Product Name	GAOTek Smart Wireless Industrial Temperature Humidity Sensor
Product SKU	GAOTek-IIT-141
Product URL	https://gaotek.com/product/gaotek-smart-wireless-industrial-temperature-humidity-sensor/

Contact us: sales@gaotek.com

Contents

GAOTek Smart Wireless Industrial Temperature Humidity Sensor

1. Introduction

1.1 Overview

The USR-N5X0 Series are network-based serial device servers that connect RS-232/422/485 serial devices, such as PLC, meters, sensors, weigh scale, barcode scanner, card reader and serial printer directly to a TCP/IP network. Data coming from the Ethernet port is sent to the designated RS-232/RS-422/RS-485 port, and data received from RS-232/RS-422/RS-485 port is sent to the Ethernet port, allowing bi-directional communication. In the computer-aided manufacturing or industrial automation areas, field devices can directly connect to an Ethernet network via the USR-N5X0 Modbus gateway. In normal PCs or laptops, a virtual COM port can be created using our virtual COM software to fetch serial data from USR-N5X0 remotely over Ethernet. This extends the traditional COM ports of a PC, with access over a TCP/IP network. Through networking, you can control and monitor remote serial devices over the LAN or even over the Internet. The specific models of this series of industrial serial server are as follows. Please contact our sales for more information.

Table 1 USR-N5X0 series models

Model name	Description
USR-N510	1 RS232/485/422 to Ethernet device server
USR-N510-4	1 RS485 to Ethernet device server
USR-N520	2 RS232/485/422 to Ethernet device server
USR-N520-6	2 RS232/485 to Ethernet device server
USR-N540	4 RS232/485/422 to Ethernet device server
USR-N540-4	4 RS485 to Ethernet device server
USR-N580	8 RS485 to Ethernet device server

1.2 Features

The USR-N5X0 field-mount serial device server series share the same software platform on different available hardware components.

It provides.

- High-performance CPU processing ability, using 32-bit Arm Cortex-M7 core CPU, up to 400MHz frequency.
- Provides remote serial access over the Internet for industrial serial devices.
- 10/100Mbps Ethernet port and support Auto MDI/MDIX
- Software selectable RS-232/422/485 3-in-1 serial port (N5X0 models)
- Rugged metal housing with IP30 protection for wall or optional DIN-Rail mount
- Built-in 15KV ESD serial port protection
- Supports a wide industrial operating temperature, -40°F- 185°F.
- Baud rate: 0.6-921.6 Kbps (maximum 230.4Kbps for N520-6 model), and any baud rate setting, support None, Odd, Even, Mark, Space Parity bit (firmware V2.0.0 or later)
- Supports Hardware and Software flow control.
- Flexible serial port data framing setting, which can satisfy user's various demands for data packets segmentation.
- Versatile operation modes: TCP Server, TCP Client, UDP, HTTP client, Websocket server
- Support virtual COM, COM Port Redirector USR-VCOM (windows)
- Modbus Ethernet-to-Serial support (Modbus/TCP, Modbus/RTU) for seamless integration of serial Modbus devices
- Provides rich configuration access, including Windows configuration tool, and Web Browser
- Firmware upgrading via Web Browser and Windows configuration tool.
- Easy-to-use Windows configuration tool for auto discovery, multiple devices setting and monitoring.
- Choice of power input: AC-DC adapter (DC Jack) or DC direct (Terminal Block)
- High security via certificate verification SSL/TLS encryption for serial data transmission, HTTPS, TCPS, MQTTS (firmware V2.0.0 or later)
- Support Modbus RTU master, edge computing, Modbus gateway, MQTT gateway (firmware V2.0.0 or later)
- Support SNMP V1/V2c (firmware V2.0.0 or later)

2. Get Started

Since the USR-N5X0 Series is connected through a TCP/IP network, you may need to know some basic facts about networking in order to connect the server correctly. Specifications and dimensions are not provided in this manual since they may differ considerably based on the hardware purchase. Please refer to datasheet of each model for more information.

2.1 Installation

You can choose whether to plug in the other peripheral ports at this point or do it later depending on the actual location of the device or level of comfort for performing such operation.

2.1.1 Wall mounting

The wall mounting option provides better shock and vibration resistance than the DIN-Rail vertical mount.

- Locate the installation site and place the device against the wall. Use the wall mount plates as a guide to mark the locations of the screw holes.
- Drill two holes over the two marked locations on the wall. Insert the wall sinks into the walls. Insert the screws into the wall sinks. Leave a 2 mm gap between the wall and the screw head to allow for wall mount plate insertion.
- Align the wall mount plate over the screws on the wall. Hang the device on two screws and slide it downward to lock in place, then tighten the screw to enhance stability, see the following Fig.1.

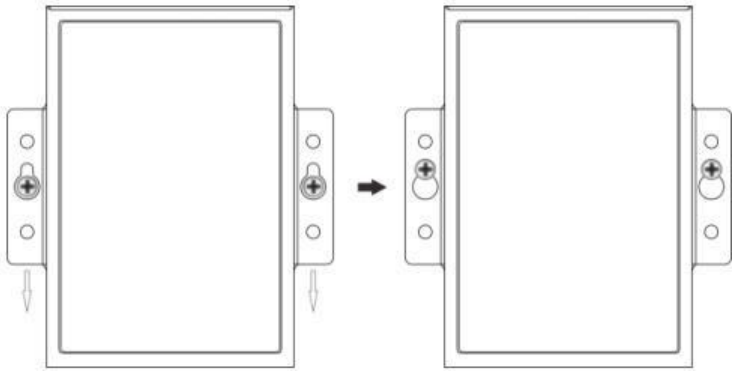


Fig.1 Wall mount installation

- For device disassembling please power off the device and unscrew the screw on the wall about 2mm. Lift the device upward slightly, take out the device.

2.1.2 DIN-Rail mounting

DIN-Rail mount kits must be purchased separately. They are not provided with the N5X0.

- If you have purchased the DIN-Rail mount kit, proceed to place the screws on the back of the device as shown in Fig.2.

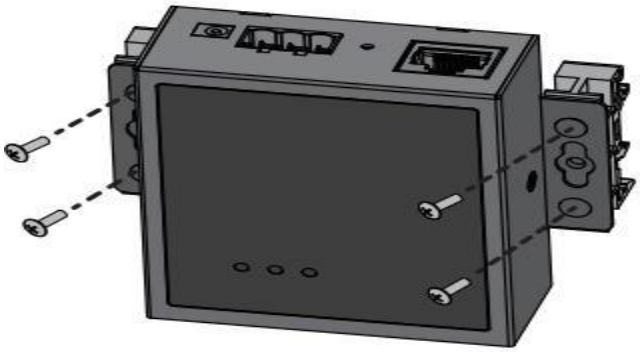


Fig.2 Fix DIN-Rail mount kit.

- Position the rear panel of the device directly in front of the DIN-Rail, making sure that the top of the DIN-Rail clip hooks over the top of the DIN-Rail, as shown in Fig.3

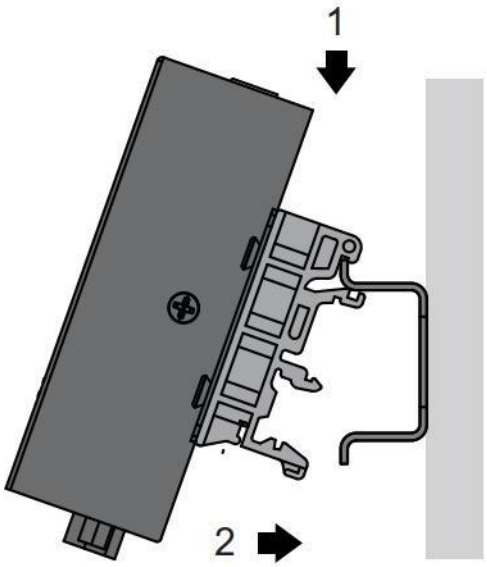


Fig.3 Install DIN-Rail mounting Kit.

- Once the DIN-Rail is seated correctly in the DIN-Rail clip, press the front of the device to rotate the device down and into the release tab on the DIN-Rail clip. If seated correctly, the bottom of the DIN-Rail should be fully inserted in the release tab.

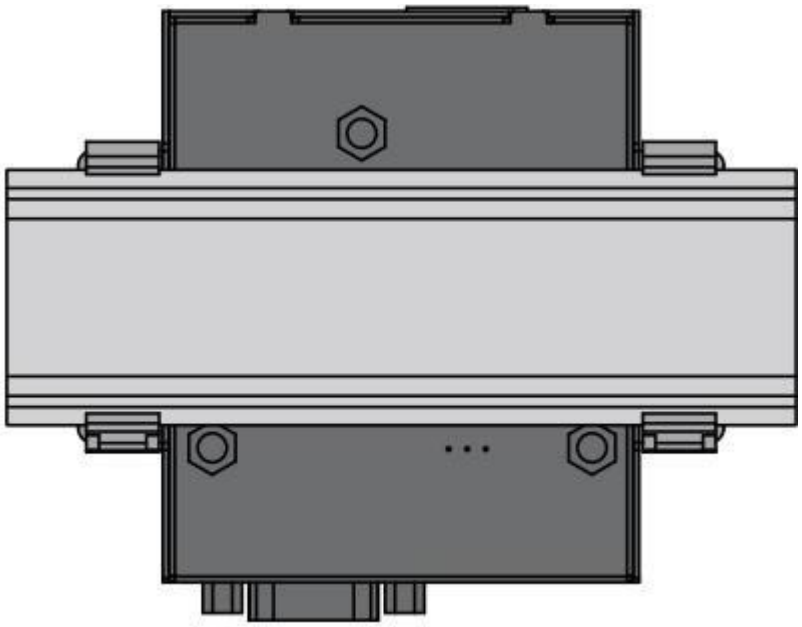


Fig.4 Correctly installed DIN-Rail Kit.

- Proceed to Fig.5 if you want to remove the device from DIN-Rail. Push down on the top of the DIN rail clip release tab with your finger. As the clip releases, lift the bottom of the device, as shown in the following illustration.

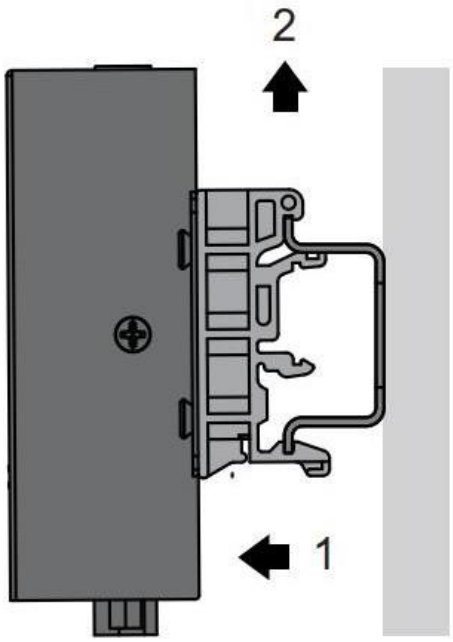


Fig.5 Remove the DIN-Rail

2.2 Serial port

The USR-N5X0 supports the RS-232, RS-422, and RS-485 protocols, adopts DB9 male connector and is software configurable. The serial port pin assignments are given in the table.

Fig. 6 DB9 male connector pin

Table 2 DB9 Male Pin Assignment (N5X0 models)

Pin	RS232	RS422	RS485
1	--	--	--
2	RXD	Rx+	
3	TXD	Tx-	B-
4			
5	GND	GND	GND
6			
7	RTS	Tx-	A+
8	CTS	Rx-	
9			

The USR-N5X0-6 supports the RS-232 and RS-485 protocols and is software configurable. And RS232 adopts DB9 male connector, RS485 adopts terminal block. The DB9 pin assignment is same to table 2(RS232).

Fig.7 N520-6 serial port

The USR-N5X0-4 supports only RS-485 protocols and adopts 3-pin 5.08mm pitch industrial terminal blocks. The serial port pin assignments are shown in Fig.8

Fig.8 N510-4 terminal block

2.3 Power supply

The USR-N5X0 serial device server provides 2-pin power supply input terminal blocks and DC jack. The power supply support anti-reverse protection. Power supply range: 5-36VDC.

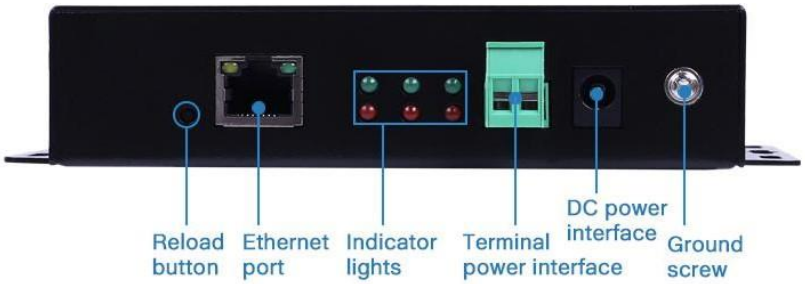


Fig.9 N520 back view

Although internal grounding has been done inside, in order to help limit the effects of noise caused by electromagnetic interference (EMI) and protect your device, it is still strongly advised to ground the device properly. There is a grounding screw next to the terminal block, you should connect it to the grounding at all times.

2.4 Ethernet RJ45 interface

The 10Base-T/100Base-TX adaptive Ethernet RJ45 interface supports automatic MDI/MDIX connection, refer to Fig.10 below for the pin distribution of the RJ45 interface. USR-N5X0 serial servers adopt RJ45 interface with light, as shown in the picture below.

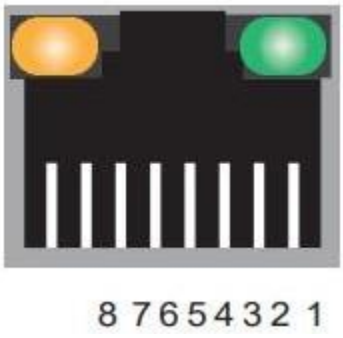


Fig.10 RJ45 with light

Table 3 Ethernet pin assignments

Pin number	Signal name
1	Send data+(TD+)
2	Send data-(TD-)
3	Receive data+(RD+)
6	Receive data-(RD-)
4,5,7,8	Unused

2.5 LED indicators

The USR-N5X0 serial device server provides LED indicators to monitor the device working status with a comprehensive simplified troubleshooting, the function of each LED is described in the table as below.

Table 4 LED indicators

LED name	status	description
PWR	Steady on	Power supply is normal.
PWR	Off	No power supply or abnormal power supply.
WORK	Blinking	Power is on and the device is ready. System is booted up and running
TXN	Blinking	Serial port is transmitting data
RXN	Blinking	Serial port is receiving data

2.6 Factory default settings

The USR-N5X0 serial device server comes with the following default settings.

Table 5 Default parameters

Parameter	Default Values
Username	admin
Password	admin
Device IP	192.168.0.7
Subnet Mask	255.255.255.0
Gateway IP	192.168.0.1
COM port	115200, None,8,1
COM operation mode	TCP server,23
MQTT	Disable (firmware V2 version)
Edge computing	Disable (firmware V2 version)

2.7 Quick test

USR-N5X0 series serial server has a built-in Web server, which provides a convenient way to access and configure the serial server. Users can use Edge, Firefox, or Google browser to access it. This chapter is a quick introduction to the USR-N5X0 series of serial server products. It is recommended that users read this chapter and follow the instructions once for the system, and you will have a basic understanding of the product. For specific function details and instructions, please refer to the subsequent chapters.

2.7.1 Download the Software

Download the setting software from PUSR's website:
https://www.pusr.com/support/downloads/H7-version-set-up-software.html
https://www.pusr.com/support/downloads/usr-tcp232-test-V13.html

You may find it in the download section under your product page. Run the software when the installation has been completed as shown in Fig.11 and Fig.12.

It is strongly recommended for the users to set the Network Parameters through configuration tool first. Other device-specific configurations can later be carried out via user-friendly Web-Interface.

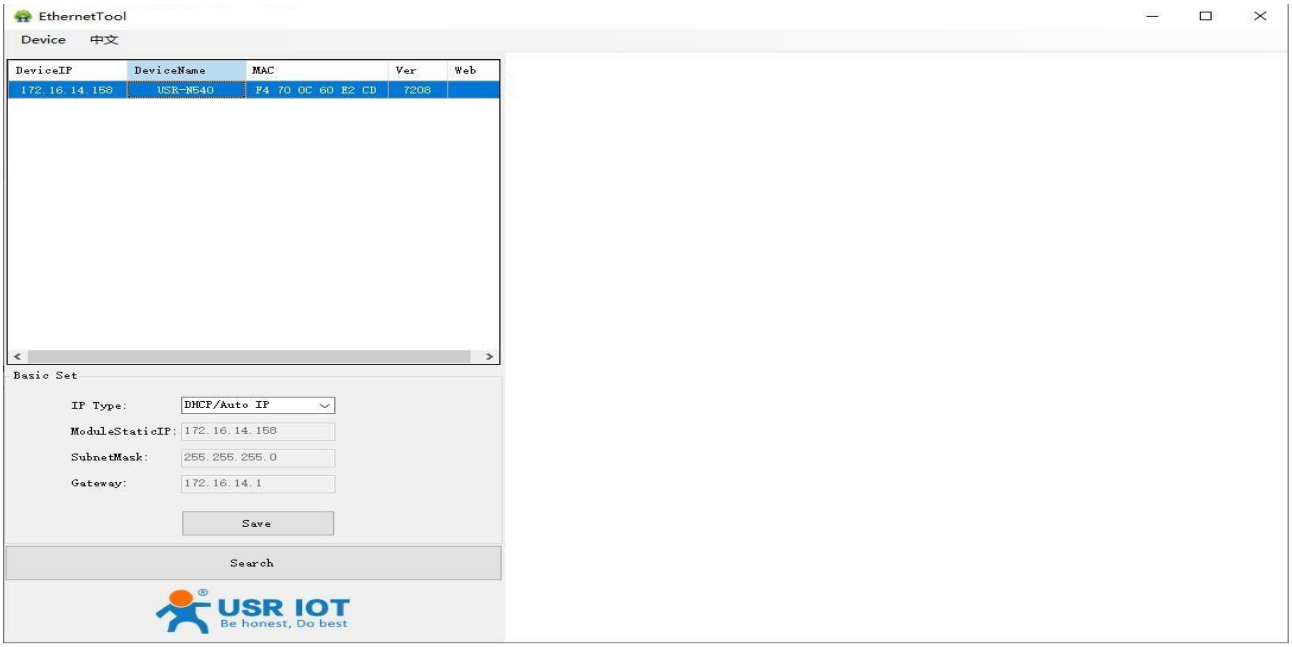


Fig.11 Windows configuration tool

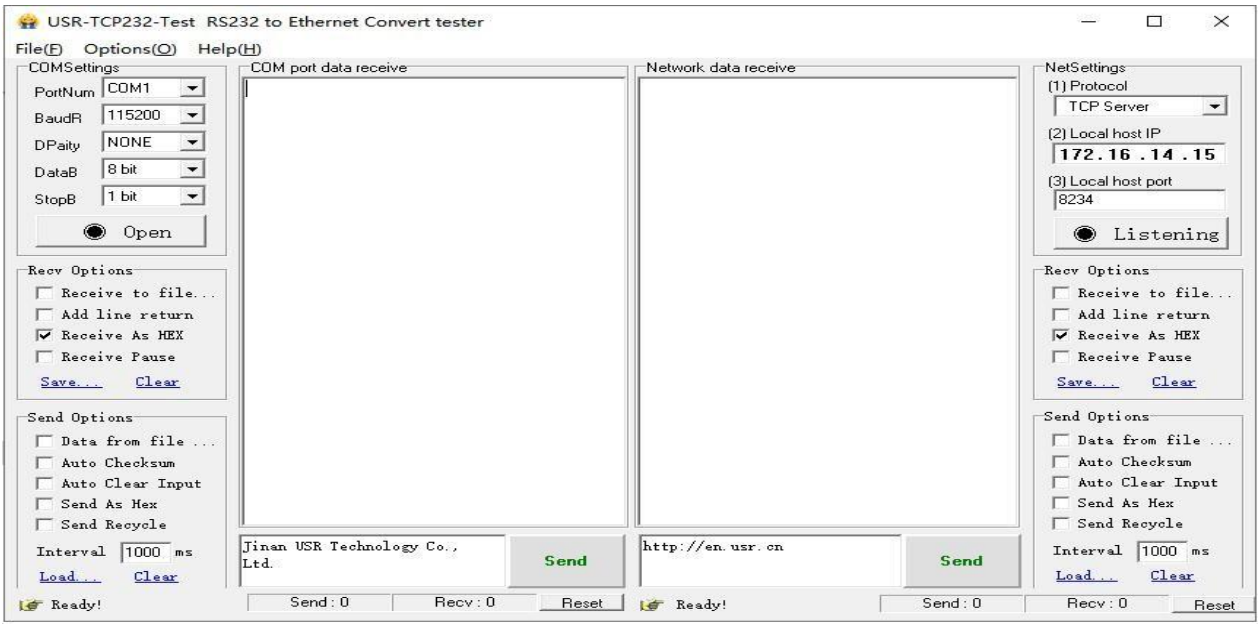


Fig. 12 Test assistant

2.7.2 Hardware Connection

For fast networking of USR-N5X0 series serial server, you need to prepare a PC, a router, a serial server, a network cable, a serial cable, and a DC12V/1A power supply. The hardware connection is shown in Fig. 13. To establish a TCP / IP network all devices must be connected to the same network either locally or via gateway connections.

Fig.13 Hardware connection

- Connect the power line with the N5X0 power input. If the power is properly supplied, the "PWR" LED will show a solid red color. After the system is ready, the "WORK" LED will

blink.

- Connect one end of the Ethernet cable to the N5X0's 10/100M Ethernet port and the other end of the cable to the same Ethernet network (same router or switch).
- Connect a serial data cable (USB to RS232 or RS485) between the N5X0 and PC.

2.7.3 Network Configuration (Step 1)

The Broadcast Search function is used to locate all N5X0 device servers that are connected to the same LAN as your computer. Since the Broadcast Search function searches by MAC address and not IP address, all N5X0 connected to the LAN will be located, regardless of whether they are part of the same subnet as the host. In EthernetTool, click Search to search your LAN for N5X0 device servers. When your unit appears in the search results, you can click device to select it and change the IP type to DHCH, save your change. Wait for 5s and search it again.

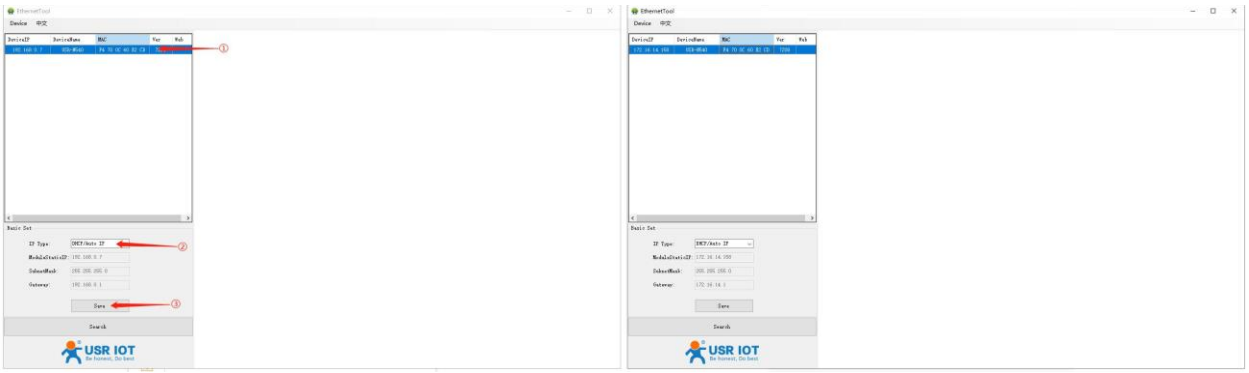


Fig.14 IP network setting

When accessing the serial server through the Web, the IP address of the serial server and the PC must be in the same network segment. After changing the IP address of the N5X0, you can access the Web page of the N5X0 series serial server through browser and perform related configuration operations on it. The username and initial password are both "admin". After, entering the username and password, click "OK" and the server will authenticate. After success, you will enter the main page of the Web server, as shown in Fig.15. The following uses firmware V2 version as an example. For details about the V1 version web page, see Section 3.1.

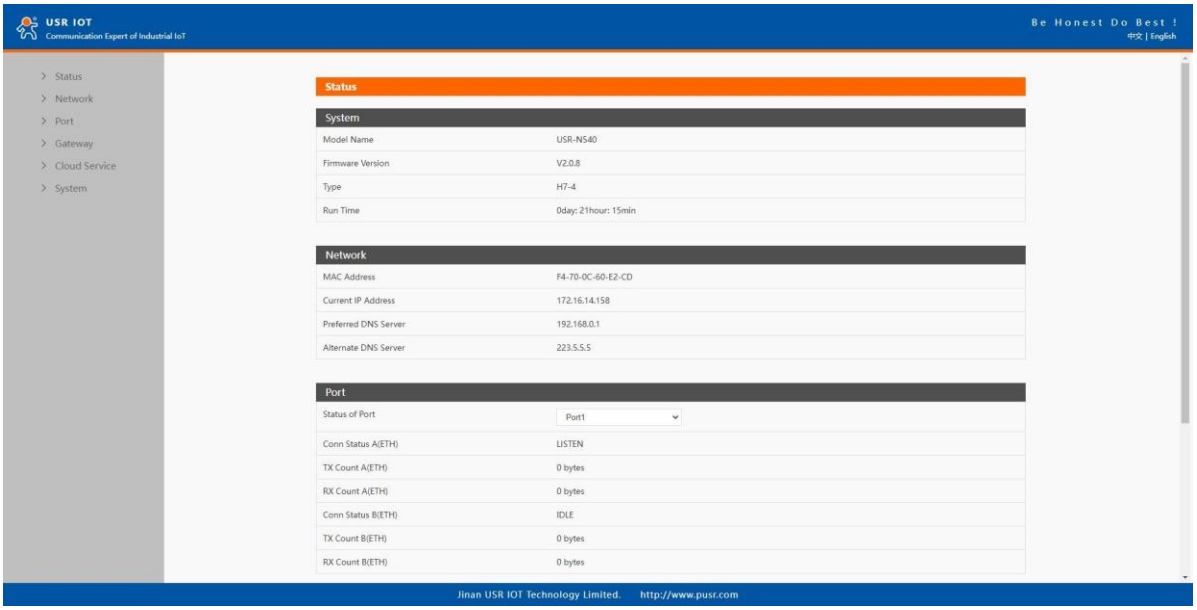
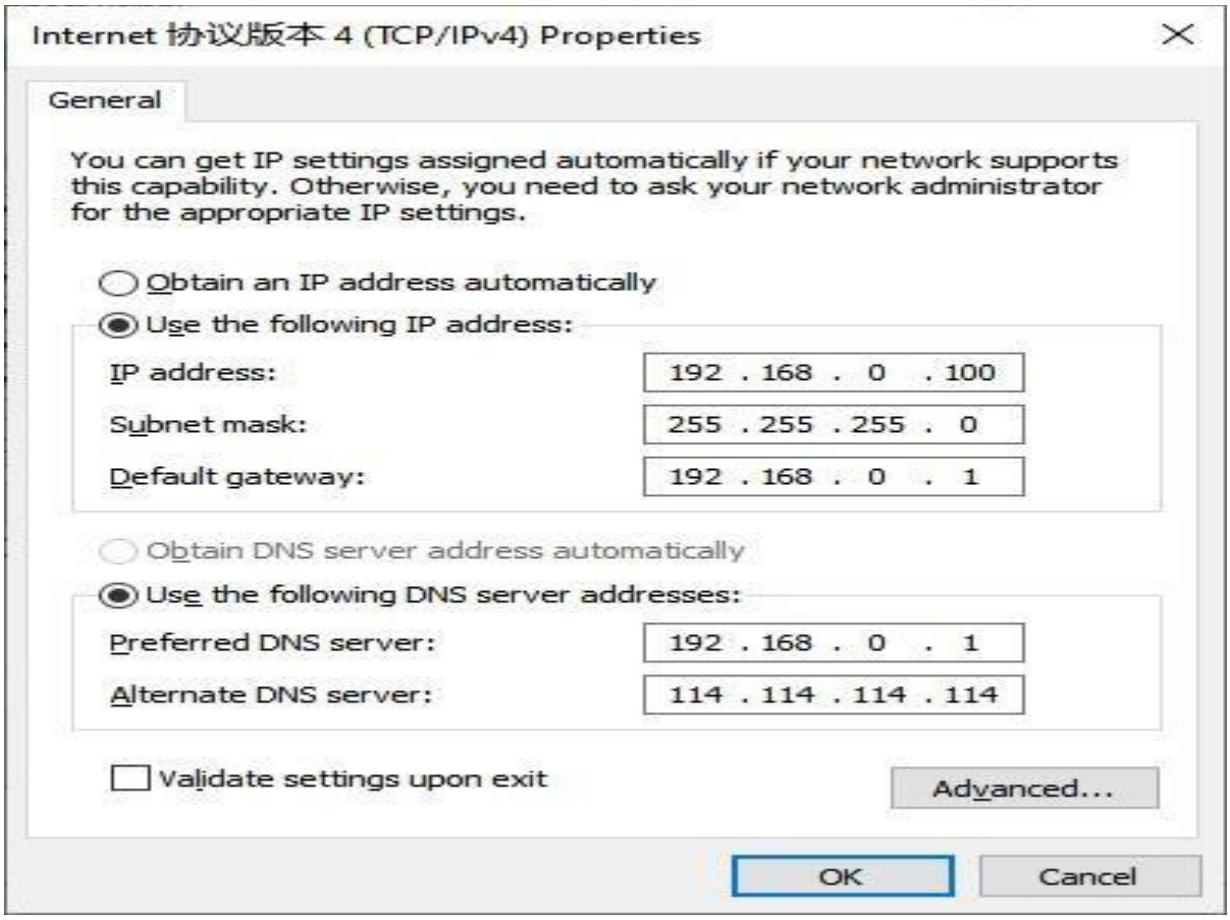


Fig.15 The main interface of the Web server

The IP address of the PC must be modified to ensure that it is in the same local area network as the IP of the serial server if you want to connect N5X0 to PC directly via a net cable. The default IP address of serial server is: 192.168.0.7. Set the PC's IP address as: 192.168.0.X (X is any valid value from 2 to 253 except 7). The specific Windows system operation page is shown in Fig.16. you can access the Web page of the USR-N5X0 series serial server through browser as mentioned above.

Fig.16 IP Setting of PC



2.7.4 Data Transmission test (Step 2&3)

You can select an operation mode in socket setting page, but for now we use default parameters to test, i.e TCP server. Now USR-TCP232-Test works as TCP client, you need configure the server IP and port, that is 172.16.14.158:23 of USR-N5X0 serial device server, the IP address of PC is 172.16.14.15. In the serial port setting module, you can configure communication parameters for the serial ports RS485 and RS232, as shown in the figure below. When configuring a serial network you need to set the following within each device-Baud rate,Parity,Stop bits,Data bits and keep serial port parameters consistent in the same network. We now configure the COM Settings to operate as required for the N5X0 devices. Go to the Port1 Settings tab for confirming values of parameters.

Fig.17 shows an example of parameters setting to test transparent transmission.

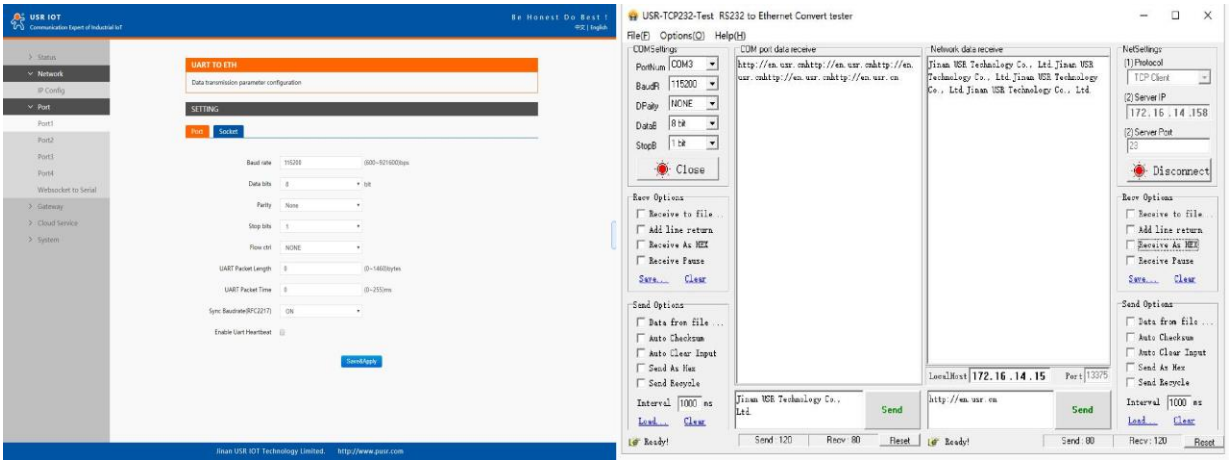
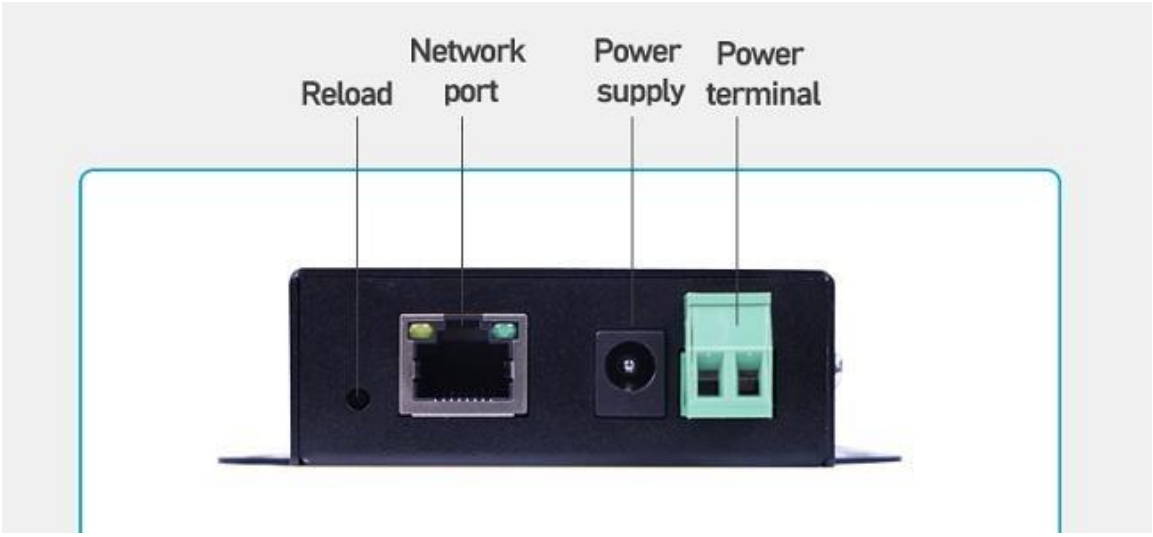


Fig.17 Transparent transmission test

2.8 Reload factory settings button



Press the "Reload" button (inside a small hole) on the back panel for 3-15 seconds and then release or follow the procedure in Section 3.1.6, to restore the USR-N5X0 Series Industrial Serial Device Server to the factory default settings.

2.9 Technical support and assistance

Please visit the USR IoT website: https://www.pusr.com where you can find the latest information about the product.

Contact your distributor, sales representative, or PUSR's support center: http://h.usriot.com/index.php?c=frontTicket&m=sign for technical support if you need additional assistance.

Please have the following information ready before you submit a ticket:

- Product model
- Description of your peripheral attachment
- Description of your software (firmware version, application, function description.)
- A complete description of the issue and steps to reproduce.

3. Configuration and parameter details

3.1 Web interface (V1 version)

Every USR-N5X0 Industrial Serial Device Server is equipped with a built-in web server in the firmware. Therefore, the device can be accessed by using a web browser for configuring by entering the device's IP address in the URL field of your web browser. An authentication will be required and you will have to enter the username (Default value is "admin") and password (Default value is "admin") for accessing the web interface as shown in Fig. 18. This approach (web interface) for configuring your device is the most user-friendly. It is the most recommended and the most common method used for USR-N5X0 Serial Device Server Series. Please go to its corresponding section for a detailed explanation.

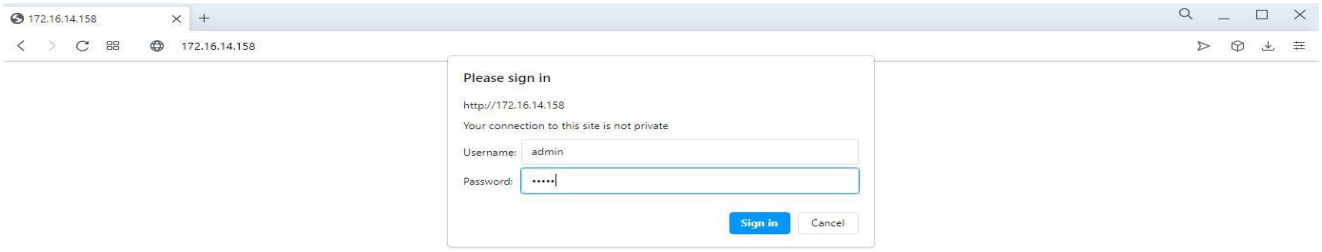


Fig.18 Authentication Required for Accessing Web Interface

3.1.1 Status

After entering the correct username and password and the authentication is successful, you will enter the main page of the Web, as shown in Fig.19. The main page can be roughly divided into three areas. The upper area displays the logo, the lower left area is the function menu area, the middle area is the main function display area, and the lower right area is the help document area. Fig.19 illustrates the status page of the web interface.

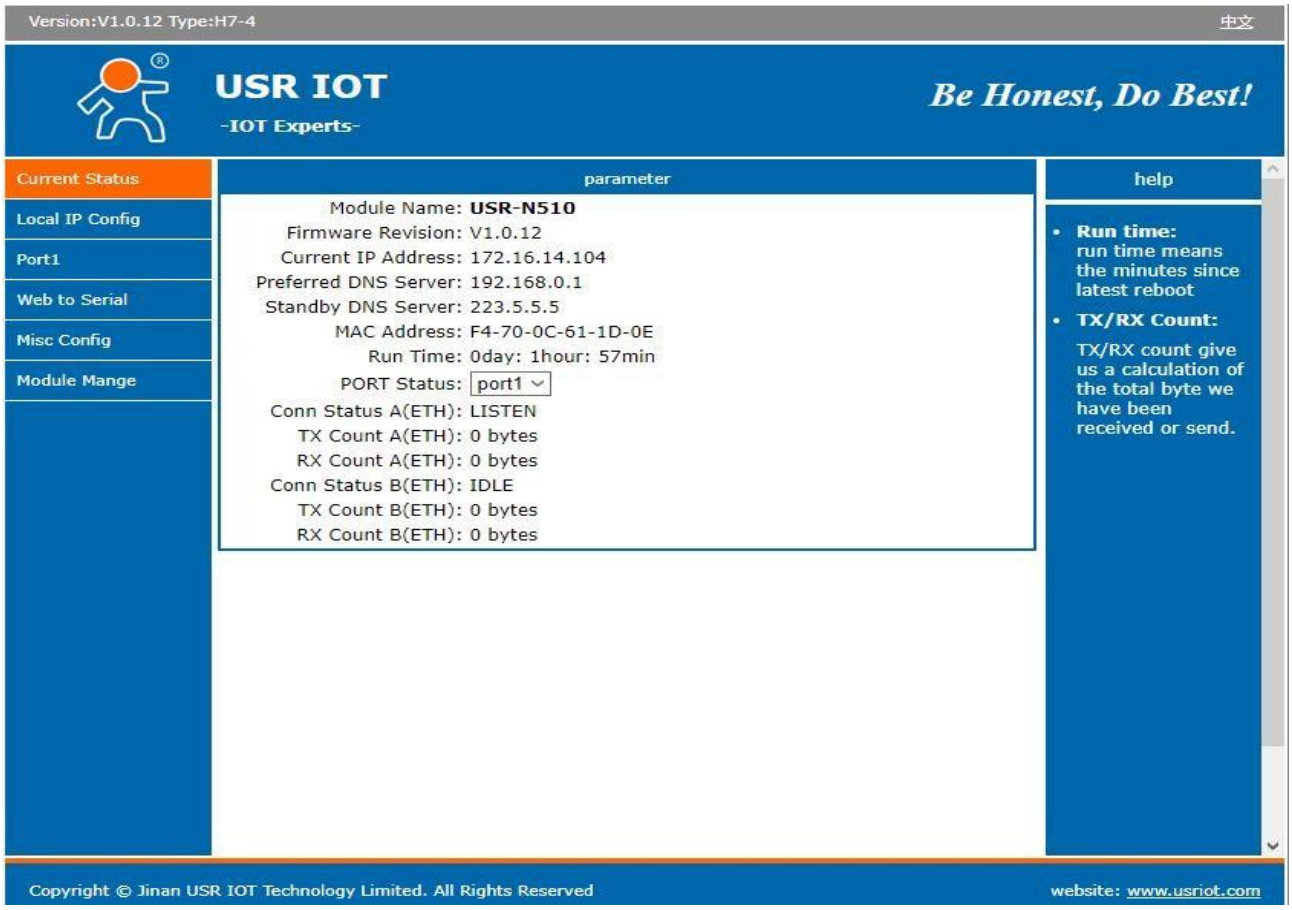


Fig.19 The main interface of Web Server

The function of the device status part is to display some specific information of the current device, including module name, firmware version, IP address, DNS, MAC address, running time and serial port status.

Table 6 Status List

Parameter Item	Description
Module name	The name of the serial server, which can be customized by the user on the "Miscellaneous settings" page.
Firmware Version	The current software version of the serial server.
IP Address	The IP address of the serial server.
MAC Address	The MAC address of the serial server.
Running time	Total time after the device start work. It will starts from 0 after reboot.
Port Status	The working status of checked serial port. Select the serial port currently to be displayed 1. Conn Status A(ETH): connection status of socket A. • IDLE：Initialization status • LISTEN：When the module works as TCP Server, it is listening for connection access CONNECTING：Works as TCP client, the module is establishing a connection to the TCP Server • CONNECTED：Works as TCP server, the TCP connection to TCP server of the module has been established • CONNECTED（n）：Number of TCP clients connected to the module. • ERROR：The module is abnormally disconnected 2. Tx Count A(ETH): To count how many bytes be send to internet. 3. Rx Count A(ETH): To count how many bytes received from internet.

3.1.2 IP settings

You must assign a valid IP address to the USR-N5X0 before it will work in your network environment. The IP address must be unique within the network. If the device is connected to the Internet and should connect to other servers over the Internet to get some services such as Network Time Protocol (NTP) server, you will need to configure the DNS server in order to be able to resolve the host name of the NTP server. The detailed description of the configuration parameters on this interface is shown in table 7.

Fig.20 Network Settings Web Page

Table 7 Network Settings List

Parameter Item	Description
Network protocol	Click the drop-down menu to select the IP Address Setting mode: Static or DHCP. If you choose DHCP, the rest of the options will be greyed out or disabled.
DNS type	Click the drop-down menu to select the DNS mode: auto or manual. If you choose auto, the DNS options will be greyed out or disabled.
Ip address	IP address is a 32-bit address assigned to devices connected to the Internet. The IP address consists of two fields: the network number field (Net-id) and host number field (host-id). In order to facilitate the management of IP addresses, IP addresses are divided into five categories: Class A, B, and C addresses are unicast addresses, Class D addresses are multicast addresses, Class E addresses are reserved addresses for future special purposes. The IP addresses currently in large numbers belong to three types of addresses: A, B and C.
Subnet mask	The mask is a 32-bit number corresponding to an IP address. Some of these numbers are 1, and the others are 0. The mask can divide the IP address into two parts: the subnet address and the host address. The part of the IP address corresponding to the 1 bit in the mask is the subnet address, and the other bits are the host address. The mask for class A addresses is 255.0.0.0, the mask for class B addresses is 255.255.0.0, the mask for class C addresses is 255.255.255.0
Default gateway	The default gateway in the host is usually called the default route. The default route (Default route) is the route chosen by the router when no other route exists for the destination address in the IP packet. All packets whose destination is not in the router's routing table will use the default route.

DNS	The IP address of the DNS server. DNS Server part is where you can specify the IP Address of your Preferred DNS (Domain Name Server) and Alternate DNS. When the device uses a static IP address, the user is required to fill in this item, 8.8.8.8(Google) will be a good choice. If a specific DNS server is not used, the default gateway IP address is generally sufficient

After finishing the network settings configuration, please click the Save button to save all changes that have been made. Finally, the web browser will be redirected to the Reboot page as shown in Fig.21. All modified parameters take effect after device restart.

