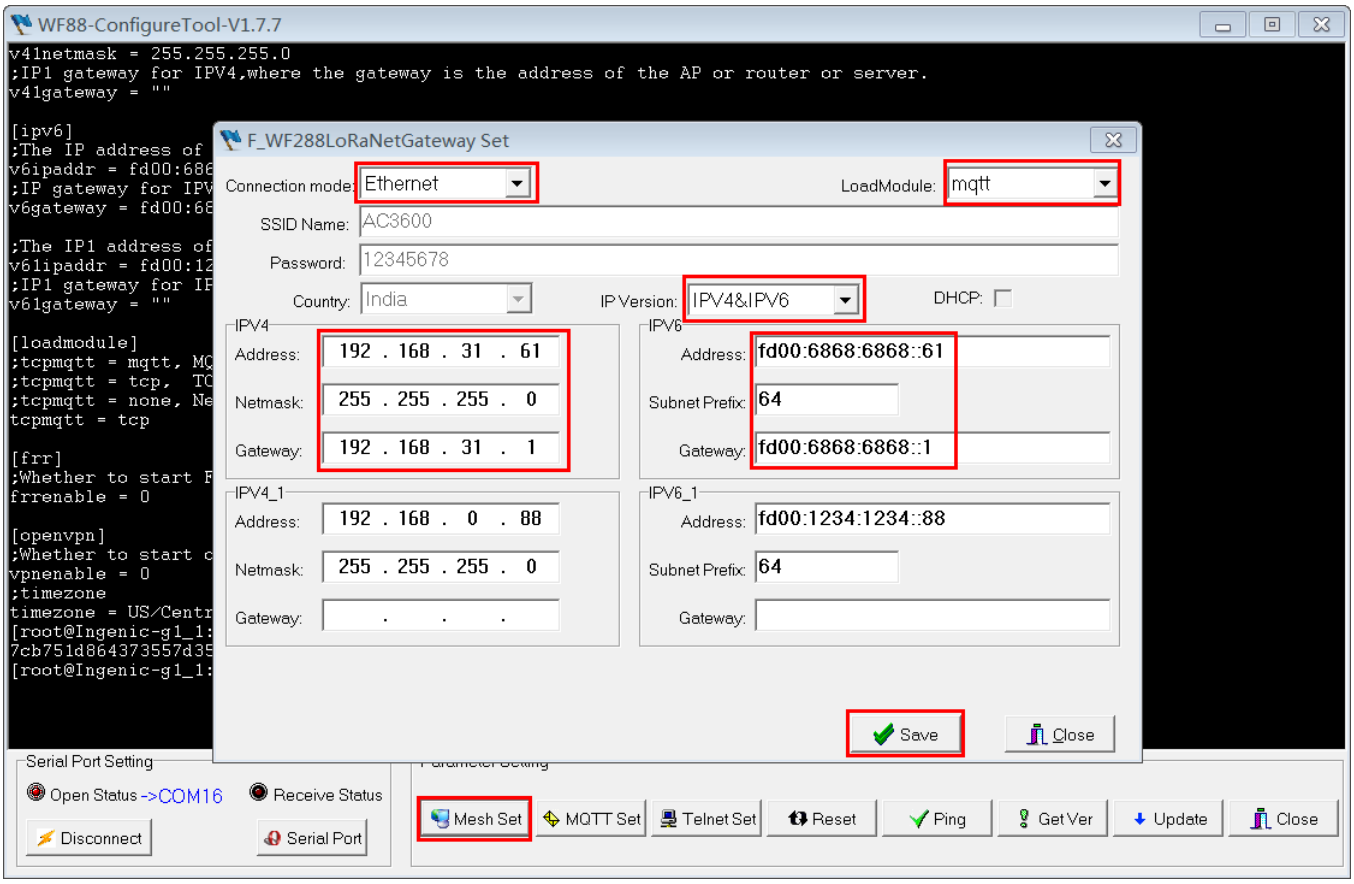


Figure 2-5-2-4. WF288 LoRaNetGateway Set configuration

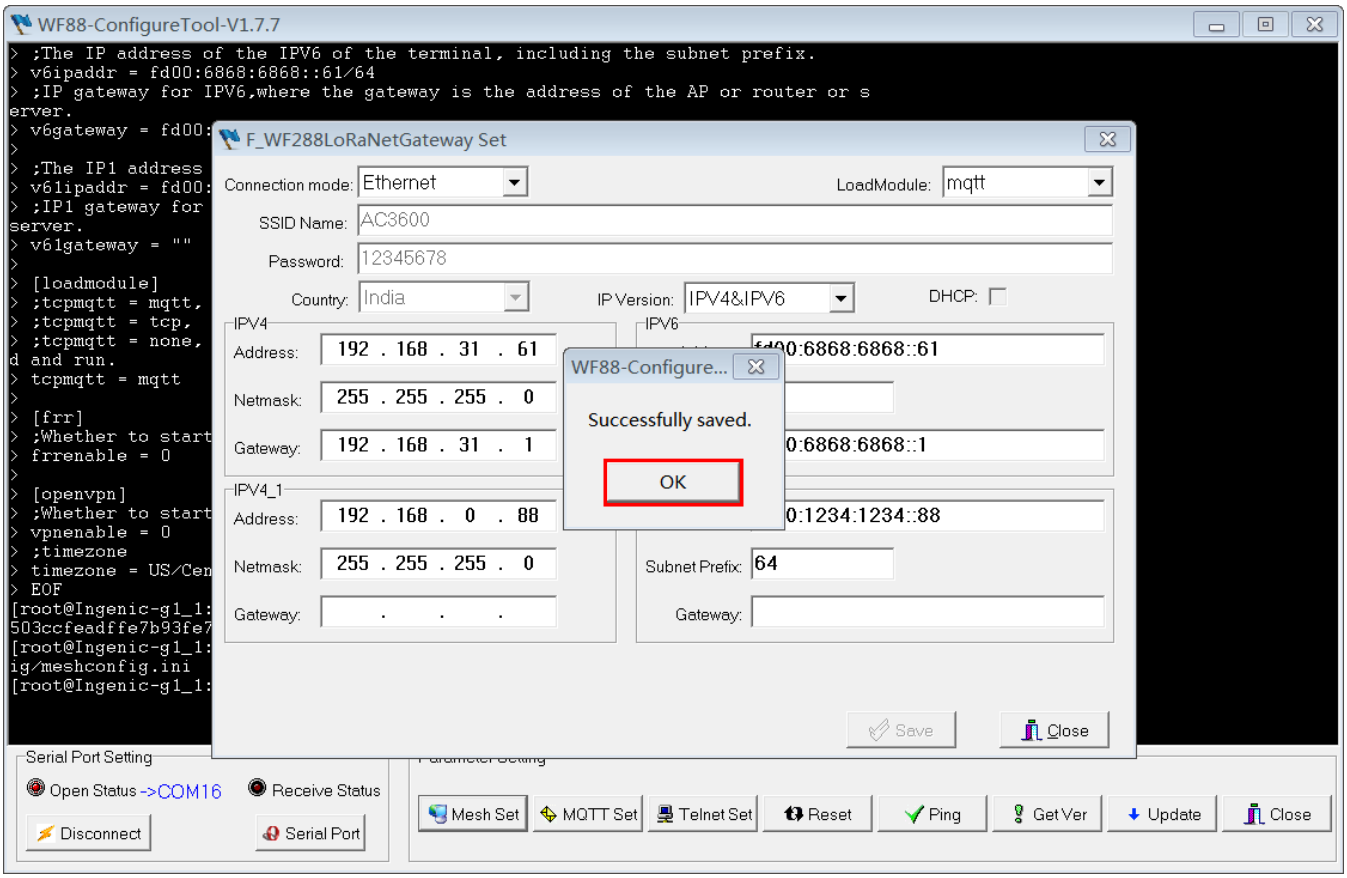


Figure 2-5-2-5. Successfully saved

(5) Click the "MQTT Set" button to bring up the "MQTT Set" dialog box. Select "tcp" from the "Protocol" drop-down list. Enter the IP address "44.232.241.40" of MQTT Broker in the "ServerIP" editing box. Enter the port "1883" of MQTT Broker in the "RemotePortNum" editing box. Other options can be set to default values. Finally, click the "Save" button. As shown in Figure 2-5-2-6.

"UART0 BaudRate" represents the communication rate of the UART interface of LoRa. User does not need to modify it, just keep it as default.

The port number of MQTT Broker corresponds to Protocol (tcp/ssl), which means that when using "tcp" protocol, there is a corresponding port number; when using "ssl" protocol, it will correspond to another port number.

"UserName" and "PassWord" indicate that MQTT Broker requires a username and password to establish a connection.

"SubTopic" represents topic the client subscriptions to, with a default value of "SToC"; "PubTopic" represents topic the client publishes to, with the default value being "CToS"; "KeepAliveInterval" refers to the time interval in seconds during which MQTT client sends keep alive messages to MQTT Broker; "QoS" refers to quality of service, with a default value of "0"; "ClientId" represents the ID of the MQTT client.

"OpenCert" and "OpenKey" indicate that MQTT Broker requires a client certificate and client private key to establish a connection.

"OpenCA" indicates that a CA certificate is required to verify MQTT Broker when establishing a connection. The five options of "UserName", "PassWord", "OpenCert", "OpenKey", and "OpenCA" need to be filled in according to the protocol and access requirements of MQTT Broker. If necessary, they should be filled in according to the requirements. Otherwise, they can be left blank by default.

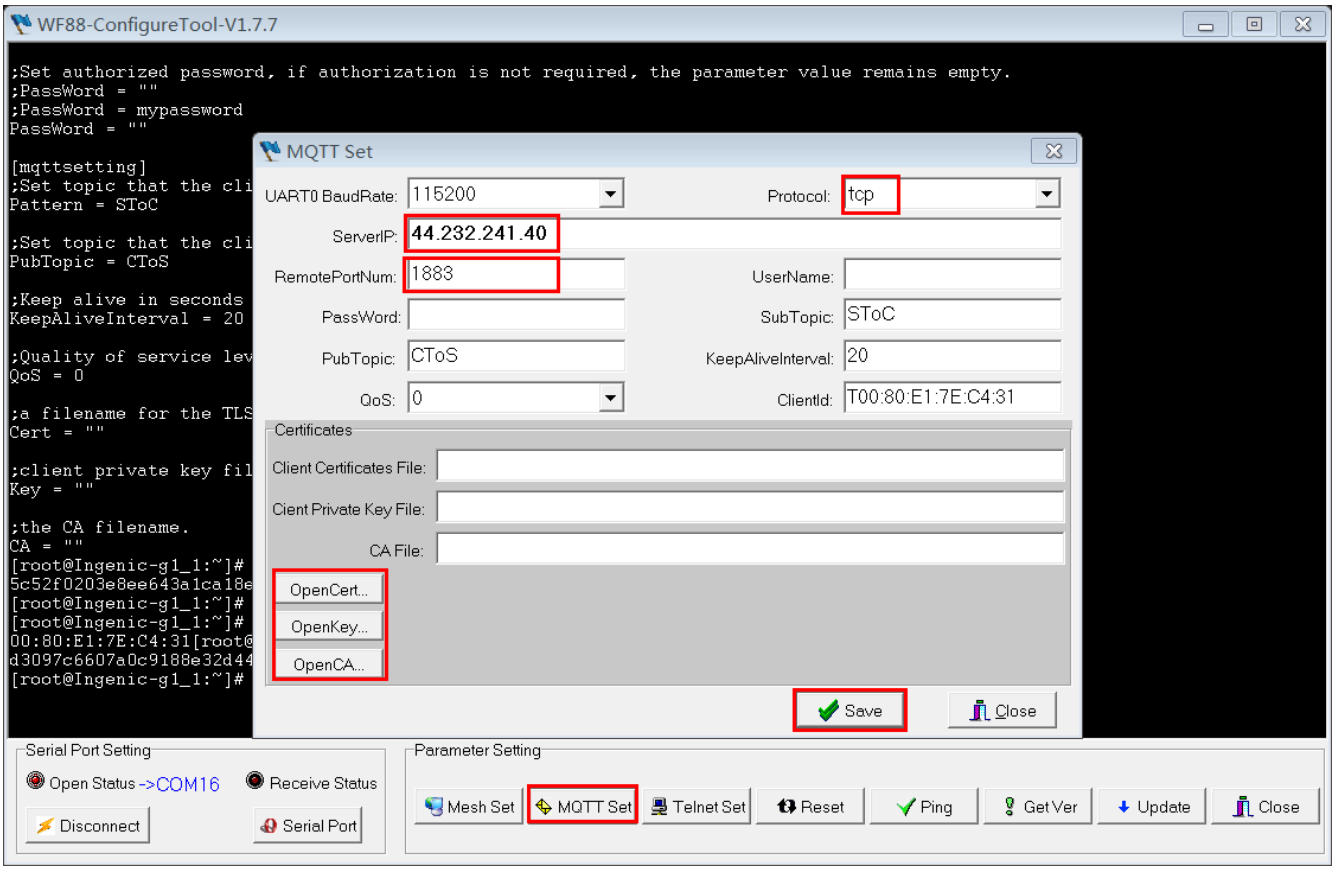


Figure 2-5-2-6. MQTT Set configuration

(6) Click the "Reset" button to restart, as shown in Figure 2-5-2-7.

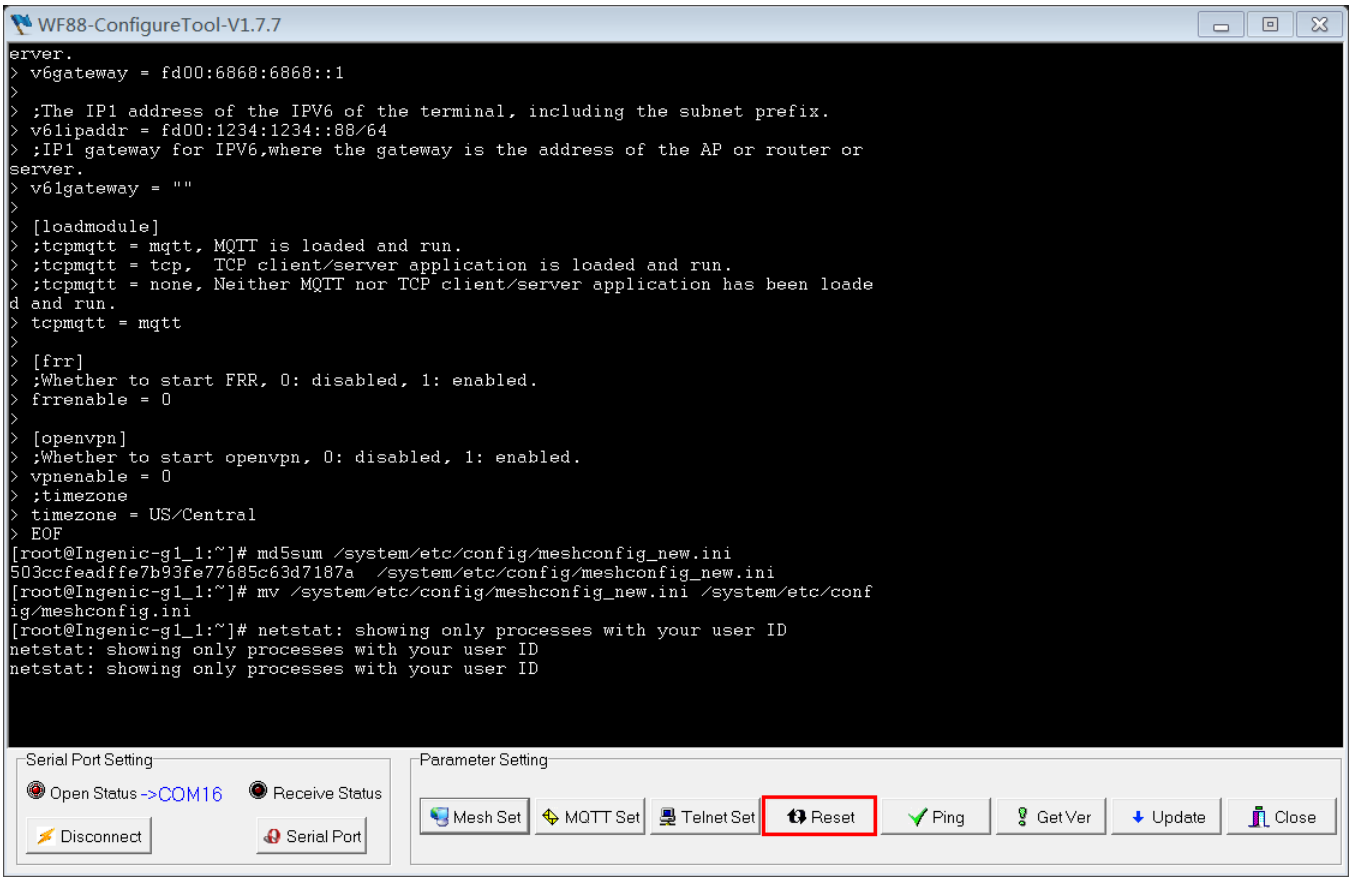


Figure 2-5-2-7. Reset

(7) After the system restarts, we will see a prompt message "Device Setup complete." indicating that the MQTT connection has been successfully established, as shown in Figure 2-5-2-8.

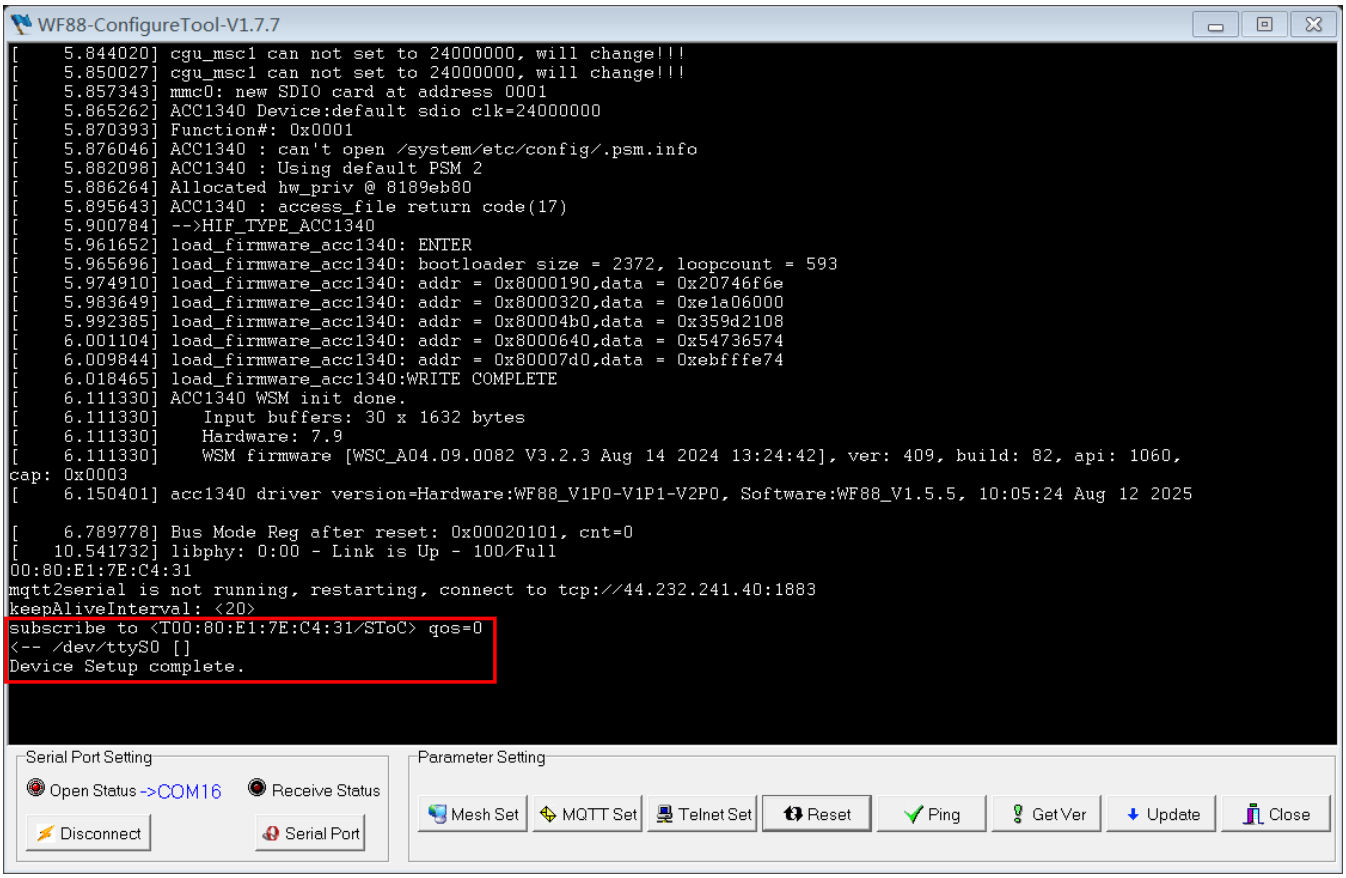


Figure 2-5-2-8. MQTT connection has been successfully established

(8) Test whether the network communication is normal. Clicking the "Ping" button will bring up the "Ping Test" dialog box. Enter the IP address to be tested in the "PingIP" editing. Firstly, we need to test whether the communication with router is normal, so we need to input "192.168.31.1" for testing. As shown in Figure 2-5-2-9, ping test router indicates if Gate can access it normally.

If MQTT Broker accepts the ping command, it can directly ping its IP address. If the MQTT Broker does not accept the ping command and is still on the Internet, we can directly ping the 8.8.8.8 IP address.As shown in Figure 2-5-2-10, ping test indicates if Gate can access the network normally.

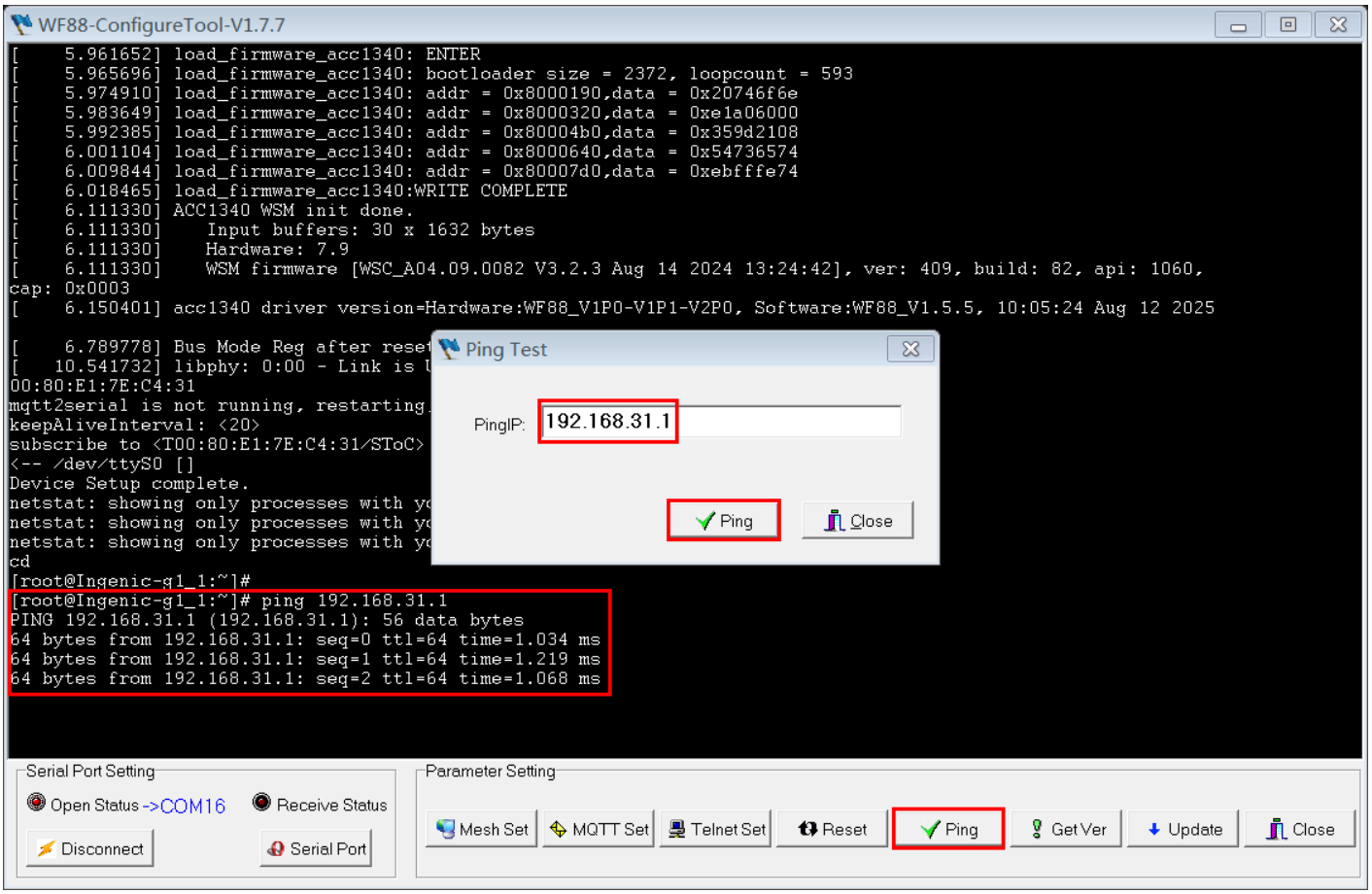


Figure 2-5-2-9. Ping test router

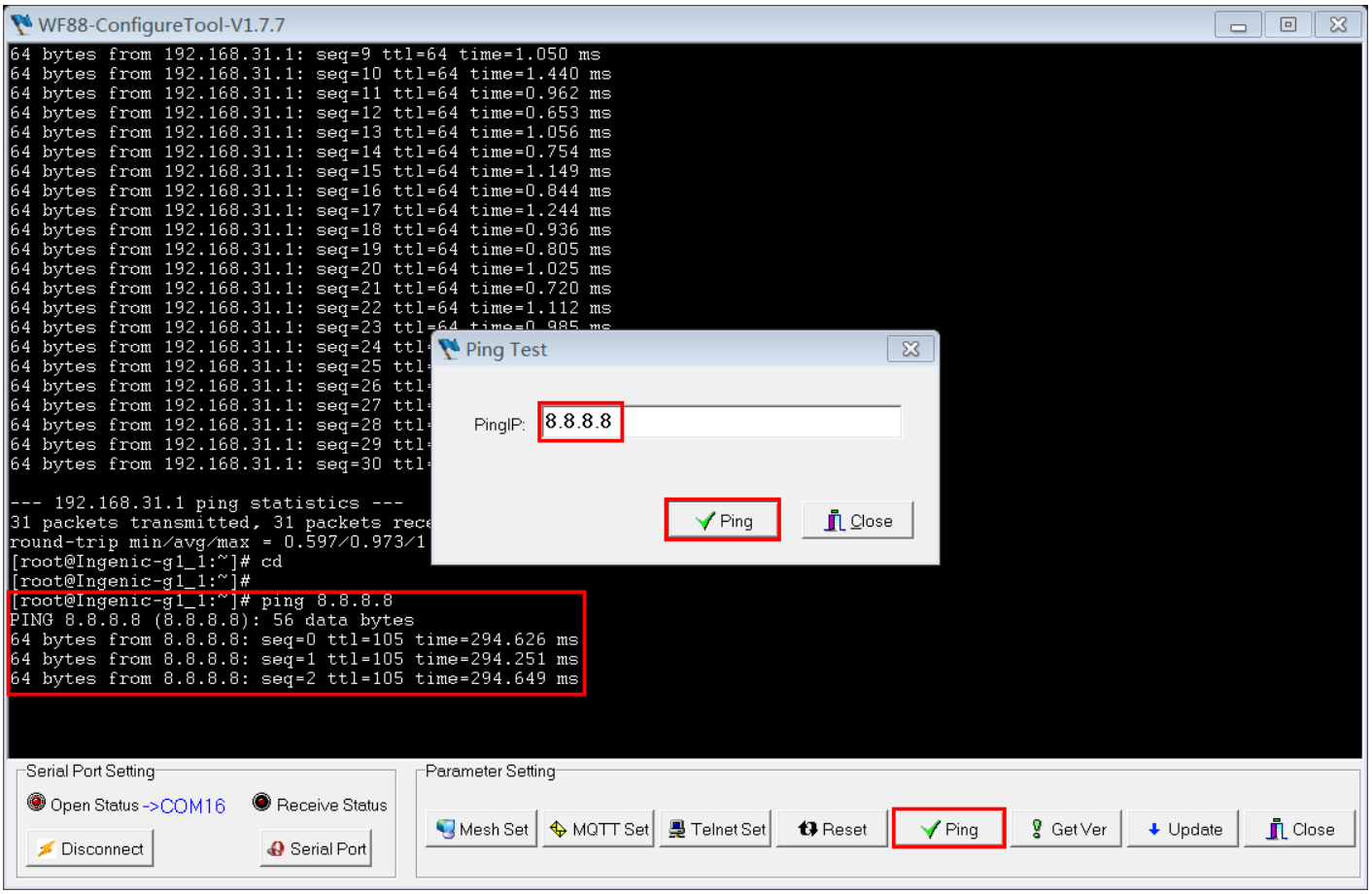


Figure 2-5-2-10. Ping test

(9) The setting of Gate is completed.

2.5.3. Configuration and usage of MQTT PC tool

Use the **mqttfx-1.7.1-windows-x64.exe** as the client. We will use the "**broker.emqx.io**" website. This is a convenient test site. Note that this test site does not support Username & Password for login authorization.

(1) Running **MQTT.fx** will bring up its main interface, and clicking on the blue gear icon will bring up the "Edit Connection Profile" dialog box, as shown in Figure 2-5-3-1.