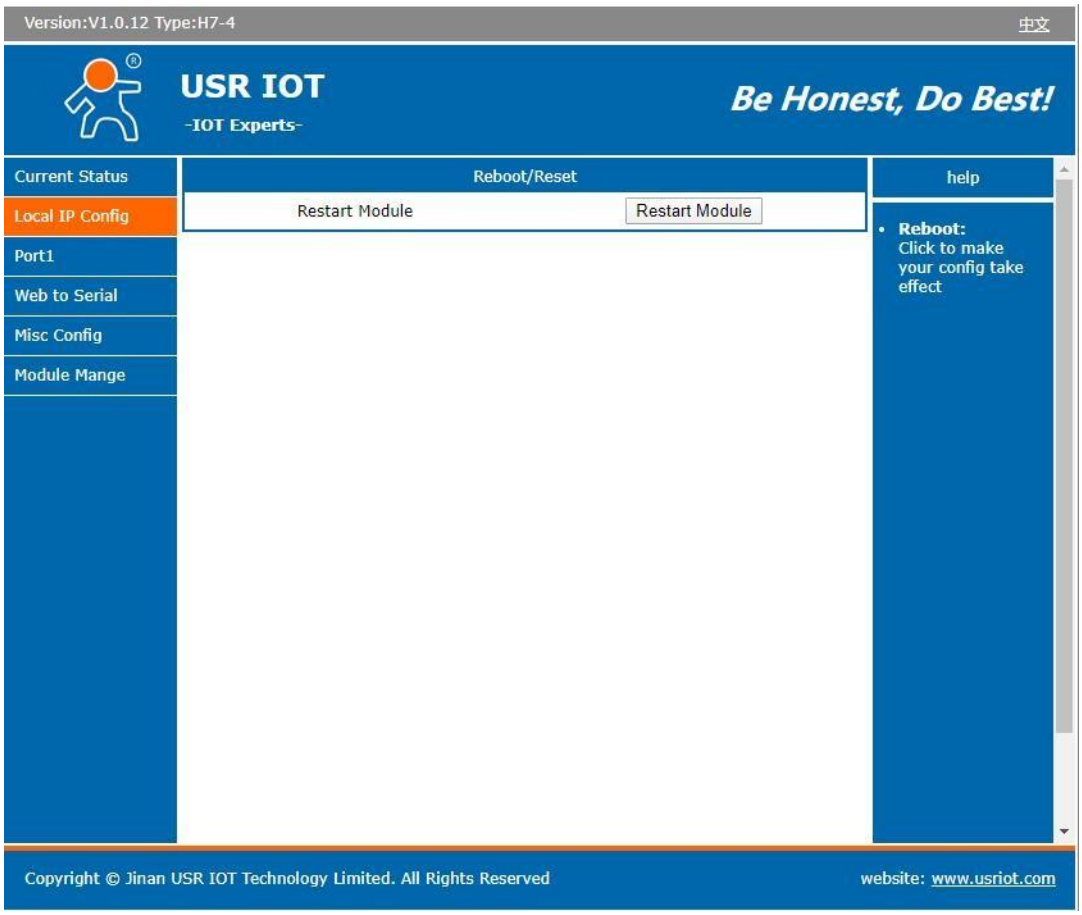


Fig.21 Reboot web page

3.1.3 Serial port settings

The serial port module includes serial port parameter configuration, network parameter configuration. The main function of the serial device server is to carry out two-way transparent transmission of standard serial bus data (RS-232, RS-485, RS-422) and standard Ethernet data supporting TCP/IP protocol to solve common serial equipment Networking problems on the Internet. The Port configuration page can configure the parameters of the serial port and socket, as shown in Fig.22.

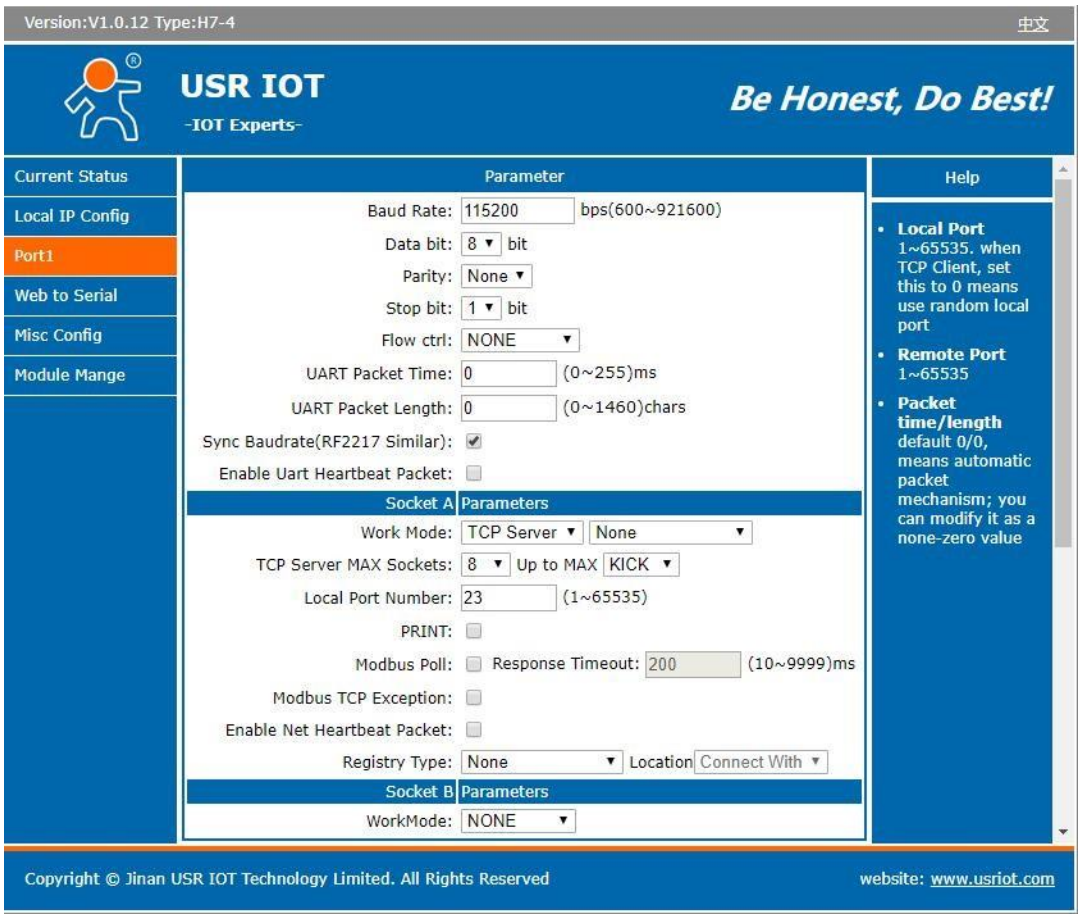


Fig.22 Serial port configuration page

Details on work mode connectivity protocols and its settings of N5X0 series are given in Chapter 4 Operation modes, this section will only focus on the part of parameter description. The description of the configuration parameters on this interface is shown in table 8 and table 9.

Table 8 Serial settings

Parameter Item	Description
Baud rate	This sets the port's data transfer speed. Choices are from 600—921600. Set this to match the baud rate setting of the connected device. Default is 115200.
Data bits	This sets the port's data transfer speed. Choices are from 600—921600. Set this to match the baud rate setting of the connected device. Default is 115200.
Parity bits	This bit checks the integrity of the transmitted data. Choices are: None, Odd, Even. Set this to match the parity setting of the connected device. Default is None (which is the default for the majority of serial devices).
Stop bits	This indicates that a character has been transmitted. Set this to match the stop bit setting of the connected device. Choices are: 1 and 2. Default is 1 (which is the default for the majority of serial devices).
Flow control	This allows you to choose how the data flow will be controlled. Choices are: (No Flow Control), RTS/CTS (Hardware Flow Control), or Xon/Xoff (Software Flow Control). Set this to match the flow control setting of the connected device. Default is None. If Xon/Xoff is selected, the Xon and Xoff characters are 0x11 for Xon and 0x13 for Xoff. Note that these are hexadecimal numbers of ASCII characters
Serial mode (N5X0 models)	Click the drop-down menu to select the type of serial interface for the port. Choices are RS-232, RS-422, RS-485 (2 Wire).
Packing time	Click the option to sent pack immediately by interval.
Packing length	Click the option to sent pack immediately by size.

Table 9 Operating modes settings

Parameter Item	Description
Work mode	USR-N5X0 series supports 5 different operation Modes which are TCP Server, TCP Client, and UDP,HTTP client and websocket. The operation Mode describes the role of the device and the connection between the device and other remote devices in the network which would like to communicate with serial device on N5X0s COM port.
Maximum socket no.(TCP server only)	This option specifies the maximum number of remote devices/clients (with maximum of 16 clients, except N580 with 8) that can be connected to the serial device on this COM port.
Local port	This option specifies the port number that the TCP/UDP server should listen to. It is also used by the remote TCP/UDP client to connect to the TCP/UDP server. The default local port is 23. You can enterdifferent port numbers in this option.
Remoter server addr.	Please specify the IP address of the TCP/UDP server program on the remote host in this field. This should match the IP settings of the TCP/UDP server program.
Remote port	Please specify the port number of the TCP/UDP server program on the remote host in this field. Once again, this should match the IP setting of the TCP/UDP server program.
Timeout reconnection(TCP/UDP client)	The default is disable. If you want to keep connection continually, you can disable it. Data idle Time is the time period for which the device waits for data. If the USR-N5X0 Series does not receive data duringestablished idle time(timeout), the USR-N5X0 Series will disconnect temporarily. When the data comes in, it will reconnect automatically. Users do not need to reconnect.
Modbus polling	This option is selected when multiple modbus maters from Ethernet are polling the same serial port. Each serial port supports up to 16 simultaneous TCP connections allowing hosts to simultaneously transmit/receive data to/from the same serial port,USR-N5X0 Series processes the data in the orderarrived. The serial device server determines the end of the serial acknowledgement through a response timeout.
Modbus exception	This option is used to enable modbus exception checking. If selected, error messages (TCP exception codes) are generated if a problem (such as a message timeout) should occur during Modbus

	operations.
Socket B	Socket B supports 2 different operation Modes which are TCP Client, and UDP client, this socket is closed by default.

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

3.1.4 WebSocket server

This function is that the serial server acts as a WebSocket server, and transparently transmits the data received by the serial to the webpage in hexadecimal or ascii format. The WebSocket server can also send data to the serial device at any time.

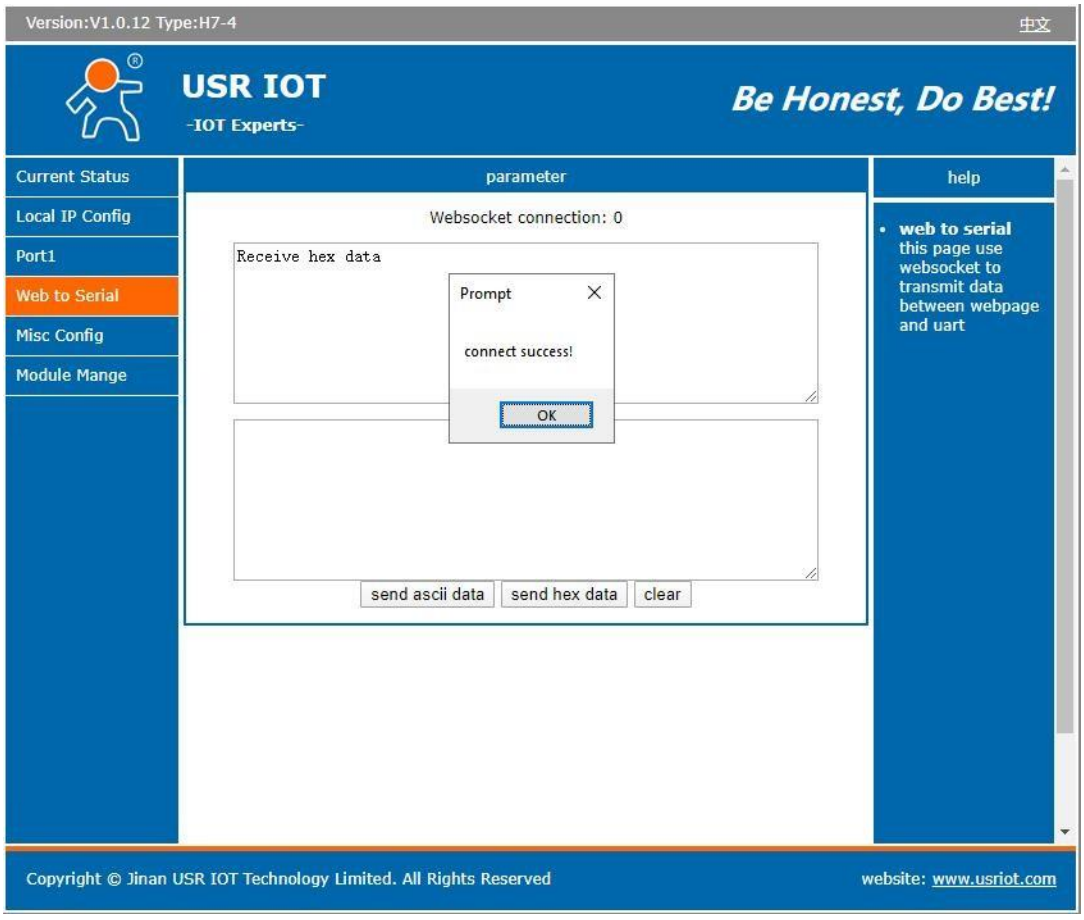


Fig.23 WebSocket Server

3.1.5 Miscellaneous settings

This configuration tab includes several system level settings, such as device name, websocket, system log, username and password. Most of these settings are optional.

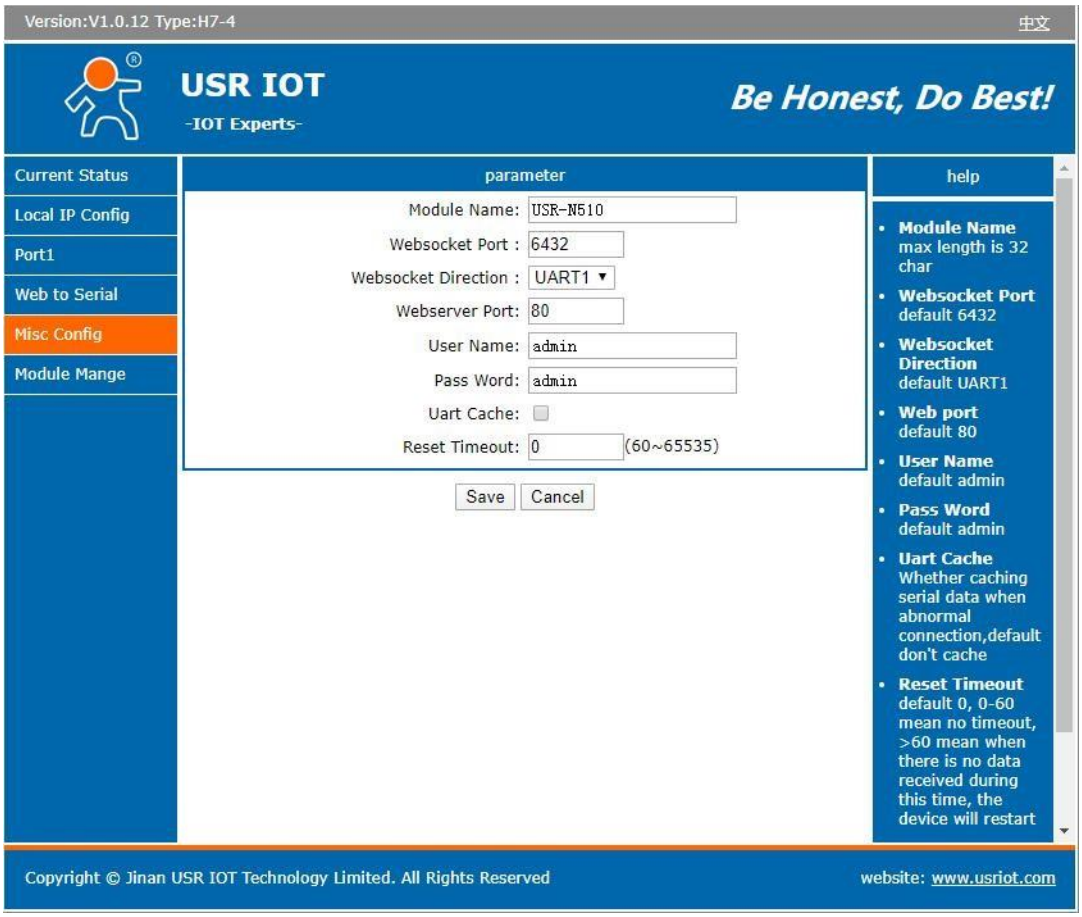


Fig.24 Miscellaneous settings

Table 10 Miscellaneous settings

Parameter Item	Description
Module name	The name of the device, up to 32 characters,can't be null
Websocket port	Websocket server listen port NO. Range 1-65535
Websocket direction	Click the drop-down menu to select websocket mapping direction: UART or Log.
Webserver port	Web server listen port NO. Range 1-65535
User name	The user name of web console and can be modified. up to 16 characters,can't be NULL
Password	The password of web console and can be modified. up to 16 characters,can't be NULL
UART cache	Click the option to enable serial buffer. By default, N5X0 will empty its serial buffer when a new TCP connection is established. This means that the TCP application will not receive buffered serial data during a TCP link breakage. To keep the serial data when there is no TCP connection and send out the buffered serial data immediately after a TCP connection is established, you can disable this option.
Reset timeout	This function is used for the serial device server without any data transmission or reception for a long time, and the serial server automatically restarts. If the restart time is set between 0 and 59 seconds, this function does not take effect. Only when the time is set to be greater than or equal to 60 seconds, the restart function of the device without data will take effect.

3.1.6 Management

This page can perform some system operations on the N5X0 series serial server, including restarting, restoring factory configuration, and upgrading. It is recommended that users use it with caution. Improper operation may damage the serial server.

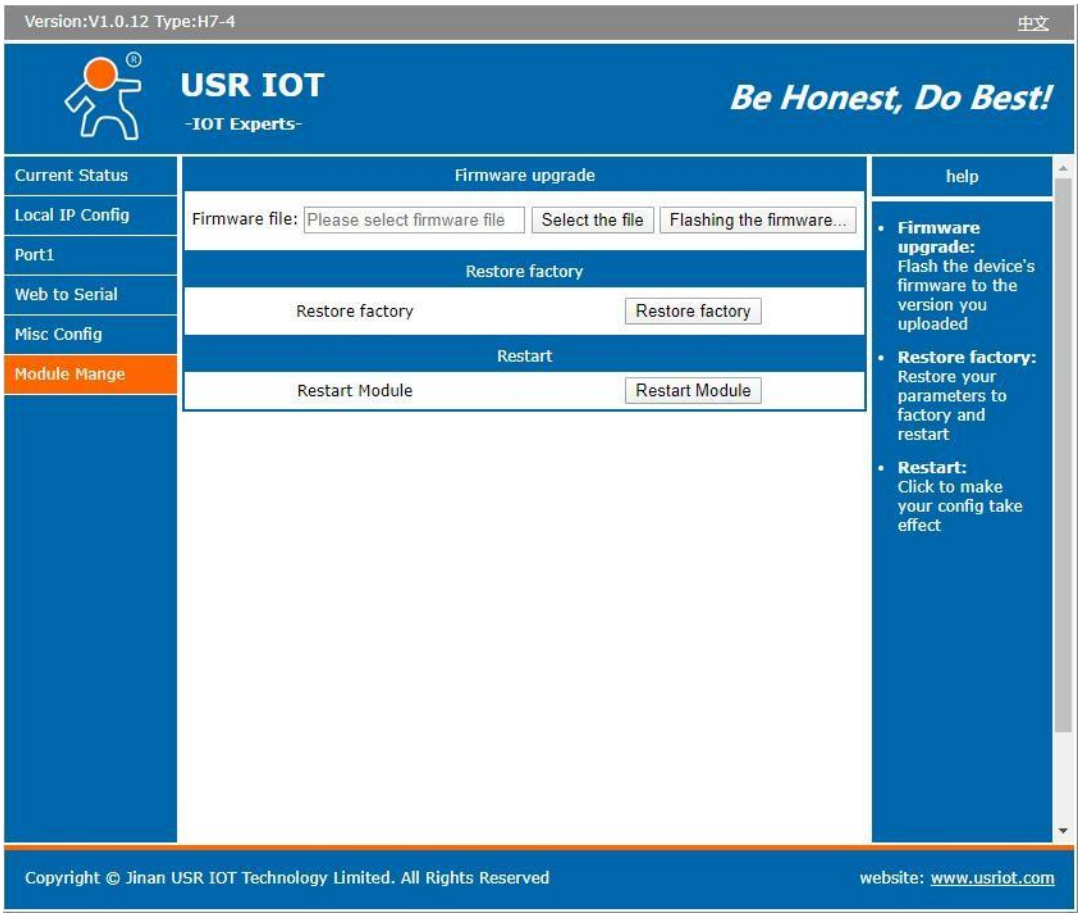


Fig.25 Module Management

Reboot

This function is used to restart the USR-N5X0 series serial server by software. Before the serial server is completely restarted, the device does not work and cannot forward any data packets. This restart is different from the hardware reset of power-on restart, but the serial server system software is reset, just like the "warm restart" of the windows operating system. Once a new setting is changed, you can use the Save function to accept the changes. You will need to reset the device to

save the settings to flash memory. Click on "restart module" Button, the page pops up a prompt box, click "yes".

Restore factory defaults

This function is used to restore the USR N5X0 serial server to the factory settings and automatically restart the serial server at the same time. Before the serial server restarts successfully, the serial server does not work and cannot forward any data packets. This function is to restore the factory default configuration value once the user sets the wrong parameter and causes the serial port server to work abnormally. Click the "Restore factory" button, and a prompt box will pop up on the page. Click "yes".

Firmware upgrade

USR IoT continually upgrades its firmware to add new features and optimize performance. Please contact the sales to obtain the latest version of the firmware. Before upgrading the firmware, please make sure that the device has a reliable power source that will not be powered off or restarted during the firmware upgrading process (please be patient as this whole process might take up to 1 -2 minutes). Copy the new firmware file to your local computer. Note that the firmware file is a binary file with ".bin" extension. Before updating the firmware, make sure that your host's Network domain is as same as the serial device server. Next, click "Select the file" button as shown in Figure to find and choose the new firmware file. Then, click "Flashing the firmware" button to start the firmware upgrade process. The program will show the upload status. Please wait until the uploading process is finished (the amount of time varies depending on the equipment used). Finally, the device will then proceed to restart itself. In most cases, you might require to re-configure your device. Please refer to "USR-N5X0 firmware upgrade from V1 to V2 version user guide" for detail if you want to use V2 firmware function.

3.2 Web interface (V2 version)

Every USR-N5X0 Industrial Serial Device Server is equipped with a built-in web server in the firmware. Therefore, the device can be accessed by using a web browser for configuring by entering the device's IP address in the URL field of your web browser. An authentication will be required and you will have to enter the username (Default value is "admin") and password (Default value is "admin") for accessing the web interface as shown in Fig. 26. This approach (web interface) for configuring your device is the most user-friendly. It is the most recommended and the most common method used for USR-N5X0 Serial Device Server Series. Please go to its corresponding section for a detailed explanation.

Fig.26 Authentication Required for accessing web Interface.

3.2.1 Status

After entering the correct user name and password and the authentication is successful, you will enter the main page of the Web, as shown in Fig.27.

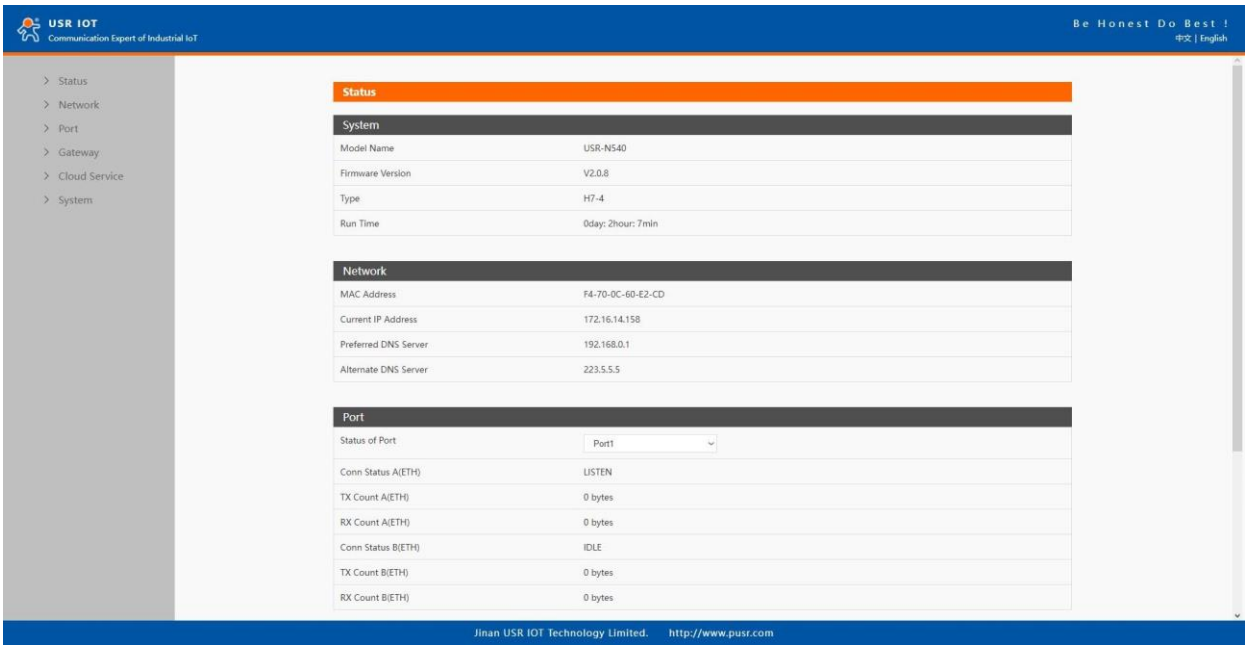


Fig.27 Overview Web page of USR-N5X0 (V2 Version)

The function of the device status part is to display some specific information of the current device, including system, network, serial port, mqtt gateway and Edge computing status.

Table 11 Overview status list

Parameter Item	Description
Model name	The name of the serial server, which can be customized by the user on the "Miscellaneous settings" page.

Firmware version	The current software version of the serial server.
Type	The current hardware version of the serial server.
Running time	Total time after the device start work. It will starts from 0 after reboot.
MAC address	The MAC address of the serial server.
IP address	The IP address of the serial server.
Port Status	The working status of checked serial port. Select the serial port currently to be displayed Conn Status A(ETH): connection status of socket A. IDLE：Initialization status LISTEN：When the module works as TCP Server, it is listening for connection access CONNECTING：Works as TCP client, the module is establishing a connection to the TCP Server CONNECTED：Works as TCP server, the TCP connection to TCP server of the module has been established CONNECTED（n）：Number of TCP clients connected to the module ERROR：The module is abnormally disconnected Tx Count A(ETH): To count how many bytes be send to internet. Rx Count A(ETH): To count how many bytes received from internet
MQTT	Whether MQTT is enable.
Connection status	Connection status of MQTT. CONNECTING：the module is establishing a MQTT connection to the MQTT broker CONNECTED：the MQTT connection to MQTT broker has been established ERROR：The module is abnormally disconnected.
Edge computing	Whether edge computing is enable.
Connection status	Connection status of Edge computing. CONNECTING：the module is establishing a socket or mqtt connection

	CONNECTED：the socket or mqtt connection has been established ERROR：The module is abnormally disconnected

3.2.2 IP settings

You must assign a valid IP address to the USR-N5X0 before it will work in your network environment. The IP address must be unique within the network. If the device is connected to the Internet and should connect to other servers over the Internet to get some services such as Network Time Protocol (NTP) server, you will need to configure the DNS server in order to be able to resolve the host name of the NTP server. The detailed description of the configuration parameters on this interface is shown in table 12.

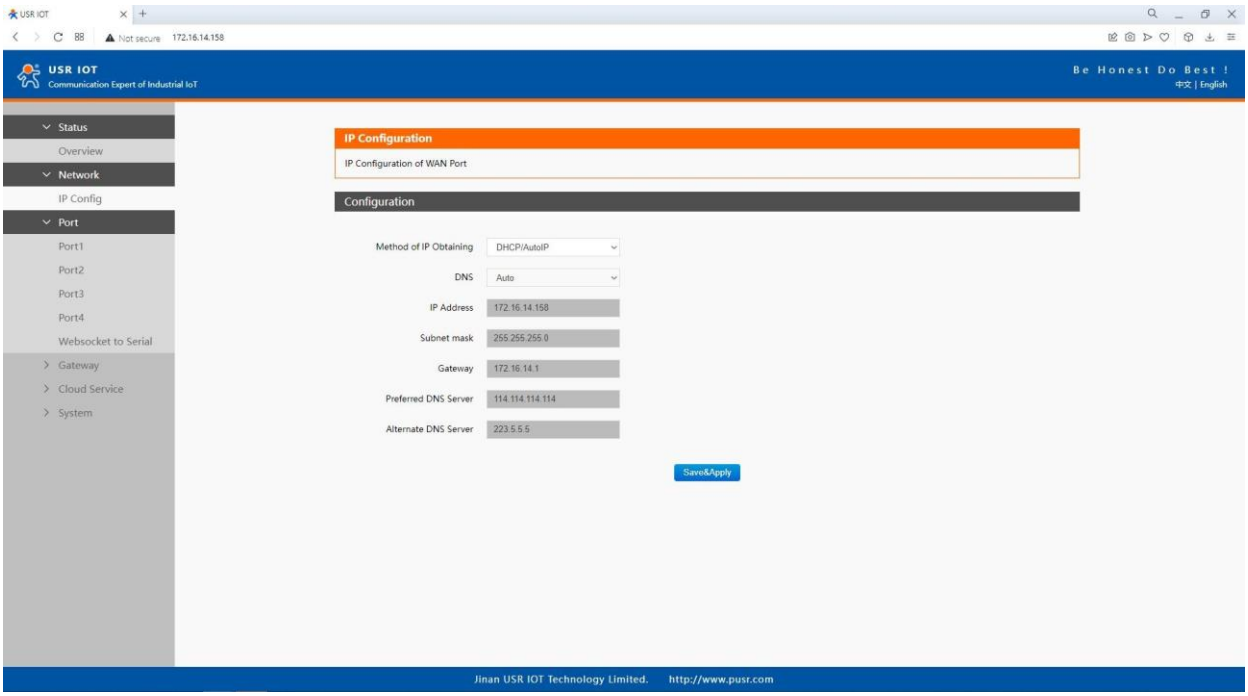


Fig.28 Network web page

Table 12 Network configuration list

Parameter Item	Description
Network protocol	Click the drop-down menu to select the IP Address Setting mode: Static or DHCP. If you choose DHCP, the rest of the options will be greyed out or disabled.
DNS type	Click the drop-down menu to select the DNS mode: auto or manual. If you choose auto, the DNS options will be greyed out or disabled.
IP address	IP address is a 32-bit address assigned to devices connected to the Internet. The IP address consists of two fields: the network number field (Net-id) and host number field (host-id). In order to facilitate the management of IP addresses,IP addresses are divided into five categories: Class A, B, and C addresses are unicast addresses, Class D addresses are multicast addresses, Class E addresses are reserved addresses for future special purposes. The IP addresses currently in large numbers belong to three types of addresses: A,B,C.
Subnet mask	The mask is a 32-bit number corresponding to an IP address. Some of these numbers are 1, and the others are 0. The mask can divide the IP address into two parts: the subnet address and the host address. The part of the IP address corresponding to the 1 bit in the mask is the subnet address, and the other bits are the host address. The mask for class A addresses is 255.0.0.0, the mask for class B addresses is 255.255.0.0, the mask for class C addresses is 255.255.255.0.
Gateway	The default gateway in the host is usually called the default route. The default route (Default route) is the route chosen by the router when no other route exists for the destination address in the IP packet. All packets whose destination is not in the router's routing table will use the default route.

DNS	The IP address of the DNS server. DNS Server part is where you can specify the IP Address of your Preferred DNS (Domain Name Server) and Alternate DNS. When the device uses a static IP address, the user is required to fill in this item, 8.8.8.8(Google) will be a good choice. If a specific DNS server is not used, the default gateway IP address is generally sufficient.

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

3.2.3 Serial port settings

The serial port module includes serial port parameter configuration, network parameter configuration. The main function of the serial device server is to carry out two-way transparent transmission of standard serial bus data (RS-232, RS-485, RS-422) and standard Ethernet data supporting TCP/IP protocol to solve common serial equipment Networking problems on the Internet. The Port configuration page can configure the parameters of the serial port and socket, as shown in Fig.29. Details on work mode connectivity protocols and its settings of N5X0 series are given in Chapter 4 Operation modes, this section will only focus on the part of parameter description. The description of the configuration parameters on this interface is shown in table 13 and table 14. **Fig.29 Serial port configuration web page**

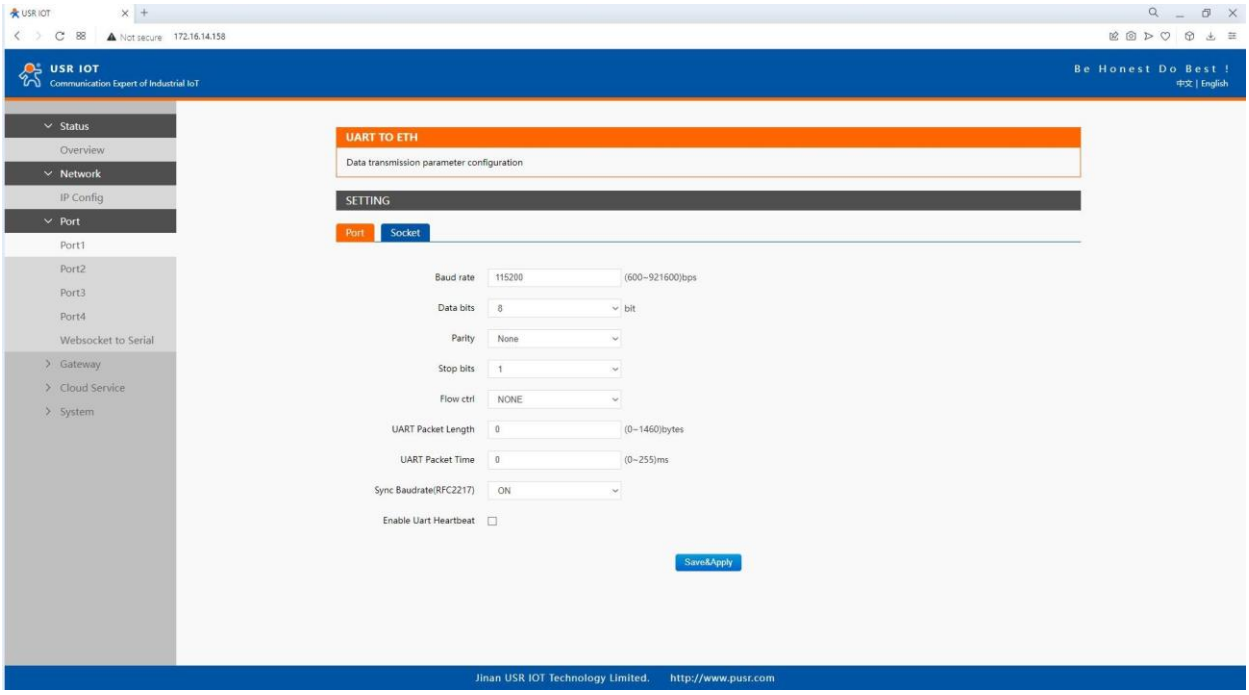


Table 13 Serial settings list

Parameter Item	Description
Baud rate	This sets the port's data transfer speed. Choices are from 600—921600. Set this to match the baud rate setting of the connected device. Default is 115200.
Data bits	This sets the number of bits used to transmit one character of data. Choices are: 7 and 8. Set this to match the data bit setting of the connected device. Default is 8 (which is the default for the majority of serial devices).
Parity bits	This bit checks the integrity of the transmitted data. Choices are: None, Odd, Even, Space, Mark. Set this to match the parity setting of the connected device. Default is None (which is the default for the majority of serial devices).
Stop bits	This indicates that a character has been transmitted. Set this to match the stop bit setting of the connected device. Choices are: 1 and 2. Default is 1 (which is the default for the majority of serial devices).
Flow control	This allows you to choose how the data flow will be controlled. Choices are: (No Flow Control), RTS/CTS (Hardware Flow Control), or Xon/Xoff (Software Flow Control). Set this to match the flow control setting of the connected device. Default is None. If Xon/Xoff is selected, the Xon and Xoff characters are 0x11 for Xon and 0x13 for Xoff. Note that these are hexadecimal numbers of ASCII characters (i.e., 0x11 = '1' and 0x13 = '3')
Serial mode (N5X0 models)	Click the drop-down menu to select the type of serial interface for the port. Choices are RS-232, RS-422, RS-485 (2 Wire).
Packing time	Click the option to sent pack immediately by interval
Packing length	Click the option to sent pack immediately by size.

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

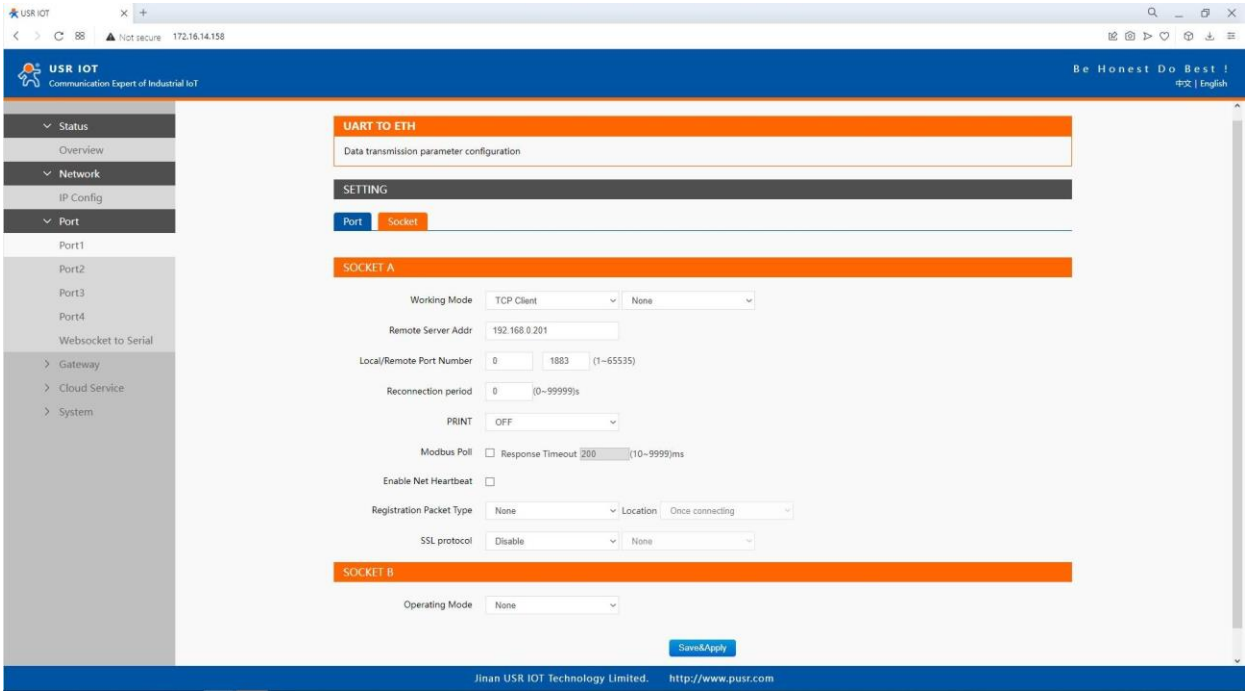


Fig.30 Socket configuration web page

Table 14 Operation modes settings list

Parameter Item	Description
Work mode	USR-N5X0 series supports 5 different operation Modes which are TCP Server, TCP Client, and UDP, HTTP client and websocket. The operation Mode describes the role of the device and the connection between the device and other remote devices in the network which would like to communicate with serial device on N5X0's COM port.
Maximum socket no. (TCP Server only)	This option specifies the maximum number of remote devices/clients (with maximum of 16 clients,except N580 with 8) that can be connected to the serial device on this COM port.
Local port	This option specifies the port number that the TCP/UDP server should listen to. It is also used by the remote TCP/UDP client to connect to the TCP/UDP server. The default

	local port is 23. You can enter different port numbers in this option.
Remoter server addr.	Please specify the IP address of the TCP/UDP server program on the remote host in this field. This should match the IP settings of the TCP/UDP server program.
Remote port	Please specify the IP address of the TCP/UDP server program on the remote host in this field. This should match the IP settings of the TCP/UDP server program
Timeout reconnection (TCP/UDP client)	The default is disable. If you want to keep connection continually, you can disable it. Data idle Time is the time period for which the device waits for data. If the USR-N5X0 Series does not receive data during established idle time(timeout), the USR-N5X0 Series will disconnect temporarily. When the data comes in, it will reconnect automatically. Users do need to reconnect.
Modbus polling	This option is selected when multiple modbus maters from Ethernet are polling the same serial port. Each serial port supports up to 16 simultaneous TCP connections allowing hosts to simultaneously transmit/receive data to/from the same serial port,USR-N5X0 Series processes the data in the order arrived. The serial device server determines the end of the serial acknowledgement through a response timeout.
Response timeout	If the Modbus device does not receive a response within the time specified here, the communication times out. Valid settings are from 10 – 9999ms.
Modbus exception	This option is used to enable modbus exception checking. If selected, error messages (TCP exception codes) are generated if a problem (such as a message timeout) should occur during Modbus operations.
SSL protocol	Choose TLS/SSL data encryption protocol version
Socket B	Socket B supports 2 different operation Modes which are TCP Client, and UDP client, this socket is closed by default

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

3.2.4 Websocket server

This function is that the serial server acts as a WebSocket server, and transparently transmits the data received by the serial to the webpage in hexadecimal or ascii format. The WebSocket server can also send data to the serial device at any time.

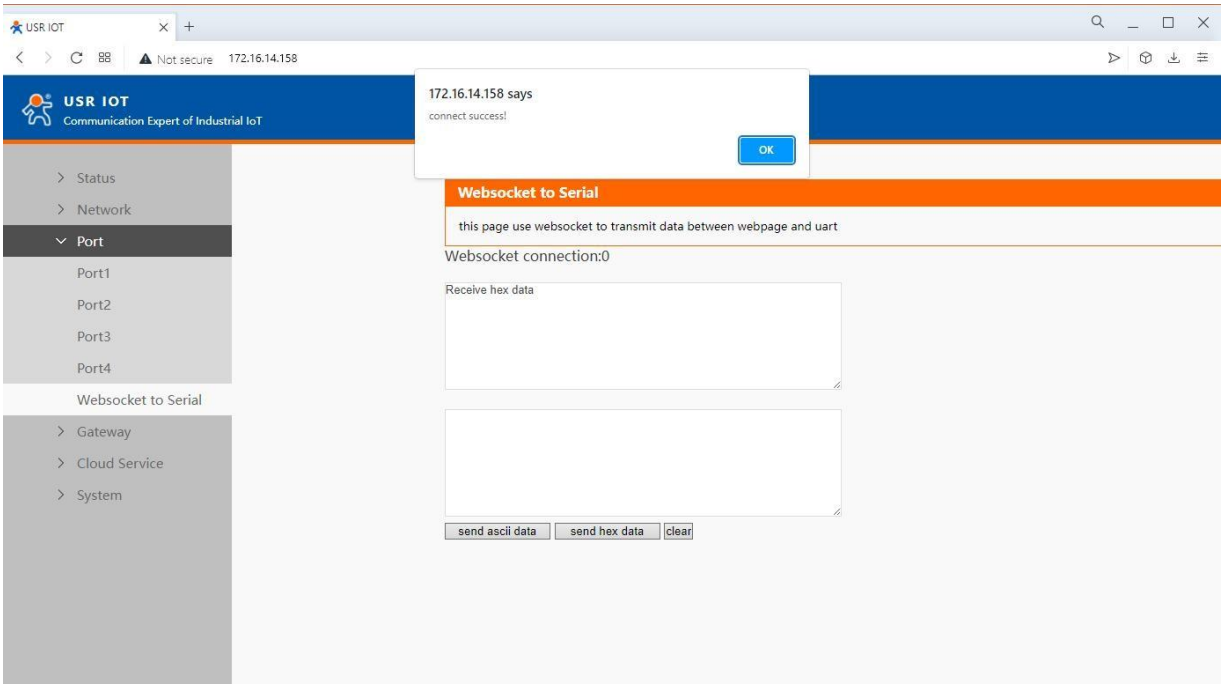


Fig.31 Websocket server

3.2.5 MQTT gateway

If you enable MQTT Broker as your northbound connection, the N5X0 will be configured as MQTT Client. In Client mode, you can setup MQTT broker basic settings, general topic settings, TLS secure transmission, last will message, and advanced settings.