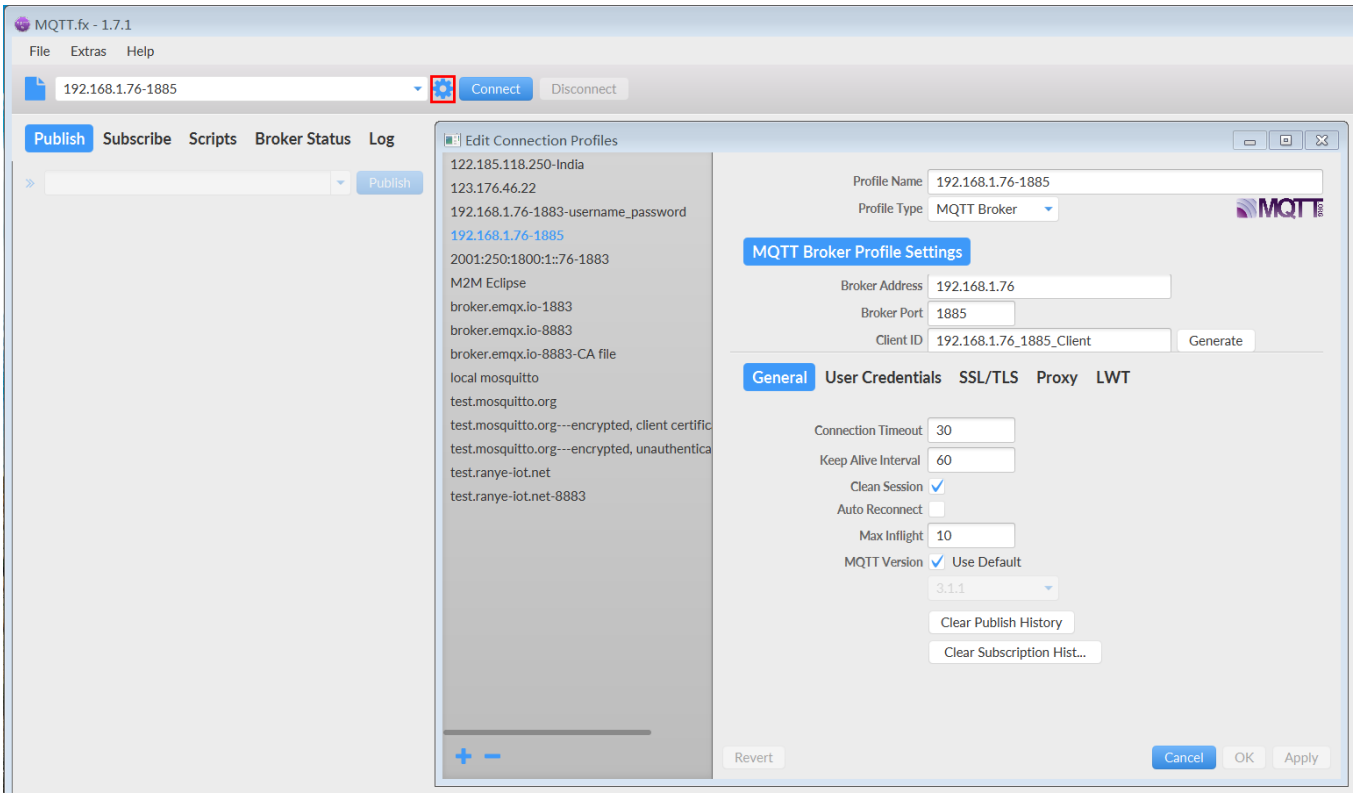


Figure 2-5-3-1. Edit Connection Profile

(2) In the "Edit Connection Profiles" dialog box, click the blue plus sign ("+") icon in the bottom right corner to create a new profile. Enter the name of the configuration file in the "Profile Name" edit box. Enter the MQTT Broker domain name "broker.emqx.io" in the "Broker Address" edit box. The default "Broker Port" is 1883. Clicking the "Generate" button will generate a Client ID. Select the "Auto Reconnect" checkbox. Finally, click the "OK" button to complete the configuration. As shown in Figure 2-5-3-2.

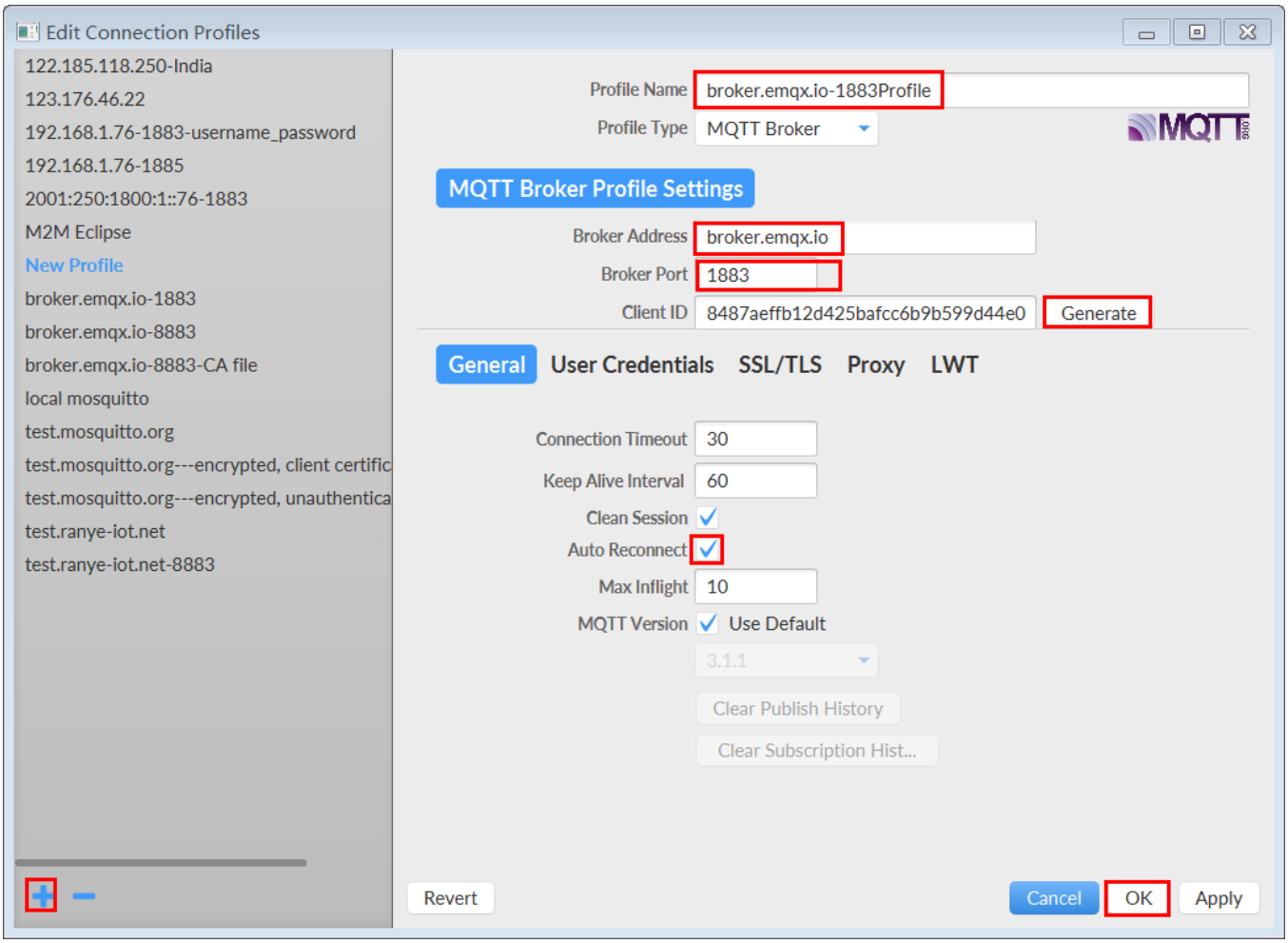


Figure 2-5-3-2. Create a new profile

(3) Click the "Connect" button to successfully establish a connection with MQTT Broker, and a green circle will appear in the upper right corner of the window. As shown in Figure 2-5-3-3.

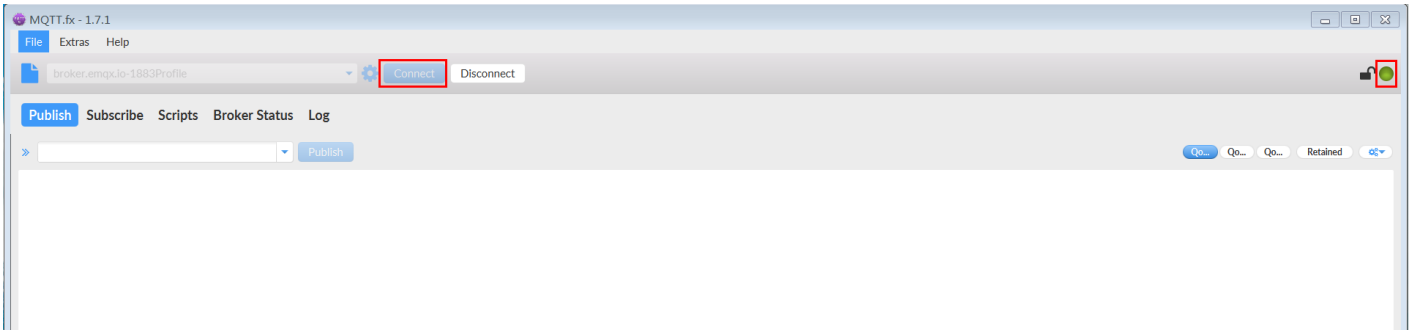


Figure 2-5-3-3. Connect to MQTT Broker

(4) To subscribe to data from Gate, click on the "Subscribe" tab, then enter "T00:80:E1:7E:C4:31/CToS" in the edit box below, and click the "Subscribe" button. As shown in Figure 2-5-3-4.

Format for: T + MAC address/Topic, for which T is fixed to character, the MAC address is Gate own MAC. Topic is defined in the "PubTopic" of the "MQTT Set" dialog box.

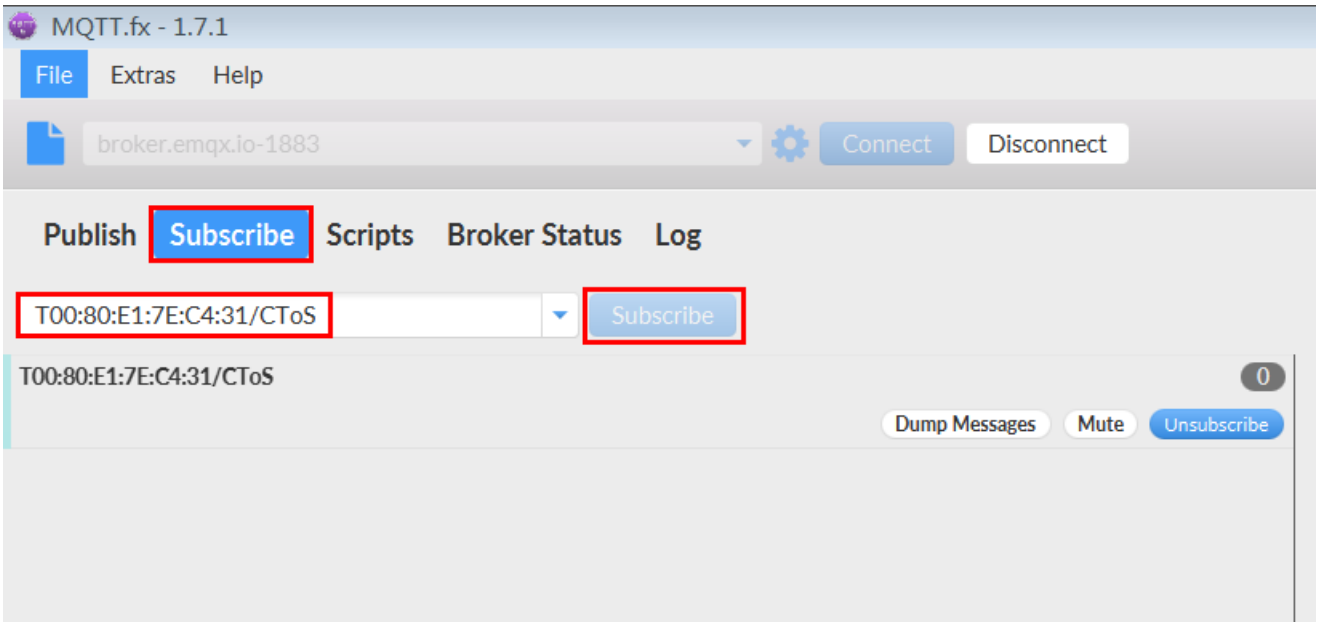


Figure 2-5-3-4. Subscribe to data from Gate

(5) Publish data to Gate, click on the "Publish" tab, then enter "T00:80:E1:7E:C4:31/SToC" in the editing box below, then input “at+ab config” and “enter” as the content to be sent. That is to say, any AT command sent to LoRa needs to end with a carriage return. Finally, click the "Publish" button. We can receive the corresponding content from the LoRa. As shown in Figure 2-5-3-5.

Format for: T + MAC address/Topic, for which T is fixed to character, the MAC address is Gate own MAC. Topic is defined in the "SubTopic" of the "MQTT Set" dialog box.

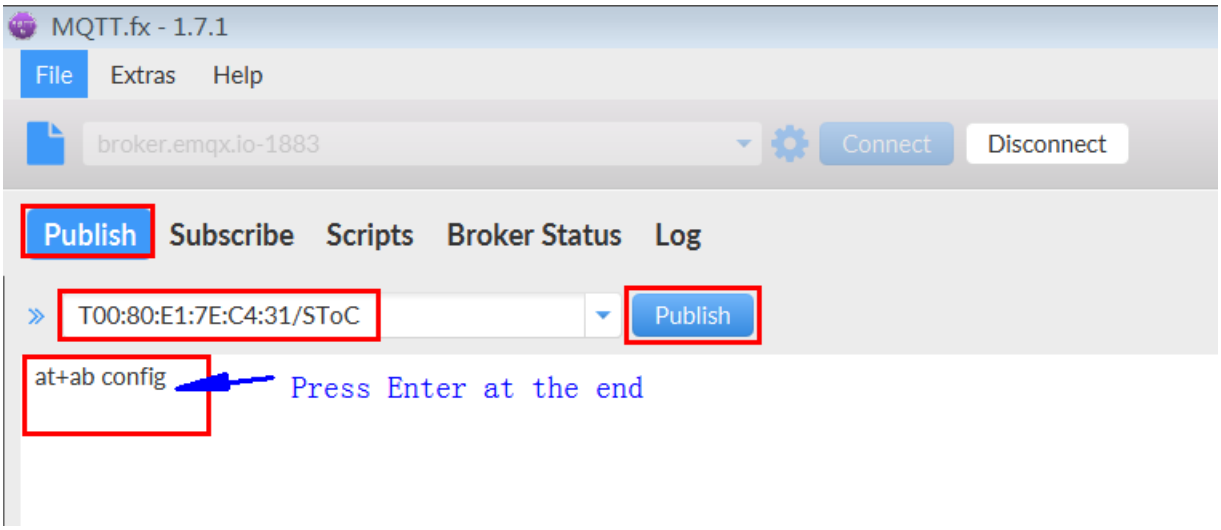


Figure 2-5-3-5. Publish data to Gate

(6) We will see Gate's response information in the subscribe. As shown in Figure 2-5-3-6.

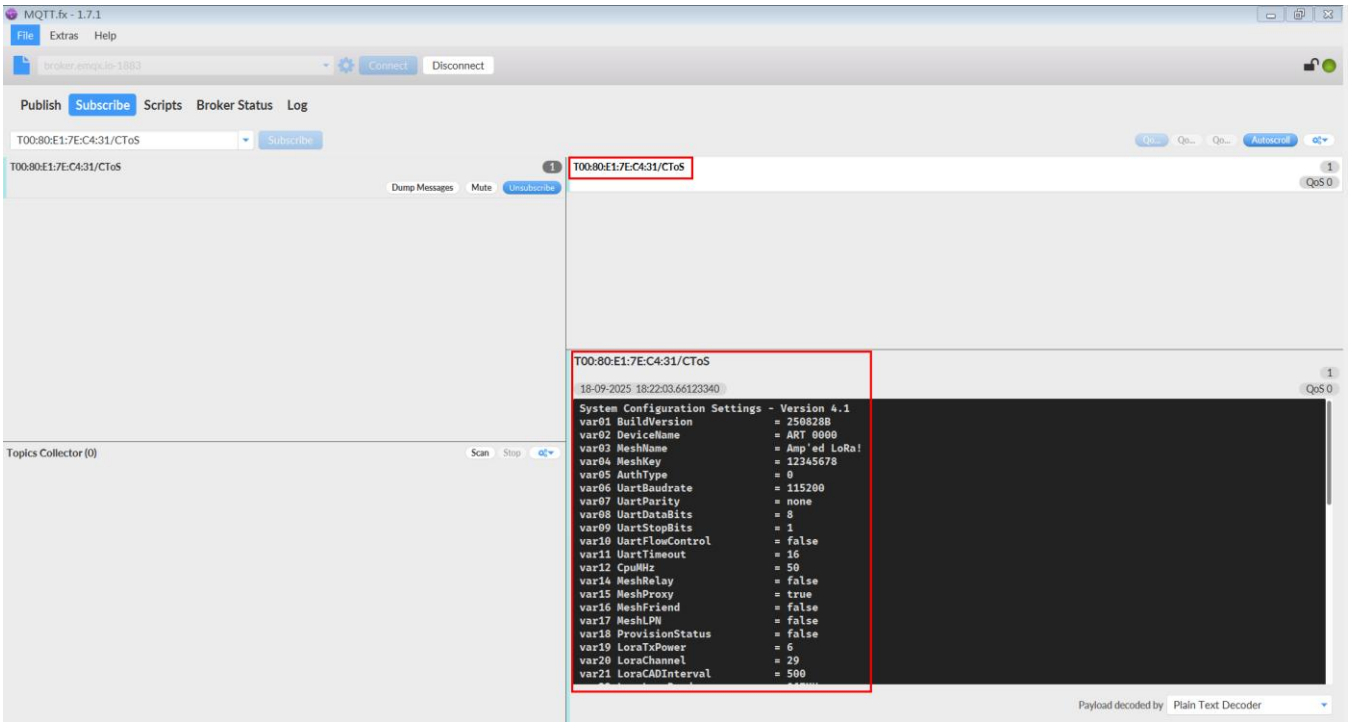


Figure 2-5-3-6. Receive Gate's response information

2.5.4. Configure the parameters of Gate for tcp

Use the WF88 configuration tool to configure the parameters of Gate for tcp. The use of WF88 configuration tool is similar to what was described earlier. Please refer to the section "2.5.2 Configure the parameters of Gate for MQTT". Below, we will skip some steps and explain the necessary steps in detail.

(1) Click the "Mesh Set" button to bring up the "WF288 LoRaNetGateway Set" dialog box. Select "Ethernet" from the "Connection mode" drop-down list. Select "TCP" from the "LoadModule" drop-down list. Select the corresponding IP version based on the user's network support in the "IP Version" drop-down list, and enter the IP address in the corresponding IP version below. Finally, click the "Save" button. As shown in Figure 2-5-4-1.

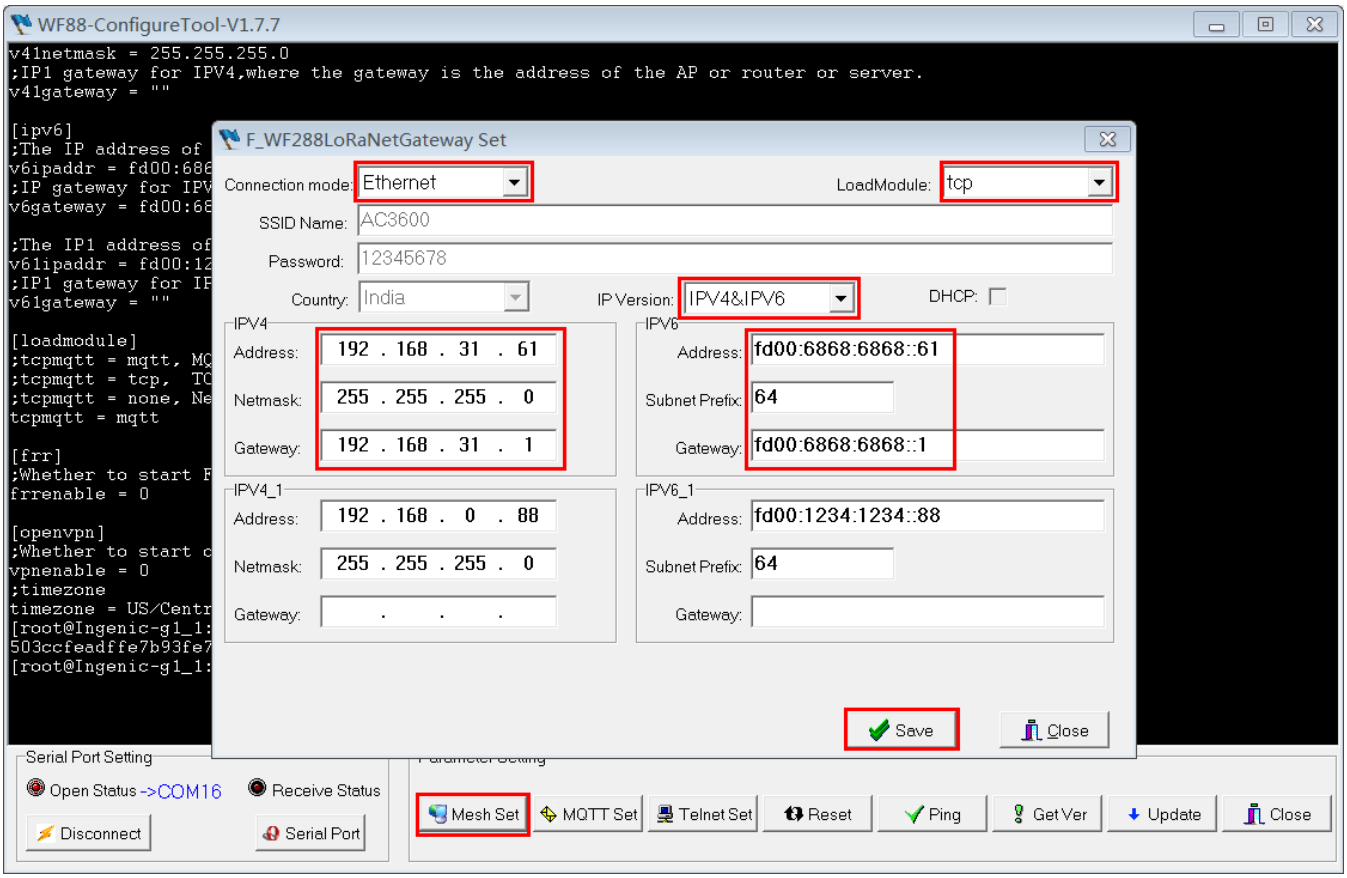


Figure 2-5-4-1. WF288 LoRaNetGateway Set configuration

(2) Click the "Telnet Set" button to bring up the "Telnet Set" dialog box. Enter the listening port "20000" of TCP in the "LocalPortNum" editing box. Finally, click the "Save" button. As shown in Figure 2-5-4-2.

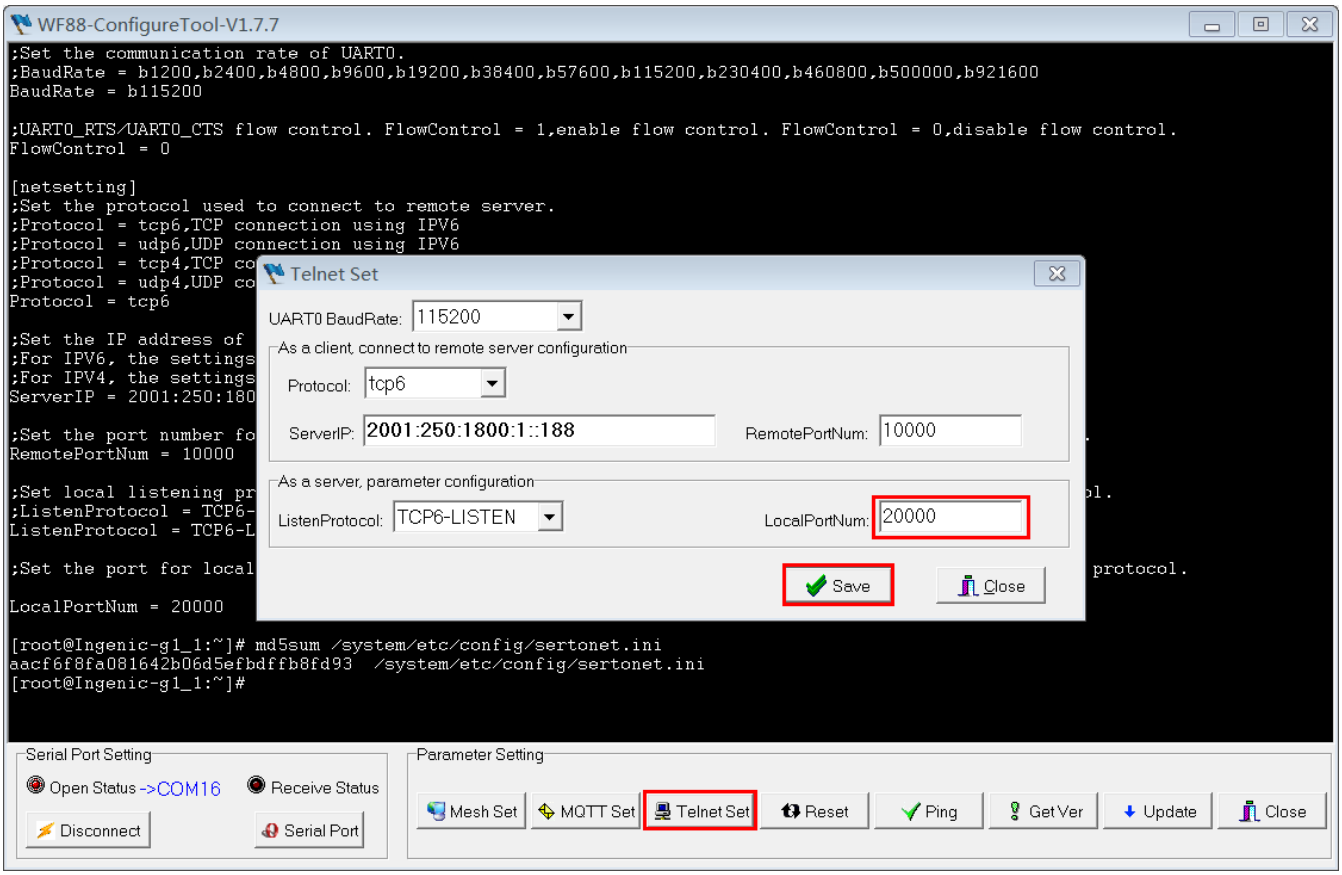


Figure 2-5-4-2. Telnet Set configuration

(3) Click the "Reset" button to restart.

(4) After the system restarts, we will see a prompt message "LocalPortNum:xxx" indicating that the Gate has started the TCP service and is listening on port xxx, as shown in Figure 2-5-4-3.

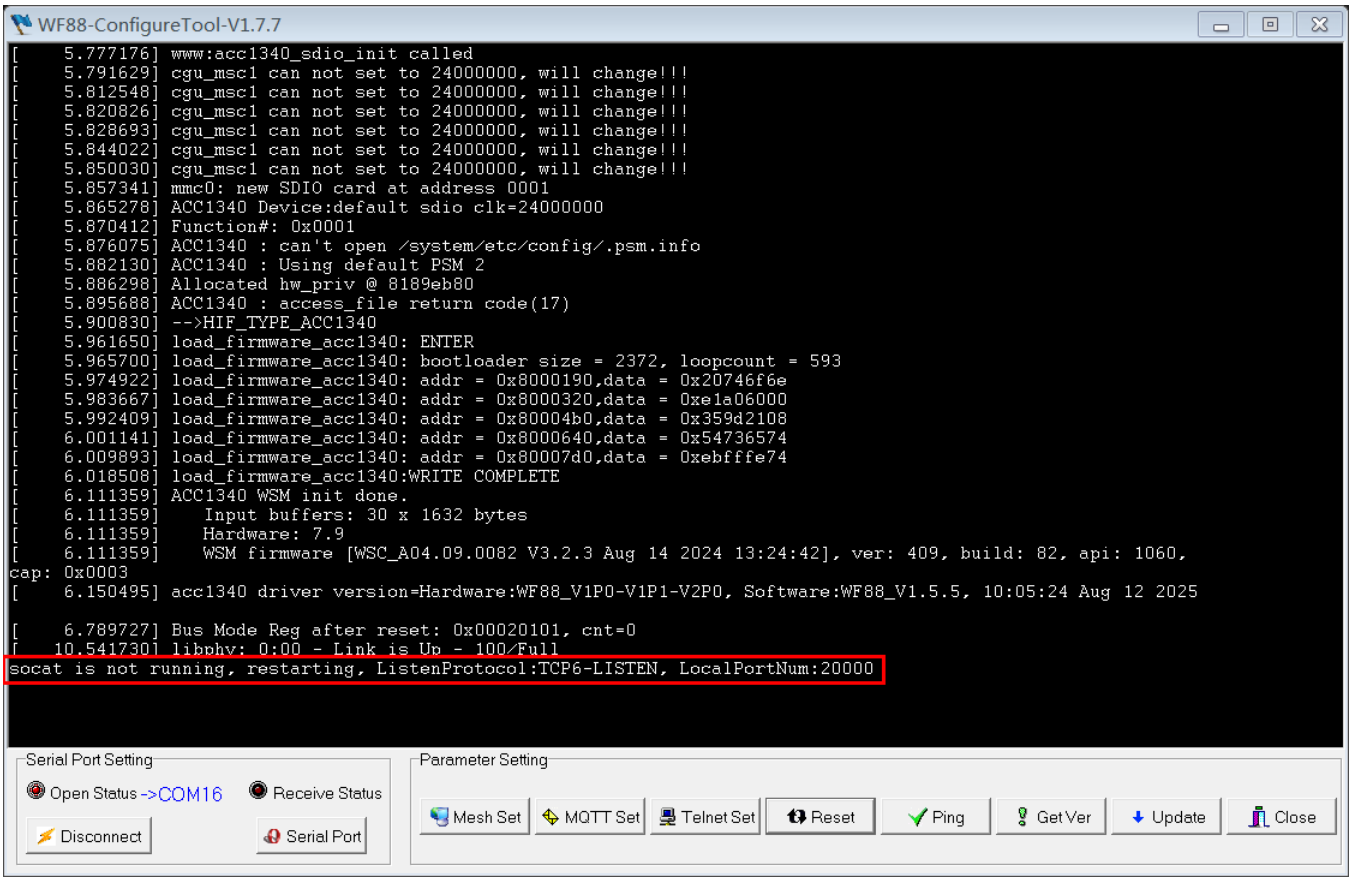


Figure 2-5-4-3. TCP service and is listening on port xxx

(5) The setting of Gate is completed.

2.5.5. Configuration and usage of tcp PC tool

Use the **TCPUDP.exe** as the client for tcp test.

(1) Running **TCPUDP.exe** will bring up its main interface, as shown in Figure 2-5-5-1.