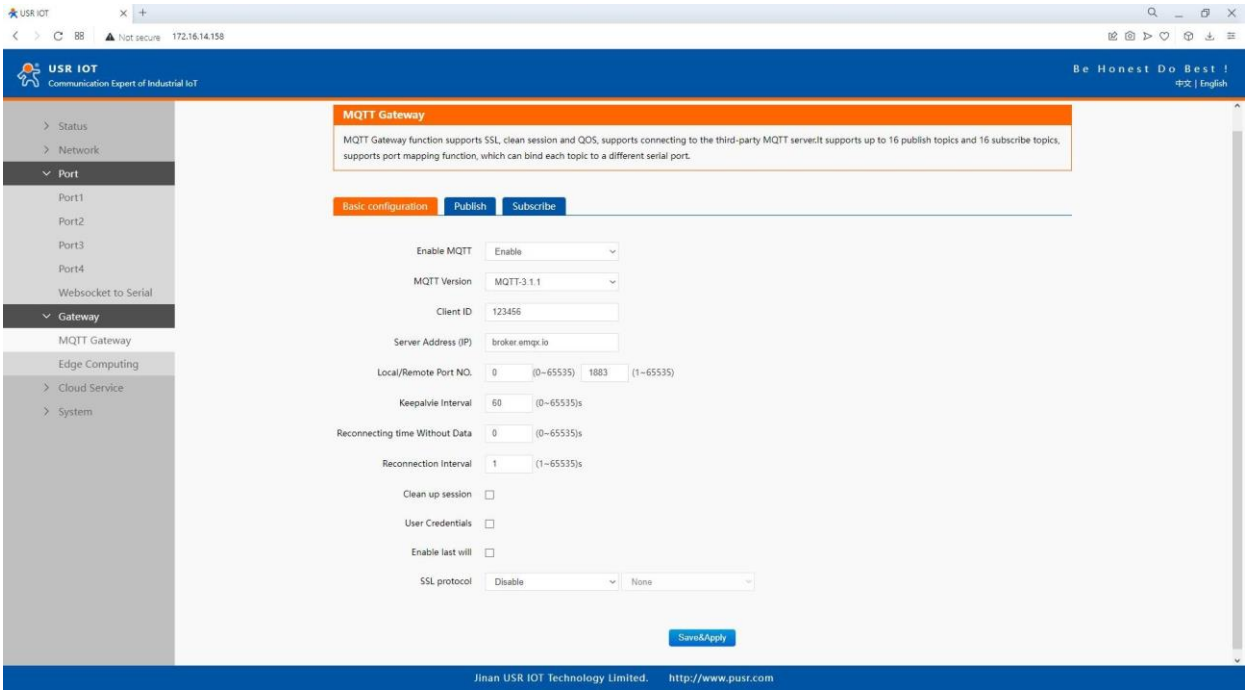


Fig. 32 MQTT connection profiles

Table 15 MQTT basic setting

Parameter Item	Description
Enable	**Turns MQTT gateway on or off.**
Version	**Select the mqtt protocol version V3.1 and V3.1.1 are supported.**
Client ID	The client ID defined the identifier of the N5X0 Gateway. The IDs of the various MQTT clients have to be unique for the respective MQTT Broker. If two MQTT clients are using an identical ID, the connections of theses clients to the MQTT Broker are disconnected. For an individual client, there is no way to find out whether a specific client ID is already used by another client or not.
Server address	IP address or hostname of an MQTT broker.
Remote port	**Port number of the MQTT broker.**
Keep alive interval	The Keep Alive is a time interval measured in seconds. It is the maximum time interval that the broker permits between when a client

	finish sending one MQTT packet and starts to send the next.
Re-connection time	Automatic reconnection when there are not data flow in the MQTT session in the setting time. If the time is set 0, this function does not take effect.
Interval	Automatic reconnection interval after a fail network connection.
Clean session	Valid only for Qos1 and Qos2. When the clean session is checked, the client does not want a persistent session. If the client disconnects for any reason, all information and messages that are queued from a previous persistent session are lost. When the clean session is unchecked, the broker creates a persistent session for the client. All information and messages are preserved until the next time that the client requests a clean session.
Username	Username for authentication to the MQTT broker.
Password	Password for authentication to the MQTT broker.
Last will	The last will message is part of the Last Will and Testament (LWT) feature of MQTT. The will message notifies other clients when a client disconnects ungracefully.
SSL/TLS	If you use a TLS connection, click the SSL/TLS tab, select Enable SSL/TLS, and then set the Protocol parameter to TLSv1.2.

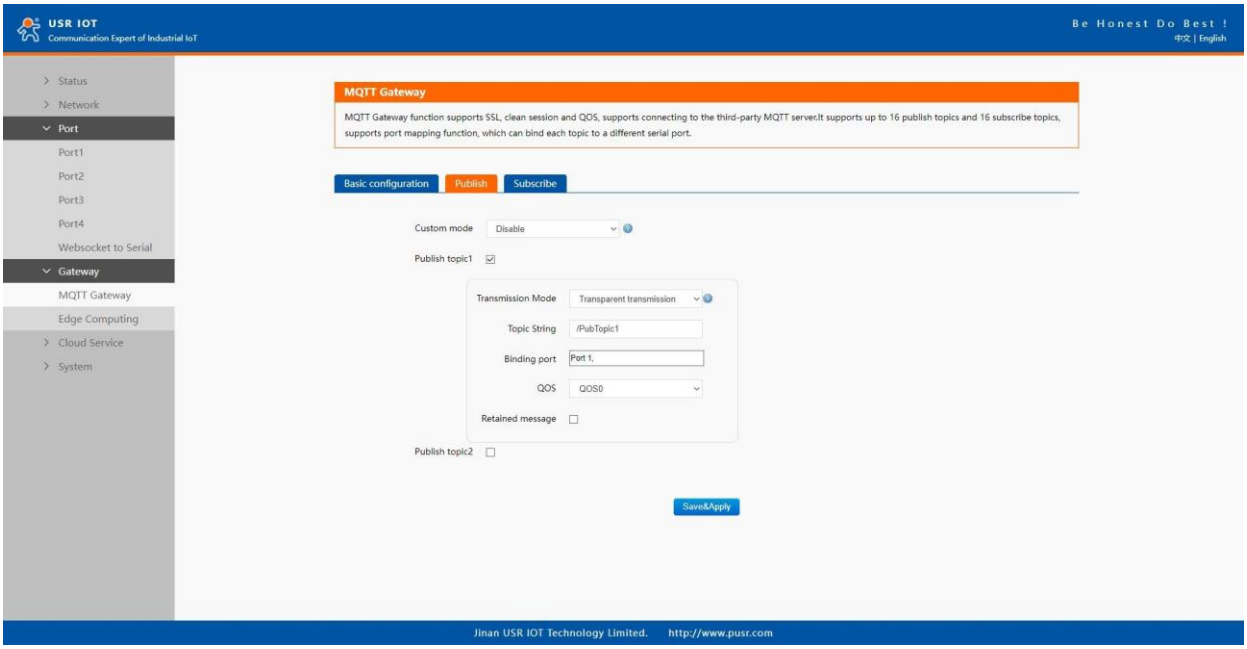


Fig.33 Topic to publish

Table 16 Publish message setting

Parameter Item	Description
Transmission mode	Transparent transmission, just as its name implies,the gateway does not process any data, forward the data directly. Topic distribution,in this mode users should define a topic name when configuring the topic. After receiving serial port data, the device pushes it to the associated topics based on the topic name. Topic name and payload are separated by comma. For example, topic name, {"message": "Hello from USR-N510 gateway"} as serial data. Different topics are allowed to have the same topic name. In this way, data is pushed to all topics with the same topic name. Custom mode, add topic, Qos(0,1,2), retain(ON,OFF) message before payload. After receiving the serial data, N510 publishes the payload of the corresponding topic to cloud according to rules. This method can be used to publish any topic at any time.

	For example, awsiot/test,0,ON,{"message": "Hello from USR-N510 gateway"} as serial data.
TOPIC string	An MQTT topic is a UTF-8 string that the broker uses to filter messages for each connected client. To receive messages, the client must subscribe to the topic. A topic can have one or more topic levels. Each topic level is separated by a slash
Binding port	The MQTT topic is bound to the serial port number of the device. Any data from the COM Port1 of the gateway will send to all the TOPIC it bindings to.
Qos	QoS 0: at most once. In this case, the client publishes a message to the broker only once. QoS 1: at least once. In this case, when a client publishes a message to the broker, the client expects the broker to acknowledge whether or not a client has received the message. If the publisher does not receive acknowledgement from the broker within a preset time interval, it will republish the message again and again until acknowledgment is received. QoS 2: exactly once. The MQTT protocol uses the confirmation of confirmations to ensure that a message is delivered exactly once.
Retained message	By setting the Retain flag the MQTT Broker is instructed to save the most recent data value for the topic. Data values without Retain flag are only transferred from the MQTT Broker to those MQTT Subscribers that are registered at the broker and have subscribed to the appropriate topic in the moment when sending the data to the broker.

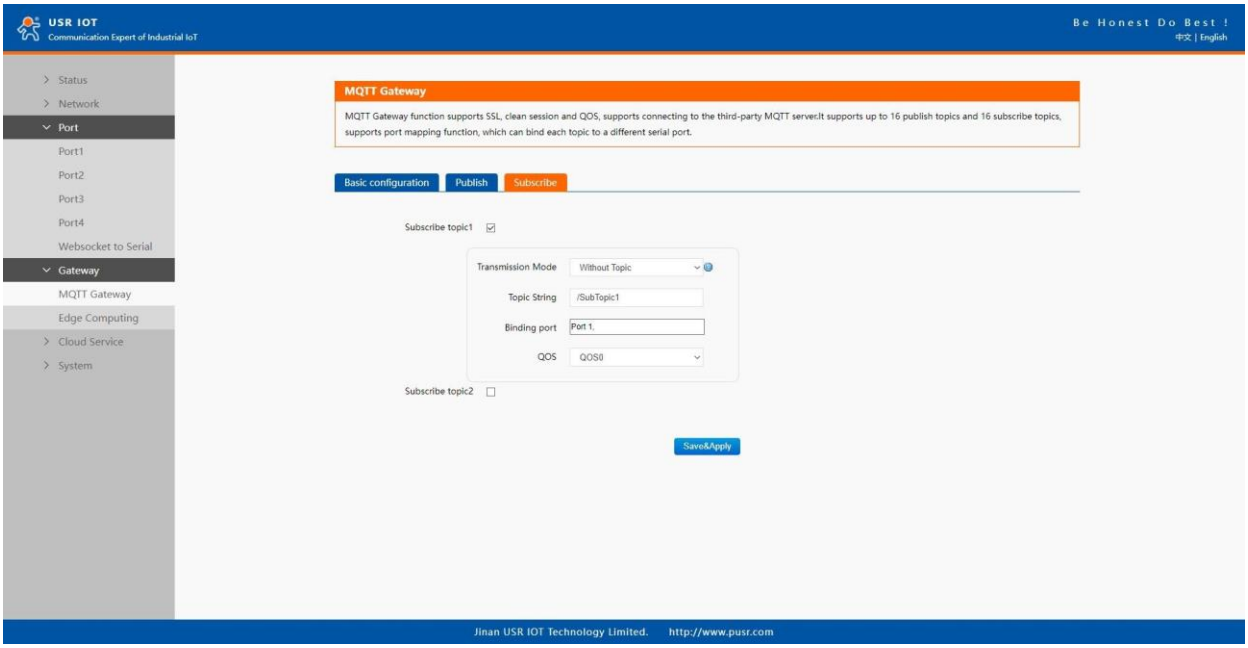


Fig.34 Topic to subscribe

Table 17 Subscribe message setting

Parameter Item	Description
Transmission modes	The data printed to the serial port can be set whether to carry the topic.
Topic string	Same to Table 16.
Binding port	Same to Table 16.
Qos	Same to Table 16.

3.2.6 Edge computing

The N5X0 supports southbound fieldbus protocols of Modbus RTU protocols. It also supports northbound MQTT/ Cloud protocols of MQTT Broker, TCP/UDP/HTTP in socket, AWS IOT, and Alibaba Cloud IoT Platform. The N5X0 fulfills a different role on each of its sides. Each role is determined by your devices' settings. Therefore, set the role of each of your devices correctly.

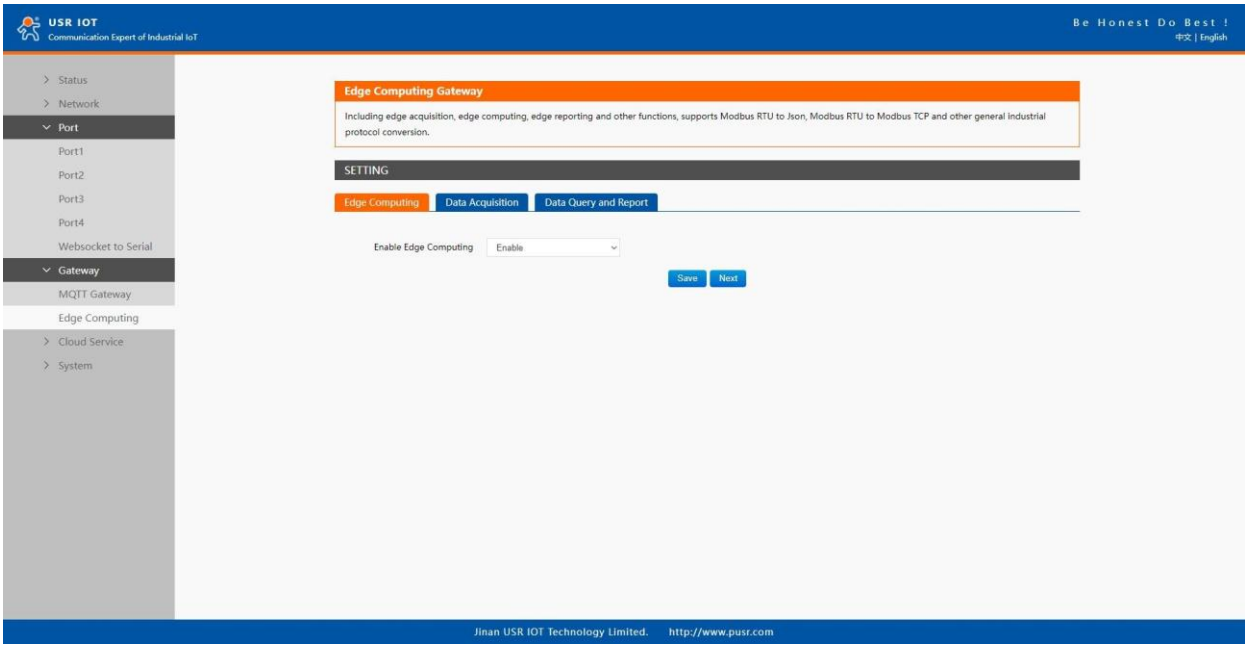


Fig.35 Edge computing enabled

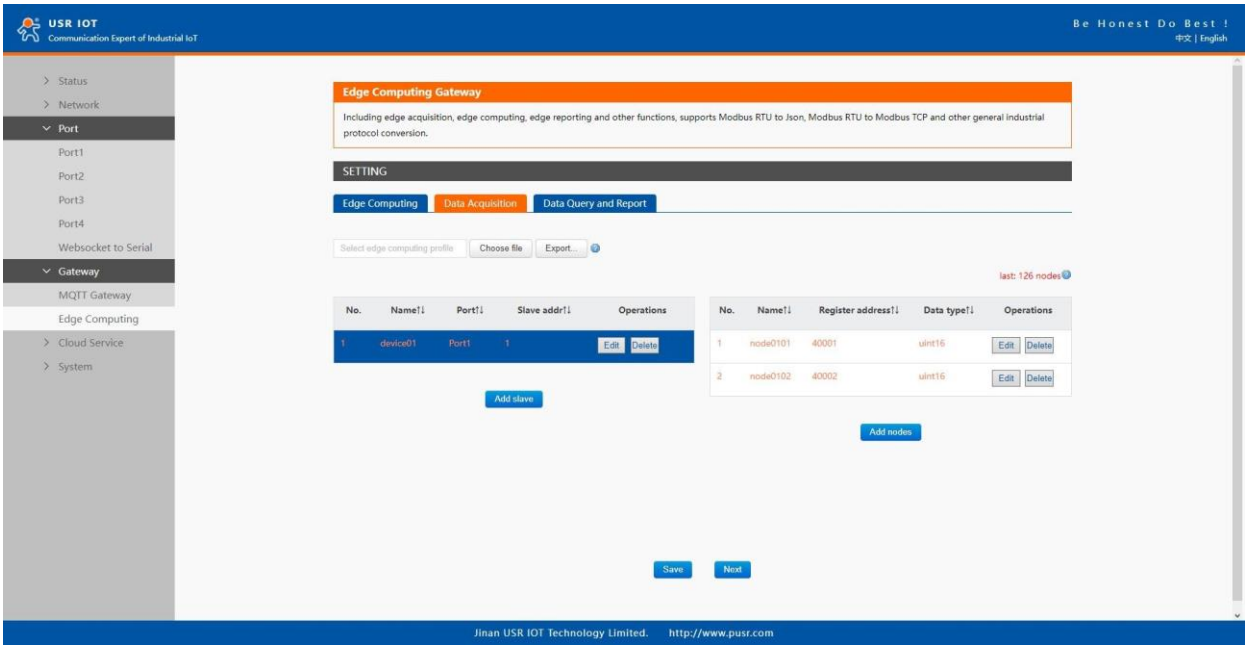


Fig.36 Modbus slaves and datapoints configuration

Table 18 Modbus RTU poll configuration

Parameter Item	Description
Device name	The Modbus slave device identifier, which is unique for the current gateway. The device name must be less than 30 characters in length, and can contain letters, digits, underscores (_).
COM port	Which serial port the modbus slave device connected to. Select an option from the drop-down list.
Slave address	Slave ID. Each slave in a network is assigned a unique identifier ranging from 1 to 255. When the master requests data from a slave, the first byte it sends is the Slave ID. When set to 0, the slave will respond to requests addressed to any ID.
Polling interval	The interval at which data is collected. Modbus is a communications protocol with half-duplex transmission. Gateways send requests to collect data from devices. Therefore, you must specify the data collection interval. The unit is millisecond. If 60 milliseconds is required to collect the data of each property, the total time required to collect the data of all properties is calculated as follows: Total required time = Time required to collect the data of each property (60 ms) × Number of properties for the slave device.
Modbus address mapping	This function is usually combined with register mapping to realize a single modbus command query in data query.
Merger collection	This function is used when the register address of many data points are sequential.

Table 19 Data point(node) configuration

Parameter Item	Description
Data point name	Identifier of the data point, which must be unique for the gateway. The name must be 1 to 30 characters in length and can contain letters, digits, and underscores (_).
Modbus function code	The Modbus RTU master supports the following Modbus functions: 1 Read Coils, 2 Read Discrete Inputs,3 Read Multiple Holding Registers, 4 read input registers.
Register address	The address of the register from which data will be read.
Data type	Defines how read data will be stored. See table 26.
Response timeout	If the Modbus device does not receive a response within the time specified here, the communication times out. Valid settings are from 10 – 65535ms.
Data report	The trigger of reporting data. Valid values: On Change: The report is triggered if the collected data changes. You can use a tolerance to only log the data point if the value changes more than X amount. Interval: Collect the variable data at the poll interval and report the data at the specified report interval. Timer: Collect the variable data at the poll interval and report the data at the regular time.
Register address mapping	This function is usually combined with modbus address mapping to realize a single modbus command query in data query.
Formula	Modbus register store only whole numbers. For this reason a scale factor often needs to be applied. For example a modbus register with a temperature value may read as 723 and a multiplier of 0.1 need to be applied to get the correct value of 72.3 in the SCADA system,the formula is %s*0.1. If the data type is a Float then the multiplier is not needed. This computation supports +, -, * and / operators.

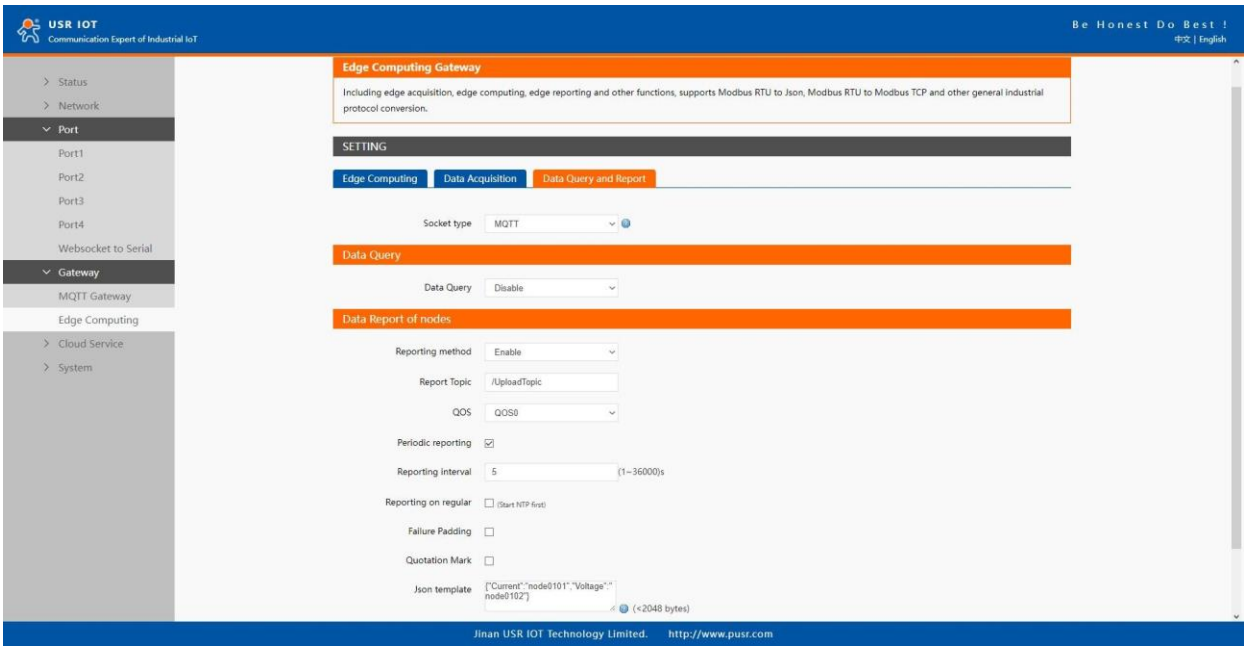


Fig.37 Transport channel and formatting

Table 20 Data Quert and report

Parameter Item	Description
Communication channel	Select the channel in the socket type. You can choose TCP/UDP or HTTP in socket A of each serial port, or MQTT you have added.
Data Query	Query type. You can choose Modbus RTU, Modbus TCP or JSON. Users can send the right format query command from remote modbus master or MQTT publisher to the N5X0 gateway. The data is retrieved from the device's cache of corresponding modbus instructions.
Data report	The trigger of reporting data. Valid values: On Change: The report is triggered if the collected data changes. You can use a tolerance to only log the data point if the value changes more than X amount. Interval: Collect the variable data at the poll interval and report the data at the specified report interval. Timer: Collect the variable

	data at the poll interval and report the data at the regular time.
Failure padding	Exception handling. Any data point did not get the response in response timeout will be filled with this string as key value into the template.
Quotation mark	Numeric values are quoted. It does not affect a string.
Json template	The payload format. Users can custom which data points should report to the server.

3.2.7 Cloud service

Please refer to "USR-N5X0 Quick Start Guide with AWS IoT" for detail.

Please refer to "USR-N5X0 Quick Start Guide with PUSR cloud" for detail.

3.2.8 System setup

This system setting tab includes several system level settings, such as device name, web socket, system log, username and password. Most of these settings are optional.

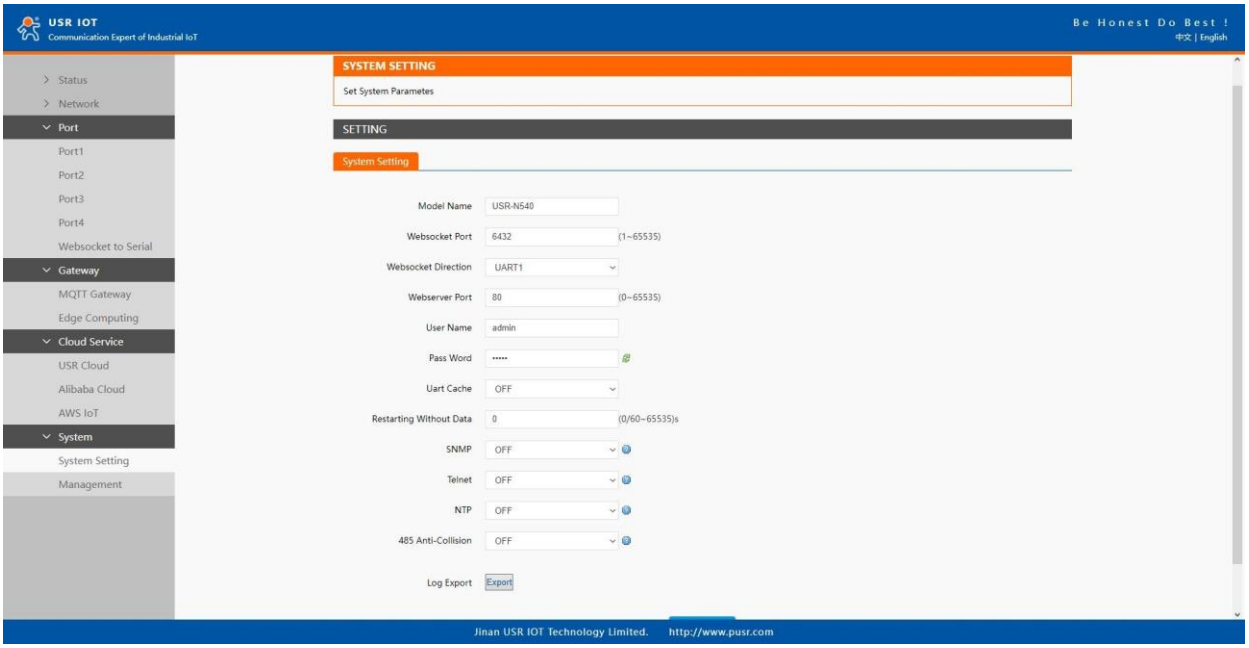


Fig.38 System settings

Table 21 System settings list

Parameter Item	Description
Module name	The name of the device, up to 32 characters, can't be null
Websocket port	Websocket server listen port NO. Range 1-6553
Websocket direction	direction Click the drop-down menu to select websocket mapping direction: UART or Log.
Webserver port	Web server listen port NO. Range 1-65535
Username	The user name of web console and can be modified. up to 16 characters, can't be NUL
Password	The password of web console and can be modified. up to 16 characters,can't be NUL
UART cache	Click the option to enable serial buffer. By default, N5X0 will empty its serial buffer when a new TCP connection is established. This means that the TCP application will not receive buffered serial data during a TCP link breakage. To keep the serial data when there is no TCP connection and send out the buffered serial data immediately after a TCP connection is established, you can disable this option.
Restarting without data	This function is used for the serial device server without any data transmission or reception for a long time, and the serial server automatically restarts. If the restart time is set between 0 and 59 seconds, this function does not take effect. Only when the time is set to be greater than or equal to 60 seconds, the restart function of the device without data will take effect.

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot. In management page users can perform some system operations on the N5X0 series serial server, including restarting, restoring factory configuration, and upgrading. It is recommended that users use it with caution. Improper operation may damage the serial server.

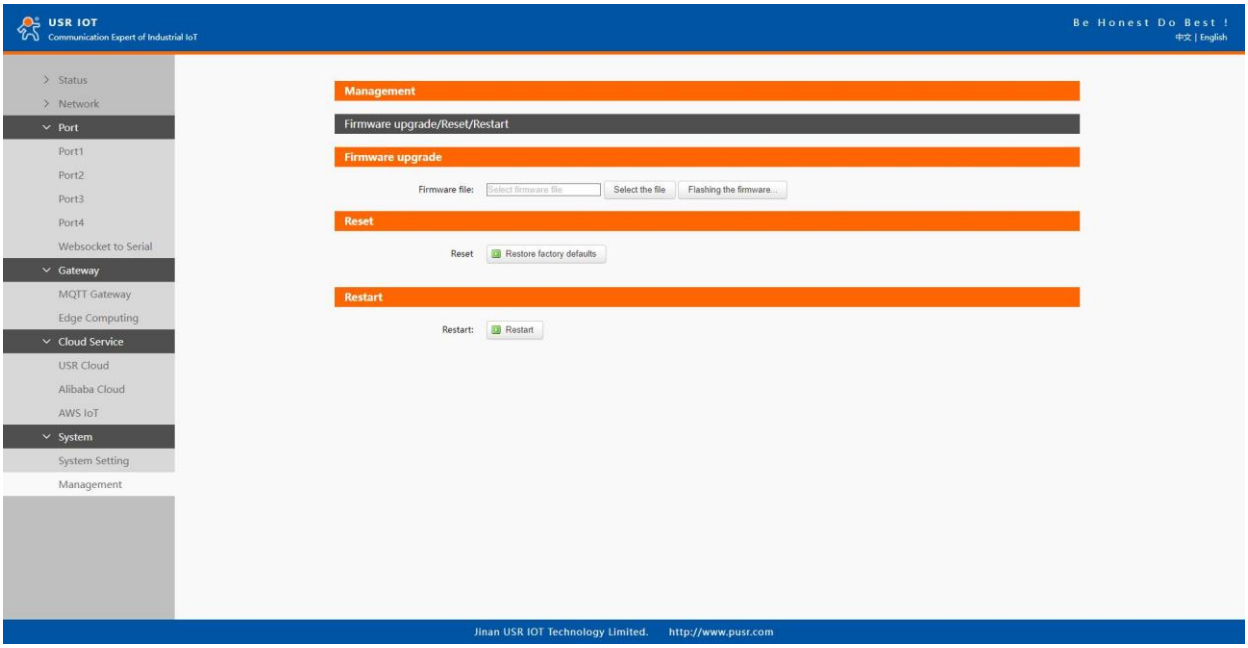


Fig.39 Module Management

Restart

This function is used to restart the USR-N5X0 series serial server by software. Before the serial server is completely restarted, the device does not work and cannot forward any data packets. This restart is different from the hardware reset of power-on restart, but the serial server system software is reset, just like the "warm restart" of the windows operating system. Once a new setting is changed, you can use the Save function to accept the changes. You will need to reset the device to save the settings to flash memory. Click on "restart" Button, the page pops up a prompt box, click "OK".

Restore factory defaults

This function is used to restore the USR N5X0 serial server to the factory settings and automatically restart the serial server at the same time. Before the serial server restarts successfully, the serial server does not work and cannot forward any data packets. This function is to restore the factory default configuration value once the user sets the wrong parameter and causes the serial port server to work abnormally. Click the "Restore factory defaults" button, and a prompt box will pop up on the page. Click "OK".

Firmware upgrade

USR IoT continually upgrades its firmware to add new features and optimize performance. Please contact the sales to obtain the latest version of the firmware. Before upgrading the firmware, please make sure that the device has a reliable power source that will not be powered off or restarted during the firmware upgrading process (please be patient as this whole process might take up to 1

-2 minutes). Copy the new firmware file to your local computer. Note that the firmware file is a binary file with ".bin" extension. Before updating the firmware, make sure that your host's Network domain is as same as the serial device server. Next, click "Select the file" button as shown in Figure to find and choose the new firmware file. Then, click "Flashing the firmware" button to start the firmware upgrade process. After the progress bar in the page is read, the serial server software upgrade is completed. Please wait until the uploading process is finished (the amount of time varies depending on the equipment used). Finally, the device will then proceed to restart itself. In most cases, you might require to re-configure your device.

3.3 Configuration software

3.3.1 Discovering your device server

After you start EthernetTool software, if the USR-N5X0 Serial Device Server is already connected to the same gateway as your PC, the device can be accessed via broadcast packets. Users can search all the USR-N5X0 Series device servers on the network and show them on the Serial Device Server List Area of the utility. Please select the right Ethernet adapter if you did not see any serial device server.

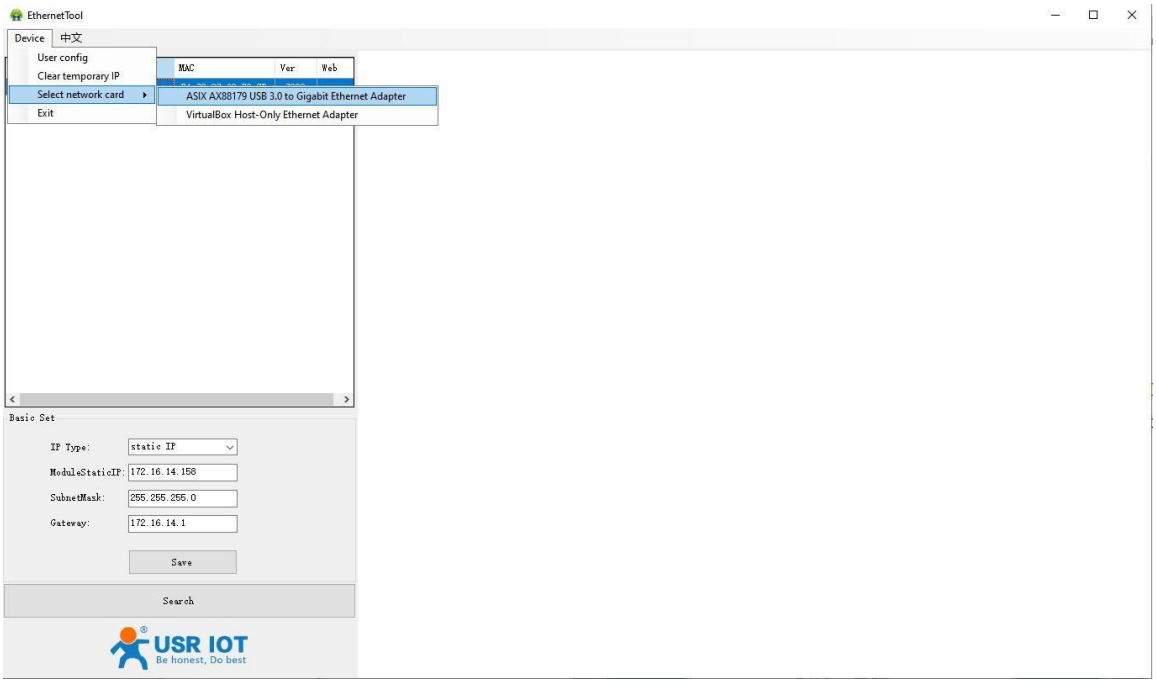


Fig.40 Searching serial device server

3.3.2 Network setting

Sometime the USR-N5X0 device might not be in the same subnet as your PC, therefore, you will have to use this utility to locate it in your environment. To configure each device, first click to select the desired device (default IP:192.168.0.7) in the list of configuration utility, and then change the IP address to avoid any IP address conflict with other hosts on your LAN, save your change.

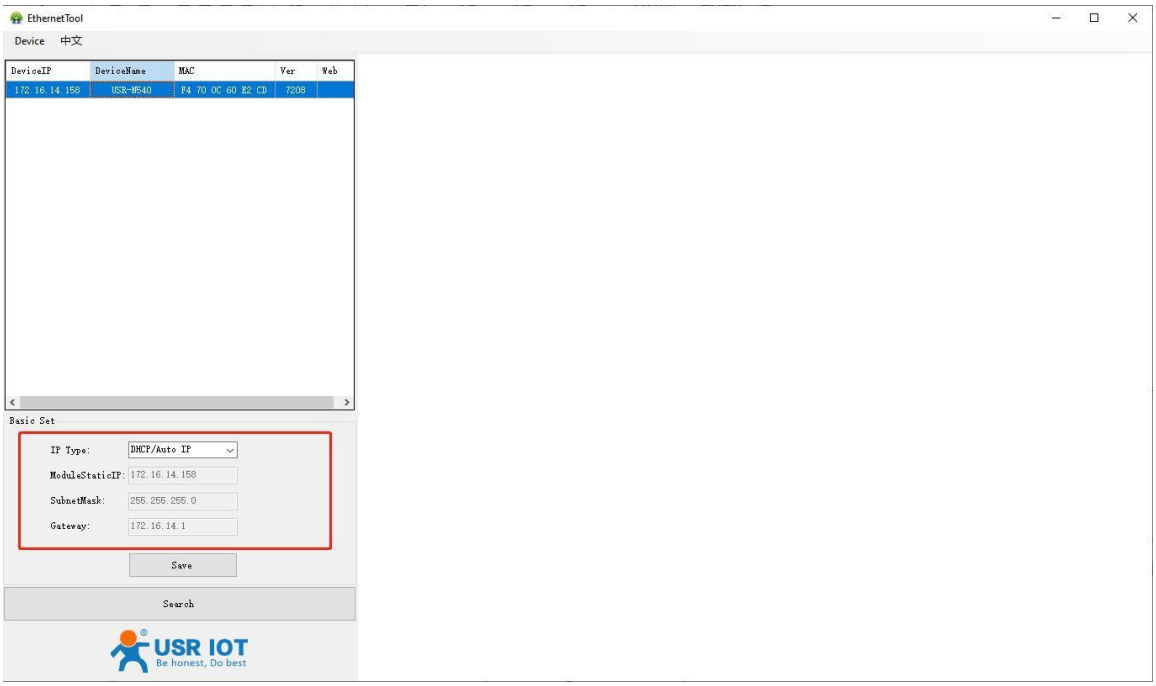


Fig.41 Changing network settings

3.3.3 Reboot the device

This function is available to allow you to reset the serial device server. The function disconnects both the ethernet and serial connections. The function also allows the serial device server to save new configuration settings to flash memory. To reset the device:

1. Right-click a desired device to display the settings menu.

2. Select Reboot.

Press the Reboot button and the system will give a reset response.

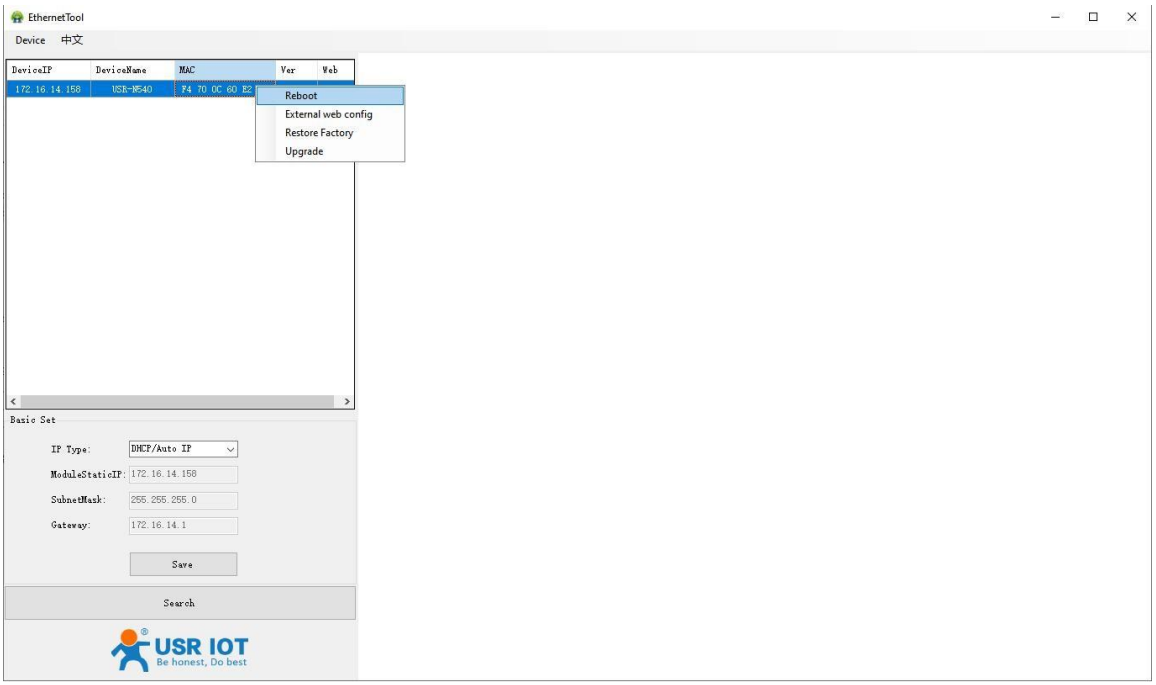


Fig. 42 Reboot the device

3.3.4 Restore to factory default settings

The configuration utility provides the function to restore the serial device server to factory default settings. If you really want to restore the serial device sever to factory default settings, please click restore factory button to continue.

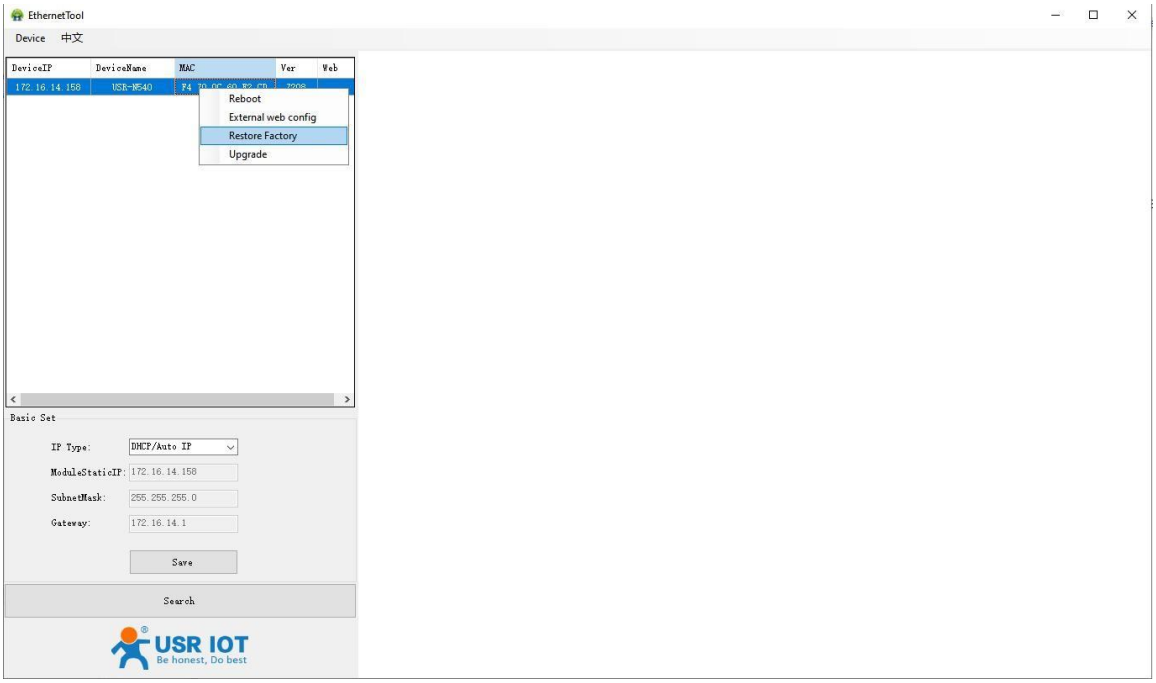


Fig.43 Restore factory defaults

3.3.5 Open web server

Users can visit the web server of serial device server conveniently with configuration tool. Select the device you want to visit and right click, then click External web config ,you will open the web server with default browser such as Google Chrome.

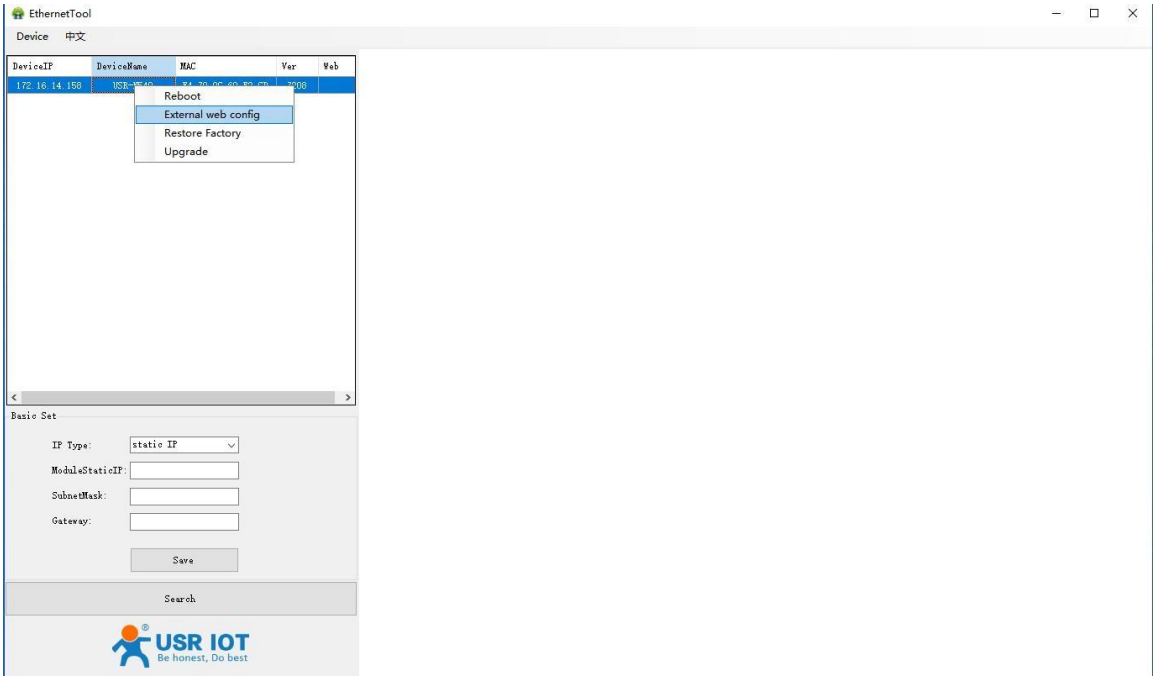


Fig.44 Open webpage in browser

3.4 At command

In order to reduce the length of this document, we have organized this section into a special document. Please refer to "USR Cortex M7 series serial to Ethernet device server AT command manual" for detail.

4. Operation modes

The USR-N5X0 Series provides various operations: TCP Server/ Client mode, UDP mode, HTTP mode and Websocket mode. The main difference between the TCP and UDP protocols is that TCP guarantees delivery of data by requiring the recipient to send an acknowledgement to the sender. UDP does not require this type of verification, making it possible to offer speedier delivery. UDP also allows unicast or multicast of data to only one IP or groups of IP addresses. Detailed descriptions of each operation are provided in following sections. After choosing the proper operation mode in this chapter, refer to Chapter 3 for detailed configuration parameter definitions. Because the V2 firmware contains all the function of V1 firmware, we describe the configuration in V2 firmware as illustration in this chapter, users of V1 version can refer to it for reference.