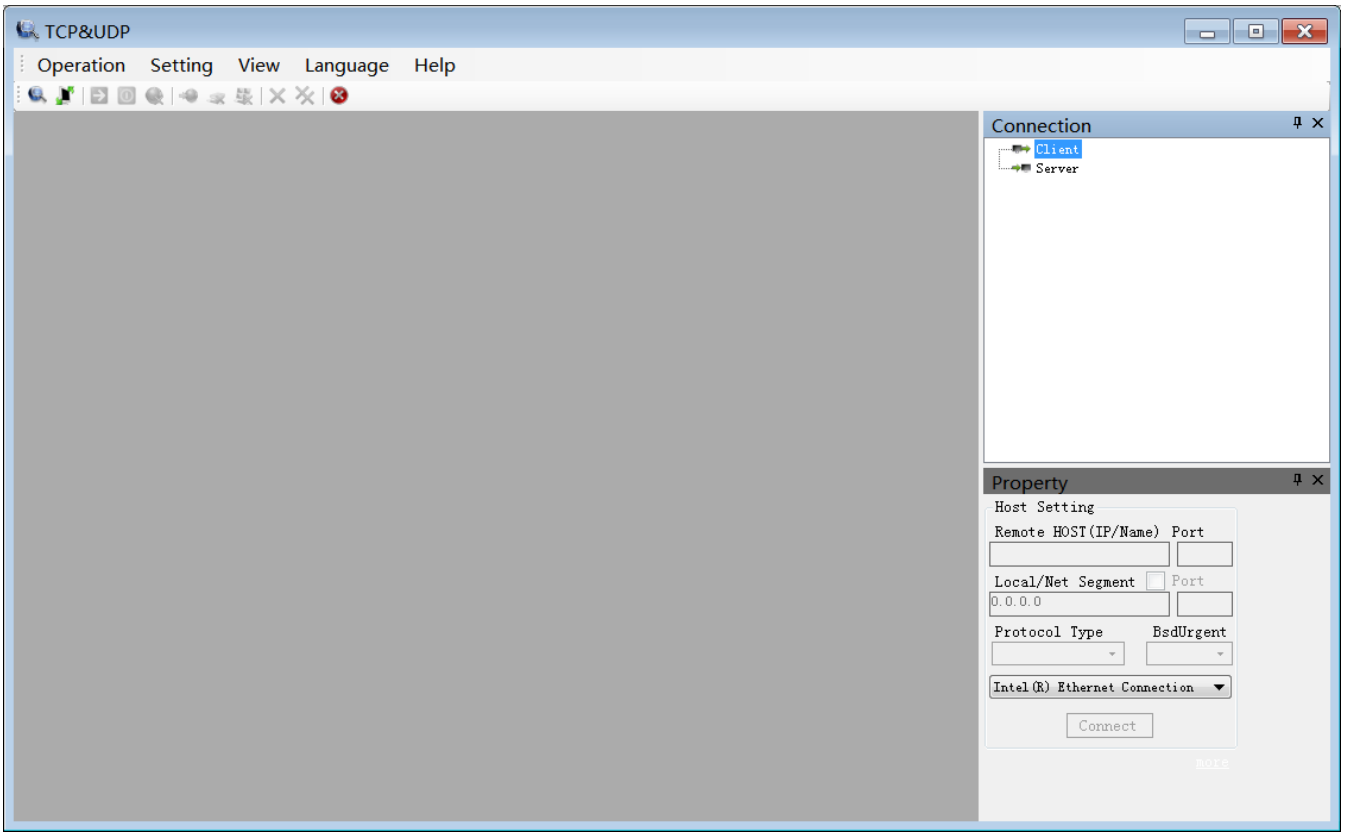


Figure 2-5-5-1. TCP&UDP main interface

(2) Right click on "Client" in the "Connection" window to bring up a shortcut menu, as shown in Figure 2-5-5-2.

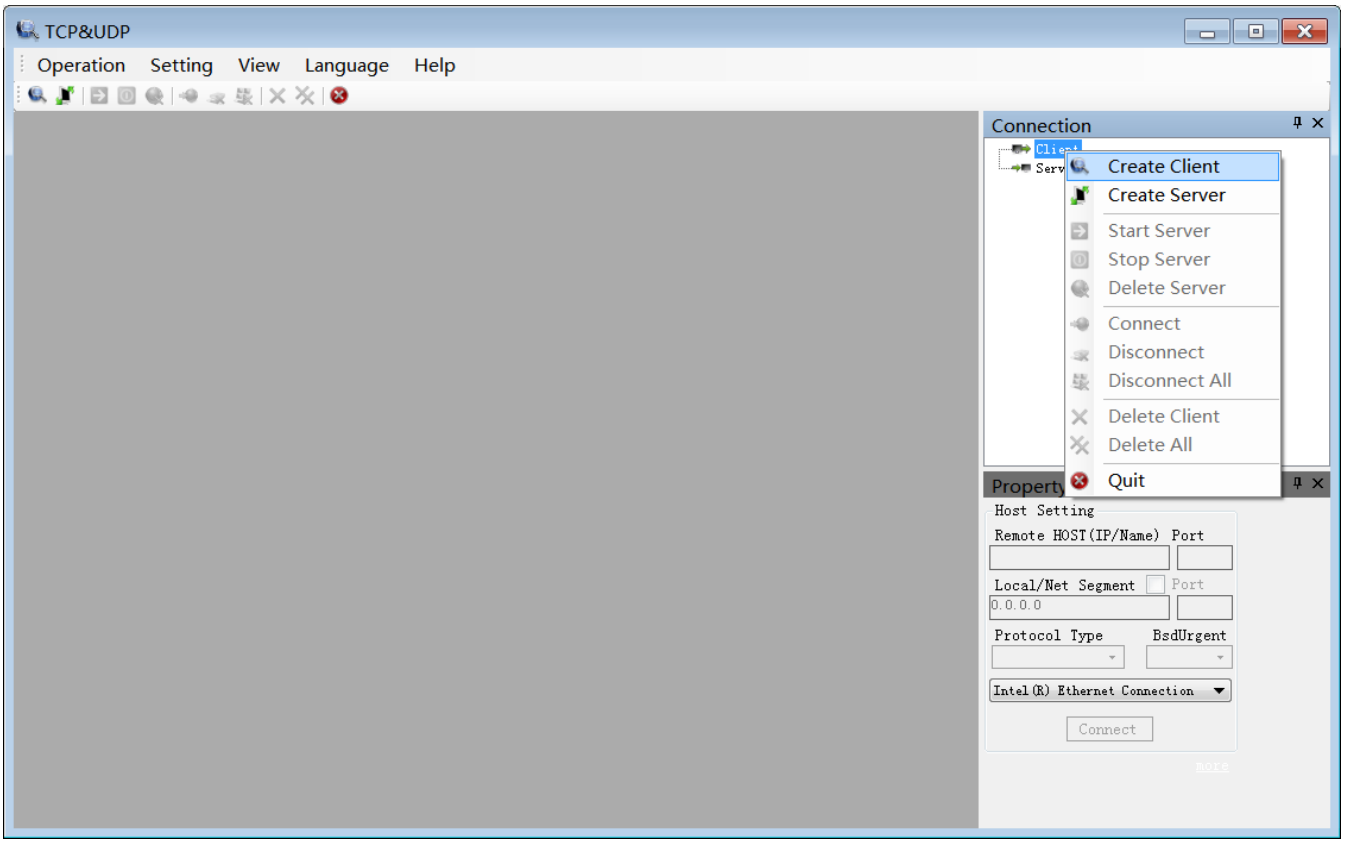


Figure 2-5-5-2. Shortcut menu

(3) In the shortcut menu, select the "Create Client" option, and a "New Connection" dialog box will pop up. Select "TCP" from the "Protocol Type" drop-down list. Enter the IP address "192.168.31.61" of Gate in the "Remote Host" editing box. Enter the port "20000" of listening in the "Remote Port" editing box, as shown in Figure 2-5-5-3.

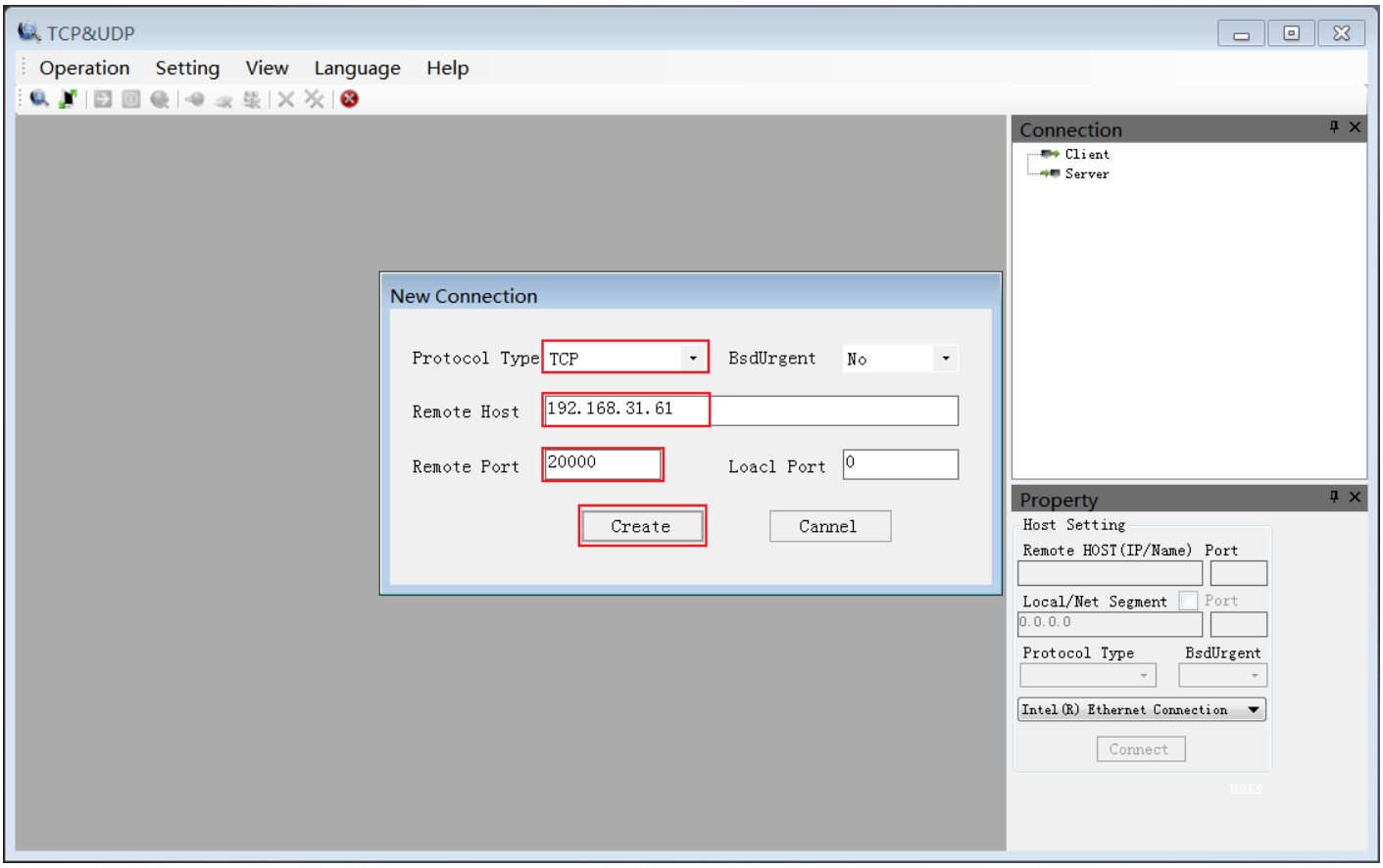


Figure 2-5-5-3. New Connection dialog box

(4) Click the “Create” button to create a new connection. Select the network card on the PC side for the connection, as shown in Figure 2-5-5-4.

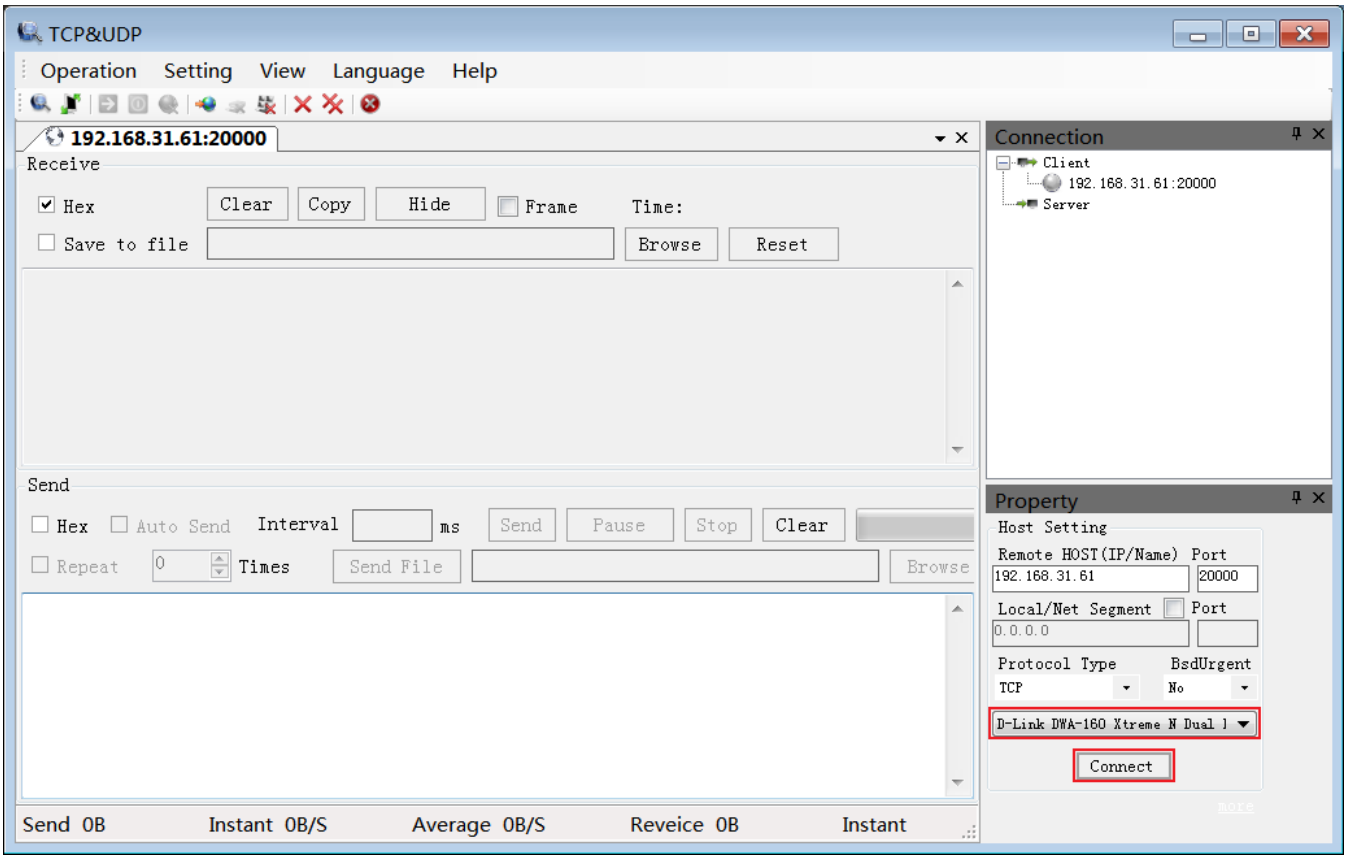


Figure 2-5-5-4. Create a new connection

(5) Clicking the “Connect” button will initiate a TCP connection to Gate. After a successful connection, click the “Hex” checkbox to deselect it, as shown in Figure 2-5-5-5.