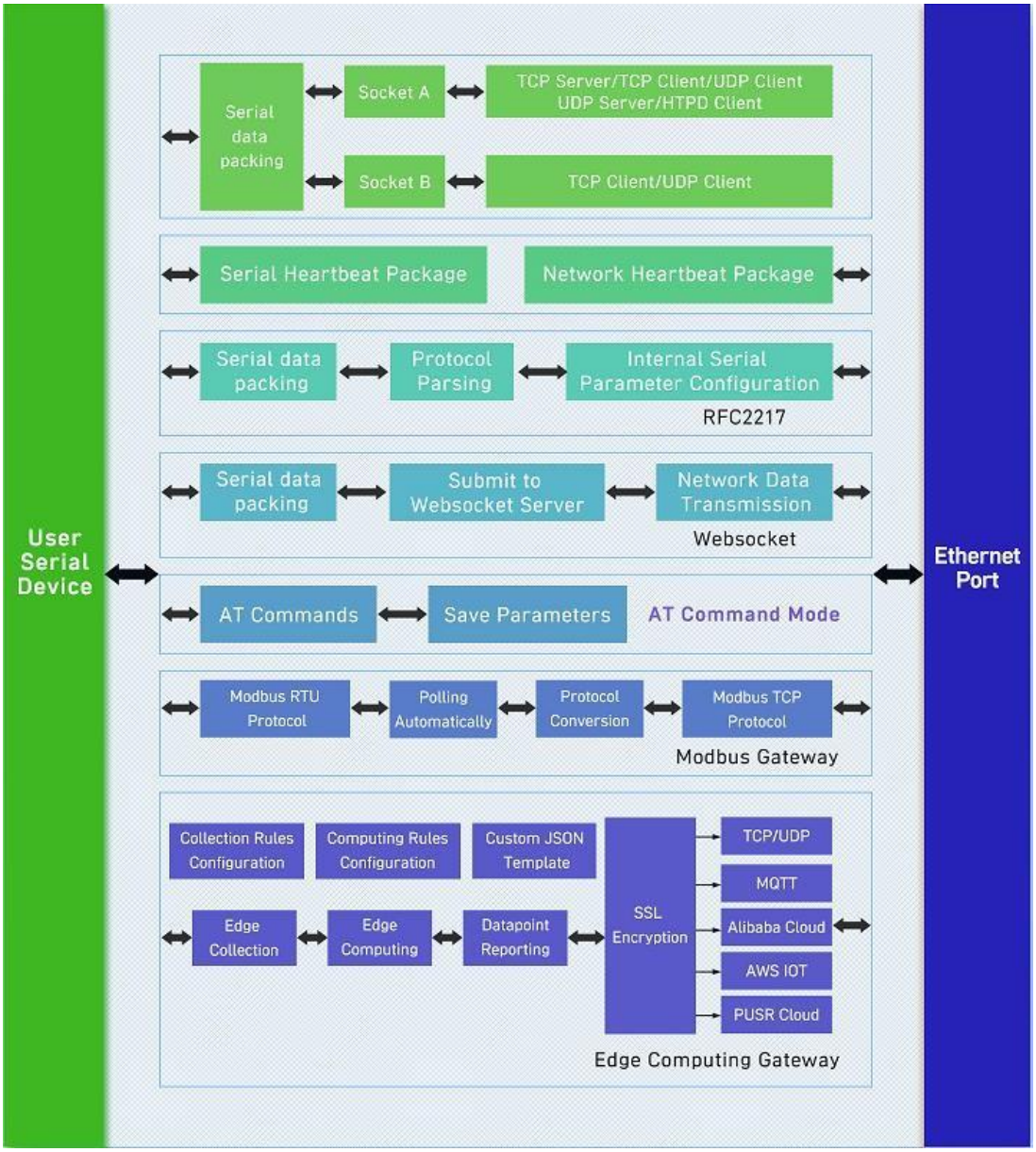


Fig.45 Block diagram

4.1 TCP Server

4.1.1 Properties

In TCP server mode, the TCP connection is initiated from the host to the USR-N5X0 Series device server. This operation mode supports a maximum of 16 (except 8 for N580) simultaneous connections for each serial port on an device server from a single or multiple hosts. After the connection is established between the serial device server and the remote host computer (remote

TCP client), data can be transmitted in both directions. The COM port on the device will forward requests from all remote connected hosts (Ethernet) to the serial device immediately and reply to all remote connected hosts once it receives data from the serial device(RS-232/RS-422/RS-485). The default operation mode of USR-N5X0 is the TCP Server mode. Fig.46 shows an example of configuration setting for TCP Server working mode under the Port1 socket tab. You can configure other serial ports in the same way. There are additional connection settings that can be configured as shown in Fig.46.

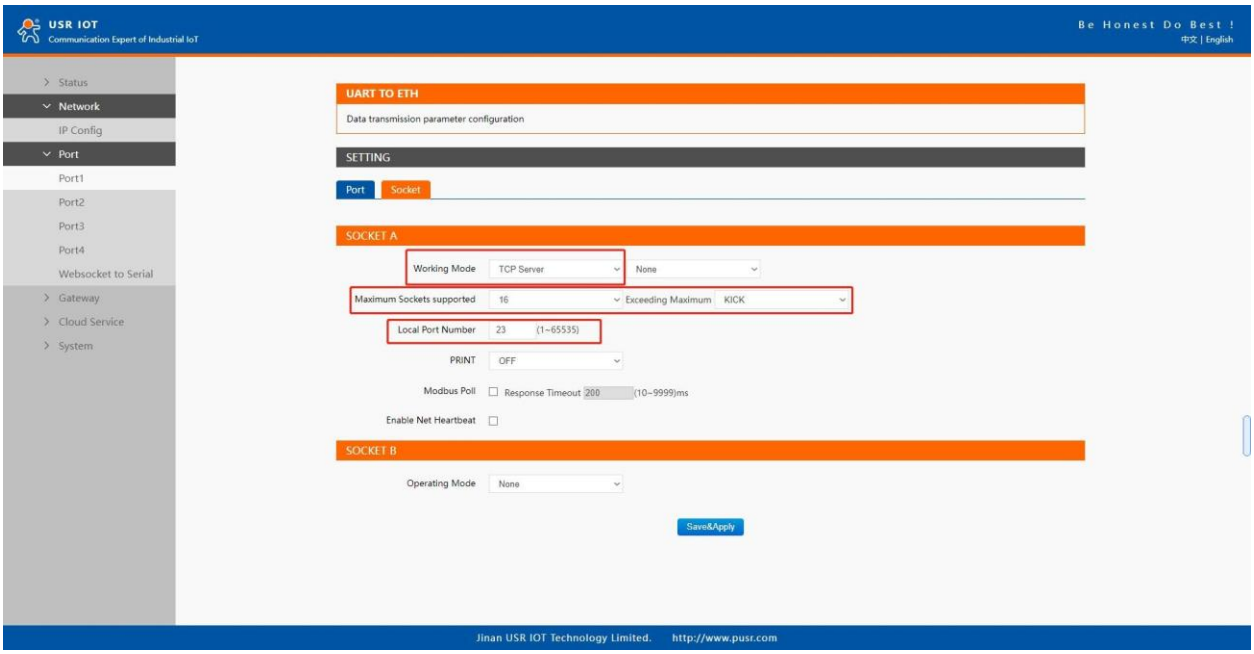


Fig.46 TCP server work mode

Please follow the following steps to configure connection settings of the work mode for PORT1 port.

1. Click on the “Port1” tab on the menu frame on the left side of Web UI to go to Port1 page as shown in Fig.46.

2. For Serial Settings on the Port configuration page, please go to Section 3.2.3.

3. Click on the Socket tab in this page, select TCP Server in the working mode options. The local ports of different serial ports must be different. After receiving network data, the device determines which serial port the data is sent to based on the local port. For example, the default port number of the first serial port (Port1) is 23, the default port number of the second serial port (PORT2) is 26, and so on.

4. After finishing configuring the working Mode, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations

take effect after a system reboot. Fig.47 shows an example of test in this mode. By selecting the TCP Server work mode, a TCP client program on a remote host computer should be prepared to connect to USR-N5X0. Server IP is IP address of USR-N5X0, server port is local port of USR-N5X0. In this case, IP address of USR-N5X0 is 172.16.14.12.

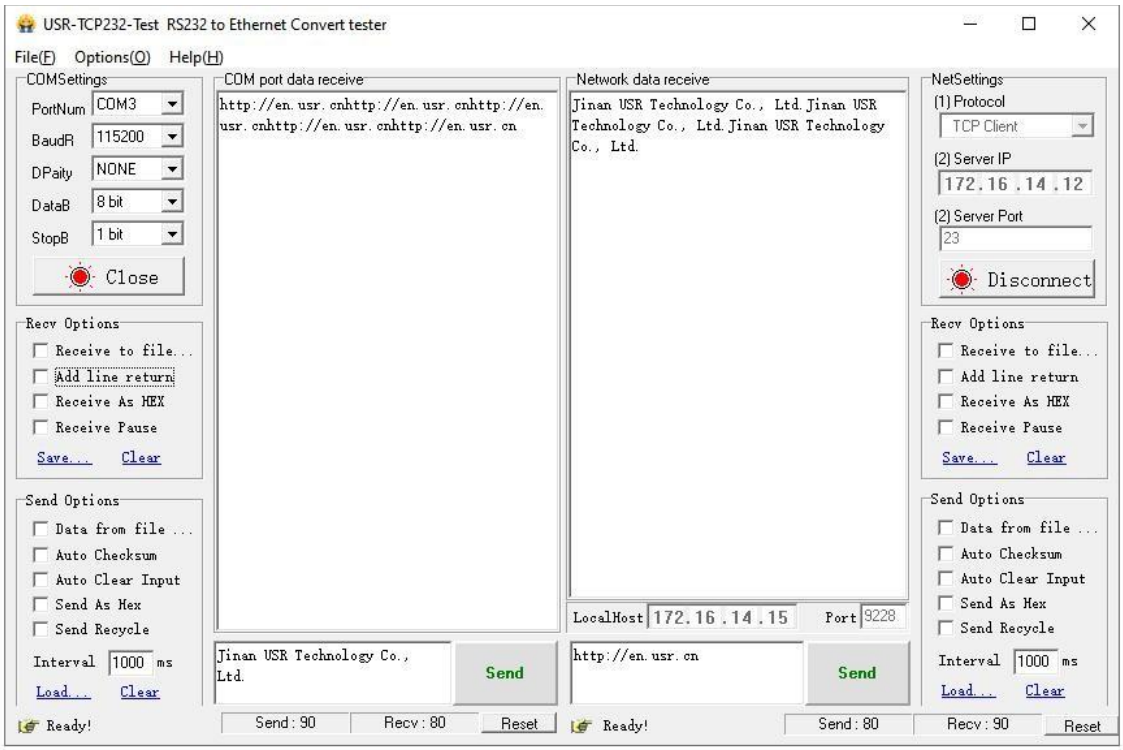


Fig.47 Host initiating TCP connection

4.1.2 Multihost setting

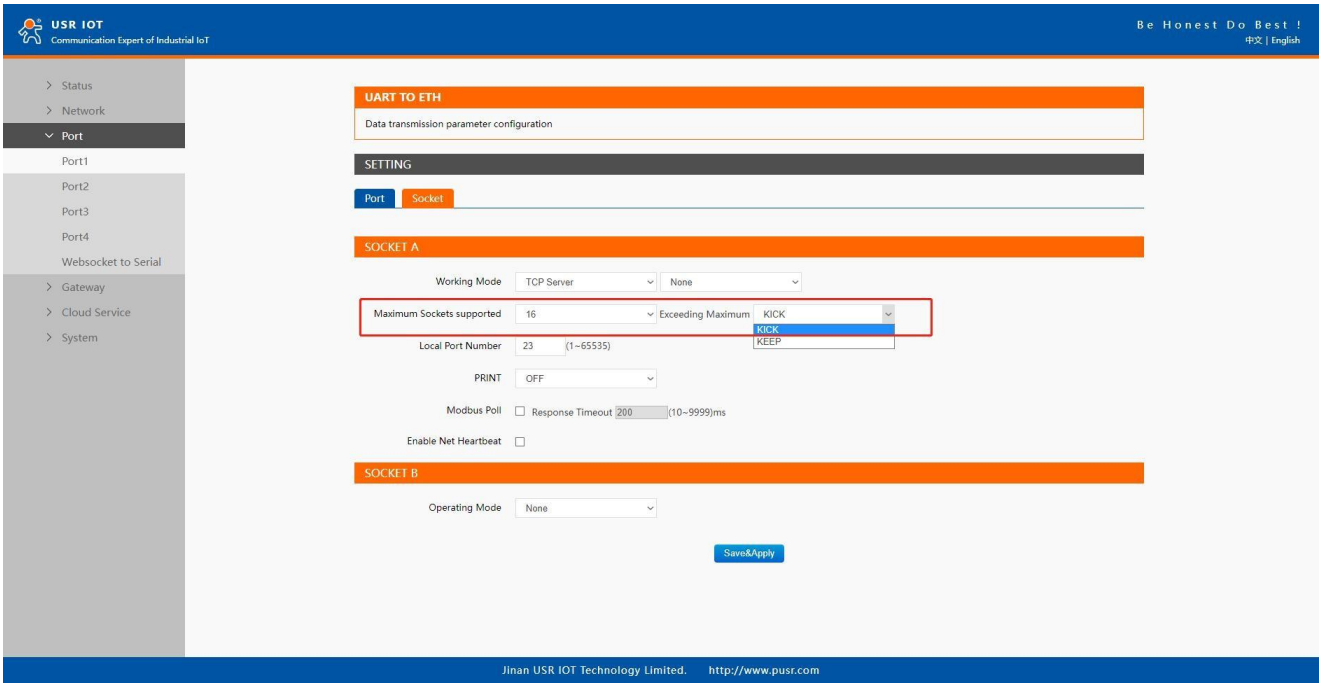


Fig.48 Maximum socket connection

Maximum connection is usually used when the user needs to receive data from different hosts simultaneously. The factory default allows 8 connection at a time. This option specifies the maximum number of remote devices/clients (with maximum of 16 clients) that can be connected to the serial device on this COM port. And users can define the behavior when the connection established exceed the maximum. Kick: when the connection exceeds the maximum number, actively kick out the oldest connection(first in first kick out). Keep: when the connection exceeds the maximum number, keep the old connection and reject new connections.

4.2 TCP Client

4.2.1 Properties

When the working mode of this device is TCP Client, the remote device must work in TCP Server mode, and its IP address and port number must be configured, which can be configured in the corresponding options of the network connection. The local port number can be ignored and no configuration is required. USR-N5X0 supports SSL (TLS v1.0 or v1.2) data encryption in this operating mode. Fig.49 shows an example of configuration setting for TCP Client working mode under the Port1 socket page. You can configure other serial ports in the same way. There are additional connection settings that can be configured as shown in Fig.49.

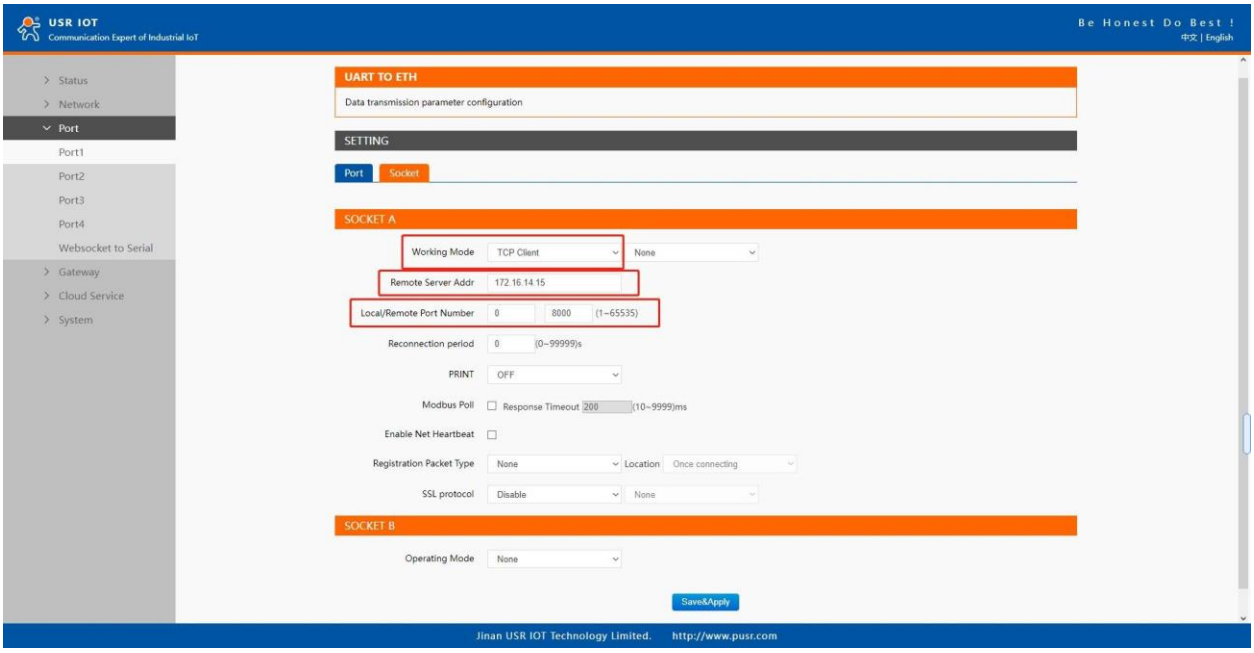


Fig.49 TCP client work mode

Please follow the following steps to configure connection settings of the work mode for PORT1 port. 1. Click on the “Port1” tab on the menu frame on the left side of Web UI to go to Port1 page as shown in Fig.49.

2. For Serial Settings on the Port configuration page, please go to Section 3.2.3.

3. Click on the Socket tab in this page, select TCP Client in the working mode options. Please specify the Destination IP address and port number of the TCP server program on the remote host. This should match the IP settings of the TCP server program. The default local port number is 0, N5X0 will assign a random TCP Port.

4. After finishing configuring the working Mode, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot. Fig.50 shows an example of test in this mode. By selecting the TCP Client operation mode, a TCP server program on a remote host computer should be prepared to accept a connection request from the device. In this case, Host IP address is 172.16.14.15.

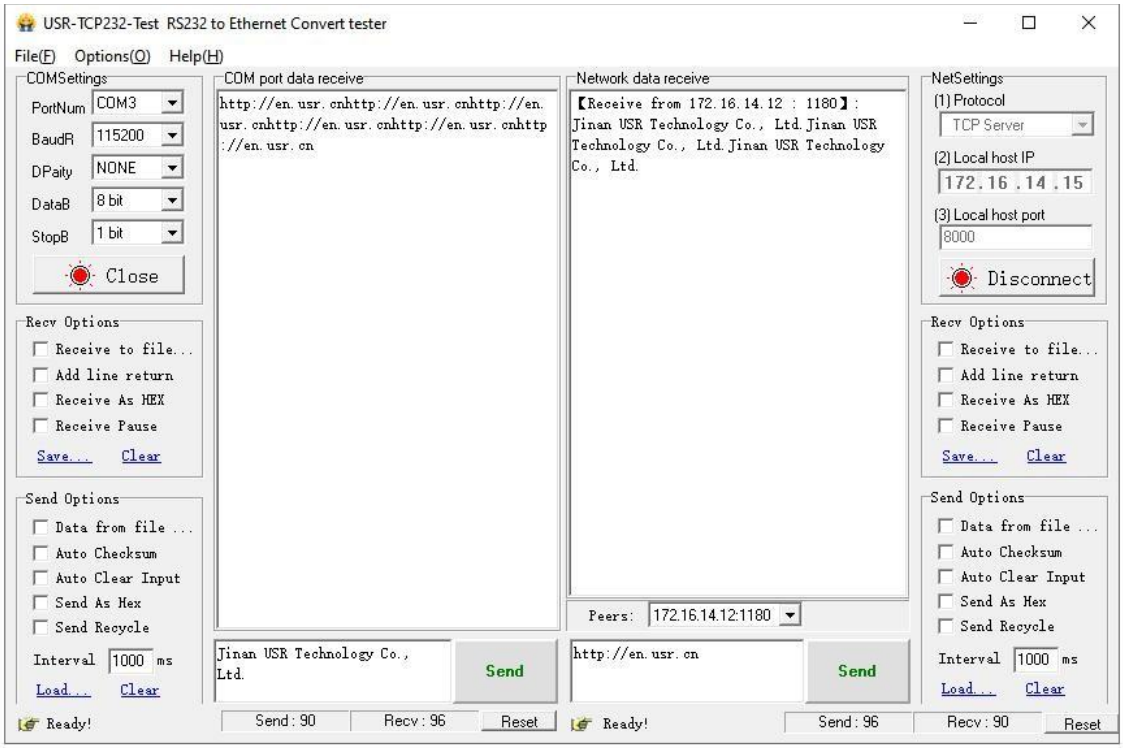


Fig.50 N5X0 initiating TCP connection

4.2.2 SSL/TLS

If SSL certificate authentication is enabled on the remote server, user need to configure SSL encryption parameters on N5X0. User can select TLS1.0 or TLS1.2 version protocol. User can select None certificate Authentication, server certificate authentication and bidirectional certificate authentication.

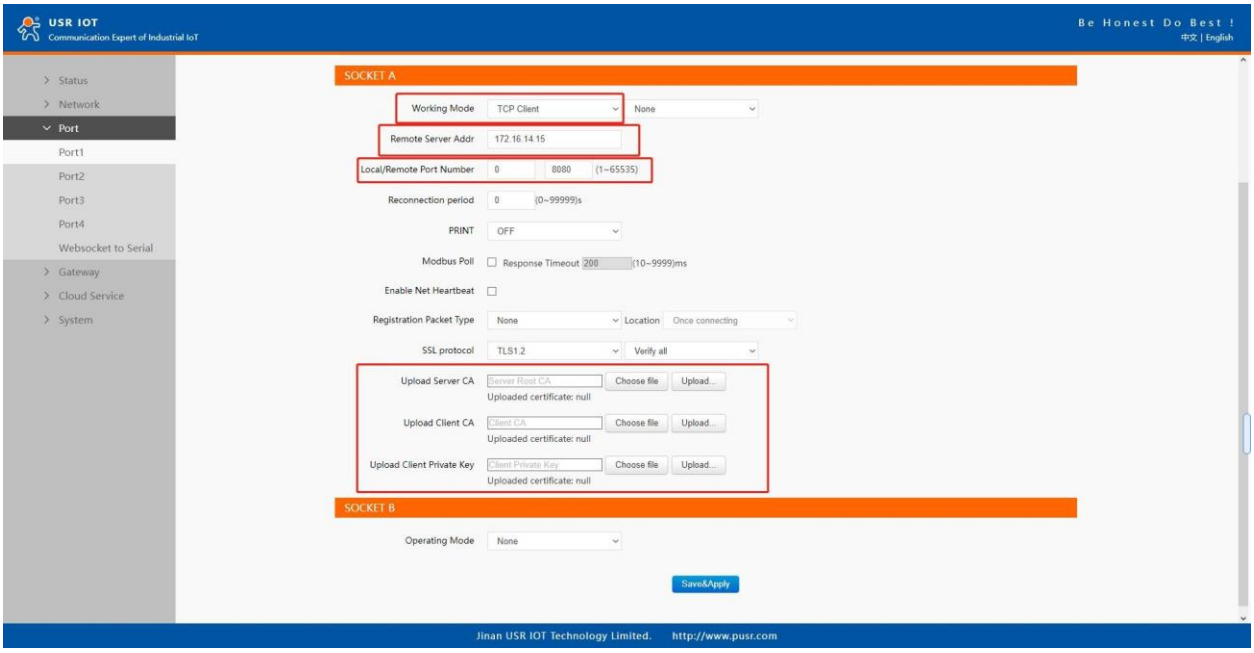


Fig.51 SSL/TLS encryption

4.2.3 Transient connection

This connection, called transitory due to its short-lived nature. If the serial port or network port receives none data within the setting time, the connection will be automatically disconnected. The serial device servers used to send serial device back to control room or a cloud application need to open a remote connection before they can transfer the serial data. If a large number of serial devices are connected to the same network, the connection will require many resources in the control room or cloud application. To handle these large numbers of remote connections properly, serial device servers should support flexible connection control. The best way to do this is to open a connection only when serial data is received from a device. When the transmission is completed, the serial device server should immediately close the connection. Without support for flexible connection control, you would need to spend extra time handling connections at the central site or cloud application. TCP transient connection is used primarily to save server resources. Fig.52 shows an example of configuration setting for transient connection in TCP Client working mode under the socket page.

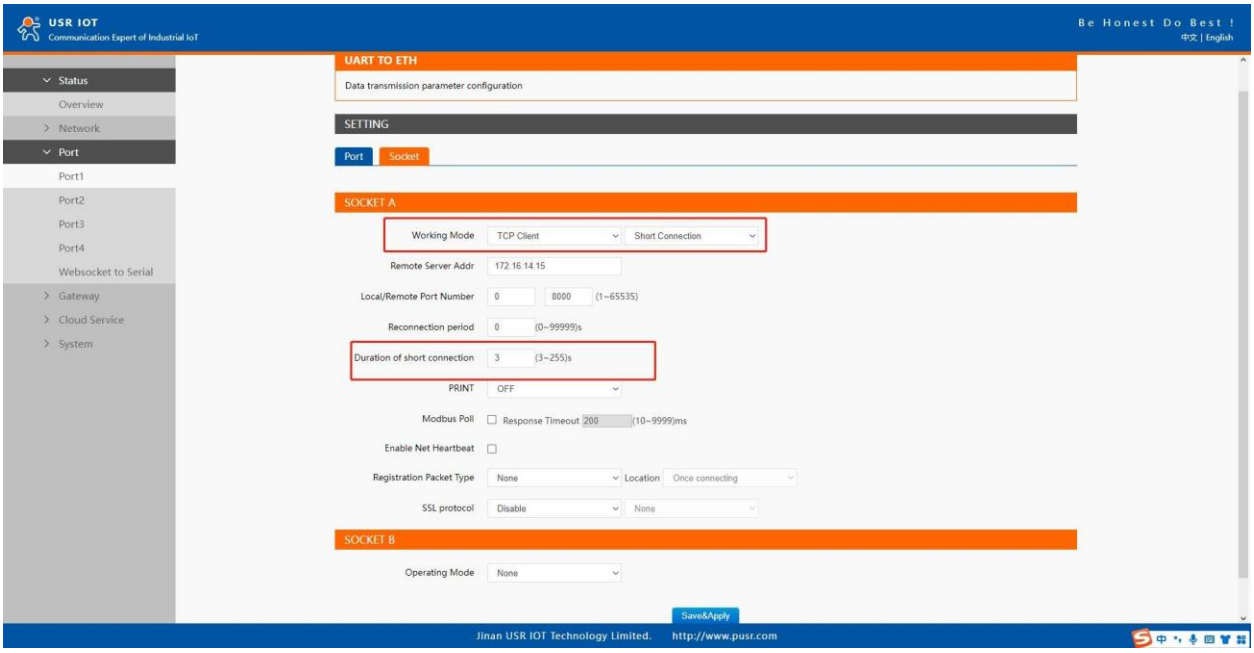


Fig.52 Transient connection

4.3 UDP Server

4.3.1 Properties

User Datagram Protocol (UDP) is a faster and more efficient transport protocol than TCP but it is a connectionless transport protocol, it does not guarantee the delivery of network datagram. In UDP mode, you can unicast or multicast data from the serial device to one or multiple host computers, and the serial device can also receive data from one or multiple host computers. Please beware that even though UDP provides better efficiency in terms of response time and resource usage, it does not guarantee data delivery. It is recommended to utilize UDP only with cyclic polling protocols where each request is repeated and independent, such as Modbus Protocol. When the working mode of the device is UDP server, the remote device must also work in UDP mode. You only need to specify the Local Port that USR-N5X0 should listen to. In UDP server mode, serial port data is always sent to the last peer UDP device (IP and port) that communicates with the USR-N5X0, and the USR-N5X0 can record the IP and port number only after the peer UDP device sends data to the USR-N5X0 first. Fig.53 shows an example of configuration setting for UDP Server mode under the Port1 socket page. You can configure other serial ports in the same way.

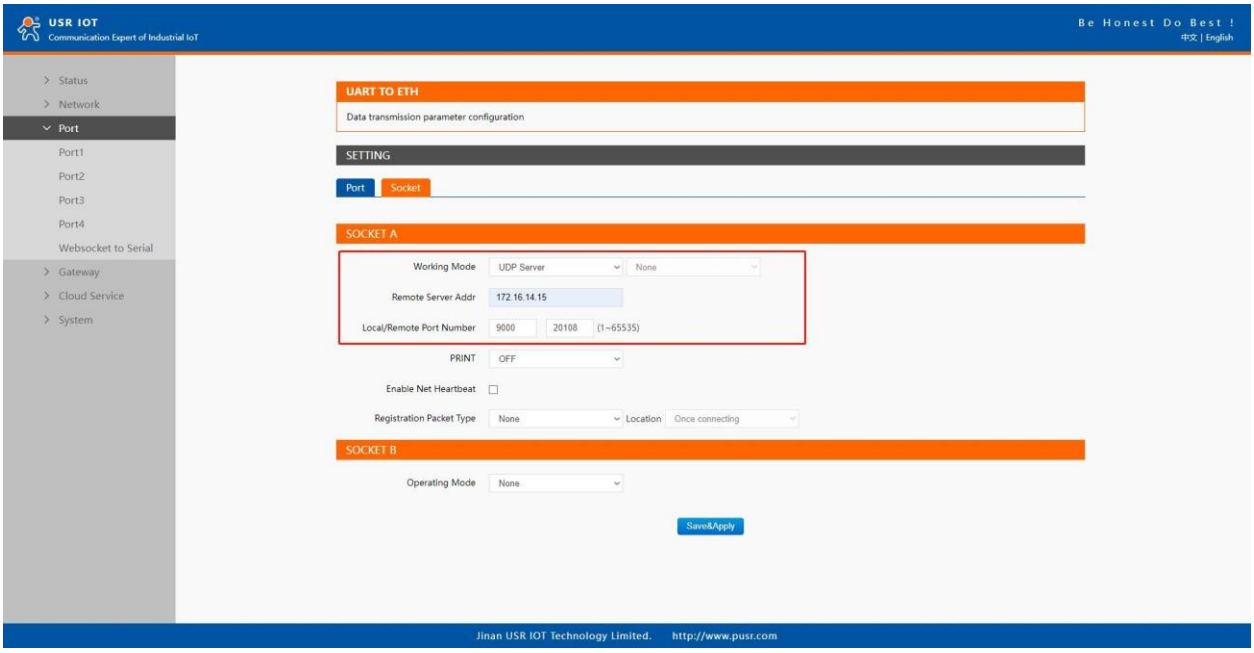


Fig.53 UDP server work mode

Please follow the following steps to configure connection settings of the operation mode for PORT1 port.

1. Click on the “Port1” tab on the menu frame on the left side of Web UI to go to Port1 page as shown in Fig.53.

2. For Serial Settings on the Port configuration page, please go to Section 3.2.3.

3. Click on the Socket tab in this page, select UDP Server in the working mode options.

4. Local Port specifies the local port number for UDP server mode on N5X0 which it will be listening to and it can be any number between 1 and 65535. The local ports of different serial ports must be different. After receiving network data, the device determines which serial port the data is sent to based on the local port.

5. After finishing configuring the working Mode, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot. Serial port data is firstly sent to the preset destination IP/domain name and Destination port. After receiving a UDP packet, the system updates the destination IP address and port number, and sends the data back to the latest IP address and port number. In this case, IP address of USR-N5X0 is 172.16.14.12, host IP address is 172.16.14.15.

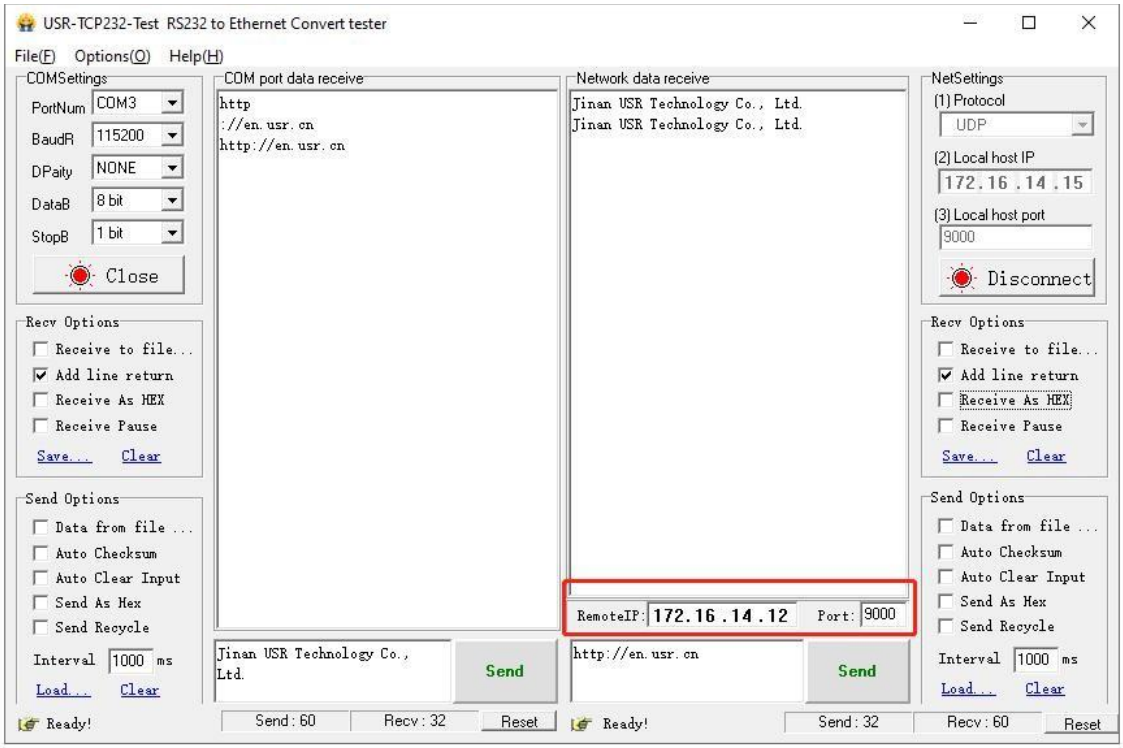


Fig.54 UDP transmission test

4.4 UDP Client

4.4.1 Properties

When the working mode of the device is UDP client, the remote device must also work in UDP mode. N5X0 supports remote IP address and port verification. After verification is enabled(OFF), the N5X0 only communicates with the destination port of the destination IP address. If the data is not from this channel, the N5X0 will discard the data. If verification is disabled(ON), N5X0 does not filter the data of the destination IP address and destination port. Fig.55 shows an example of configuration setting for UDP Client mode under the Port1 socket page. You can configure other serial ports in the same way.

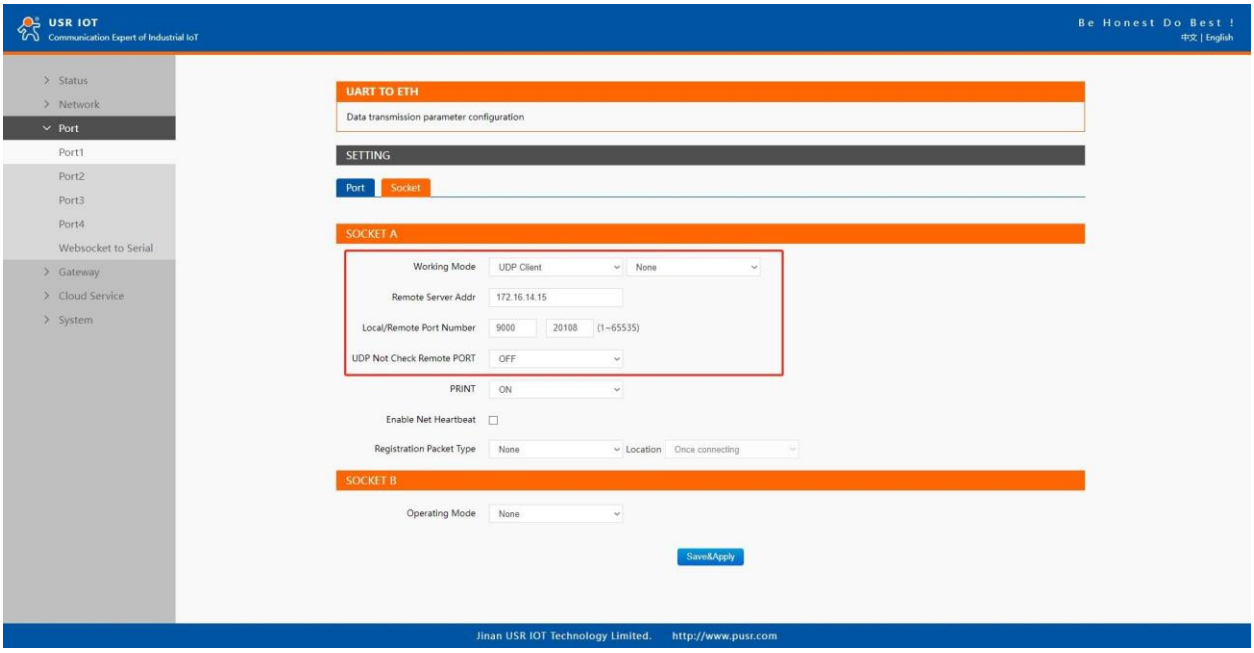


Fig.55 UDP client work mode

Please follow the following steps to configure connection settings of the UDP client mode for PORT1 port.

1. Click on the “Port1” tab on the menu frame on the left side of Web UI to go to Port1 page as shown in Fig.55.

2. For Serial Settings on the Port configuration page, please go to Section 3.2.3.

3. Click on the Socket tab in this page, select UDP Client in the working mode options.

4. Please specify the Destination IP address and port number of the UDP program on the remote host. Local Port specifies the local port number which socket A will be listening to and it can be any number between 1 and 65535. The local ports of different serial ports must be different. After receiving network data, the device determines which serial port the data is sent to based on the local port. Note that typically the port number that is larger than 1024 is recommended to avoid conflicting with the well-known port numbers. You should match this setting with the remote UDP program. Note that this number is usually called destination port in the remote UDP program.

5. After finishing configuring the working Mode, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot. Fig.56 shows an example of test in this mode. In this case, IP address of USR-N5X0 is 172.16.14.12, host IP address is 172.16.14.15.

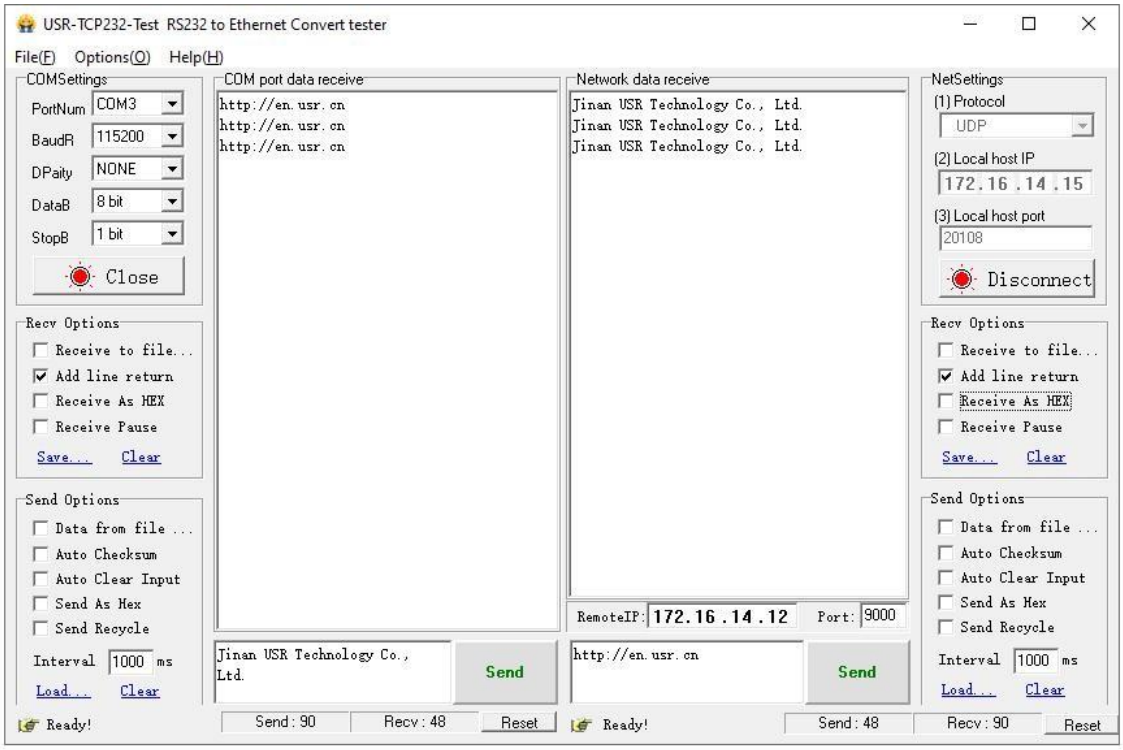


Fig.56 UDP Client test

4.4.2 UDP multicast

UDP also allows multicasting of data to groups of IP addresses. A multicast is a packet sent by one host to multiple hosts. In multicast mode, each host that belongs to a specific multicast group will receive multicast packets for that group. For a host to be configured as a multicast receiver over the Internet, the must inform the routers on its LAN. The Internet Group Management Protocol (IGMP) is used to communicate group membership information between hosts and routers on a LAN. The USR-N5X0 Series supports IGMP version 2.

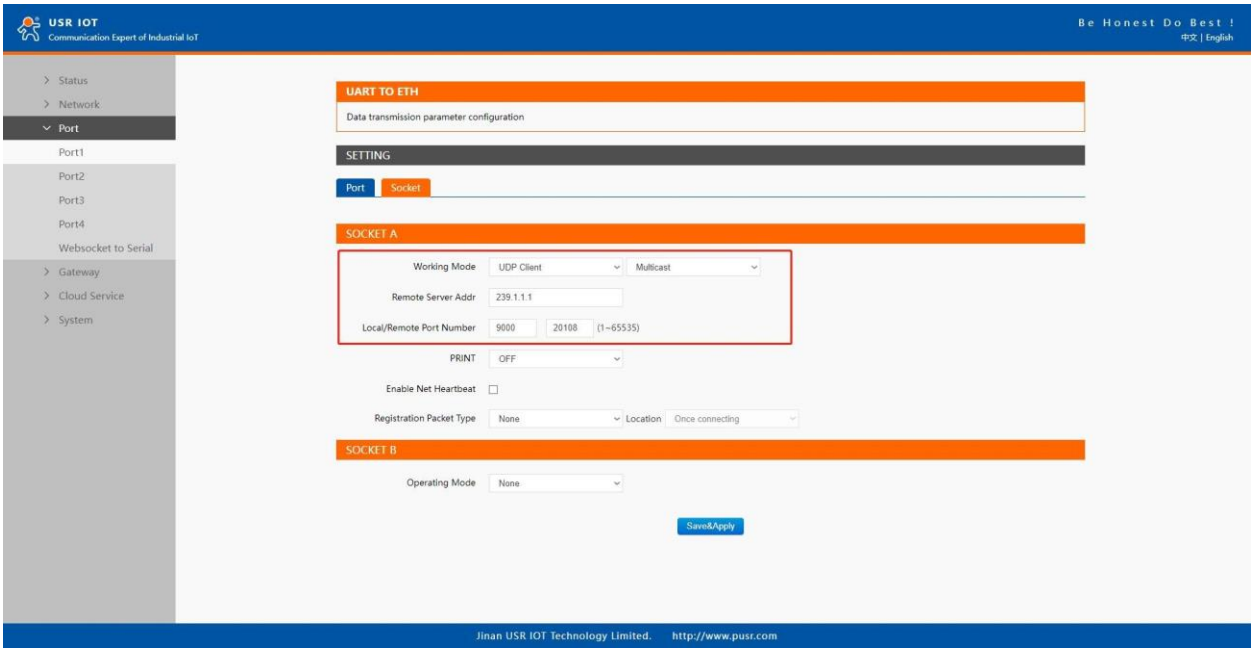


Fig.57 USR-5X0 #1UDP multicast setting

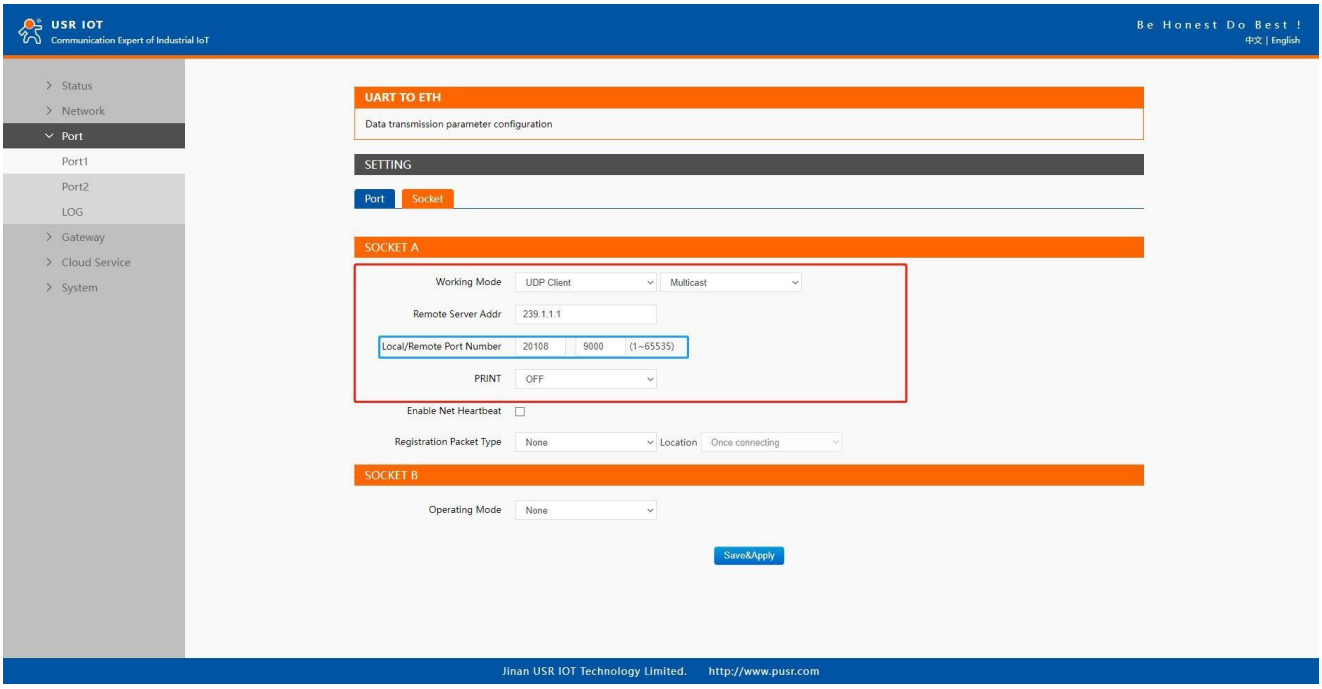


Fig.58 USR-N5X0 #2 UDP multicast setting

Fig.59 shows an example of test in this mode with two N5X0s

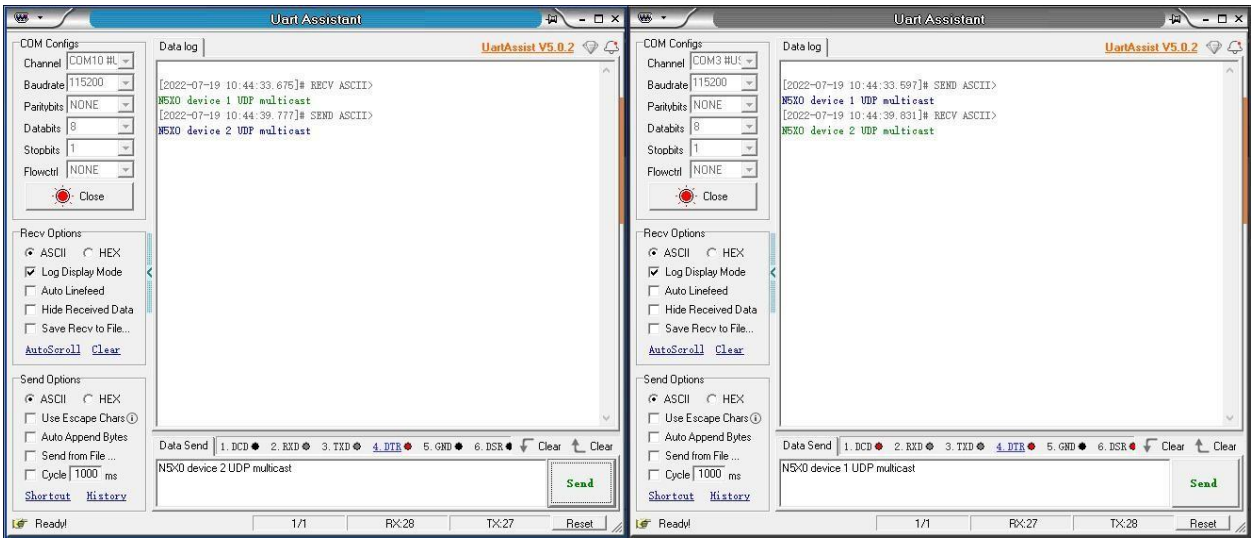


Fig.59 UDP multicast transmission test

4.5 HTTP Client

4.5.1 Properties

When the operation mode of this device is Httpd Client, users need to specify the remote httpd server's address, port, method and other parameters. The device will submit the serially received data to the httpd server in the form of GET or POST. At the same time, the data sent by the httpd server can be transparently transmitted to the serial port. Fig.60 shows an example of configuration setting for HTTP Client working mode under the Port1 socket page. You can configure other serial ports in the same way.