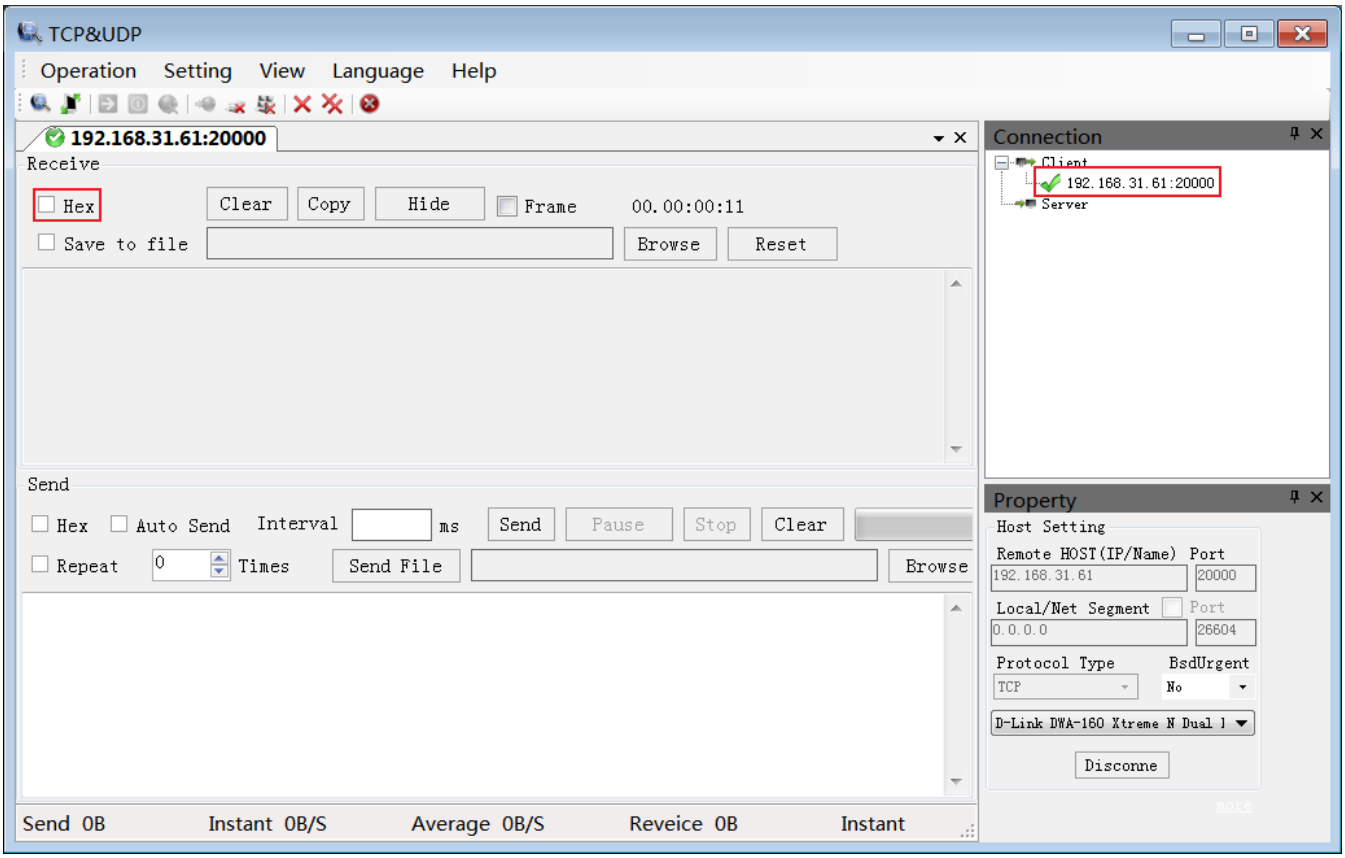


Figure 2-5-5-5. Initiate a TCP connection to Gate

(6) In the sending area, we input “at+ab config” and “enter” as the content to be sent. That is to say, any AT command sent to LoRa needs to end with a carriage return. Finally, click the "Send" button. In the receiving area, we can receive the corresponding content from the LoRa, as shown in Figure 2-5-5-6.

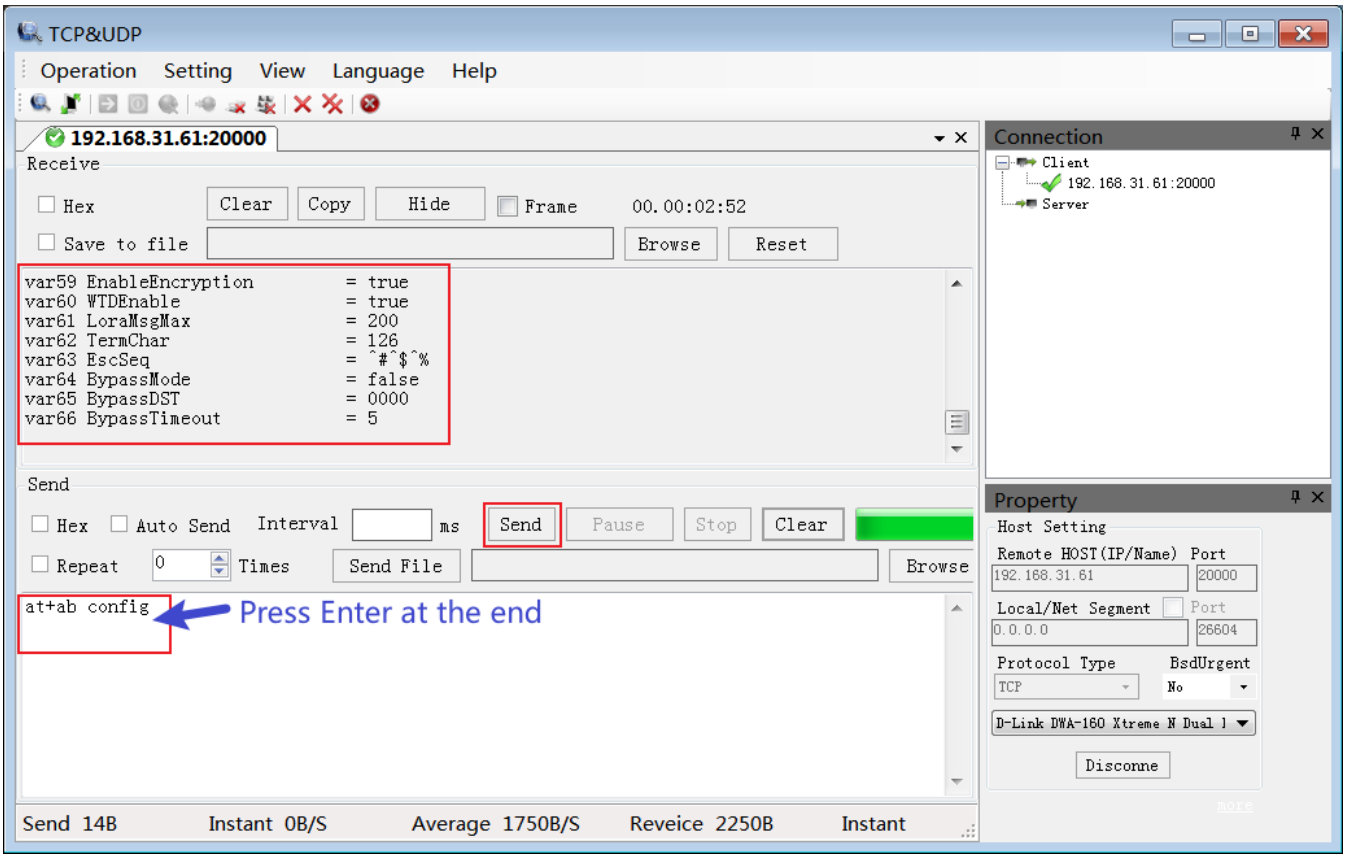


Figure 2-5-5-6. Receive the corresponding content

2.6. Build a network through Wi-Fi

We build a network through Wi-Fi interface to achieve remote control of LoRa.

2.6.1. Network topology diagram

As shown in the network topology diagram in Figure 2-6-1-1. If MQTT Broker supports IPV6, the entire network can be configured using IPV6. If MQTT Broker only supports IPV4, the entire network can be configured using IPV4. In this network, Gate can obtain an IP address from the router through DHCP, or manually enter the IP address, in which case it needs to be in the same network segment as the router.

- LoRaNetGateway loads “mqtt” functionality:

  It is necessary to ensure that PC and Gate can access MQTT Broker normally. Since the MQTT Broker in the figure is on the Internet, the PC and Gate need to be able to access the Internet normally first. Since the IP address of the MQTT Broker in the figure (44.232.241.40) does not support ping, use the "ping 8.8.8.8" command to test on the PC and Gate to confirm whether the Internet can be accessed normally. If the IP address of MQTT Broker can accept ping command, then ping its IP address directly is sufficient.

- LoRaNetGateway loads “tcp” functionality:

  PC can access Gate, and router may need to NAT the port that Gate listens on.

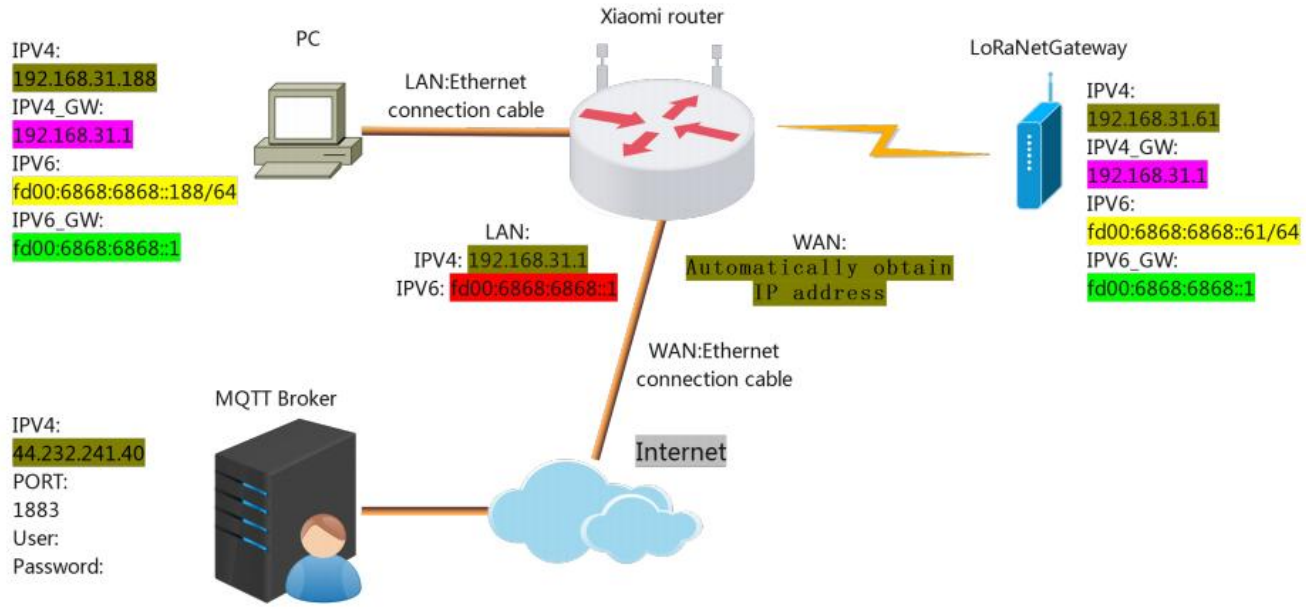


Figure 2-6-1-1. Network topology diagram

2.6.2. Configure the parameters of Gate for MQTT

Use the WF88 configuration tool to configure the parameters of Gate for MQTT. The use of WF88 configuration tool is similar to what was described earlier. Please refer to the section "2.5.2 Configure the parameters of Gate for MQTT". Below, we will skip some steps and explain the necessary steps in detail.

(1) Click the "Mesh Set" button to bring up the "WF288 LoRaNetGateway Set" dialog box. Select "Wi-Fi" from the "Connection mode" drop-down list. Select "MQTT" from the "LoadModule" drop-down list. Enter the SSID and password of the AP we want to connect to in the "SSID" and "PSK" editing boxes respectively, and select the "DHCP" checkbox. If we manually enter the IP address, we can select the corresponding IP version based on the user's network support in the "IP Version" drop-down list, and enter the IP address in the corresponding IP version below. Finally, click the "Save" button, as shown in Figure 2-6-2-1.

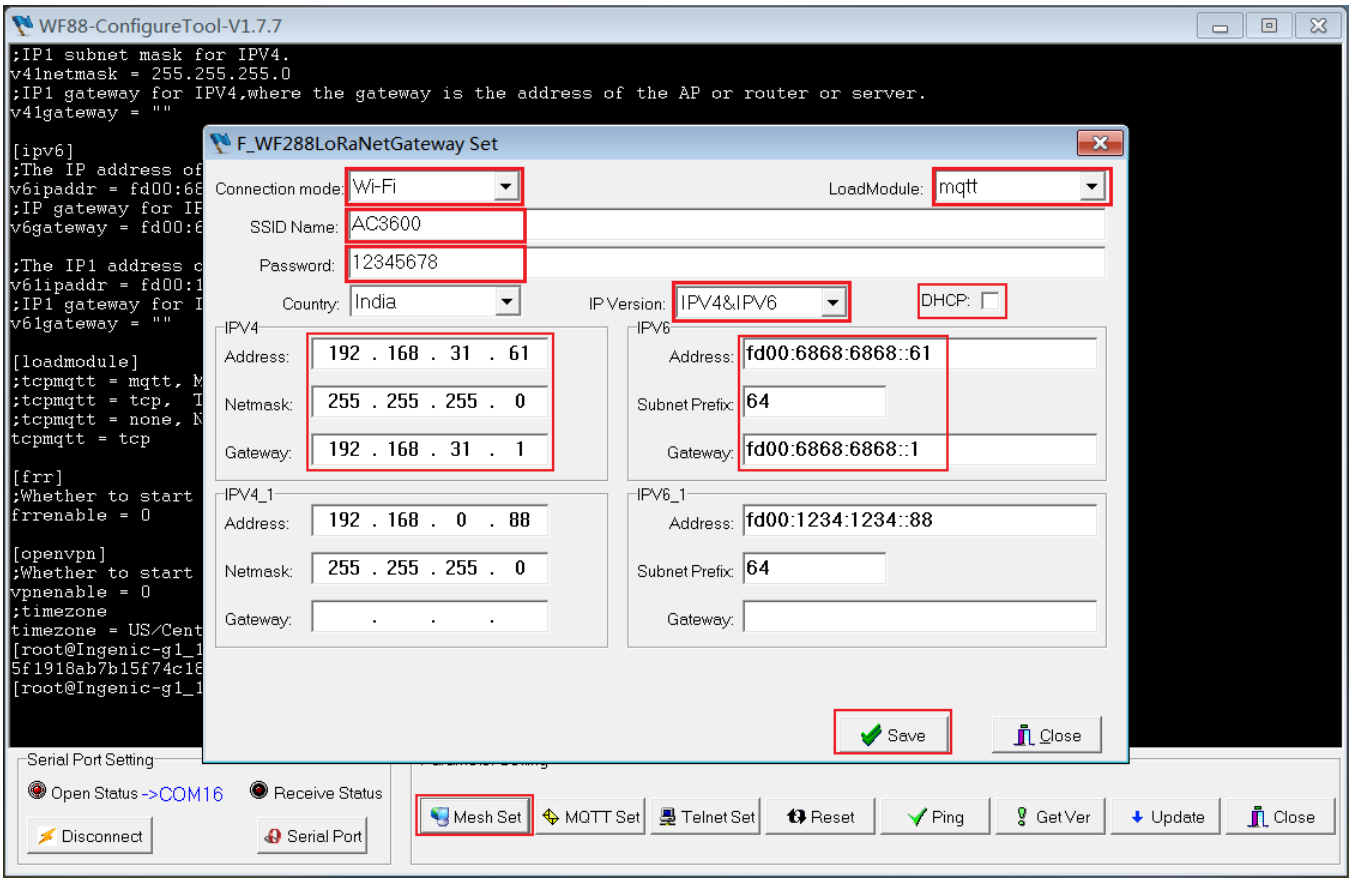


Figure 2-6-2-1. WF288 LoRaNetGateway Set configuration

(2) If we need to modify the relevant parameters of MQTT, we can refer to the previous chapter to modify the corresponding parameters. Here, we use the default parameters. After the parameter settings are completed, we will restart the Gate.