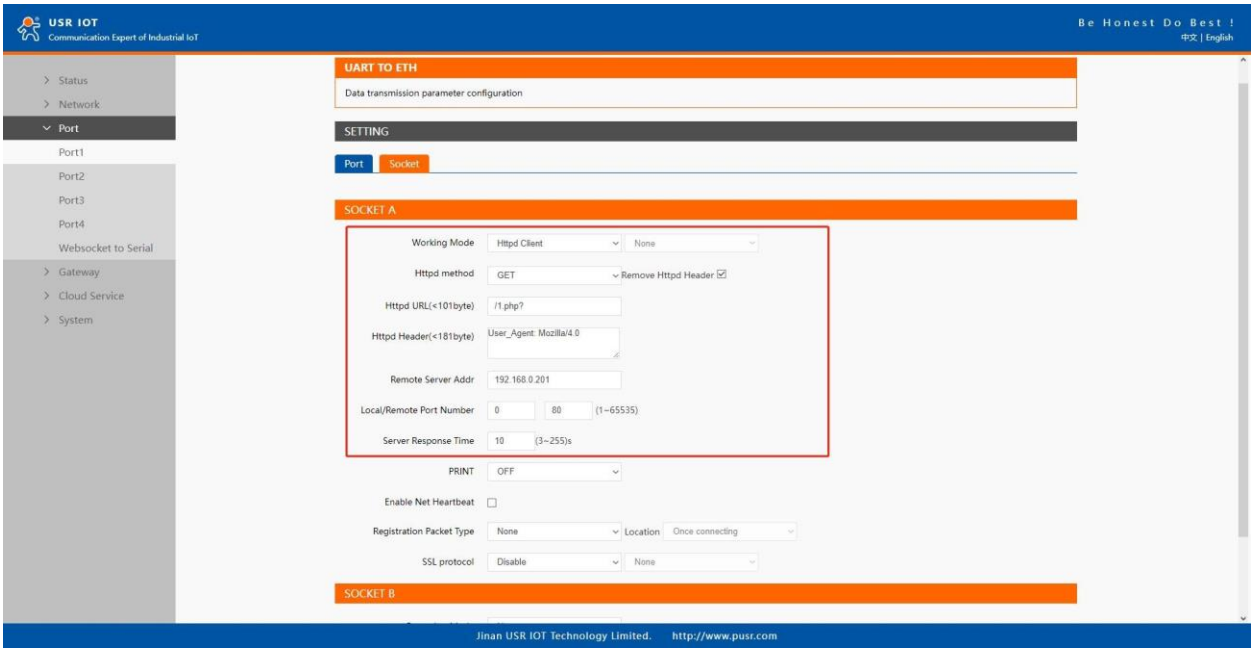


Fig.60 HTTP client mode

Please follow the following steps to configure connection settings of the work mode for PORT1 port. 1. Click on the “Port1” tab on the menu frame on the left side of Web UI to go to Port1 page as shown in Fig.60.

2. For Serial Settings on the Port configuration page, please go to section 3.2.3.

3. Click on the Socket tab in this page, select Httpd Client in the working mode options.

4. The HTTPD method needs to fill in the correct URL path, and select the GET or POST method as needed.

5. Fill in the HTTPD request header as needed.

6. Fill in the HTTPD address, that is, the address of the HTTP server, which can be an IP address or a domain name (the ability to connect to foreign countries is required).

7. Fill in the HTTPD port number. The default local port number is 0, N5X0 will assign a random TCP Port.

8. After finishing configuring the working Mode, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot.

4.5.2 HTTPS

If SSL certificate authentication is enabled on the remote server, user need to configure SSL encryption parameters on N5X0. User can select TLS1.0 or TLS1.2 version protocol. User can select None certificate Authentication, server certificate authentication and bidirectional certificate authentication.

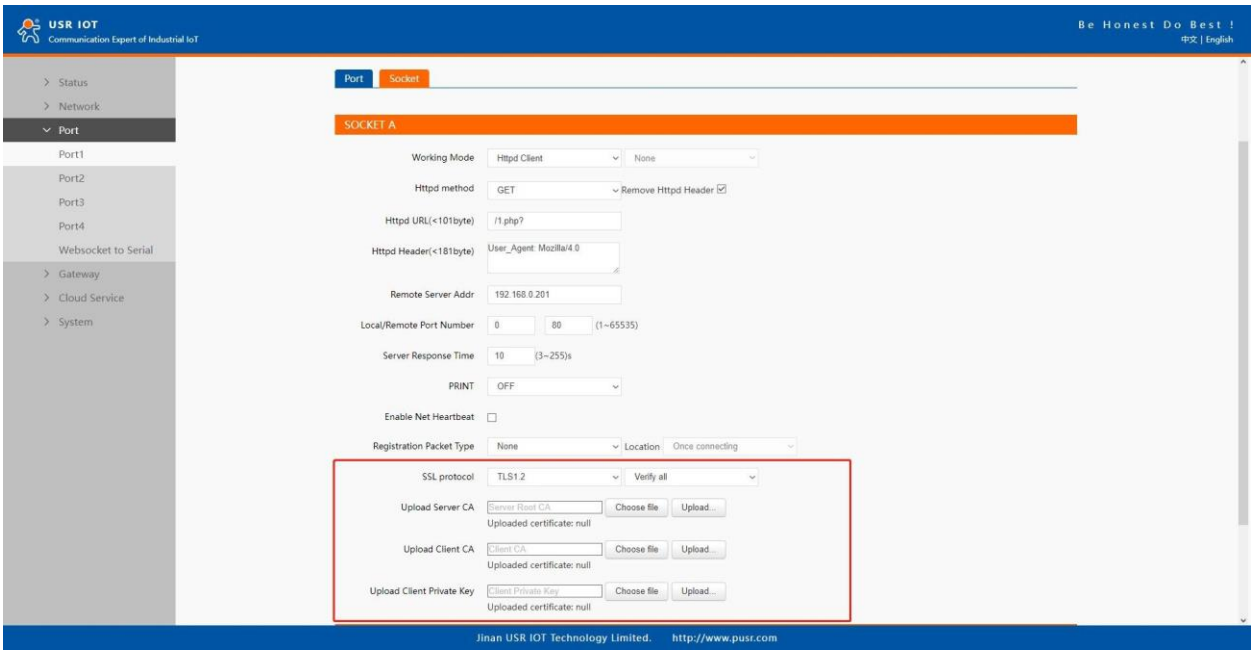


Fig.61 SSL/TLS encryption

4.6 Websocket server

When the operation mode of this device is WebSocket server, the user needs to specify the main parameters such as listening port, forwarding direction. This function is that the serial server acts as a WebSocket server, and transparently transmits the data received by the serial to the WebSocket client in hexadecimal format. The WebSocket server can also forward data to the serial device at any time.

1. Click on the “system setting” tab on the menu frame on the left side of Web UI to go to system setting page as shown in Fig.62.

2. Fill in the WebSocket server listening port number, default 6432.

3. Select UART1 in websocket direction.

4. For Serial Settings on the Port configuration page, please go to section 3.2.3.

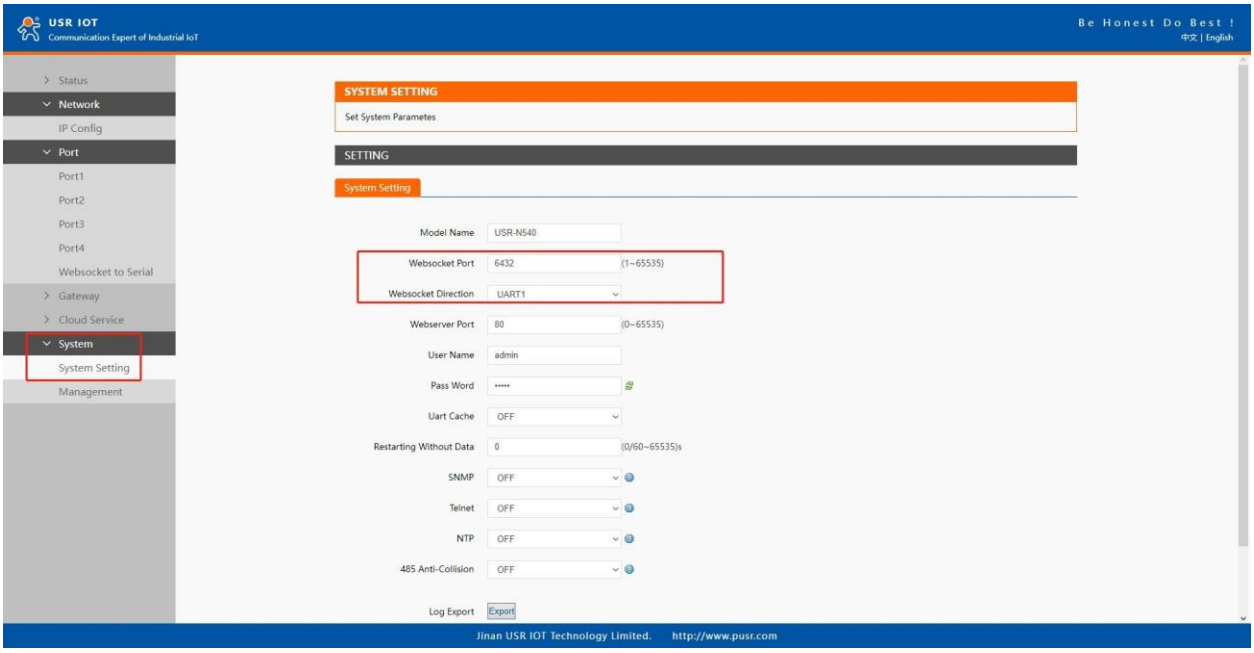


Fig.62 Websocket server setting

5. Click on the websocket to serial tab,browser will connect to the websocket server of N5X0 automatically.

Fig.63 Browser as websocket client to connect N5X0

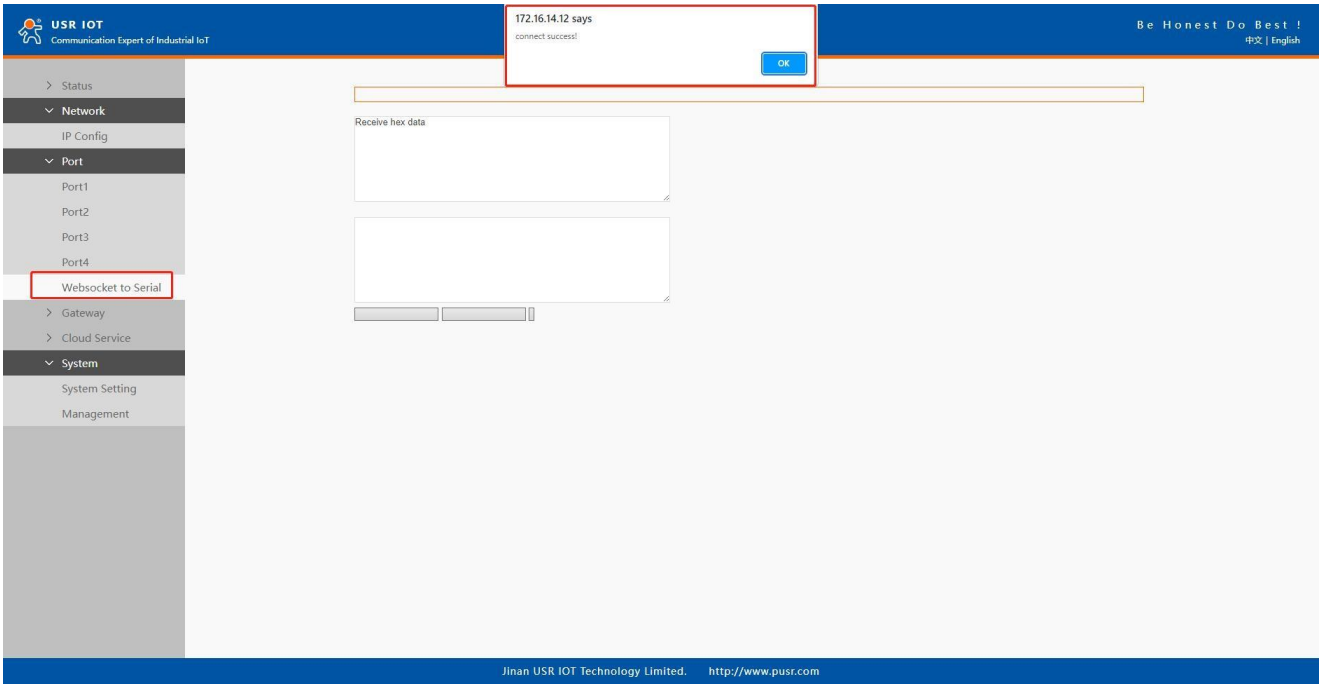


Fig.64 shows an example of test in this mode

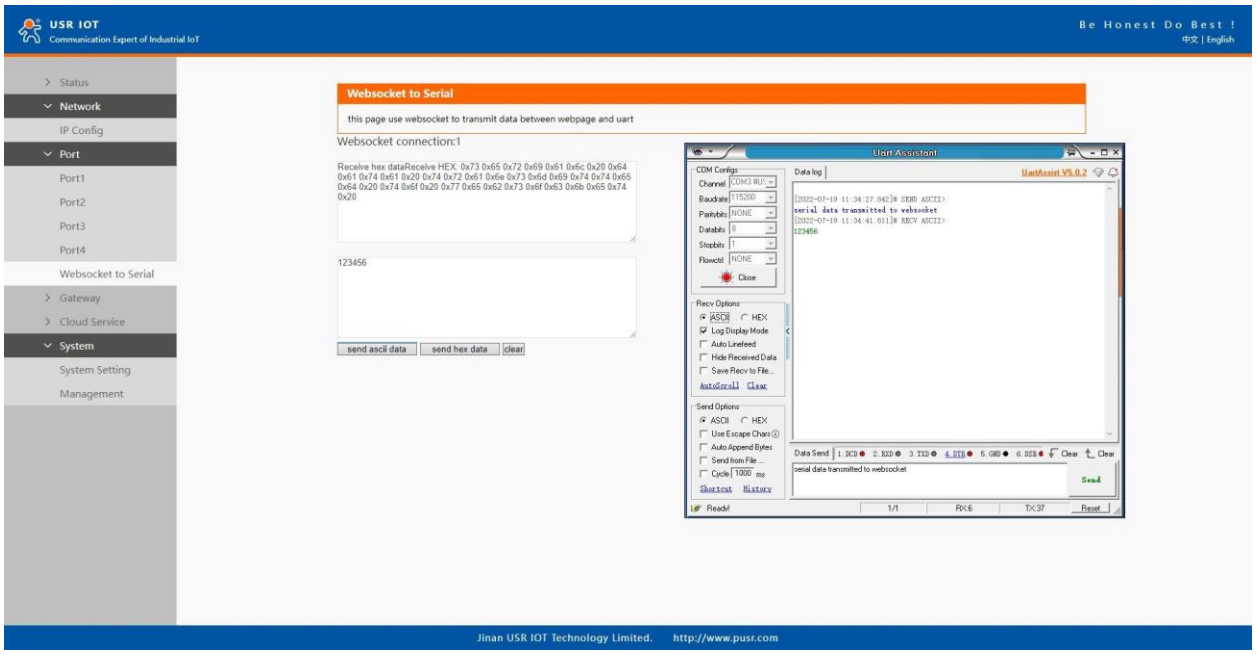


Fig.64 Data transmission test

5. Virtual COM port

Traditional SCADA and data collection systems rely on serial ports (RS-232/422/485) to collect data from various kinds of instruments. Virtual COM ports on host computer allows remote access of serial devices over TCP/IP network that works like local native COM ports. Since USR-N5X0 serial device servers enable network operation of instruments equipped with an RS-232/422/485 communication port, your SCADA and data collection system will be able to access all instruments connected to a standard TCP/IP network, regardless of whether the instruments are used locally or at a remote site. To enable Virtual COM on host computer, you will require a VCOM software to emulate the COM port. For Windows operating system, a software utility called VCOM is supported by PUSR to be used for this purpose. This function is useful with devices such POS terminals, Bar Code Readers, Serial printers, etc. since it allows you to use software that was written for pure serial communication applications. Download the software from PUSR's website: https://www.pusr.com/support/downloads/VCOM_Setup_exe.html Execute the VCOM program, click quick-install to install program files in the default directory, or select an alternative location. The Installing window reports the progress of the installation.

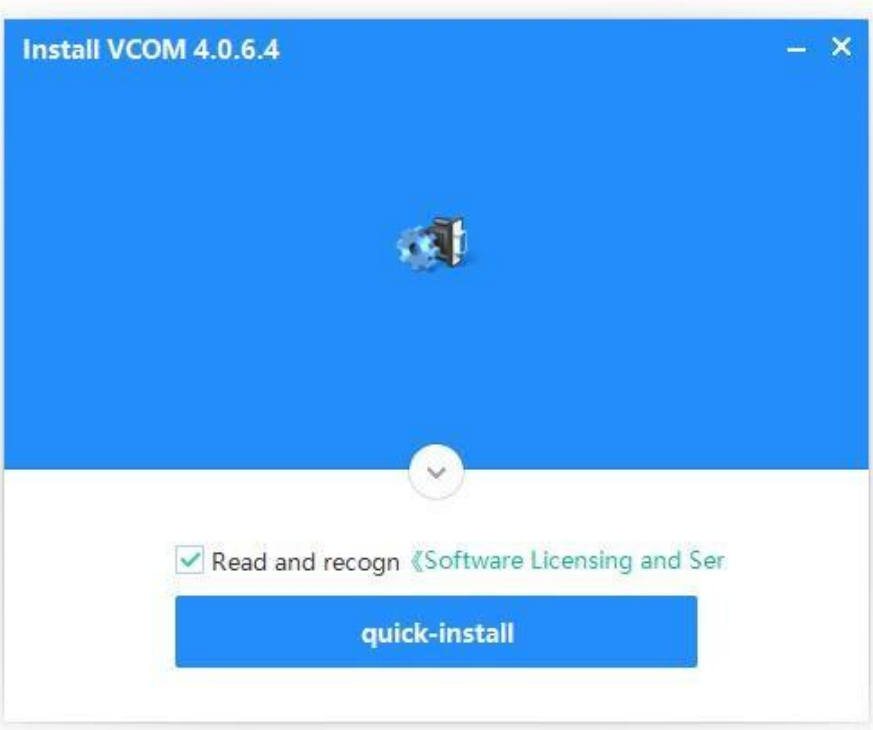


Fig.65 Install wizard 1

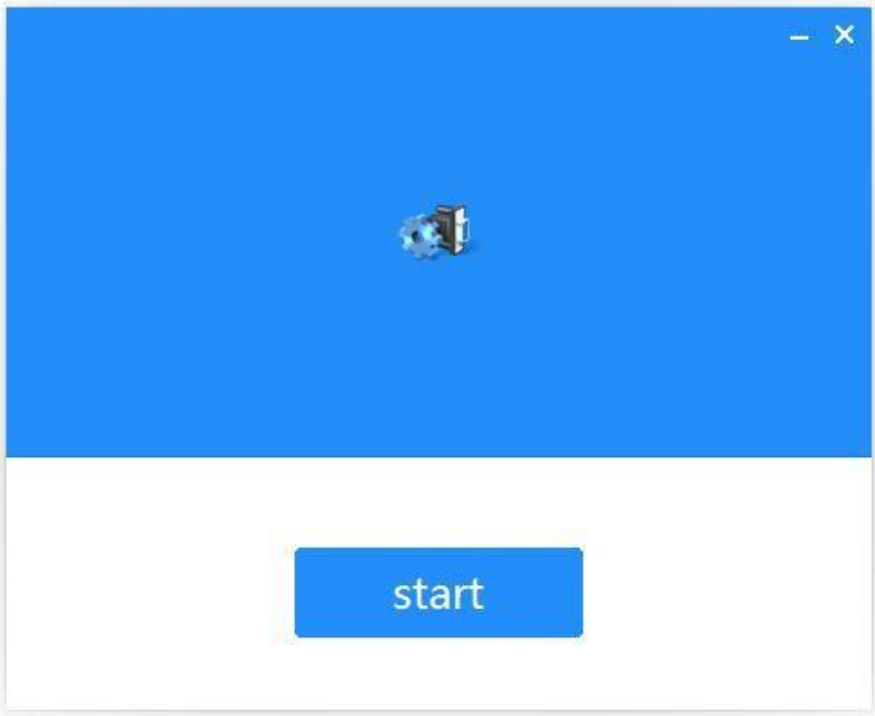


Fig.66 Install wizard 2

Once the installation of the package is finished a start screen display. Click start to conclude the process and launch the VCOM software.

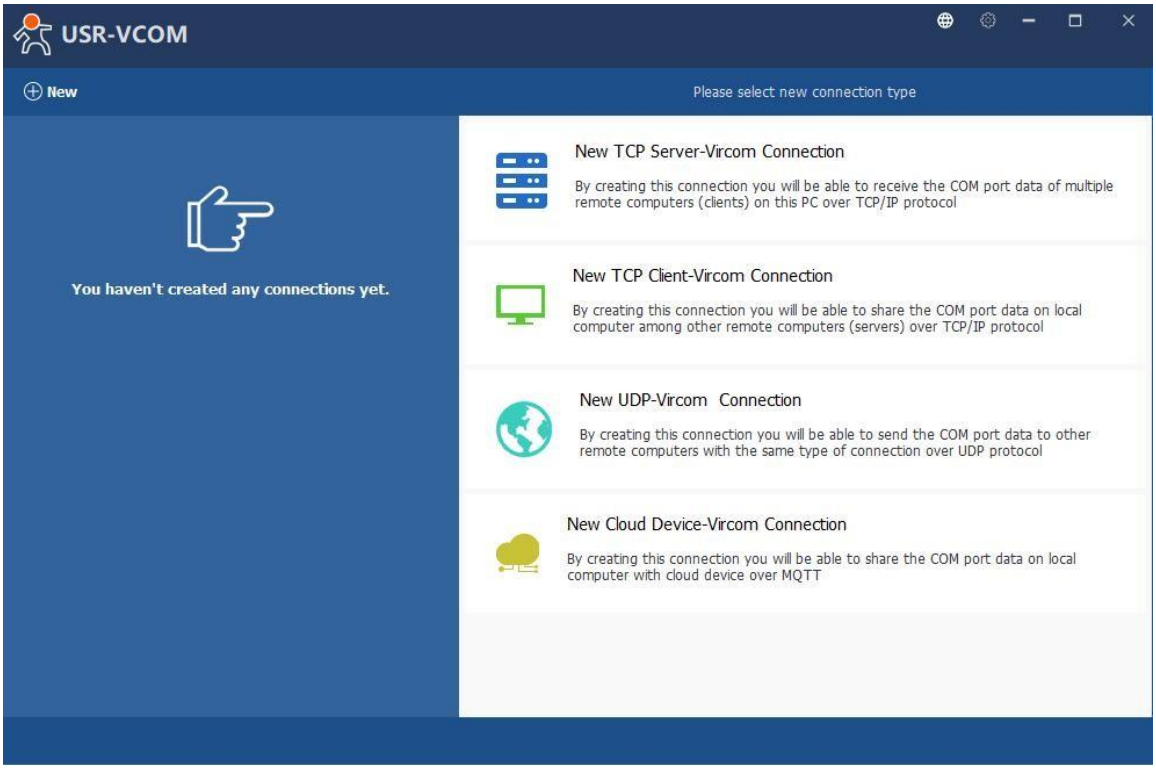


Fig.67 VCOM overview

5.1 TCP Server Application with Virtual COM

Virtual COM on host computer allows remote access of serial devices over TCP/IP networks through Serial/IP Virtual COM ports that work like local native COM ports. Fig.68 is an example of Virtual COM application diagram. There are traditionally only two Physical COM ports (COM 1 and COM 2) on the personal computer (PC) while there can be several Virtual COM ports such as COM 11, 12, 13, and so on. This section will provide the procedure to enable Virtual COM (VCOM) on Windows based PC. Please follow the steps described here to configure your Virtual COM application.

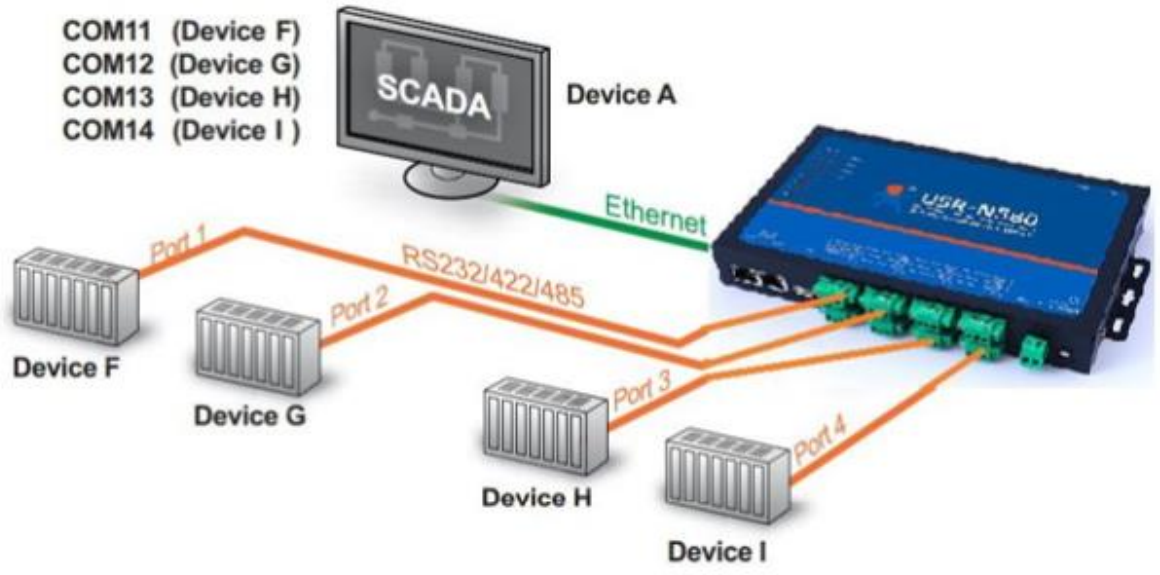


Fig.68 Diagram of virtual COM Application over TCP/IP Network

1. If the serial device server is running in TCP Server Mode (recommended), the VCOM utility on the host computer should be configured as the TCP client connecting to the serial device server. The characteristic of this mode is that the IP address of the host can be changed (usually automatically assigned by the router), and the IP address of the serial server must be fixed.

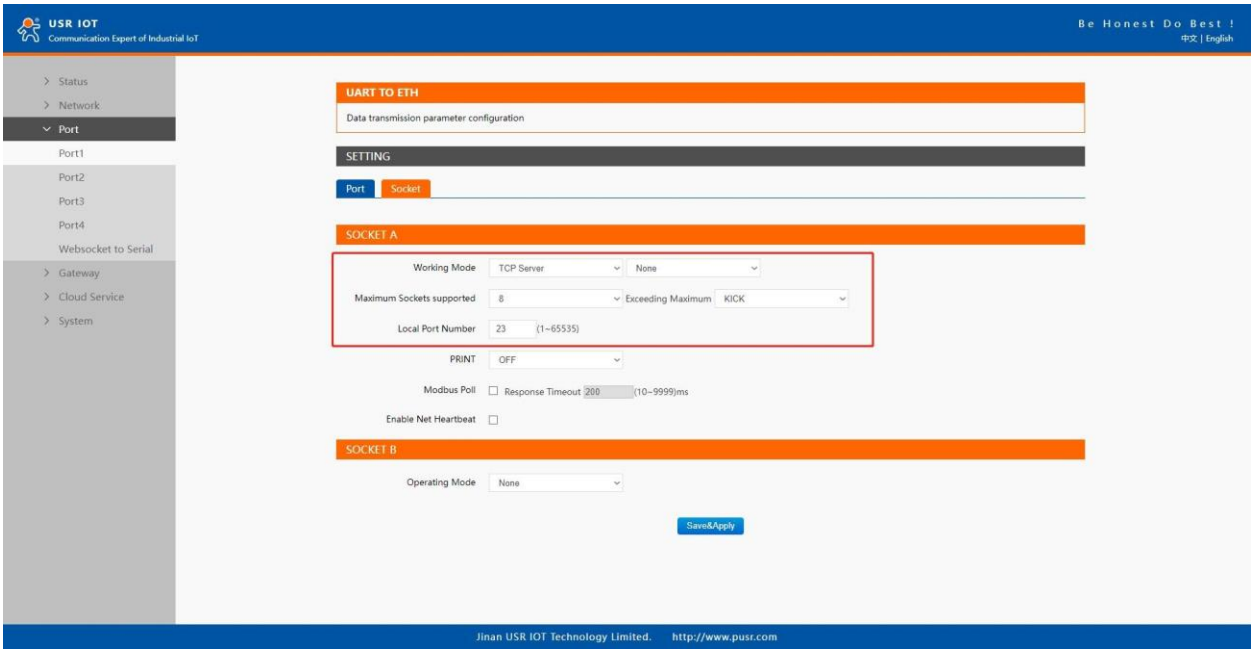


Fig.69 TCP Server mode in USR-N5X0

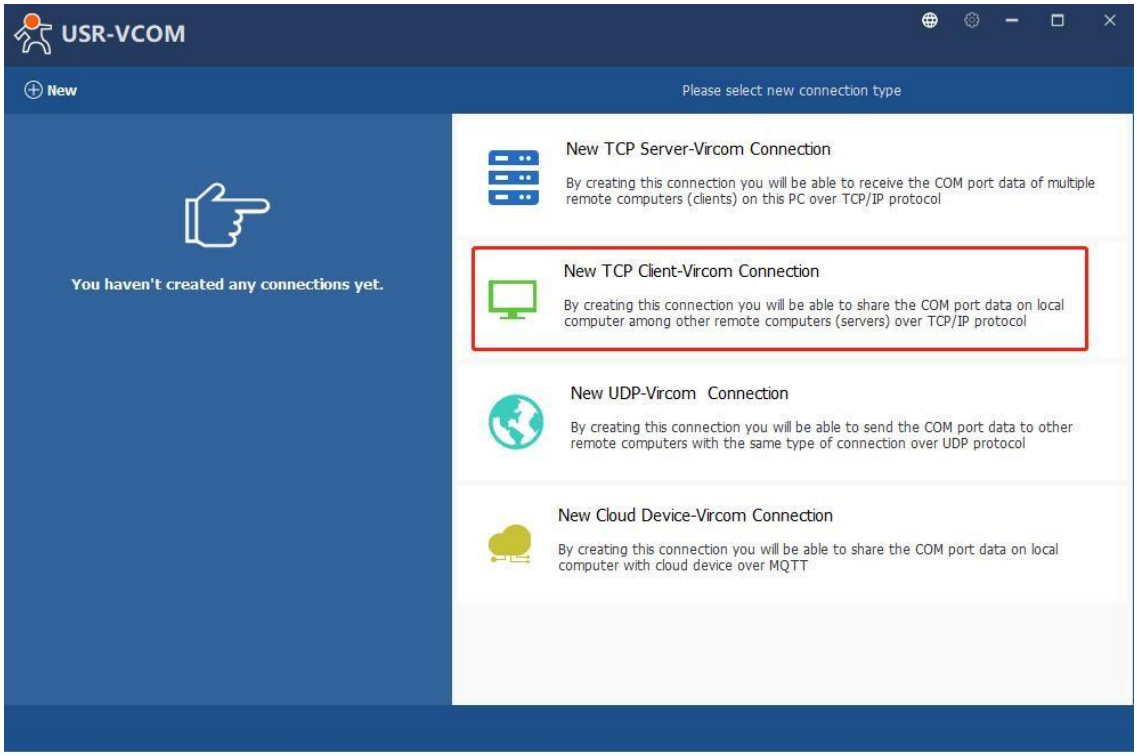


Fig.70 New Virtual COM connection

2. Select one COM port as the Virtual COM port before proceeding as shown in Fig.71. Note that if a COM port number is used by other application or your operating system, you can not select it.

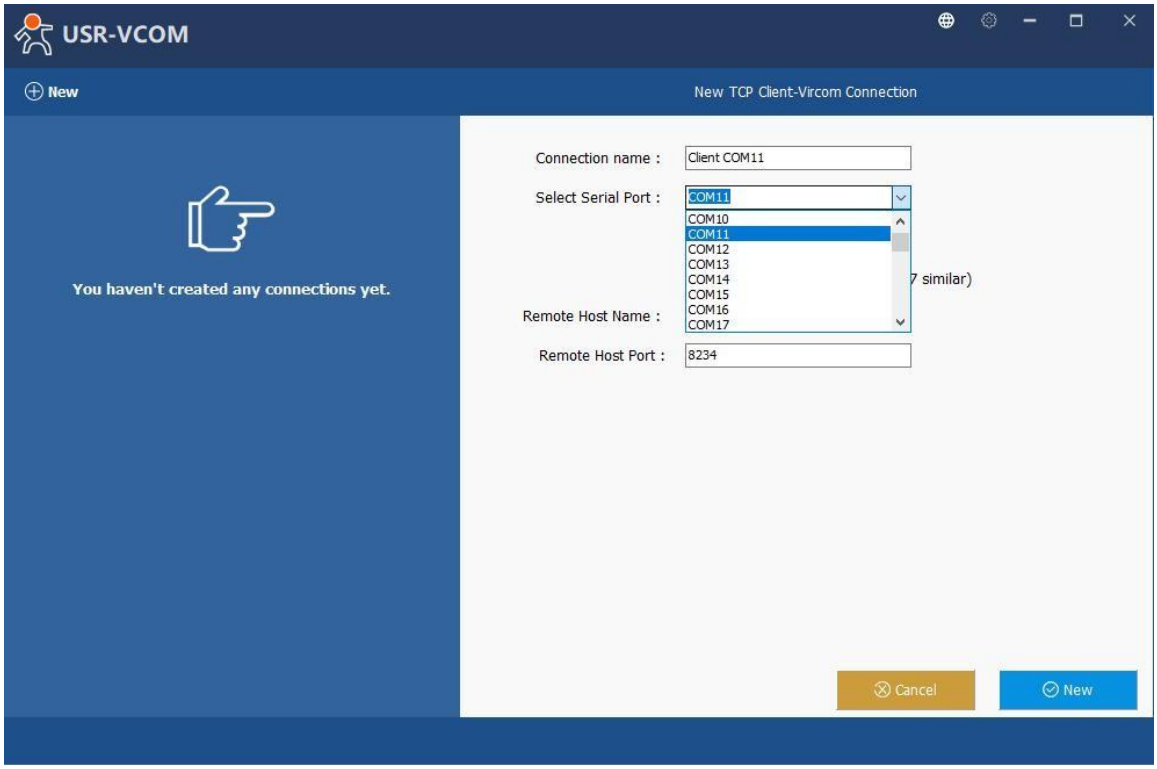


Fig.71 Select one COM port

3. After selecting the virtual COM ports, please enter the IP Address of the serial device server with the specified Port Number. The Port Number here is the Local Listening Port for the serial device server which is specified in the Local Port field of Fig.72

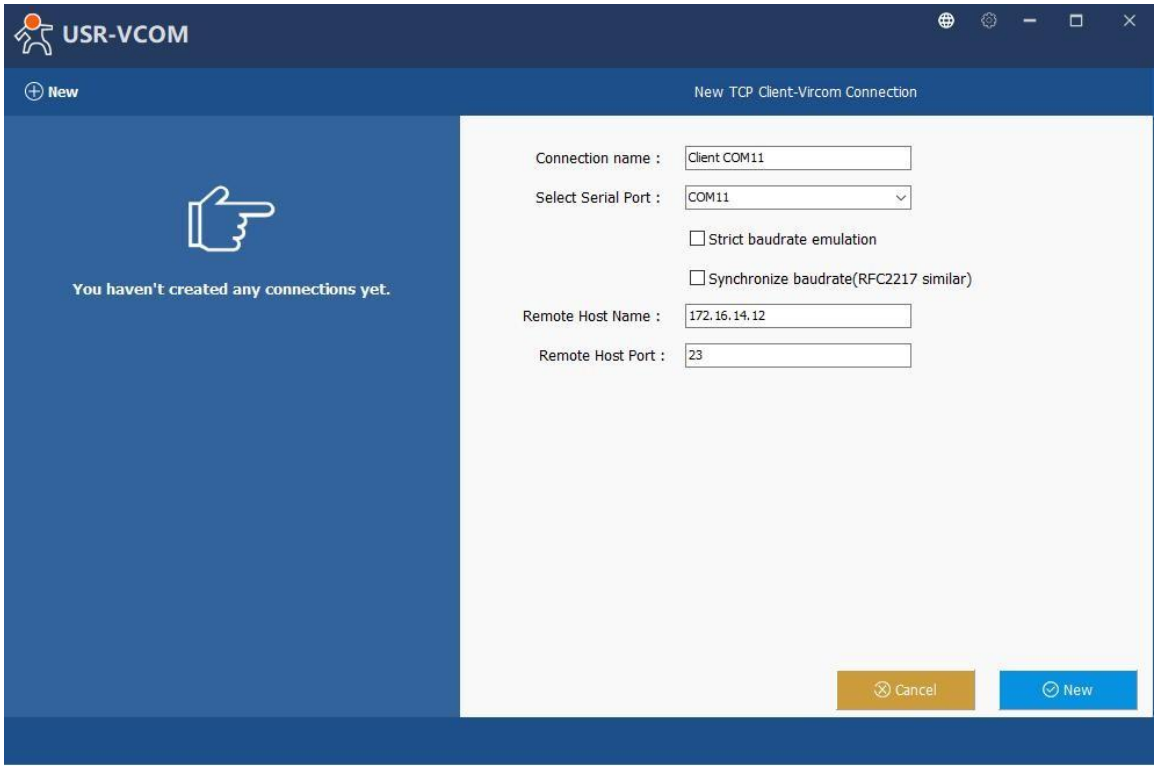


Fig.72 Virtual COM port mapping

4. Click new to add the Virtual COM11. Click client COM11 on the left side of VCOM panel to check the status. If status become connected, the process is completed.

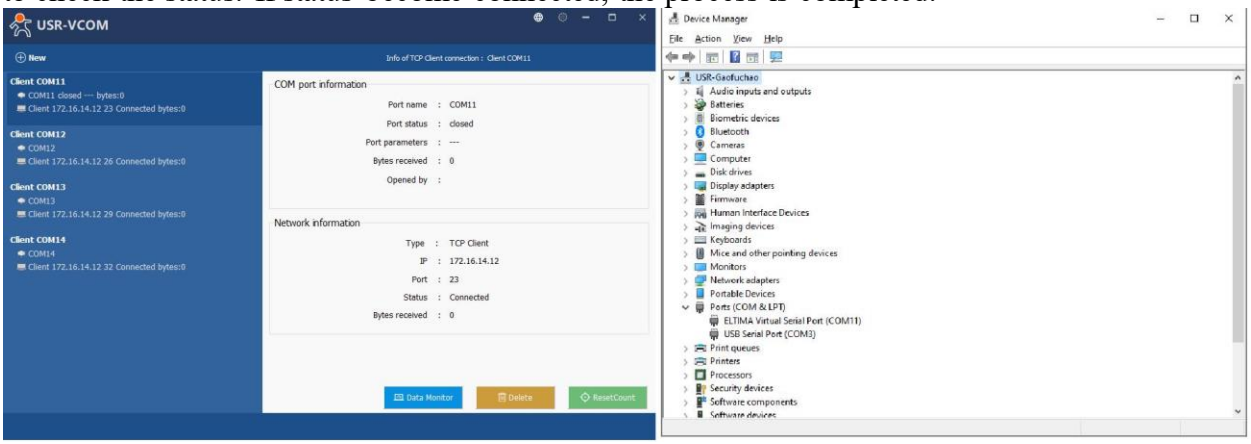


Fig.73 Virtual COM11 status

5.2 TCP Client Application with Virtual COM

1. If the serial device server is running in TCP Client Mode, the VCOM utility on the host computer should be configured as the TCP server waiting for a serial device server to connect to the host computer. The feature of this mode is that the IP address of the computer cannot be changed, but the IP address of the serial device server can be changed (which can be automatically assigned by the router).

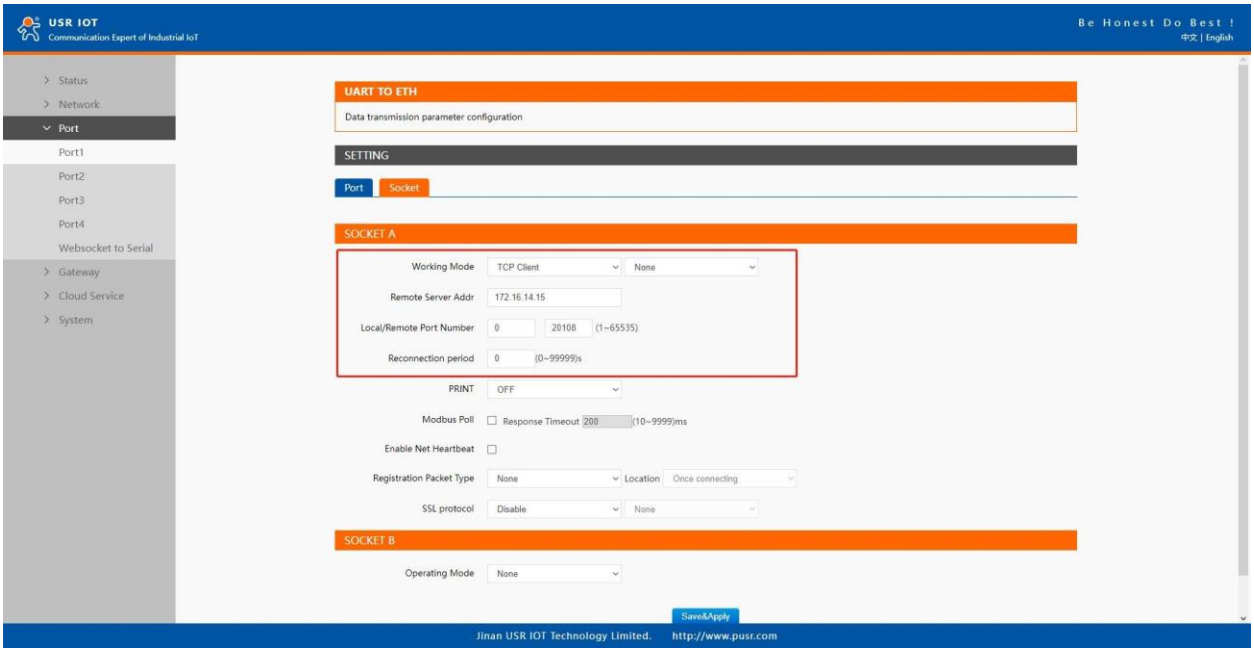


Fig.74 TCP client mode in USR-N5X0

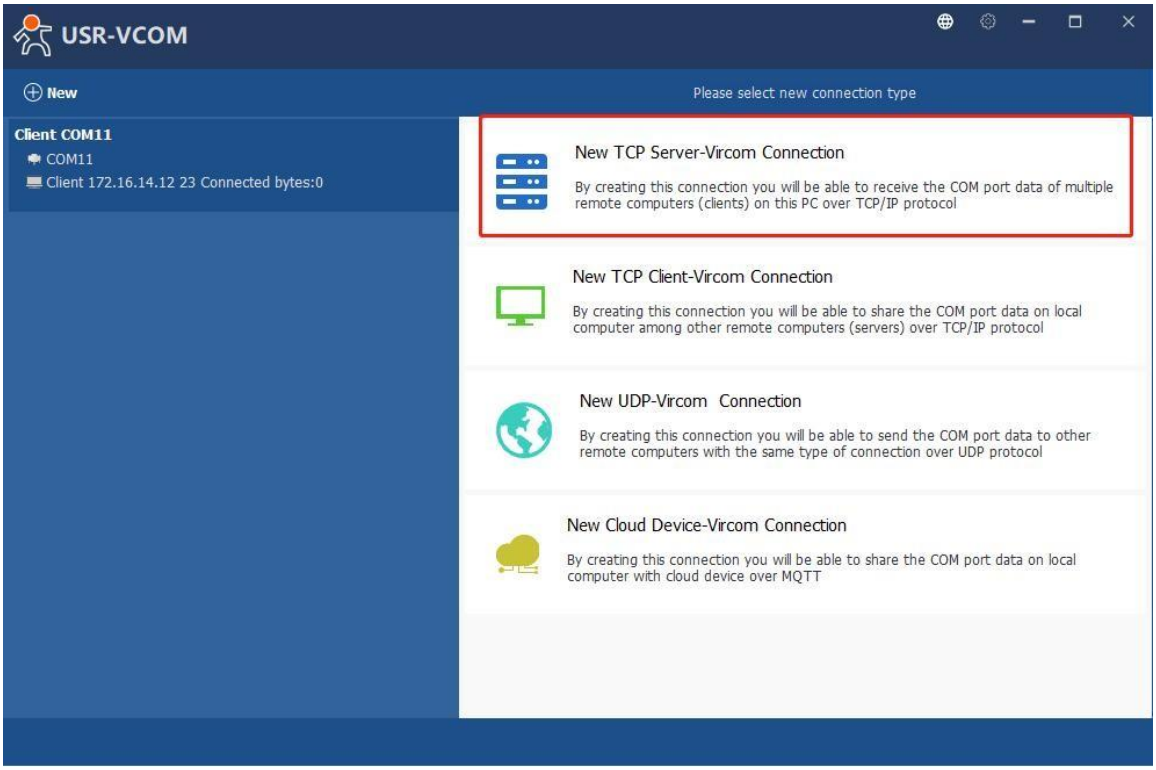


Fig.75 New Virtual COM connection

2. Select one COM port as the Virtual COM port before proceeding as shown in Fig.76. Note that if a COM port number is used by other application or your operating system, you can not select it.
3. After selecting the virtual COM ports, please enter the specified Port Number. This Port Number is the Destination Port of the serial device server.

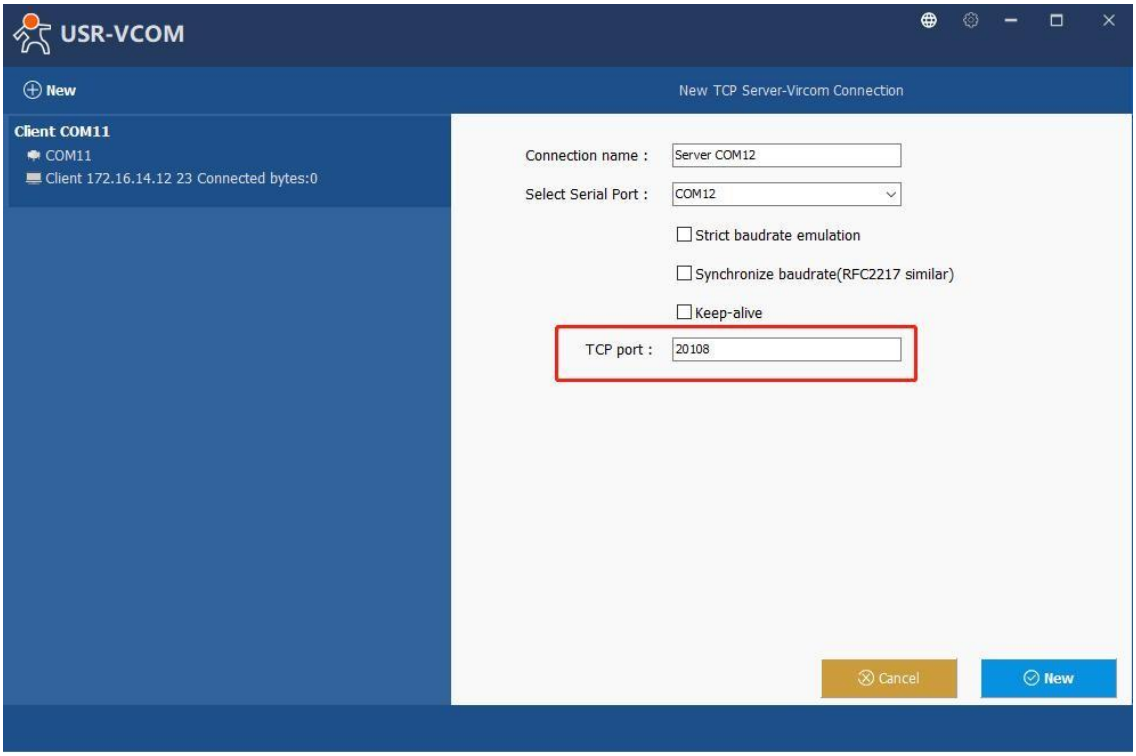


Fig.76 Virtual COM port mapping

4. Click new to add the Virtual COM12. Click client COM12 on the left side of VCOM panel to check the status. If status become connected, the process is completed.

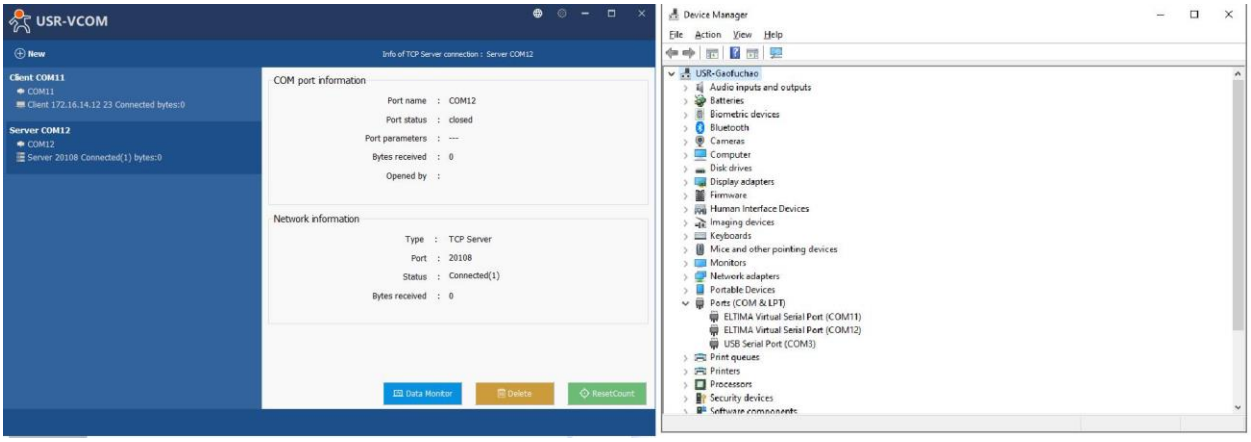


Fig.77 Virtual COM12 Status

5.3 Enable RFC2217 through Virtual COM

Enabling this function allows users to use customized RFC2217 commands on the network to dynamically modify the serial port's baud rate, data bits, stop bits, and parity bits. This function is only allowed when the working mode is TCP Server and TCP Client. Note that this protocol is used to change the serial port parameters of USR-N5X0.

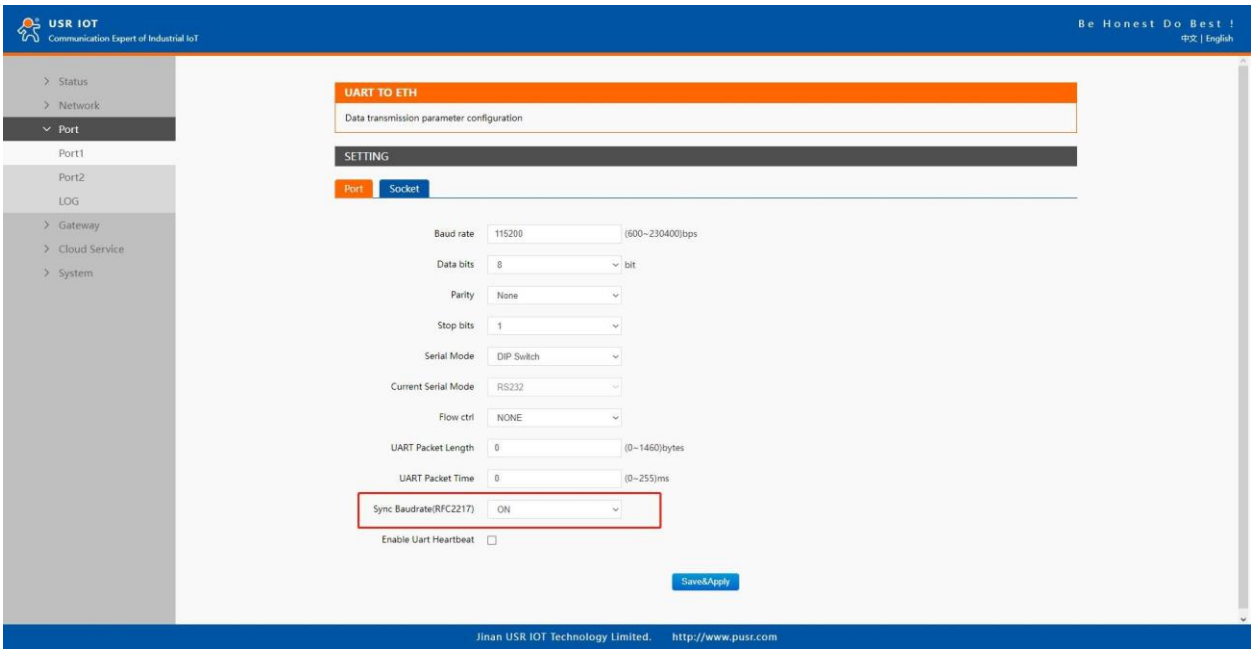


Fig.78 RFC2217 enabled

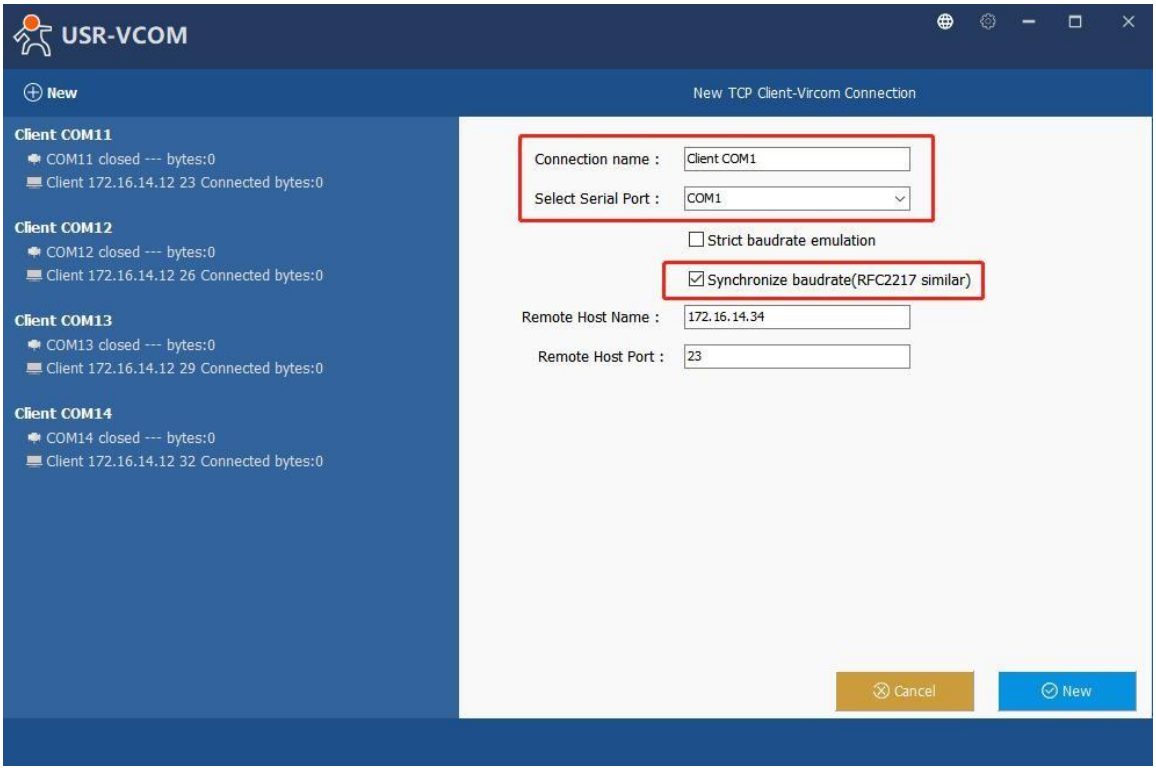


Fig.79 enable RFC2217 in VCOM

When we change serial parameters in Virtual COM port 1, we can see these parameters have took effect in serial port of USR-N5X0.

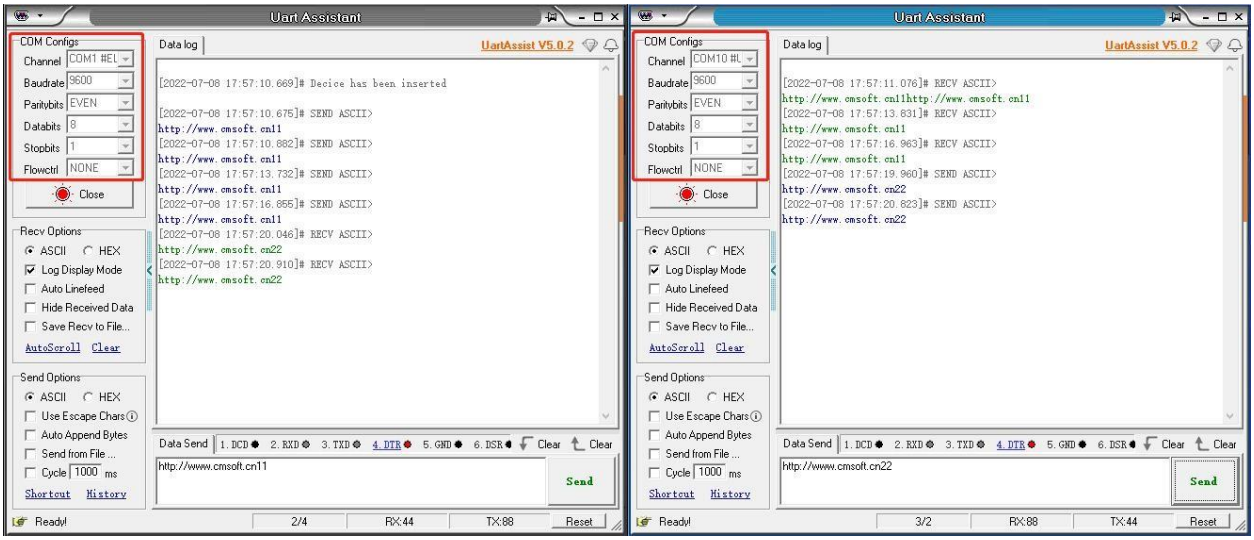


Fig.80 Synchronizing serial port parameters

5.3.1 PUSR customized RFC2217 protocol

Table 22 Com Port Control Commands

Name	Header	Baud rate	Serial parameter definition	Sum check
Length(bytes)	3	3	1	1
Description	Fixed	Big endian, e.g. 600 (00 02 58)	Data bits/stop bits/ parity bits setting. As shown in the table 23 below	Check sum of 4 bytes of baud rate and serial parameter definition, retain the least significant byte
115200,N,8,1	55AA55	01C200	03	C6
9600,N,8,1	55AA55	002580	03	A8

Table 23 Serial Parameter definition

Bit Position	Function	Value	Description
1:0	Data bits	10 11	7 Data bits 8 Data bits
2	Stop bits	0 1	1 Stop bits 2 Stop bits
3	Parity bit enable	0 1	Disable the parity bit Enable the parity bit
5:4	Parity bit type	00 01 10 11	ODD EVEN Mark Space
7:6	undefinition	00	Please write 0

6. Modbus TCP/RTU gateway

Modbus is one of the most popular automation protocols in the world, supporting traditional RS-232/422/485 devices and recently developed Ethernet devices. Many industrial devices, such as PLCs, DCSs, HMIs, instruments, and meters, use Modbus as their communication standard. In industrial applications, the most common protocol conversion is Modbus RTU to Modbus TCP conversion, and it is usually required when legacy devices such as meters, mostly using Modbus RTU, need to be integrated with SCADA systems, mostly using Modbus TCP. Most modern PLCs and host computers support Modbus TCP over Ethernet. In order to access discrete Modbus RTU devices for data collection and control, they can rely on the N5X0 Modbus gateway. When connecting up Modbus devices via an RS485 network they should be daisy chained together, and a dual twisted pair cable are recommended. The connections should be kept the same throughout the network: positive to positive, and negative to negative. These may sometimes be labelled up as A and B. When wiring Modbus serial devices there is a limit of 32 per network, the master device takes up an address on the network. The maximum length of the serial network cannot exceed 1200m regardless of boosters and repeaters.

6.1 Ethernet masters with serial slaves

When the host computer or PLC is Modbus TCP Master, the Modbus TCP function must be enabled, the remote device must work in Modbus RTU Slave mode. The N5X0(TCP Server mode) supports Modbus TCP with up to 16 simultaneous connections. The serial interface supports both RS-232 and RS-422/485, selectable through software. Each serial port can be connected to one RS-232 or RS-422 serial device, or to 32 RS-485 serial devices. When connected with more than one RS485 devices, please refer to section 7.5 for bus collision direction.

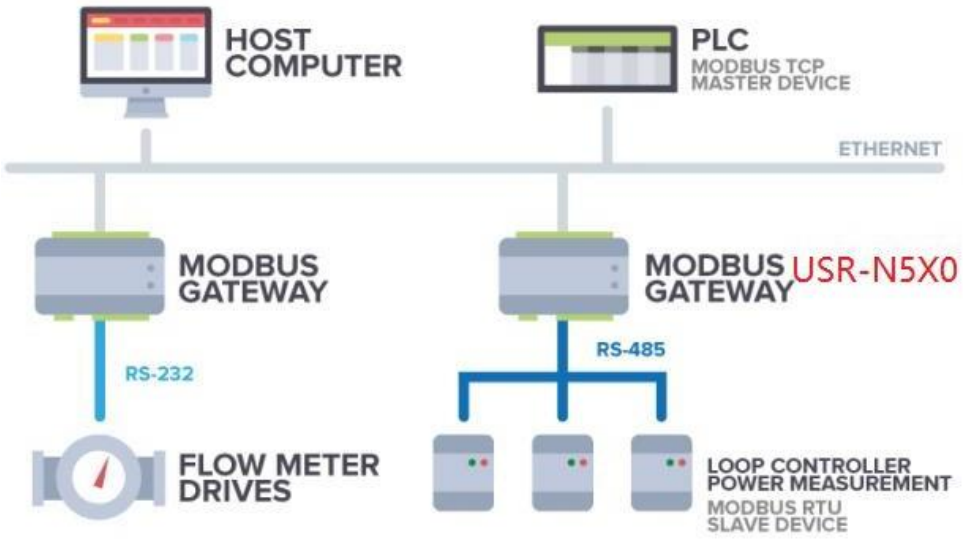


Fig.81 Ethernet masters with multiple serial slaves

The device supports multiple hosts to query data from the slave in q&A mode. Please select modbus polling function as shown in Fig.82. When USR-N5X0 Series serial device server does not receive a response from the serial port after a response timeout, the device replies with an acknowledgement and then processes the next host request. When you need to use long frame data frequently or have high data transmission requirements, please adjust the baud rate and lengthen the sending interval appropriately to prevent the slow serial port from causing messy codes or packet loss.

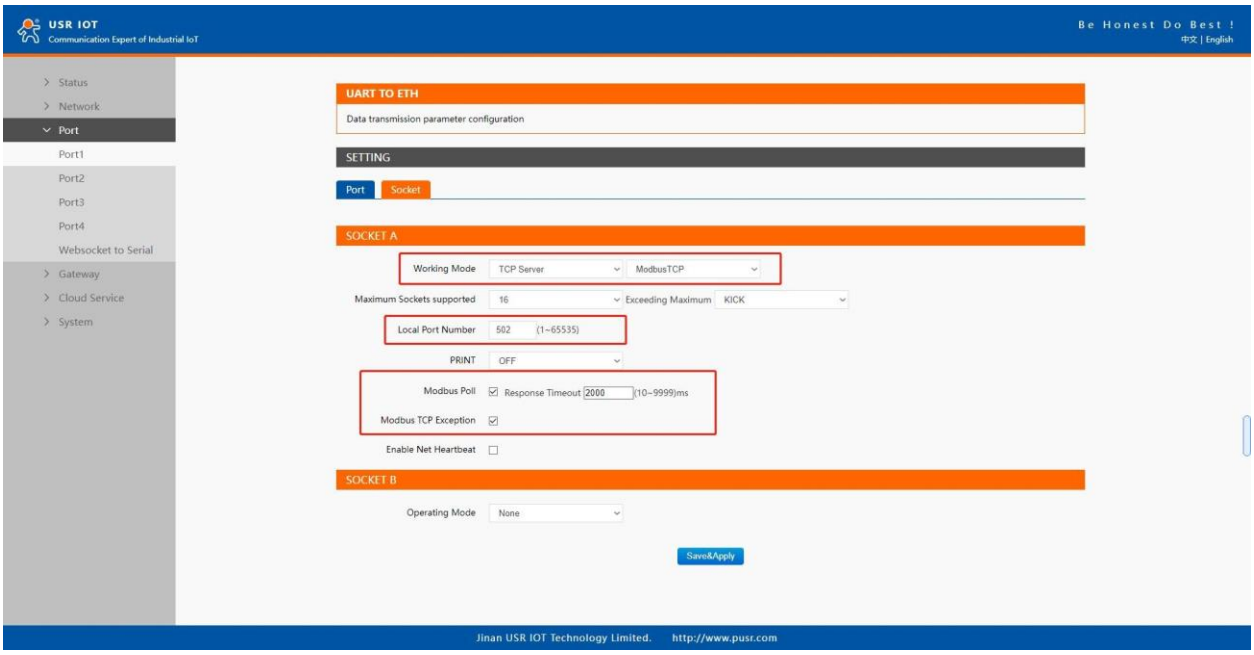
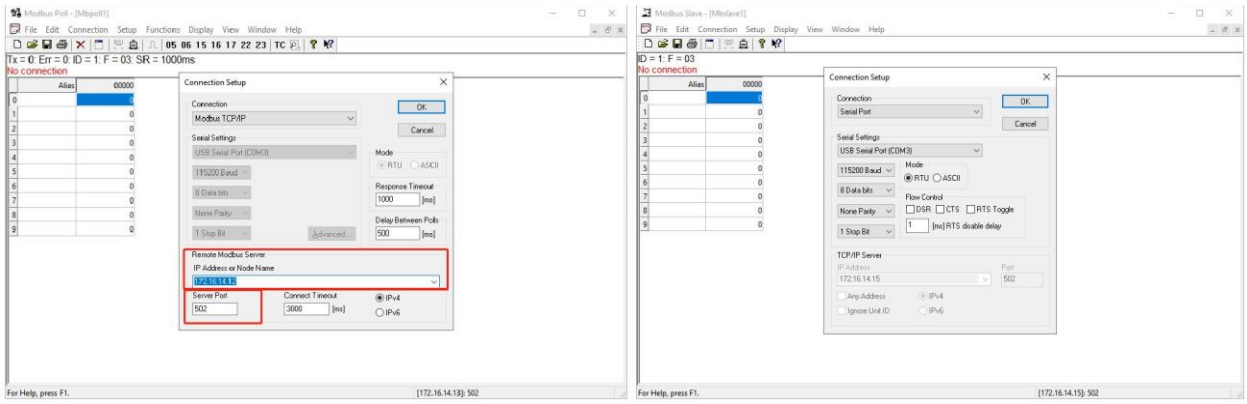


Fig.82 Modbus TCP master settings

Open the Modbus Poll and Modbus Slave software, go to "Connect" -> "Connect", and the connection parameters are configured as follows, in this case, IP address of USR-N5X0 is 172.16.14.12.

Fig.83 Modbus emulator settings



6.2 Serial master with Ethernet slave

Many HMI (Human Machine Interface) systems use a serial interface to connect to a discrete DCS (Data Control System). However, many DCSs are now Ethernet-based and operate as a Modbus TCP server device. The N5X0 Modbus gateway can link a serial-based HMI to distributed DCSs over an Ethernet network. When the host computer or HMI is Modbus RTU Master, if the remote device work in Modbus TCP Slave mode, the Modbus function must be enabled. The N5X0(TCP Client mode) supports only one Modbus TCP slave.

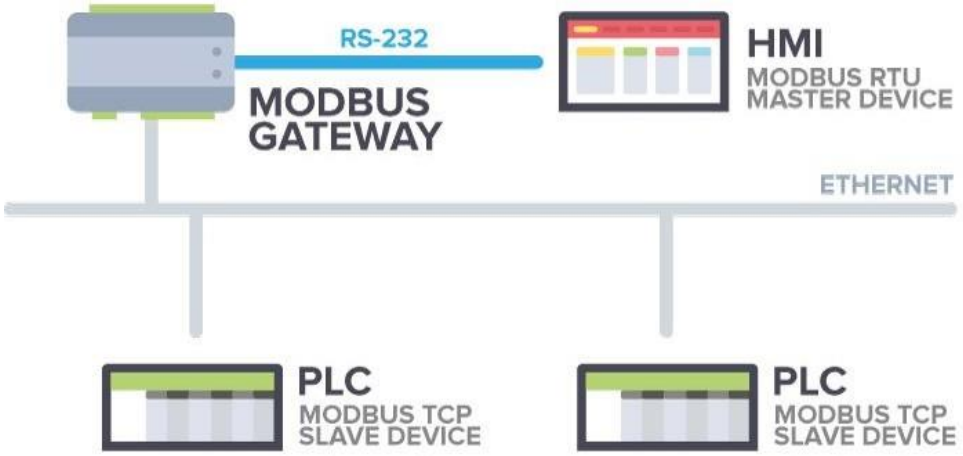
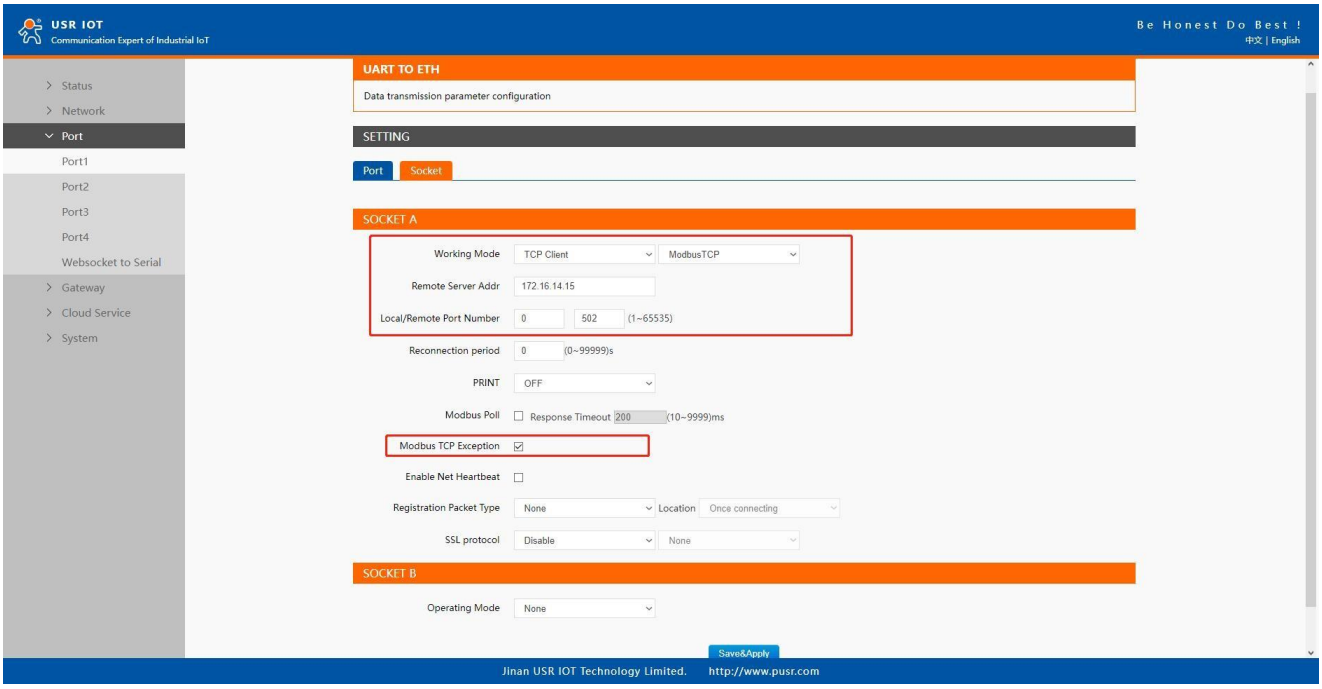


Fig.84 Serial master with one Ethernet slave

Fig.85 Modbus TCP slave settings



Open the Modbus Poll and Modbus Slave software, go to "Connect" -> "Connect", and the connection parameters are configured as follows, in this case, IP address of USR-N5X0 is 172.16.14.12, host IP address is 172.16.14.15.

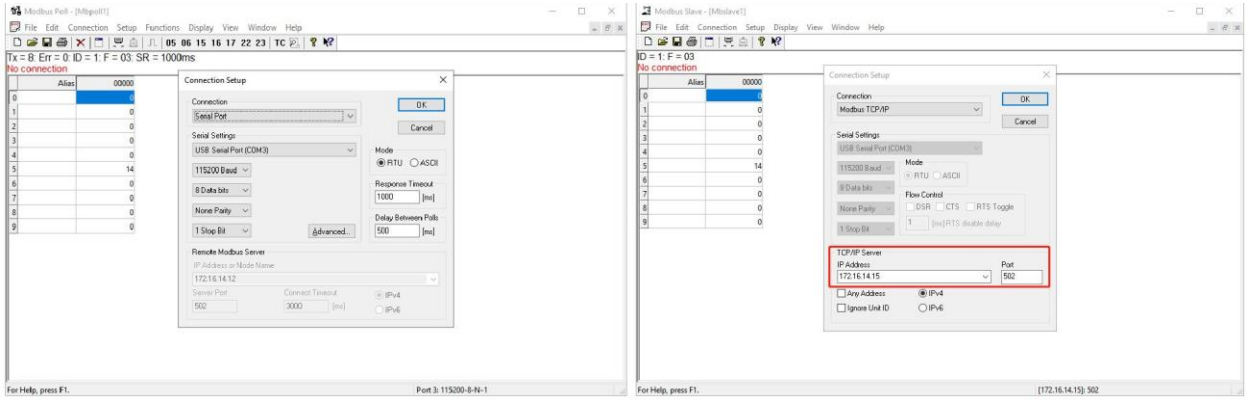


Fig.86 Modbus emulator settings

6.3 Serial master with serial slaves

When the HMI is Modbus RTU Master, all N5x0 must enable or disable ModbusTCP function at the same time, the remote device must work in Modbus RTU Slave mode. The N5X0 supports up to 16 simultaneous TCP connections.

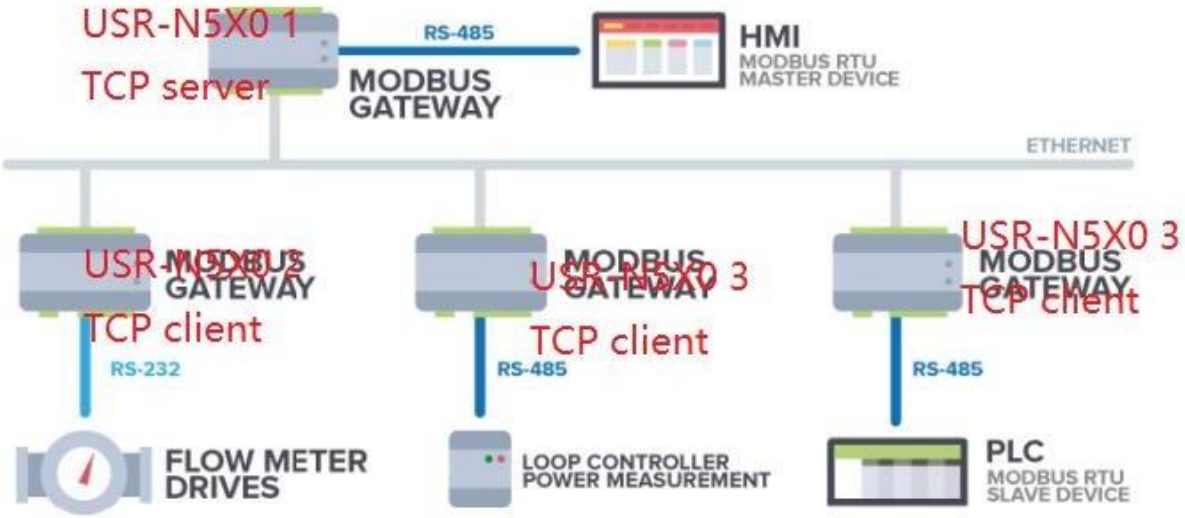


Fig.87 Serial master with multiple serial slaves

If there are more than one serial masters in RS485 network, users should select modbus poll function and configure response timeout in Fig.88. please refer to section 7.5 for bus collision detection.

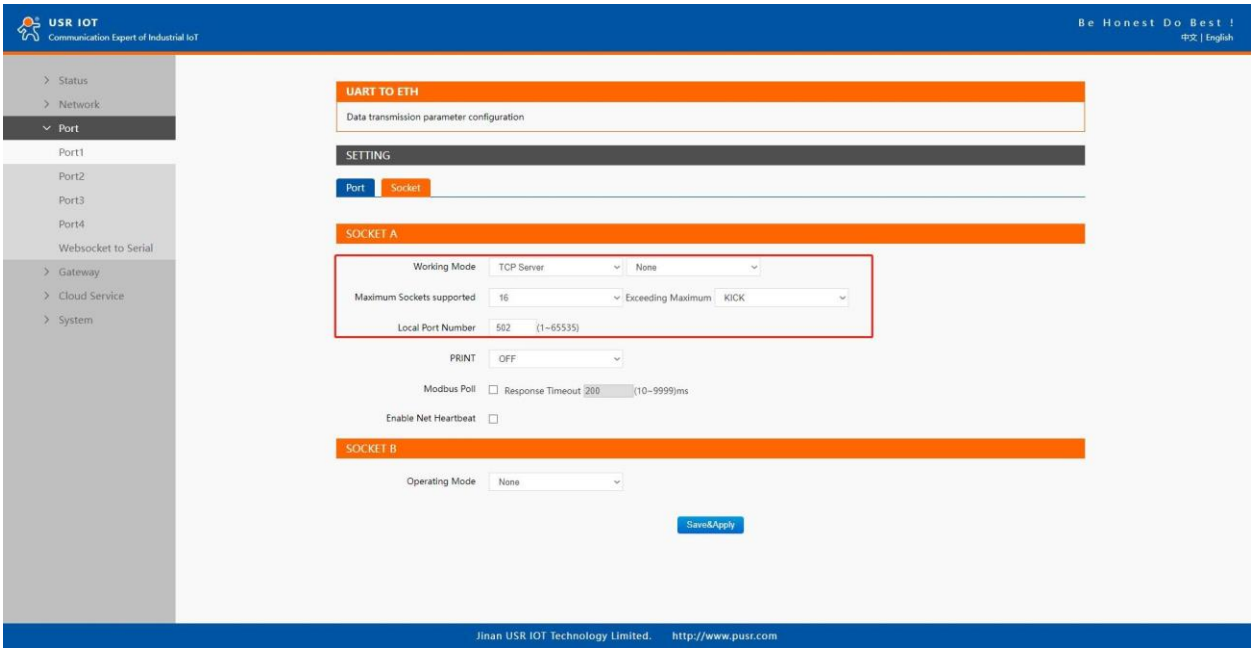


Fig.88 Modbus RTU masters settings

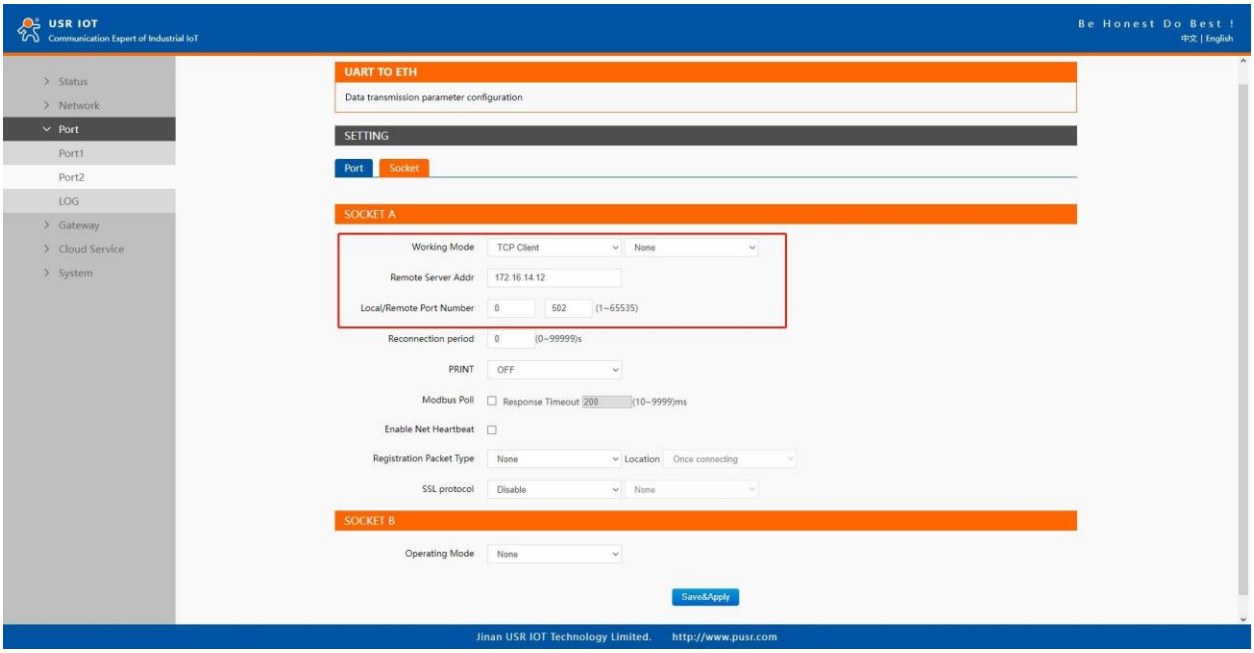


Fig.89 Modbus RTU slave settings

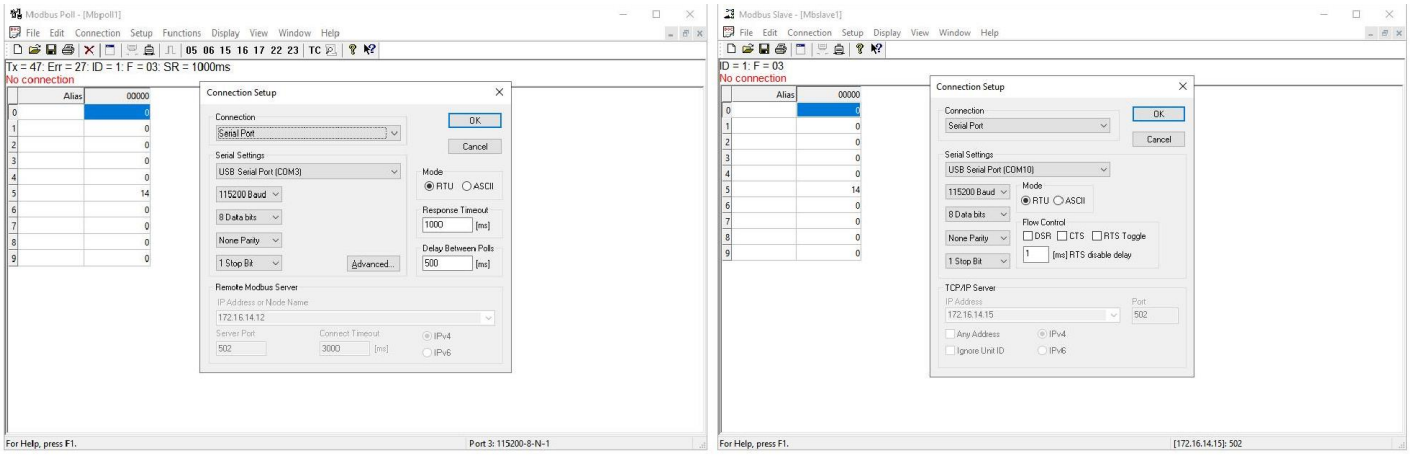


Fig.90 Modbus emulator settings

6.4 Serial master via virtual COM with serial slaves

When the host computer is Modbus RTU master, if we use VCOM, the Modbus TCP function must be disabled, the remote device must work in Modbus RTU Slave mode.