(3) After the system restarts, we will see a prompt message similar to "Connection to 88:c3:97:ce:b0:c5 completed" and "Sending select for 192.168.31.61", indicating that the Gate has been successfully established a connection with the AP and obtained an IP address. If we manually enter the IP address, we will not be able to see "Sending select for 192.168.31.61" like information.

We will also see a prompt message "Device Setup complete." indicating that the MQTT connection has been successfully established, as shown in Figure 2-6-2-2.

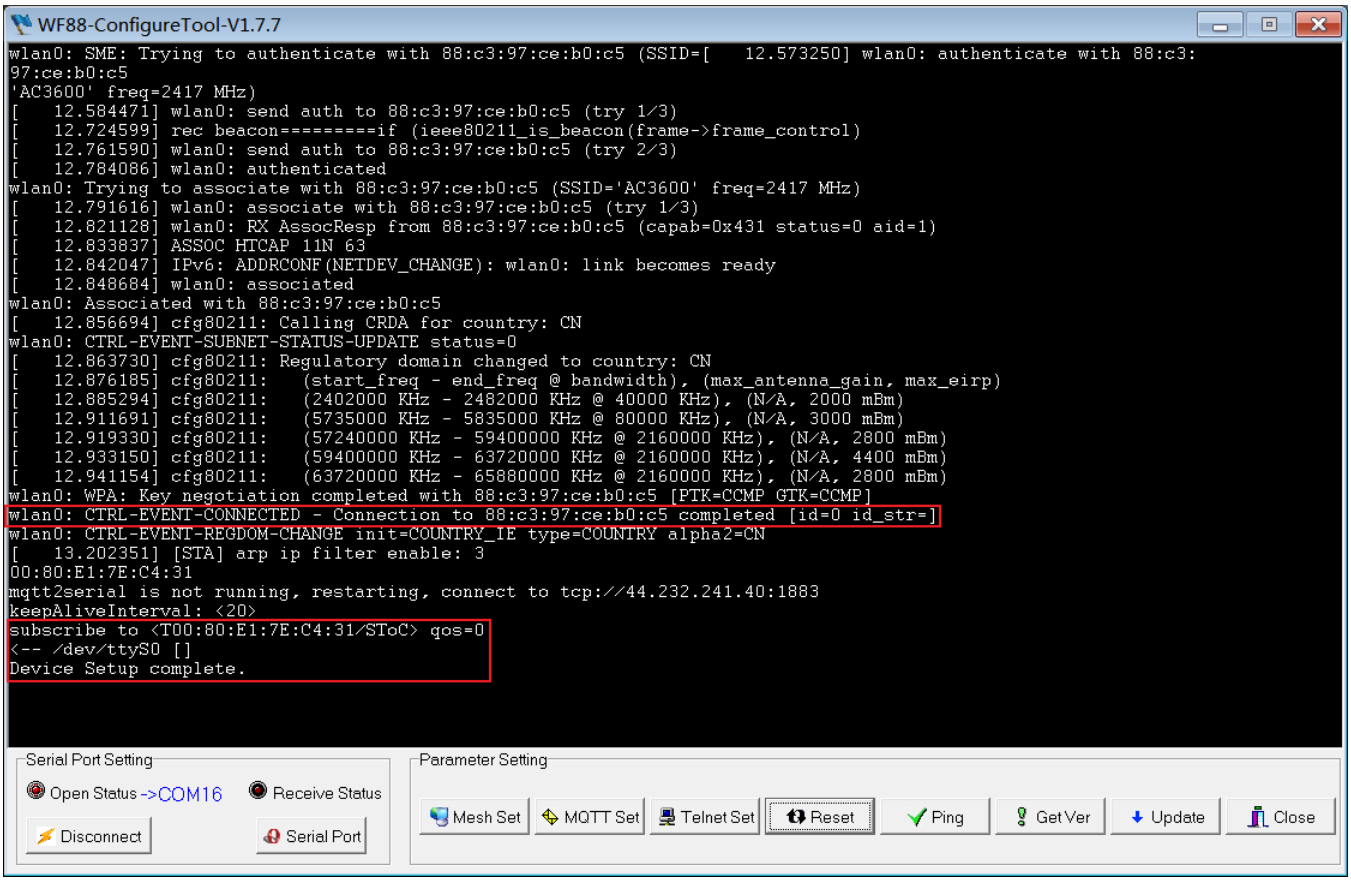


Figure 2-6-2-2. Establish MQTT through Wi-Fi interface

(4) If we don't see similar prompt messages, we can test whether the network communication is normal. Clicking the "Ping" button will bring up the "Ping Test" dialog box. Enter the IP address to be tested in the "PingIP" editing. Firstly, we need to test whether the communication with router is normal, so we need to input "192.168.31.1" for testing. As shown in Figure 2-6-2-3, ping test router indicates if Gate can access it normally.

If MQTT Broker accepts the ping command, it can directly ping its IP address. If the MQTT Broker does not accept the ping command and is still on the Internet, we can directly ping the 8.8.8.8 IP address.As shown in Figure 2-6-2-4, ping test indicates if Gate can access the network normally.

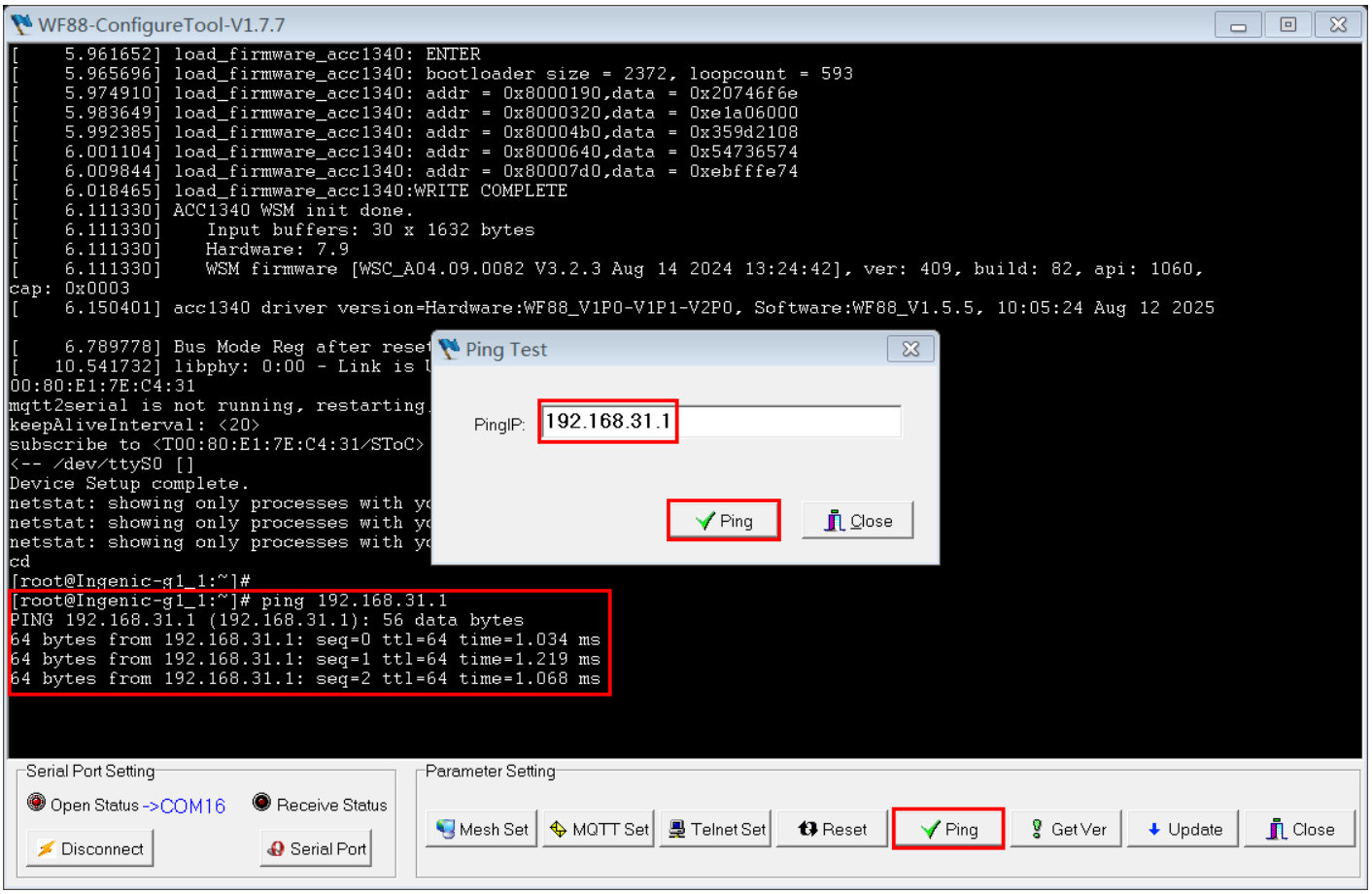


Figure 2-6-2-3. Ping test router

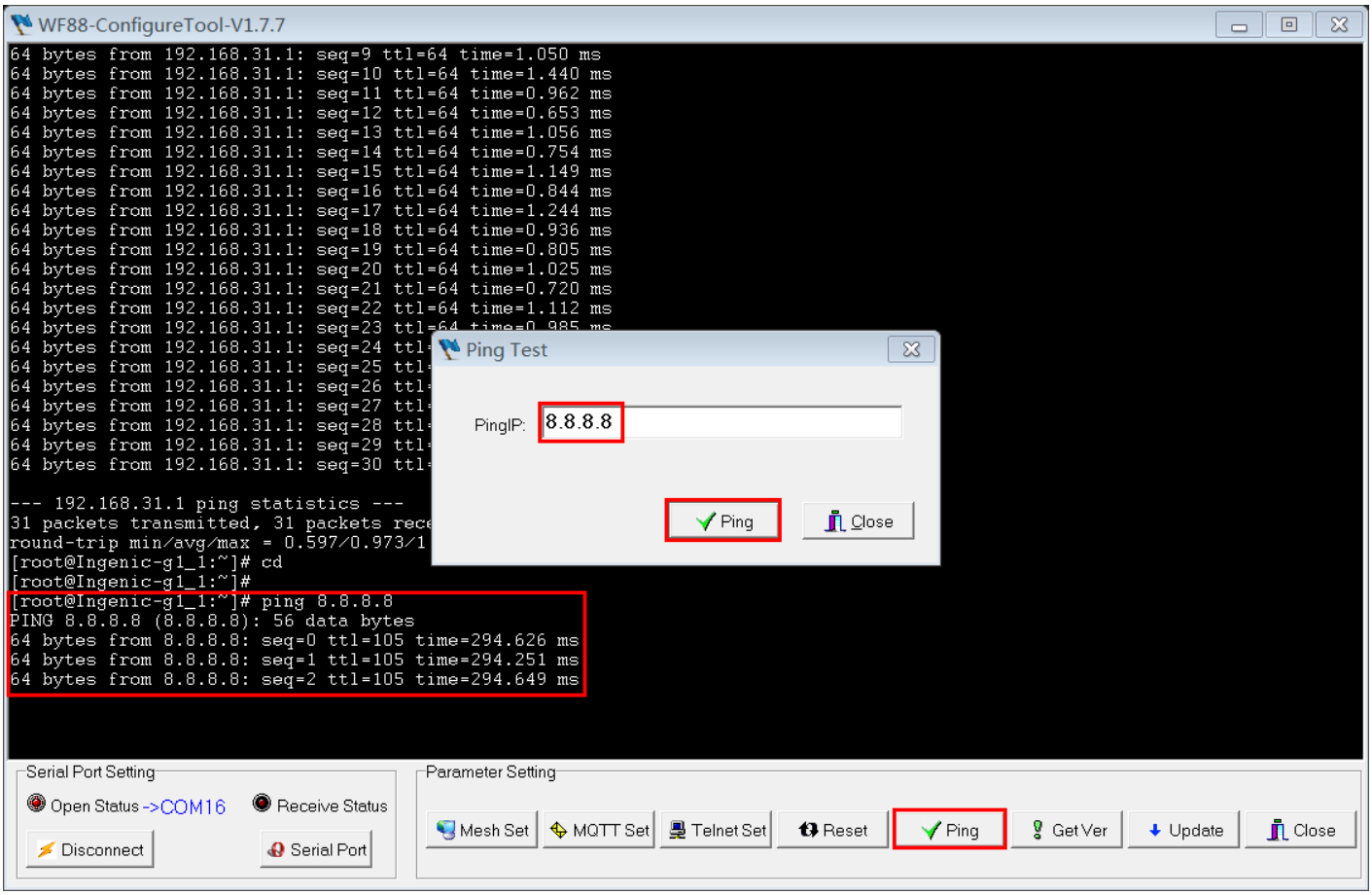


Figure 2-6-2-4. Ping test

(5) The setting of Gate is completed.

2.6.3. Configuration and usage of MQTT PC tool

Please refer to the section "2.5.3. Configuration and usage of MQTT PC tool" for the settings and usage of this section.

2.6.4. Configure the parameters of Gate for TCP

Use the WF88 configuration tool to configure the parameters of Gate for tcp. The use of WF88 configuration tool is similar to what was described earlier. Please refer to the section "2.5.2 Configure the parameters of Gate for MQTT". Below, we will skip some steps and explain the necessary steps in detail.

(1) Click the "Mesh Set" button to bring up the "WF288 LoRaNetGateway Set" dialog box. Select "Wi-Fi" from the "Connection mode" drop-down list. Select "TCP" from the "LoadModule" drop-down list. Enter the SSID and password of the AP we want to connect to in the "SSID" and "PSK" editing boxes respectively, and select the "DHCP" checkbox. For manually entered IP address, select the corresponding IP version based on the user's network support in the "IP Version" drop-down list, and enter the IP address in the corresponding IP version below. Finally, click the "Save" button, as shown in Figure 2-6-4-1.