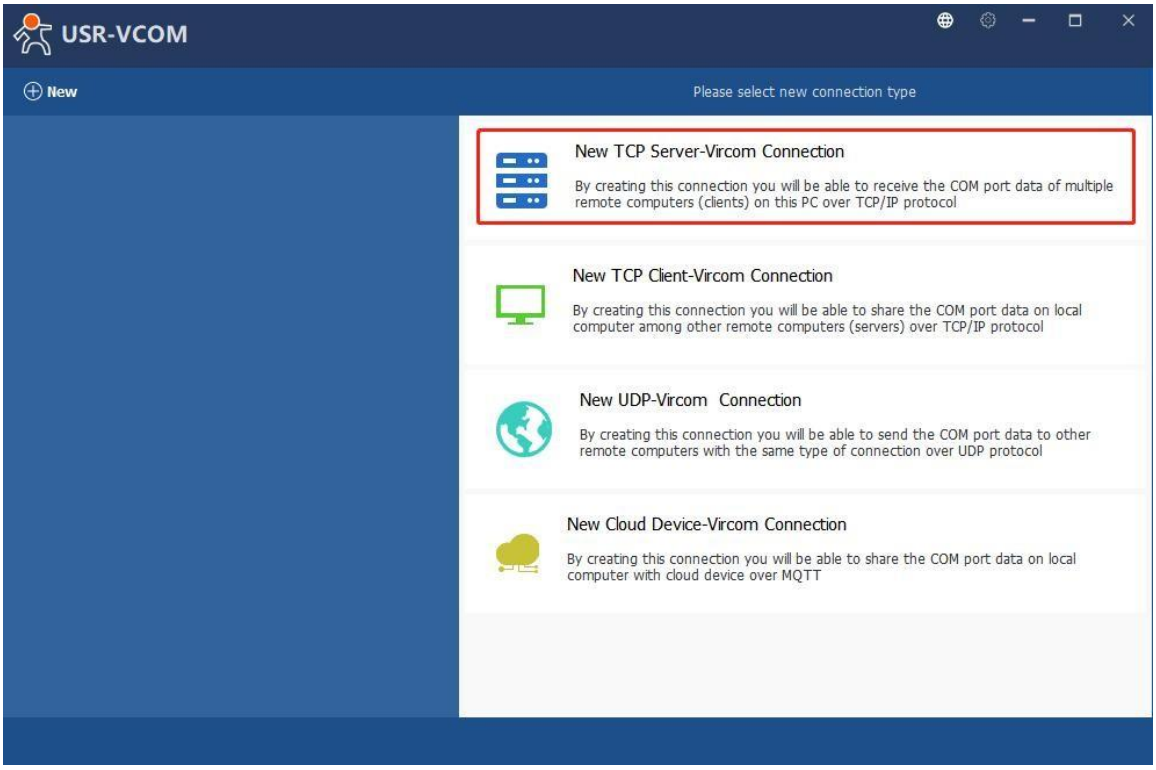


Fig.91 New virtual COM port mapping

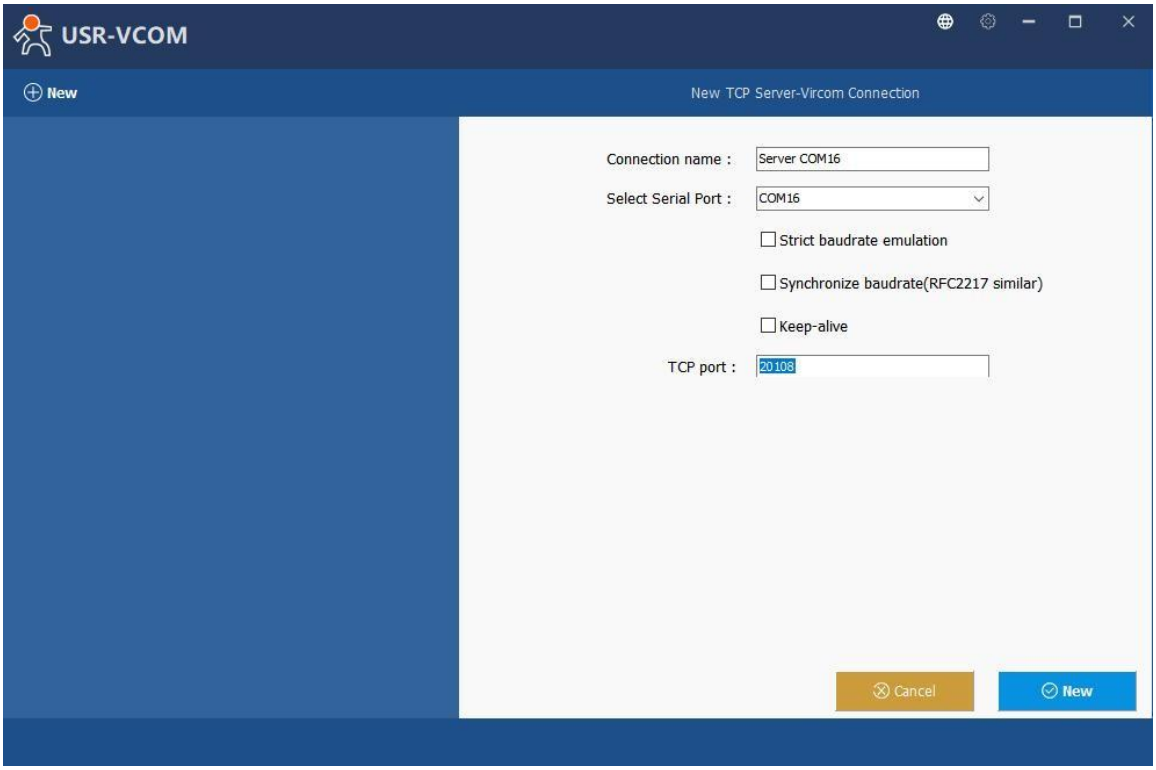


Fig.92 Mapping a virtual COM port

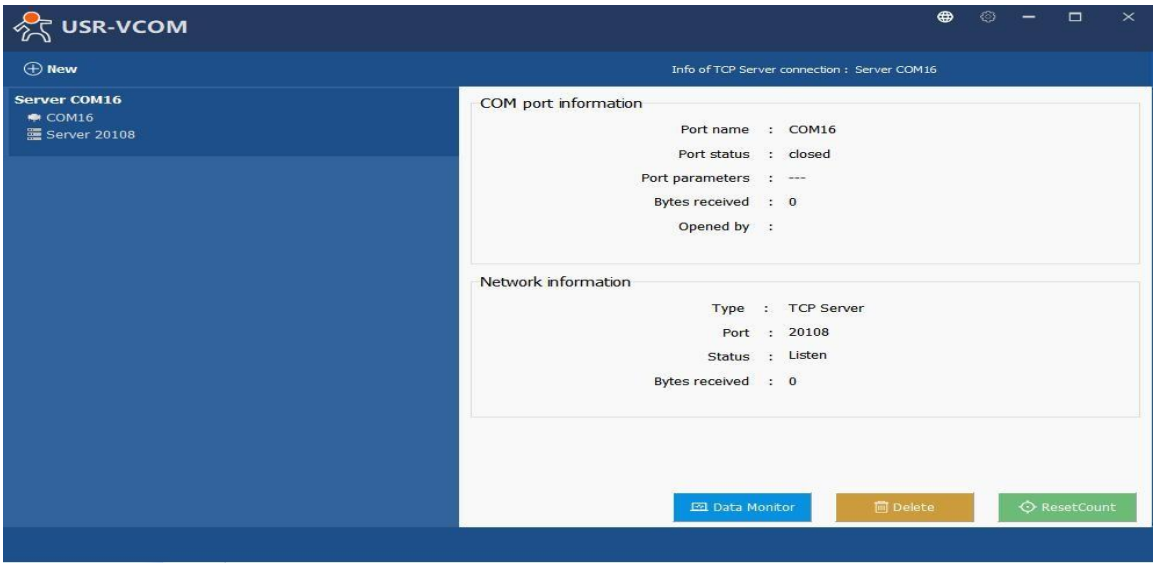


Fig.93 Virtual COM port mapping details

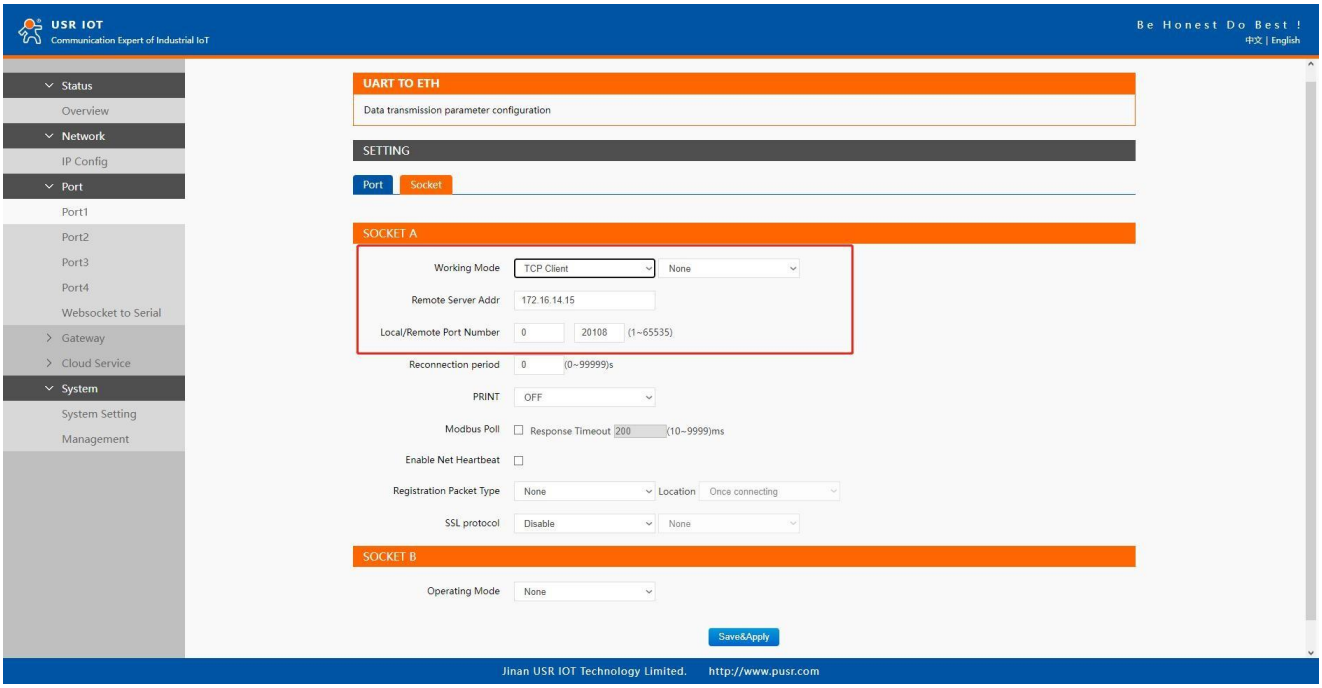


Fig.94 Serial device settings

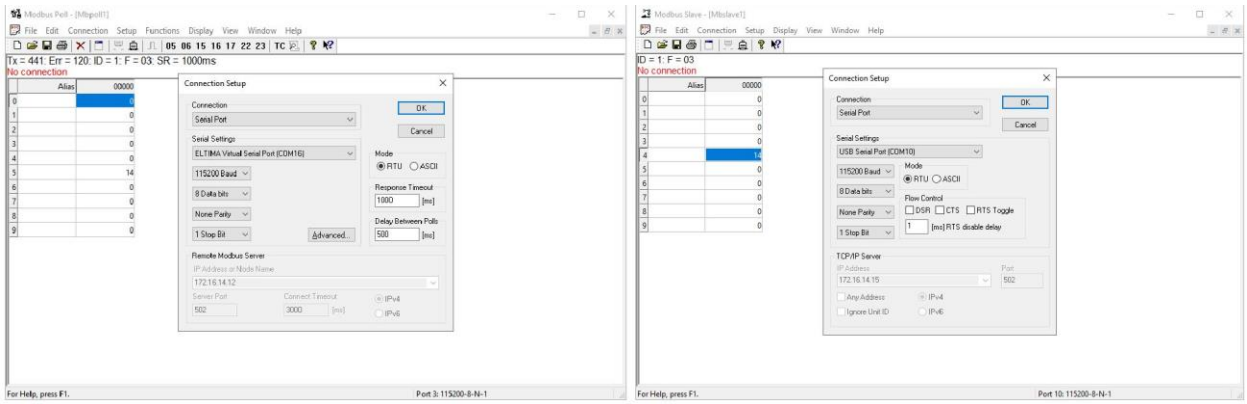


Fig.95 Modbus emulator settings (Serial master and serial slave)

6.5 Modbus poll with serial heartbeat packet

When the N5X0 is Modbus RTU Master, the serial device work in Modbus RTU Slave mode, the ModbusTCP function must be disabled. N5X0 works in TCP server mode, it supports up to 16 TCP connections.

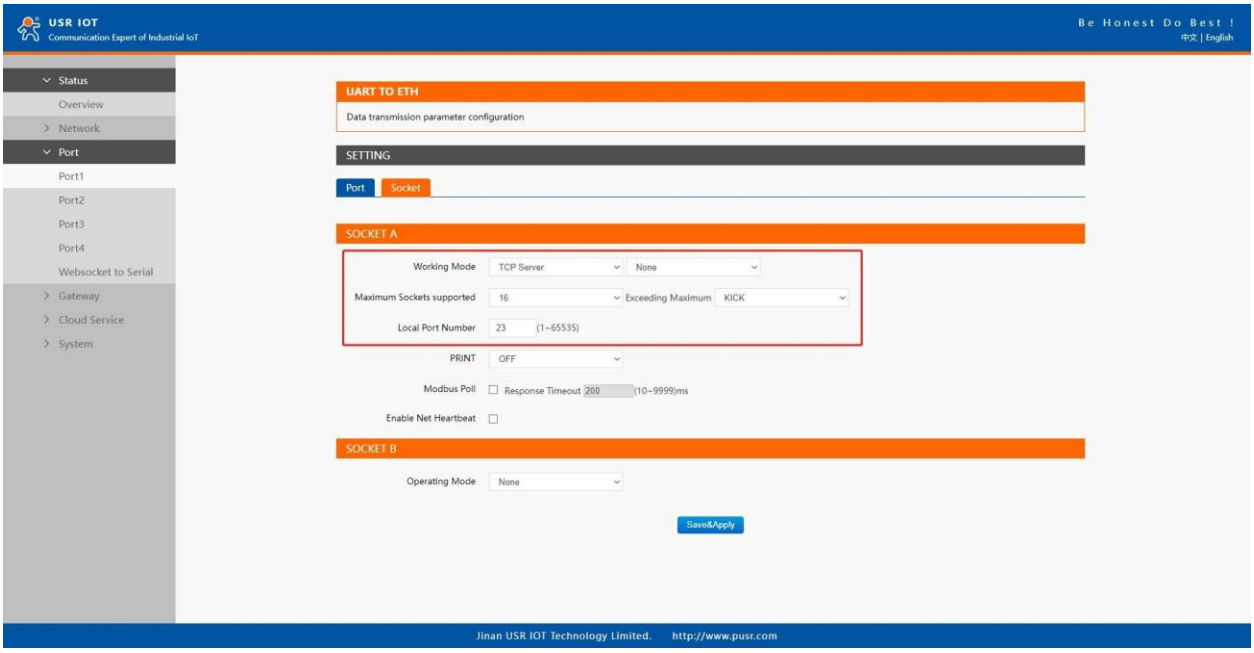


Fig.96 Modbus RTU master settings

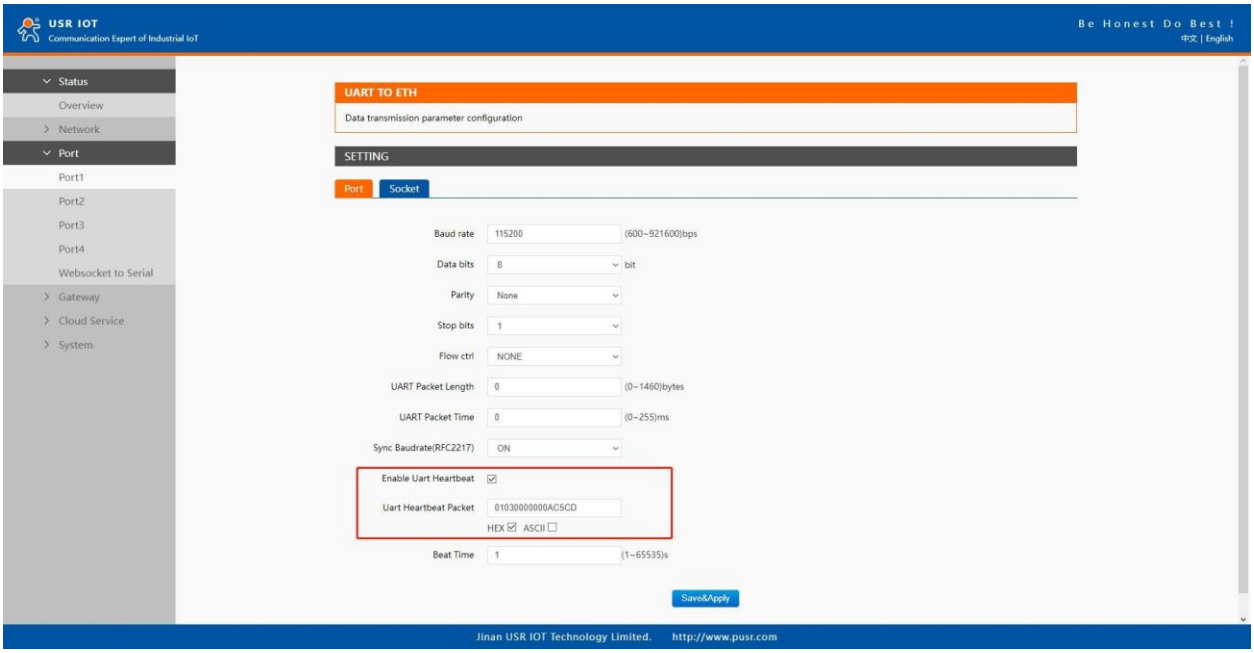


Fig.97 Serial heartbeat packet as modbus command

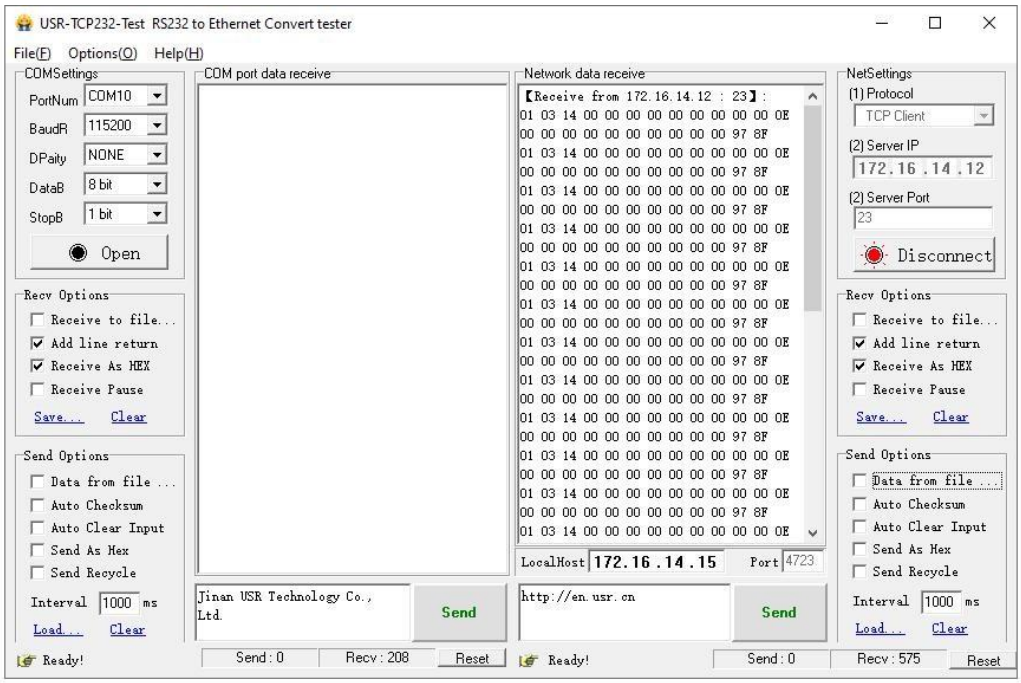


Fig.98 Modbus response transparently transmission

7. Advanced features

7.1 Packing mechanism

Serial to Network Packet Delimiter: Packet delimiter is a way of packing data in the serial communication. It is designed to keep packets intact. USR-N5X0 provides two types of delimiter: Time Delimiter, Maximum Bytes Delimiter. Note that the following delimiters (time, length) when they are selected are programmed in the OR logic. Meaning that if any of the two conditions were met, the device would transmit the serial data in its buffer over the network.

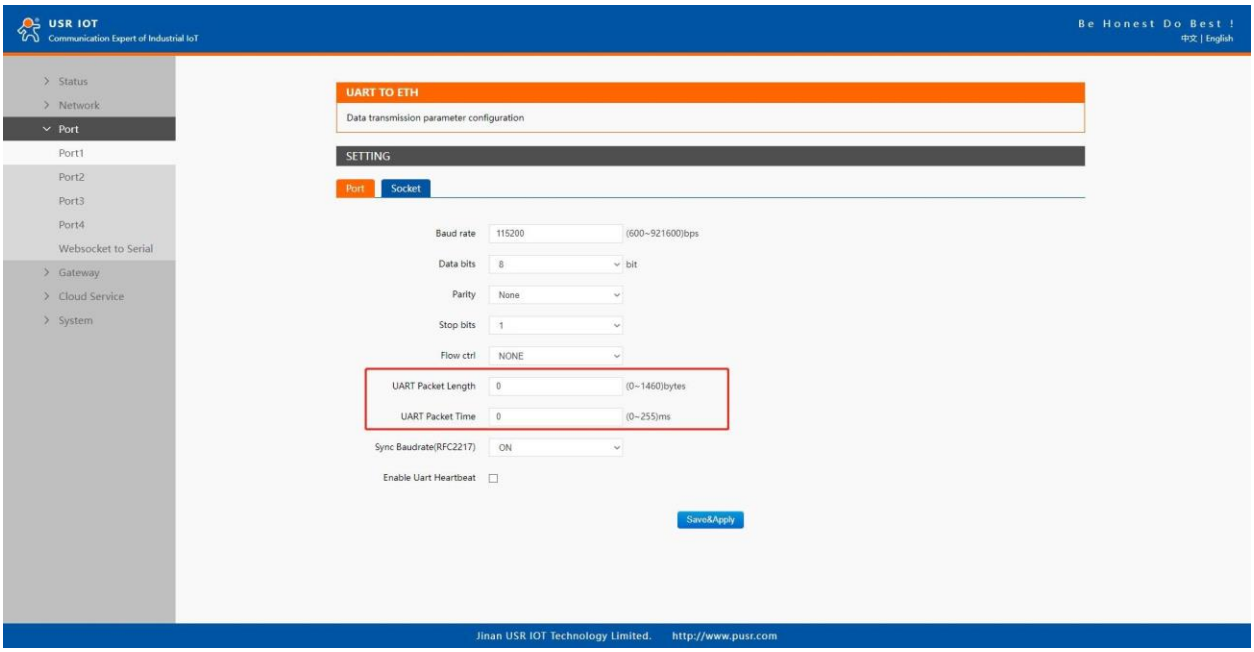


Fig.99 Data packing mechanism

Packet time: USR-N5X0 will transmit the serial data in its buffer when the specified time interval has reached and no more serial data comes in. The default value is calculated automatically based on the baud rate. If the automatic value results in chopped data, the timeout could be increased manually by specifying a larger value in the text box above. Note that the maximum interval is 255 milliseconds. This option is disabled by default. The optimal "Interval timeout" depends on the application, but it must be at least larger than one-character interval within the specified baud rate. For example, assuming that the serial port is set to 1200 bps, 8 data bits, 1 stop bit, and no parity. In this case, the total number of bits needed to send a character is 10 bits (included 1 start bit), and the time required to transfer one character is (10 (bits)/1200 (bits/s))*1000 (ms/s) = 8.3 ms. Therefore, you should set the "Interval timeout" to be larger than 8.3 ms. Rounding 8.3 ms to the next integer would give you 9 ms. Which can be set as your interval timeout. Packet length: USR-N5X0 will transmit the serial data in its buffer when the specified length in the unit of bytes has reached. If you would like USR-N5X0 to queue the data until it reaches a specific length,the

data length can be configured for 1 to 1460 bytes. If the data length (in bytes) matches the configured value, the data will be forced out. Set to 0 if you do not need to limit the length.

7.2 Heartbeat packet

Network heartbeat packet: The serial device server sends a heartbeat packet regularly to notify the server that it is active and maintains a normal network connection with the server. This function is only allowed when the working mode is UDP and TCP Client. Serial heartbeat packet: The serial device server notifies the serial device it is active via packet, and this packet can also be used to actively capture sensor data. Heartbeat packet only works in no data traffic in the setting direction. There are no data coming from serial port or internet in heartbeat interval.

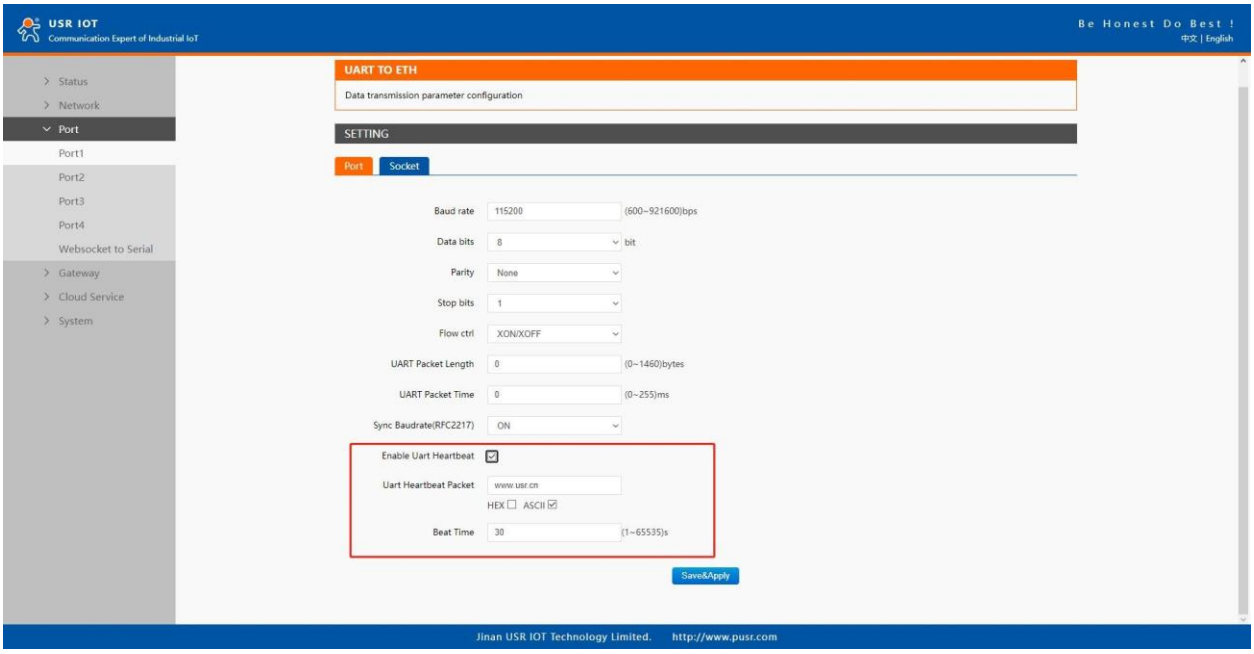


Fig.100 Serial heartbeat packets

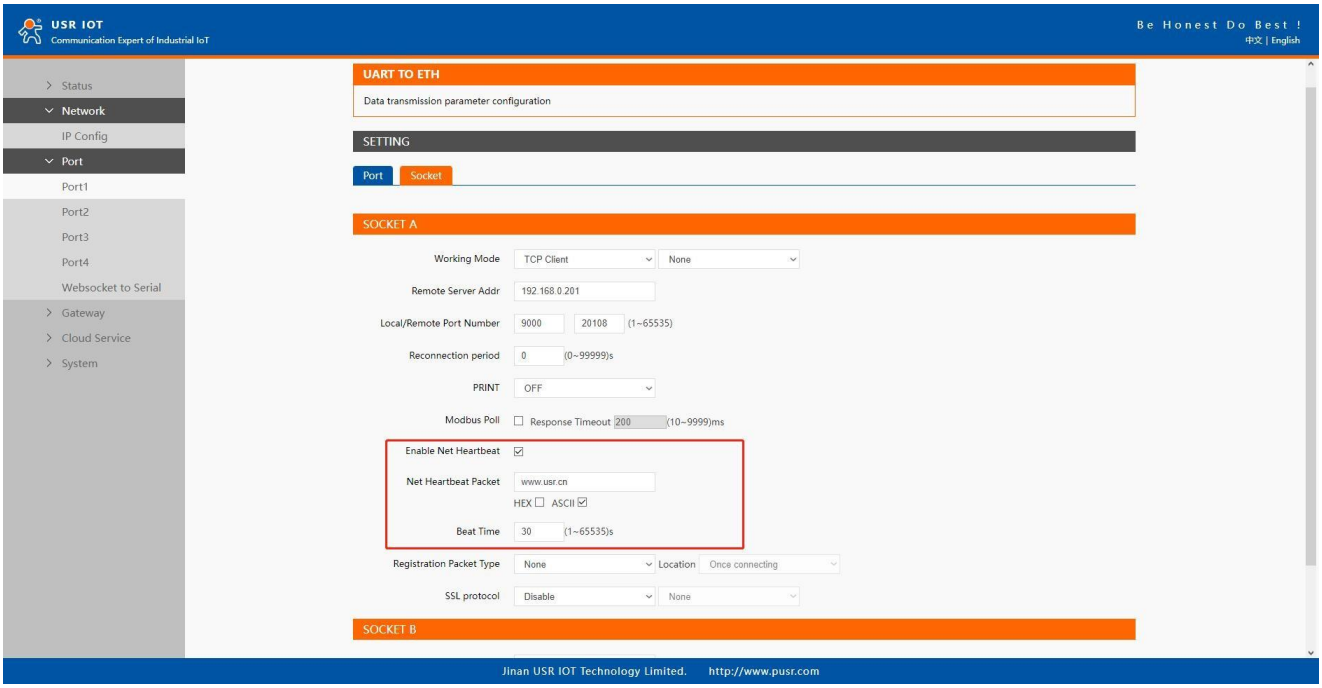


Fig.101 Network heartbeat packets

7.3 Registration packet

This function is only allowed when the working mode is UDP and TCP Client. The content of the registration packet can be up to 40 bytes long. Users can choose to display this content in hexadecimal format or ASCII format. Once connected: The registration packet is only sent once when the network connection is established; Prefix of DATA: The registration packet is filled in front of the serial port data every time the serial port sends data to the network.

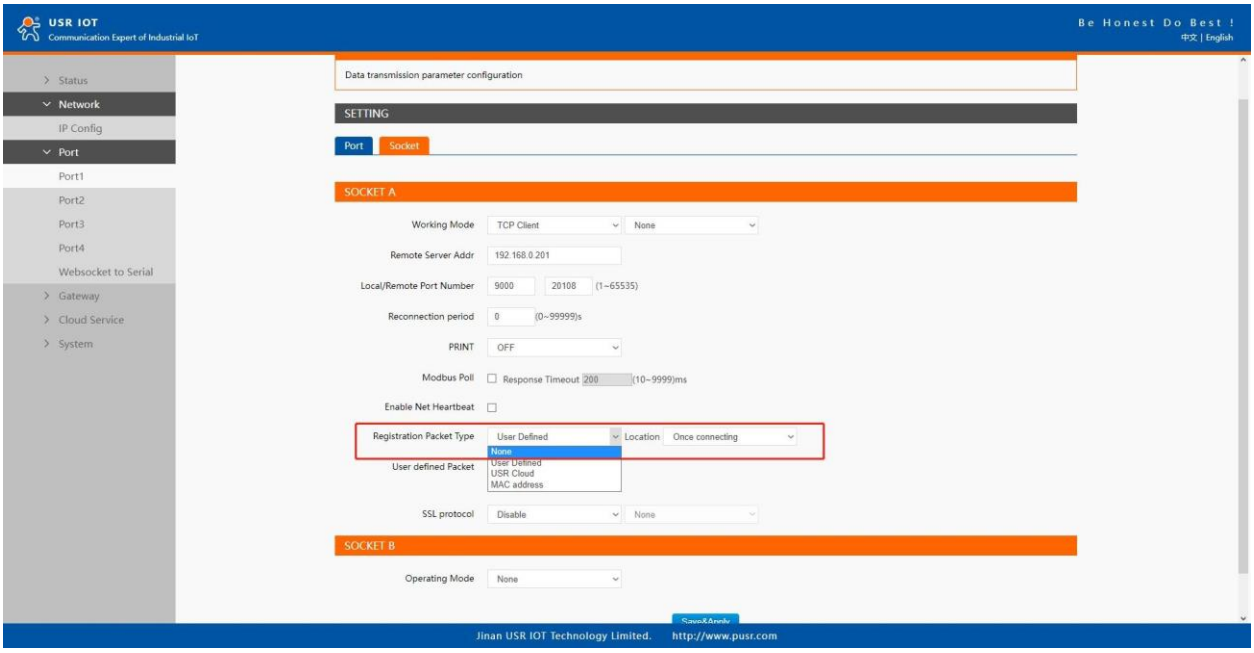


Fig.102 Registration packet type

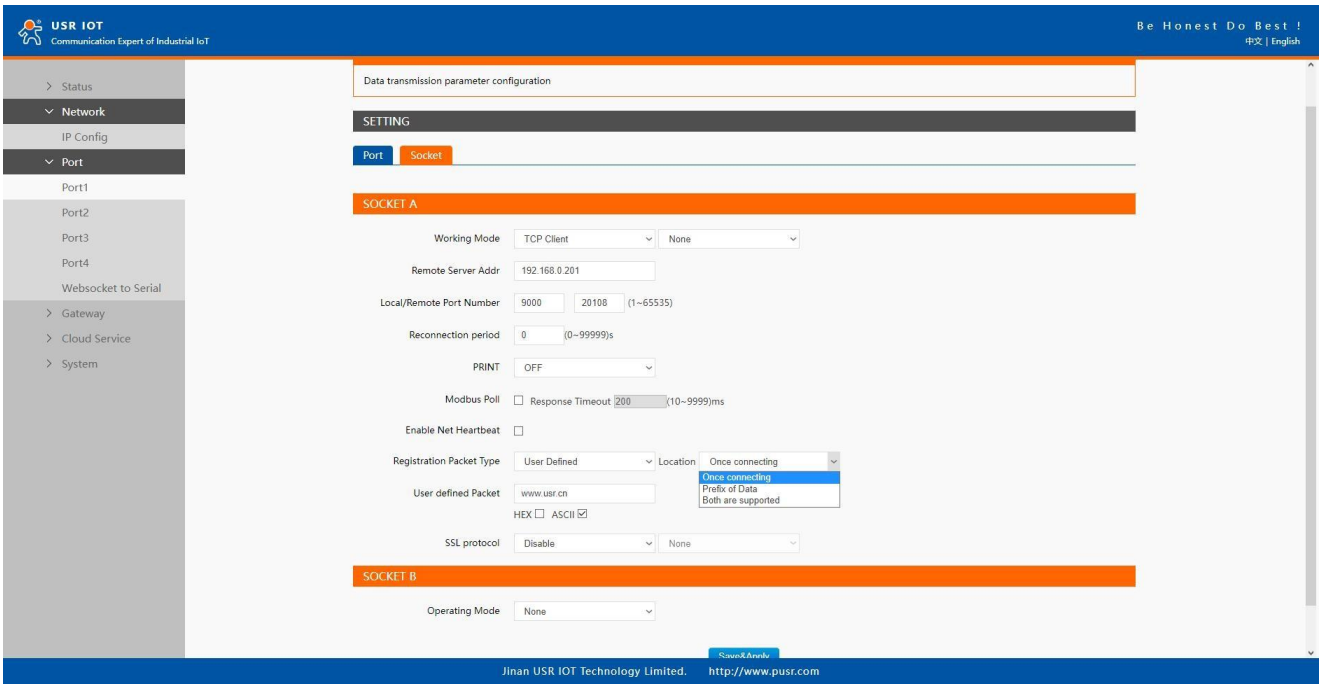


Fig.103 Registration packet method

7.4 Socket B

Socket B supports TCP Client and UDP Client. Socket B and Socket A share the registration packet and heartbeat packet. When Socket B initiates a connection, it uses a random local port number to connect to the target server.

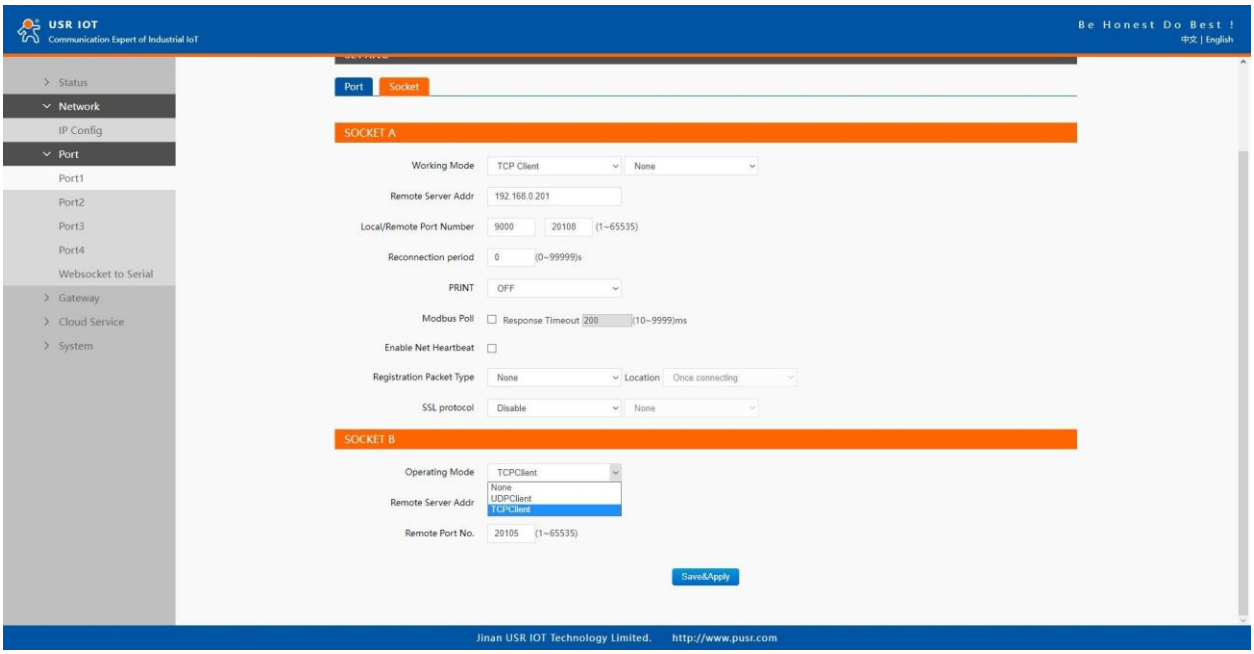


Fig.104 Socket B operating mode

7.5 Rs485 bus detection

If RS485 bus is in the receiving state, N5X0 can not output data to serial port to achieve the 485 bus anti-conflict function. Idle time: the interval time when N5X0 is allowed to send data to RS485 bus after the receiver is idle. The value ranges from 0 to 65535 (ms). Default value: 10. This parameter is mandatory.

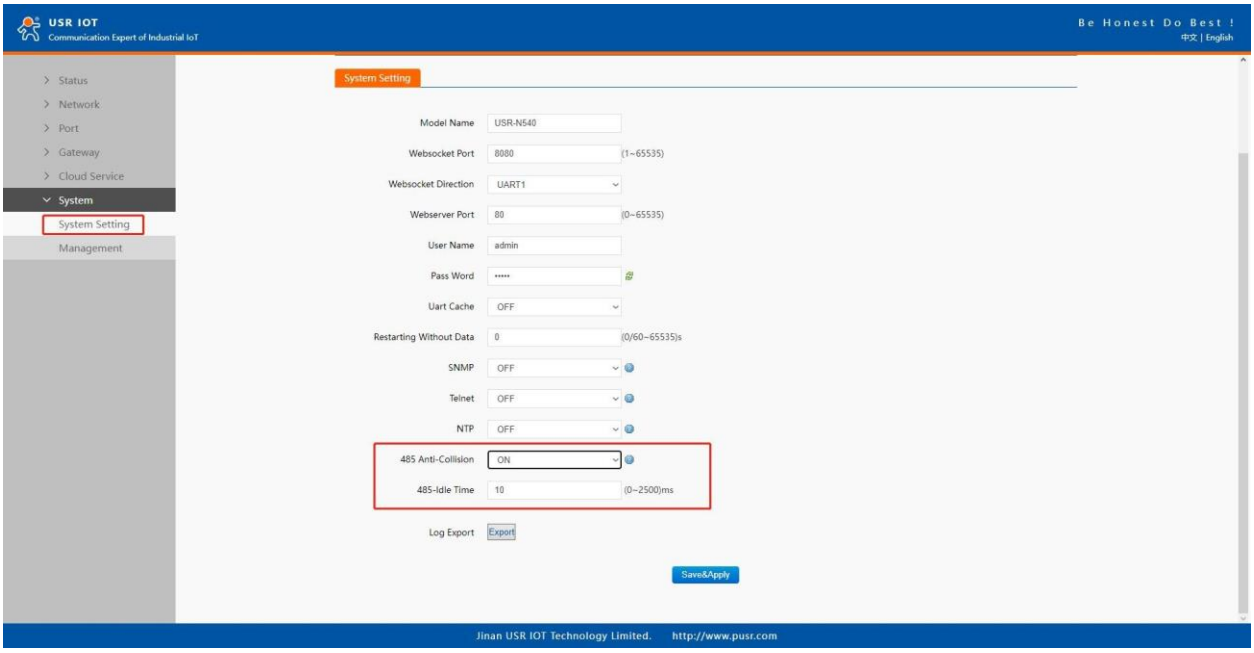


Fig.105 RS485 bus detection

7.6 Serial Printer setting

Serial device servers transform any serial device into an Ethernet-capable device that can be used in a network. These servers allow serial devices such as a printer, control mechanisms or control systems to be used in a network without relying on the serial port of a computer for connectivity. This way, any serial device can be connected to the network and the internet and accessed from anywhere. Sharing a printer among coworkers in the same physical office can be implemented with a simple serial server that does not need to offer security or authorization capabilities. The serial device server, N5X0, features a Serial Printer option which functions in similar fashion to the Serial Printer option in the (COM) Ports dialog box. This option allows the associated TCP port to be identified as a serial printer connection. The connection does not consume a user license, is restricted to output only, and filters out the end-of-document marker correctly. In this case, IP address of USR-N5X0 is 172.16.14.12.