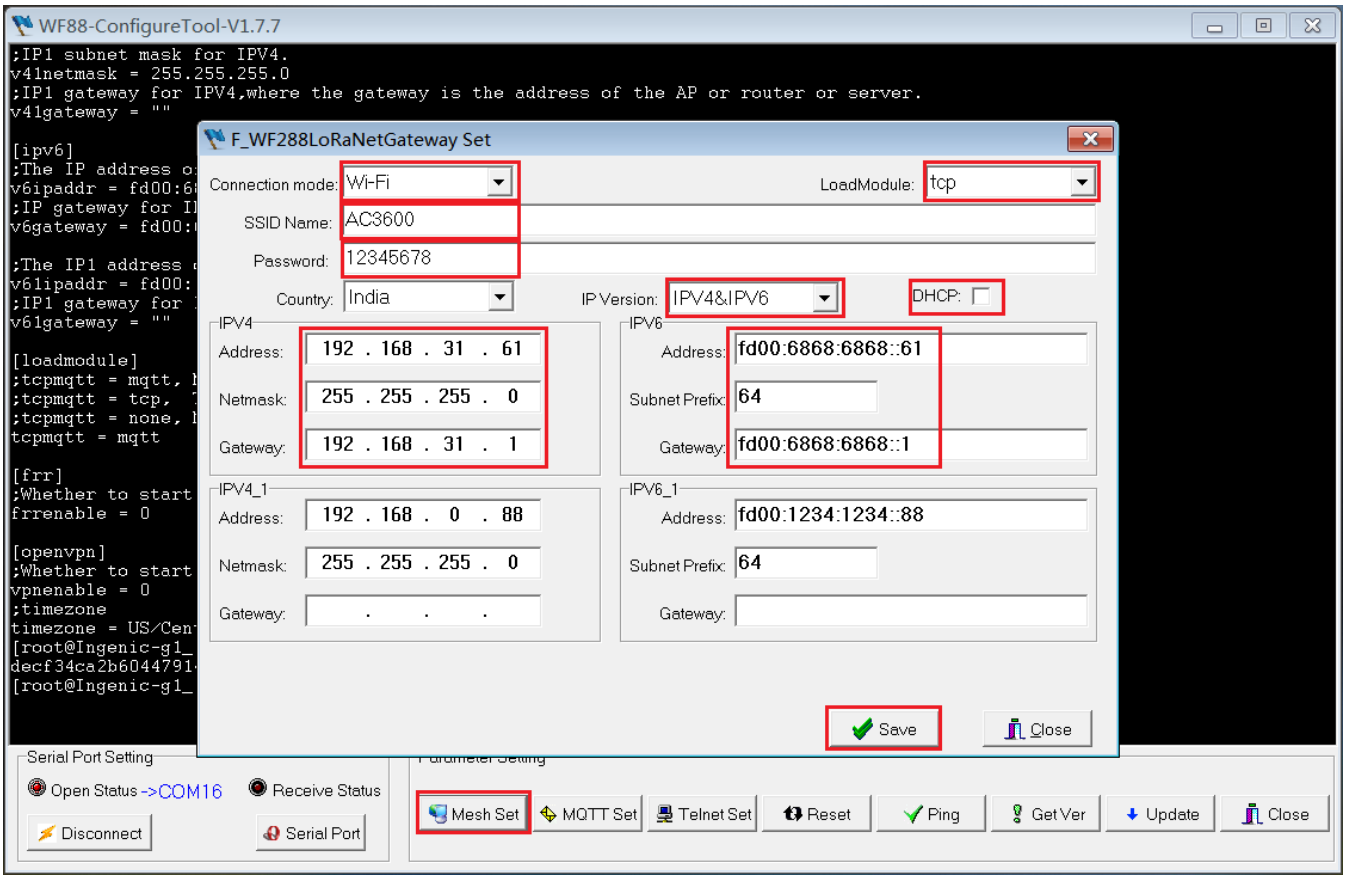


Figure 2-6-4-1. WF288 LoRaNetGateway Set configuration

(2) To modify the relevant parameters of TCP, refer to the previous chapter to modify the corresponding parameters.

(3) After the system restarts, note a prompt message similar to "Connection to 88:c3:97:ce:b0:c5 completed" and "Sending select for 192.168.31.61", indicating that the Gate has been successfully established a connection with the AP and obtained an IP address.

Also note a prompt message "LocalPortNum:xxx" indicating that the Gate has started the TCP service and is listening on port xxx, as shown in Figure 2-6-4-2.

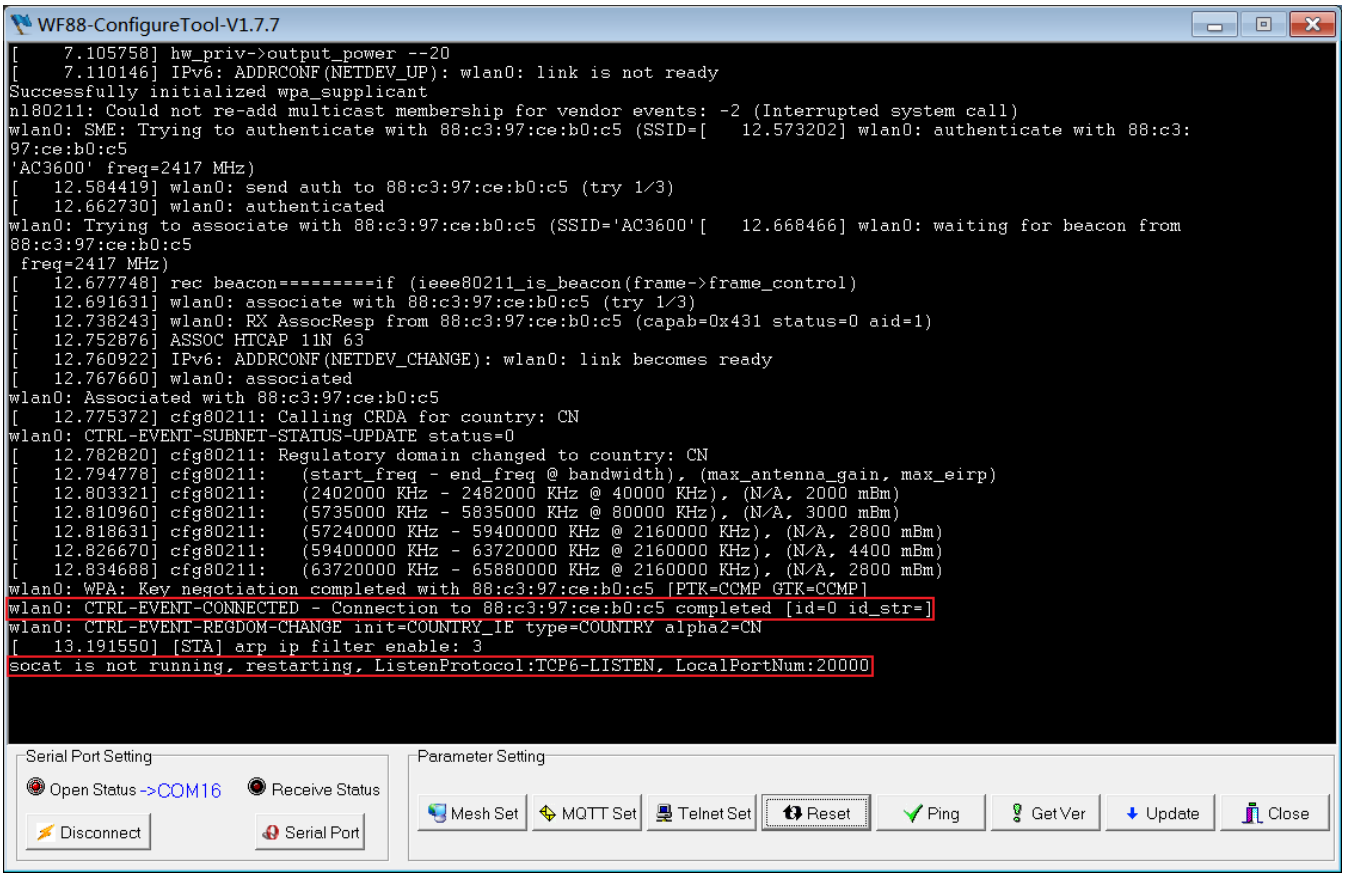


Figure 2-6-4-2. TCP service and is listening on port xxx

(4) Test whether the network communication is normal. Clicking the "Ping" button will bring up the "Ping Test" dialog box. Enter the IP address to be tested in the "PingIP" editing. First, test whether the communication with router is normal, so we need to input "192.168.31.1" for testing. As shown in Figure 2-6-4-3, ping test router indicates if Gate can access it normally.

If MQTT Broker supports the ping command, it can directly ping its IP address. If the MQTT Broker does not accept the ping command and is still on the Internet, directly ping the 8.8.8.8 IP address.As shown in Figure 2-6-4-4, ping test indicates if Gate can access the network normally.

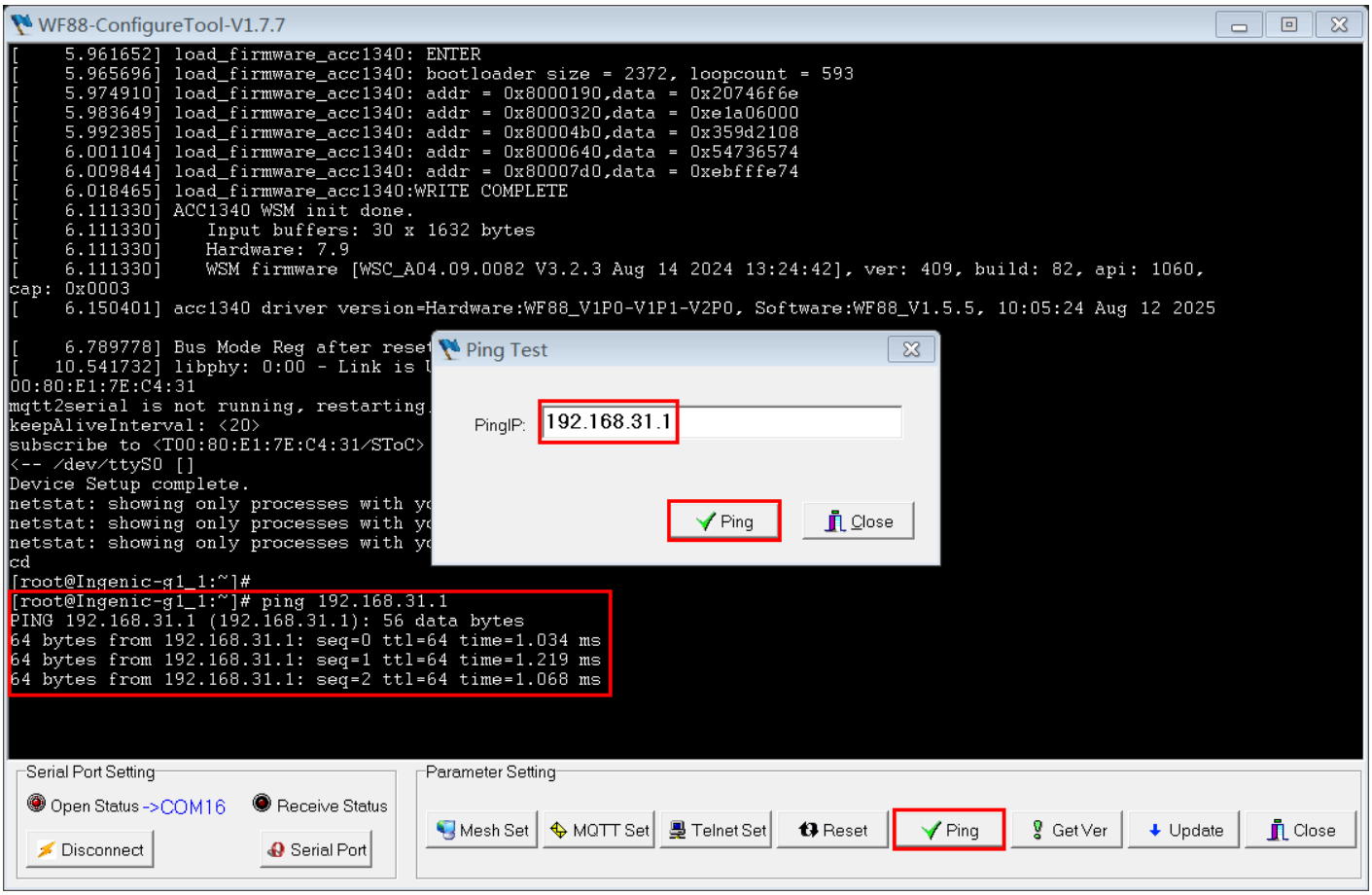


Figure 2-6-4-3. Ping test router

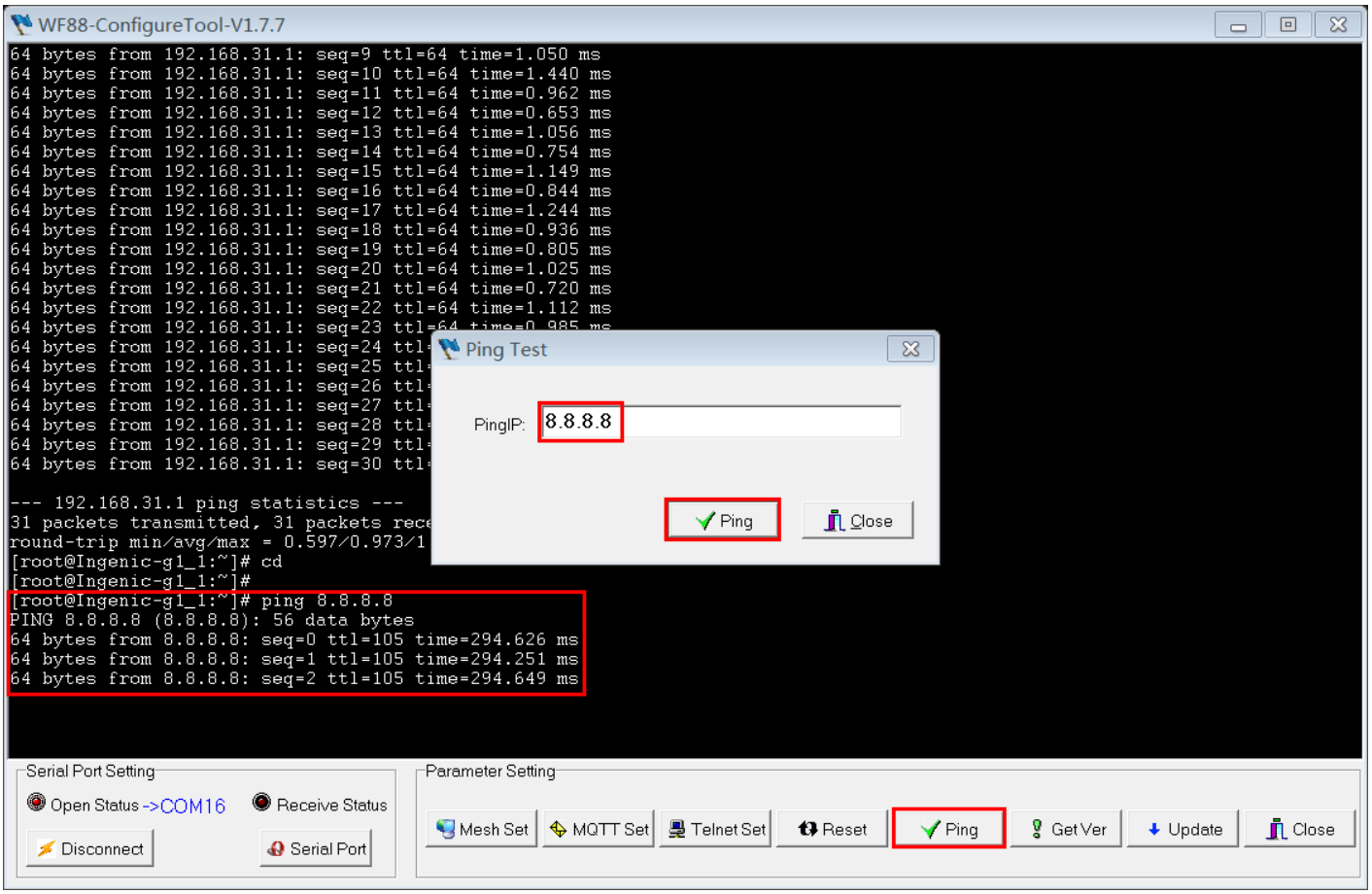


Figure 2-6-4-4. Ping test

(5) The setting of Gate is completed.

2.6.5. Configuration and usage of TCP PC tool

Please refer to the section "2.5.5. Configuration and usage of tcp PC tool" for the settings and usage of this section.