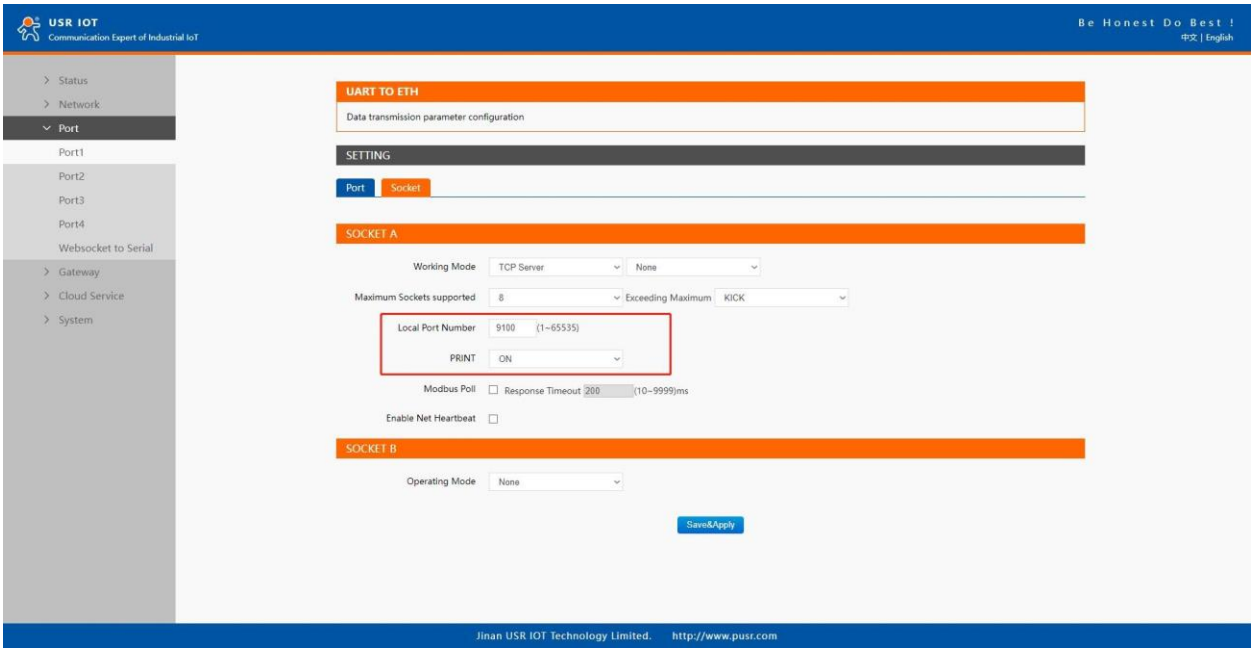


Fig.106 Serial printer option

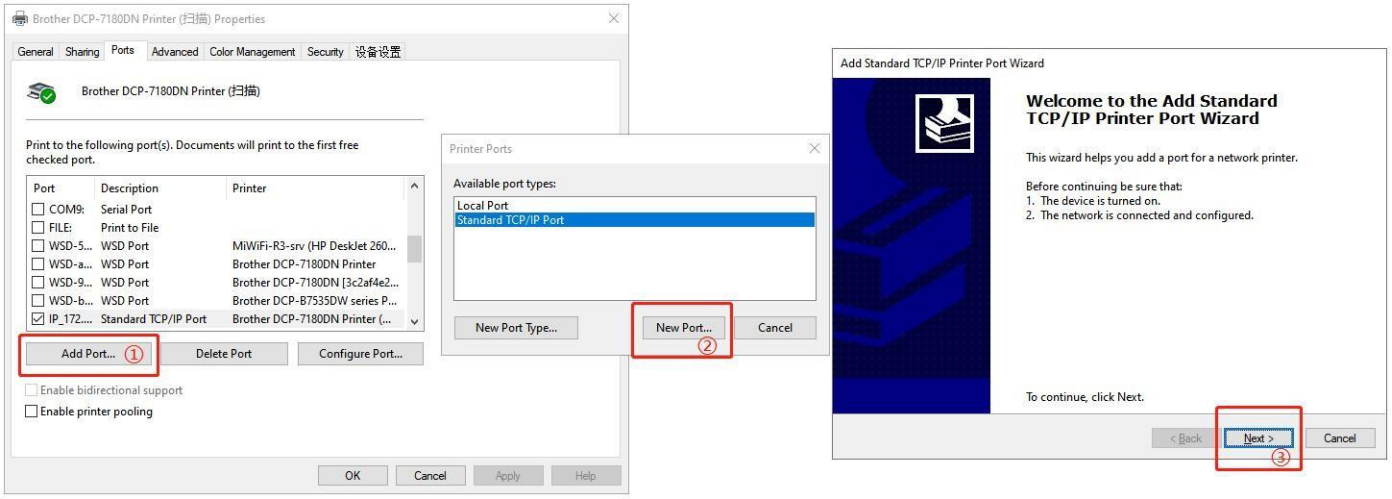


Fig.107 Serial Printer setting wizard

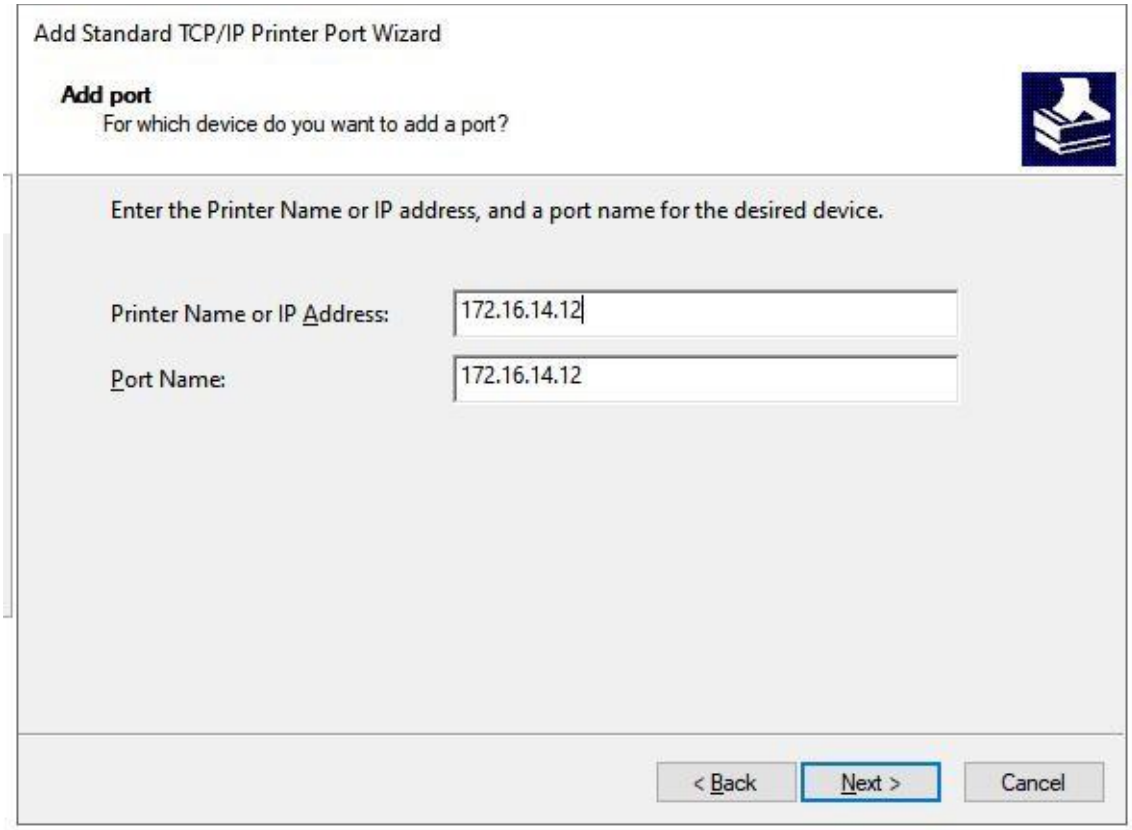


Fig.108 Serial printer setting wizard 1

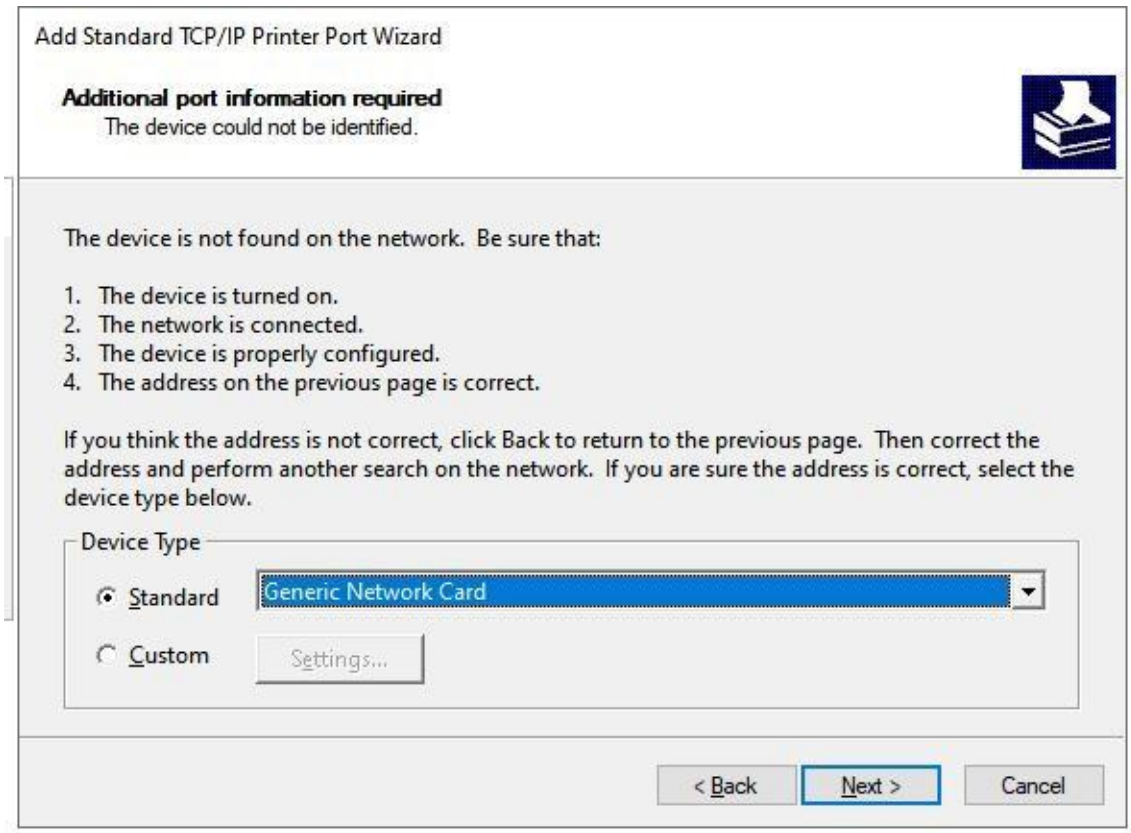


Fig.109 Serial printer setting wizard 1

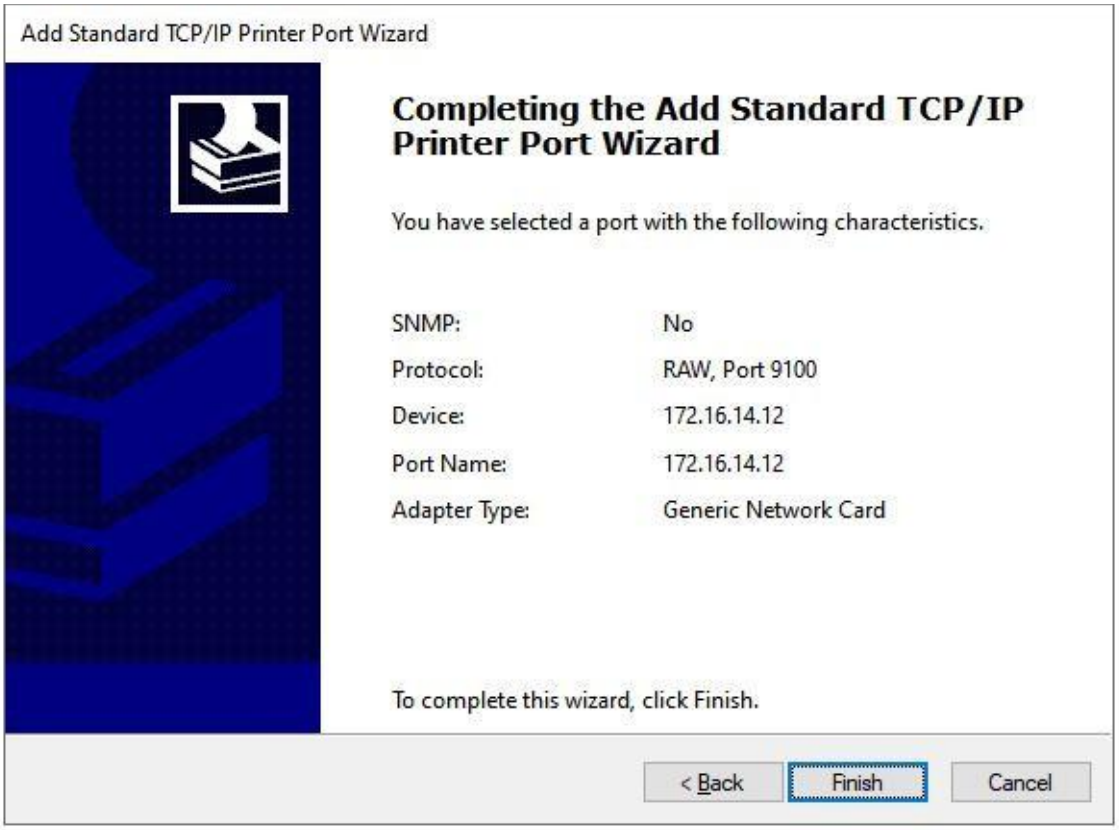


Fig.110 Serial printer setting wizard 1

7.7 NTP

If device is connected to the internet or to a local NTP server, the Date/time can be set automatically by enable NTP function. If this option is chosen, the default value "cn.ntp.org.cn" should be shown in the NTP server field. User can select a proper Time Zone from the dropdown box. If the N5X0 device is connected to the Internet and should connect to other servers over the Internet to get NTP server, you will need to configure the DNS server in order to be able to resolve the host name of the NTP server.

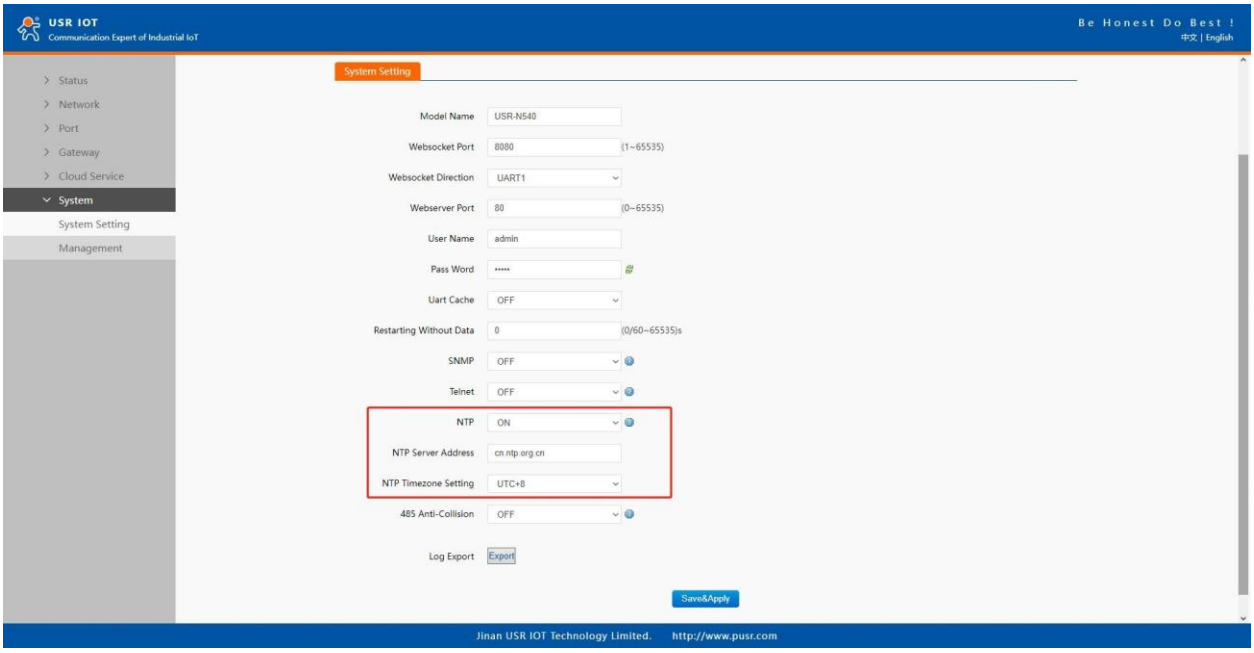


Fig.111 NTP settings

7.8 SNMP

The Simple Network Management Protocol (SNMP) is used by network management software to monitor devices in a network, to retrieve network status information of the devices, and to configure network parameters of the devices. To make the device's information available for public viewing/editing, you can enable the SNMP function by checking the Enable box. The supported SNMP Version:v1/v2c.The default SNMP Community Strings (or passphrases) is "admin".

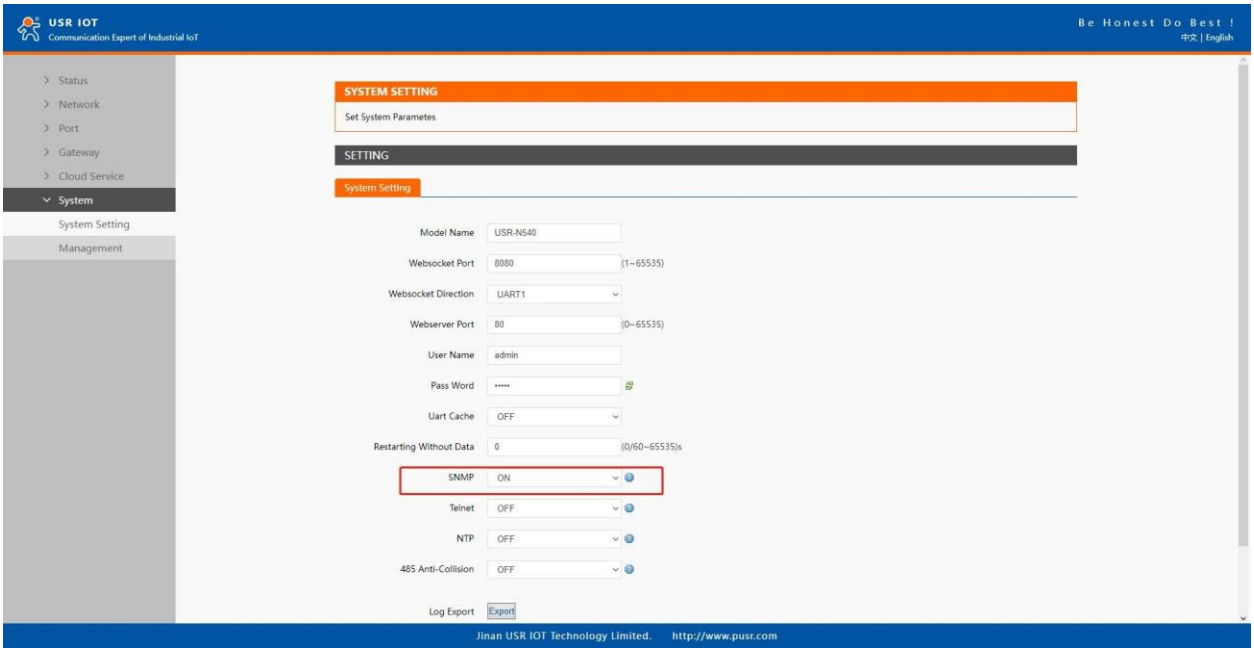


Fig.112 Enable SNMP agent

Table 24 PUSR OLD List

Item	OID
IP address	.1.3.6.1.2.1.4.20.1.1.172.16.14.12
Subnet mask	.1.3.6.1.2.1.4.20.1.1.172.16.14.12
Preferred DNS	.1.3.6.1.2.1.12.5.0
Alternate DNS	.1.3.6.1.2.1.12.6.0
Gateway	.1.3.6.1.2.1.4.21.1.1.172.16.14.12
Running time	.1.3.6.1.2.1.1.3.0
Port1	.1.3.6.1.2.1.13.1.0
Port2	.1.3.6.1.2.1.13.2.0
…	…
Port8	.1.3.6.1.2.1.13.8.0
Firmware version	.1.3.6.1.2.1.12.1.0
Hardware version	.1.3.6.1.2.1.12.2.0

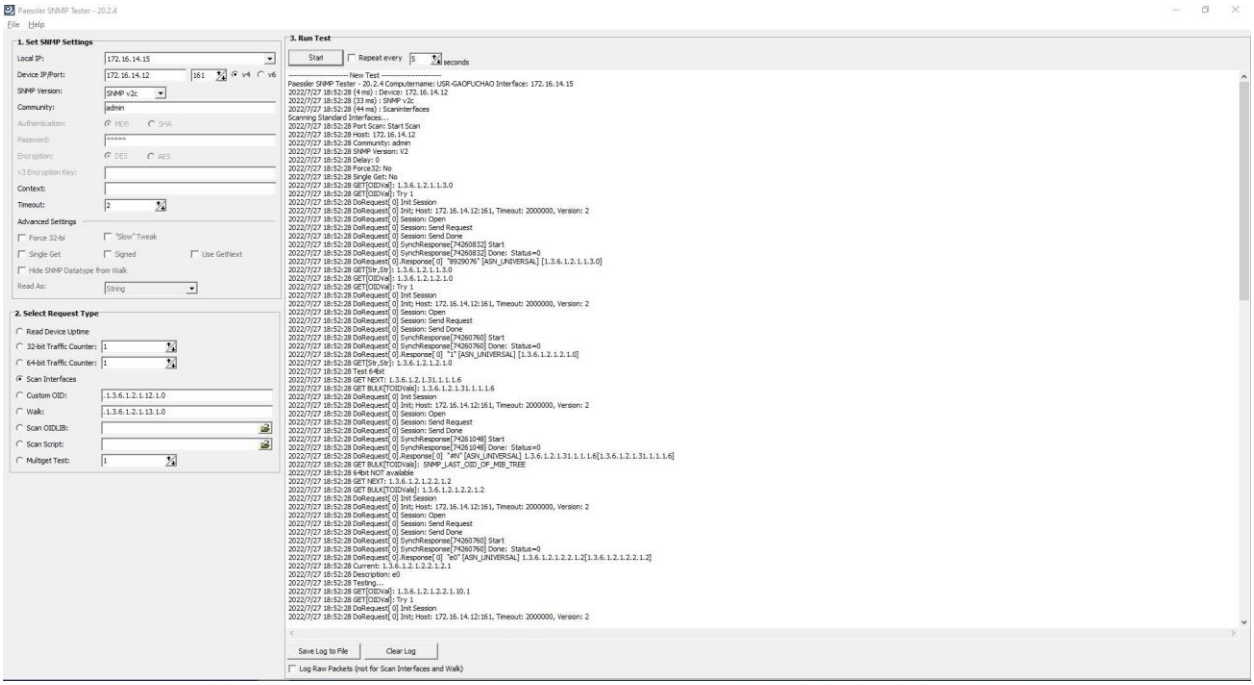


Fig.113 SNMP test

8. MQTT gateway

Although the MQTT protocol has been around for nearly three decades, the design of the protocol makes it ideal for IIoT (Industrial Internet of Things) applications, the latest trend in automation engineering. This is particularly true for applications that stress “active notification,” in which devices provide data only when needed, as opposed to “passive notification,” in which devices are polled at regular intervals. MQTT’s broker/client design eliminates the need for all devices in the system to be online at the same time. The clients (i.e., “devices” or “things”) communicate directly with the broker, which plays the role of middleman to pass messages back and forth between clients.

8.1 Basic settings

When configuring the Broker information, Client ID, Host, and Port are already filled in by default. You can also modify it by yourself based on the actual Broker information. We will use Free Public MQTT Server provided by EMQX Cloud as the MQTT server address for quick testing.

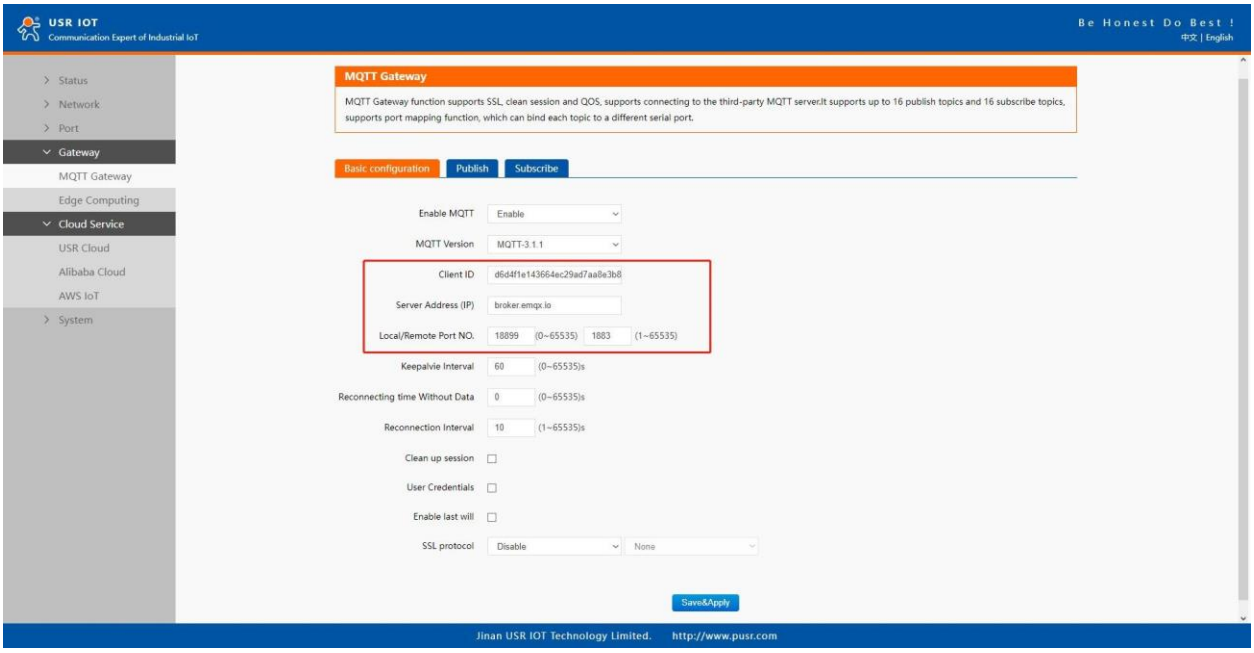


Fig.114 MQTT broker setting

If your broker has enabled user authentication, you can fill in the information of Username and Password in the configuration item.

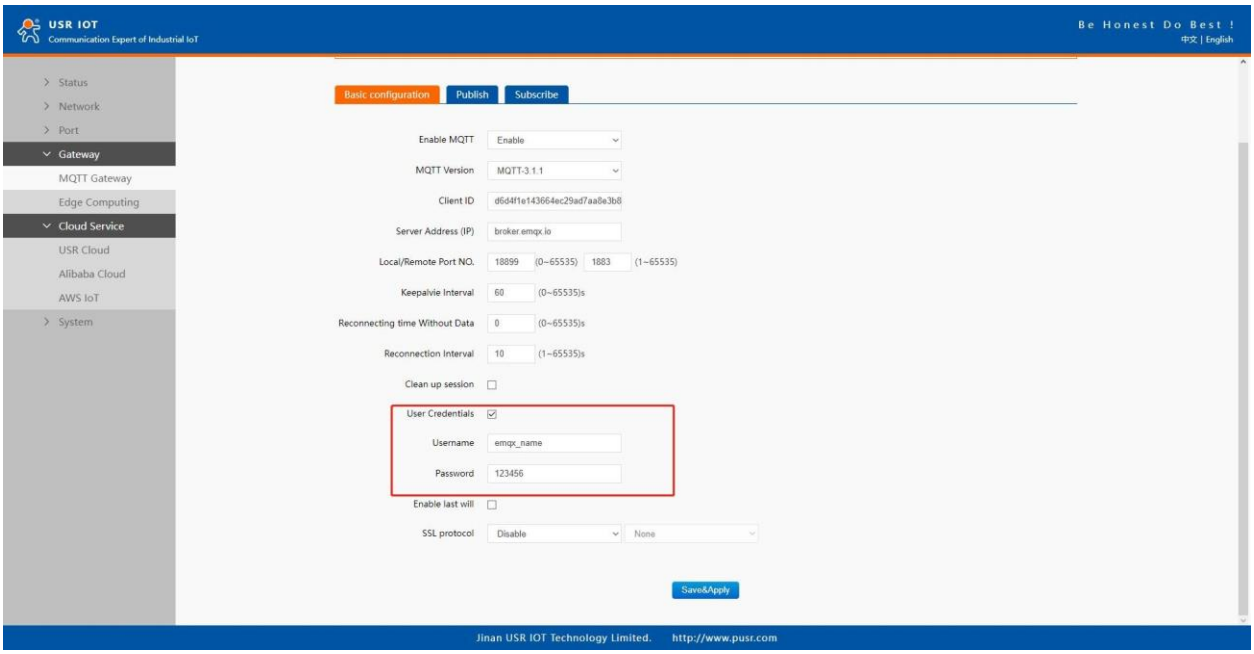


Fig.115 User Credential

When you need to enable SSL/TLS authentication, you need to set the SSL/TLS configuration item. The two versions,TLS 1.0 and TLS 1.2 are provided. If SSL/TLS is selected, certificate configuration can be performed. If it is a one-way connection, you only need to select your CA File. If it is a two-way authentication, you also need to select to configure Client Certificate File and Client key file. Click the choose file button on the far right to select the certificates you have generated.

- Uploads a Certificate Authority (CA) file. A Certificate Authority (CA) is an entity that issues digital certificates. A digital certificate certifies the ownership of a public key by the named subject of the certificate.
- Uploads a client certificate (cert) file. A certificate file is a type of digital certificate that is used by client systems to make authenticated requests to a remote server.
- Uploads a private key file.

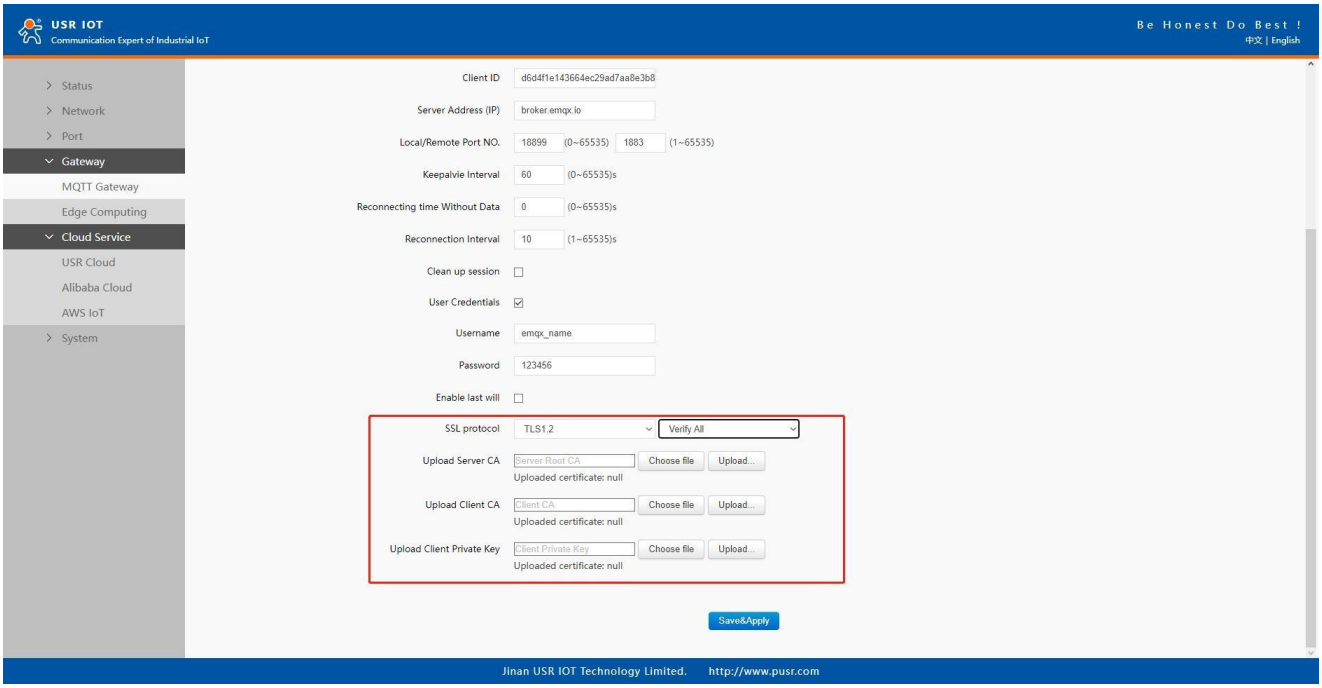


Fig.116 SSL/TLS connection

You can configure KeepAlive, Clean Session, Auto Reconnect, MQTT Version, etc

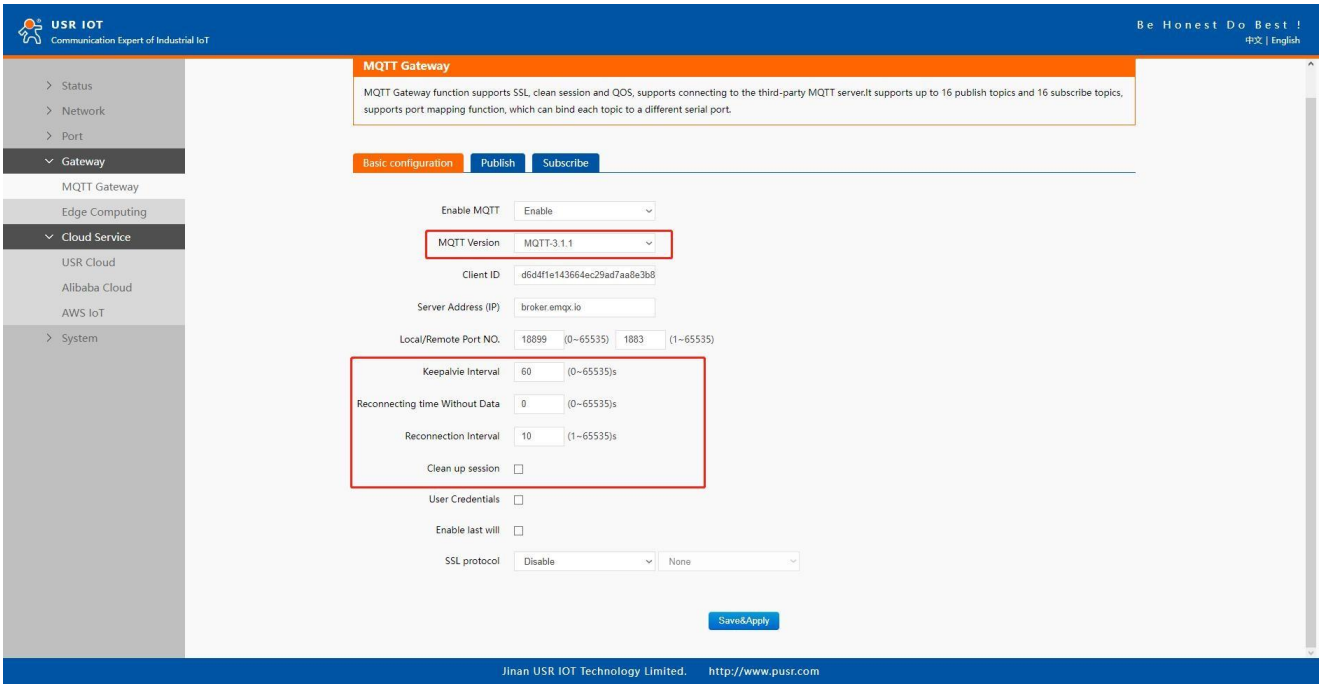


Fig.117 Advanced configuration

You can configure the Will Message. The values of Last-Will-QoS and Last-Will-Retain are filled with 0 and False by default. When you enter the values of Last-Will-Topic and Last-Will-Payload, you can complete the configuration of Will Message.

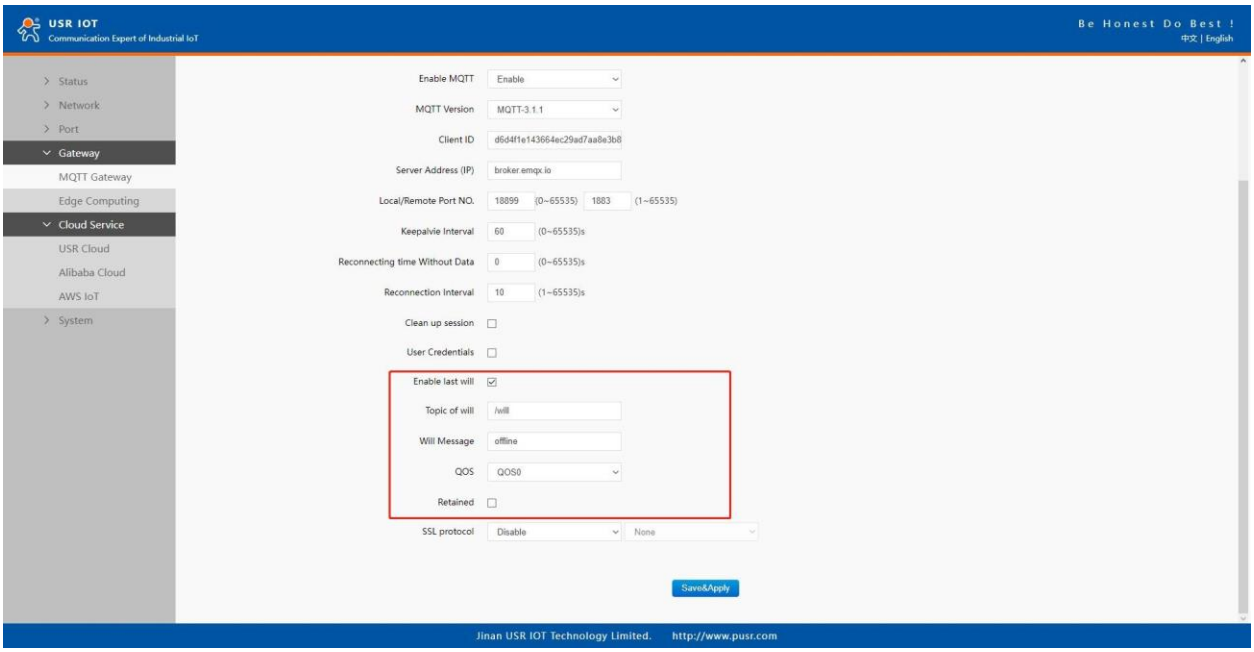


Fig.118 Last will message

After finishing configuring the basic settings, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot. In this case we only finish the follow parameters setting.

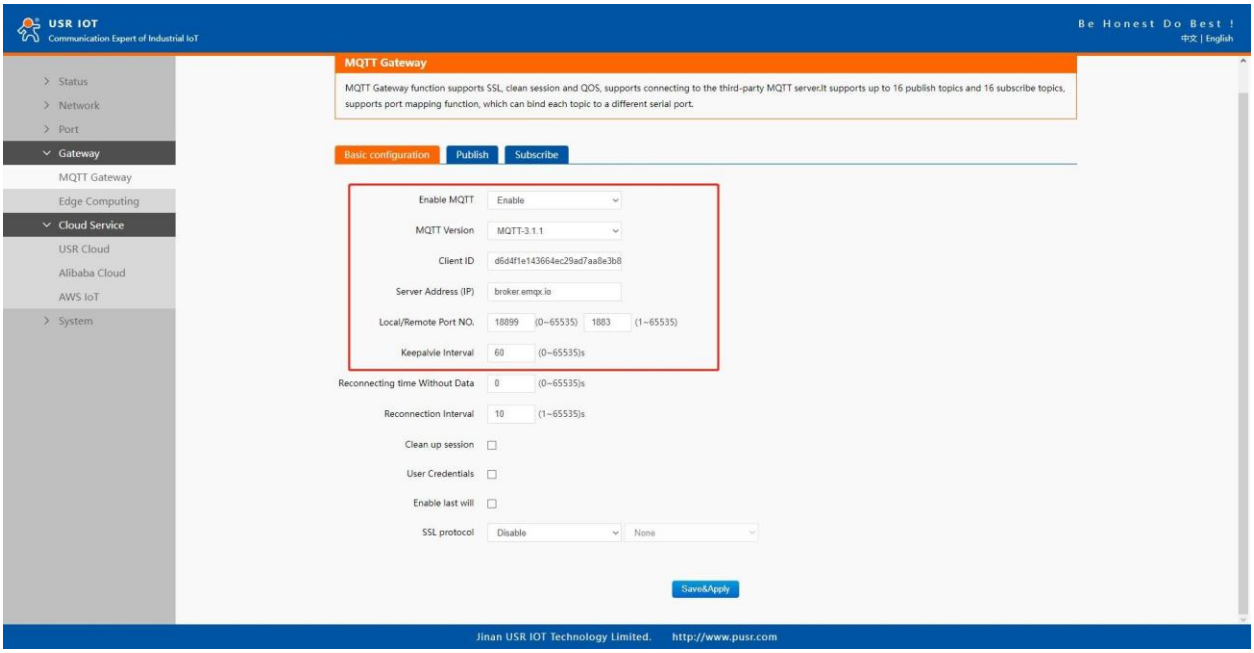


Fig.119 EMQX broker connection

To view the status of the device, choose Status>Overview, the device is in the CONNECTED state, the connection to IoT Hub is successful, and publishing and subscribing operations can be performed.

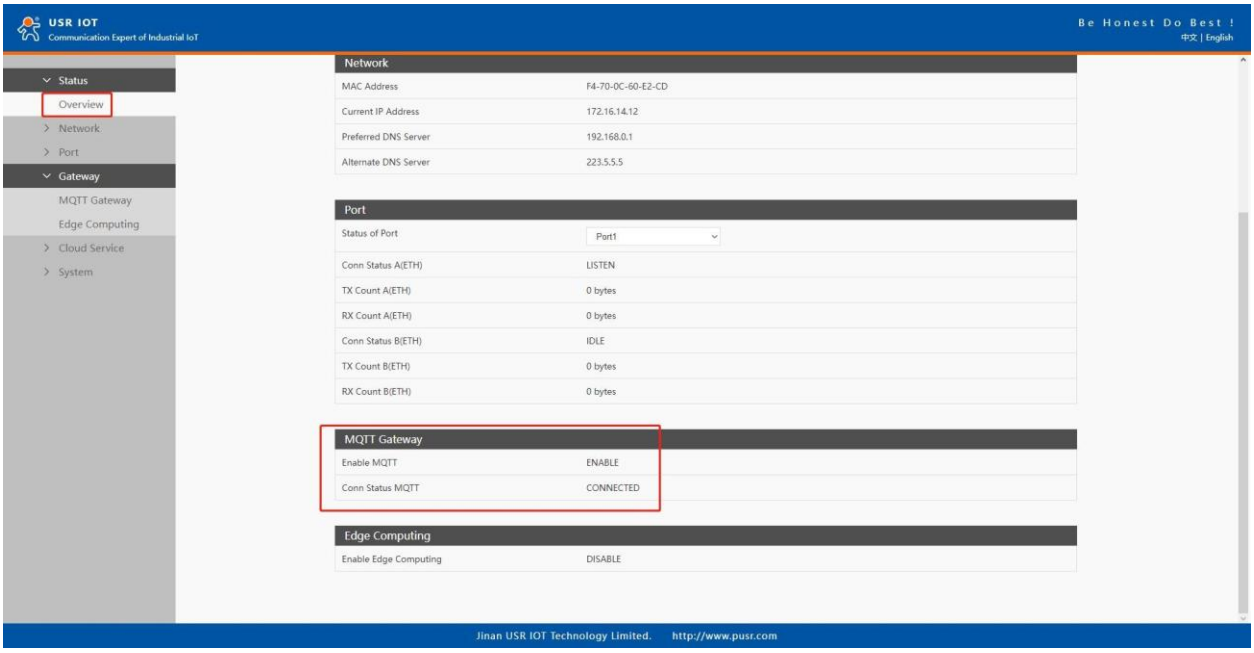


Fig.120 MQTT connection status

8.2 Publishing a message

8.2.1 MQTT.fx tool introduction

MQTT.fx is a mainstream MQTT desktop client. Compatible with Windows, macOS, and Linux, it can quickly verify whether it is possible to connect to IoT Hub and publish or subscribe to messages. MQTT.fx in this article refers to version 1.7.1 without special instructions. The main page is shown in the figure below. The top part is the MQTT Broker connection address bar and its connection configuration. The following function Tabs include Publish column, Subscribe column, Scripts column, Broker Status column, Log column for log information control.

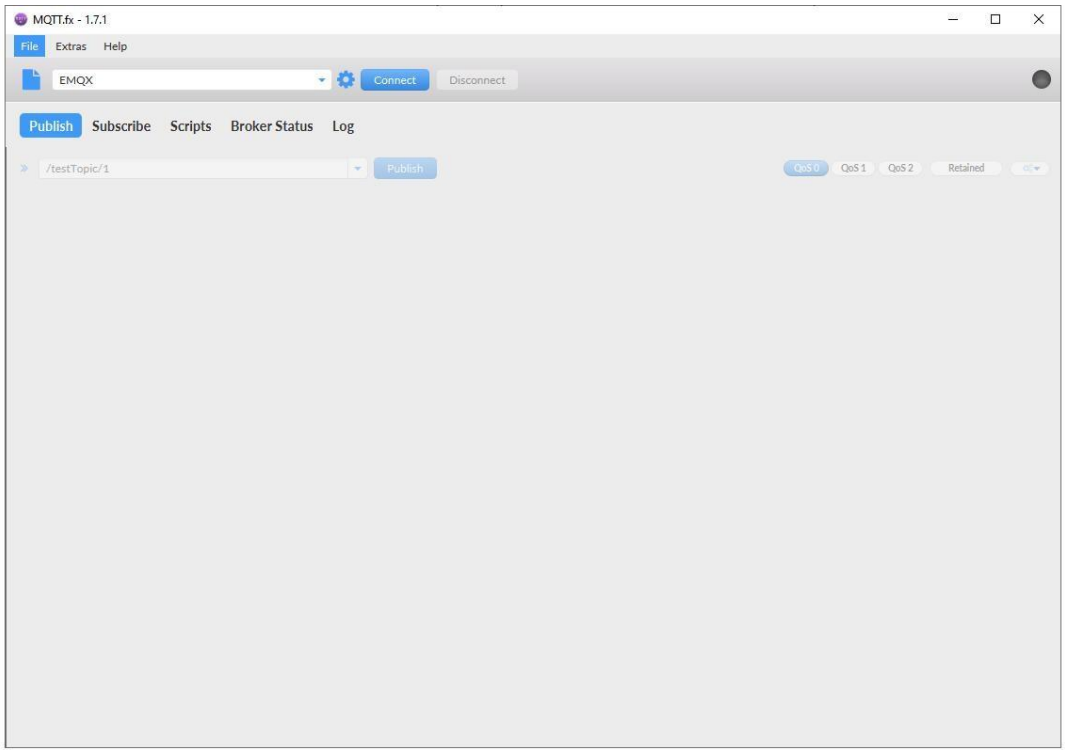


Fig.121 MQTT.fx main page

First, the MQTT client and Broker need to establish a connection to communicate. Click the configuration icon on the right side of the input box in the connection address bar to enter the specific connection configuration. Select the Profile Type as MQTT Broker. Fill in broker.emqx.io for Broker Address and 1883 for Broker Port, as shown in the figure below.

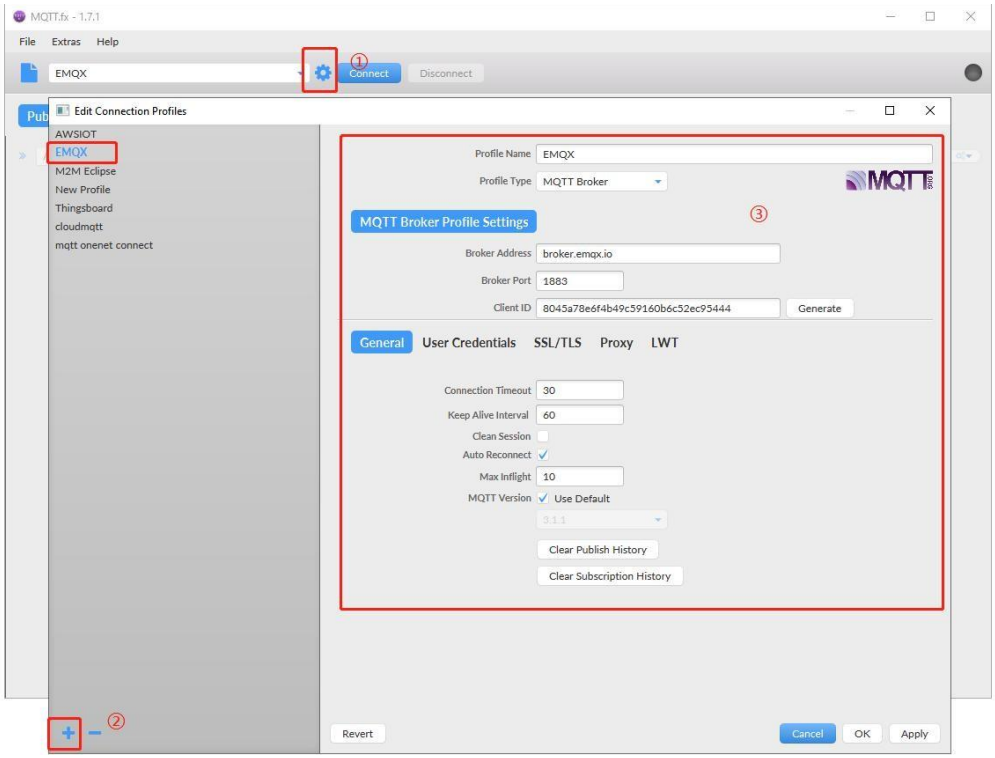


Fig.122 Connection Profiles

Click OK to confirm the configuration, return to the main interface, and click Connect. It can be seen that the indicator on the right side turns to green, indicating that the current connection is successful, as shown in the following figure.

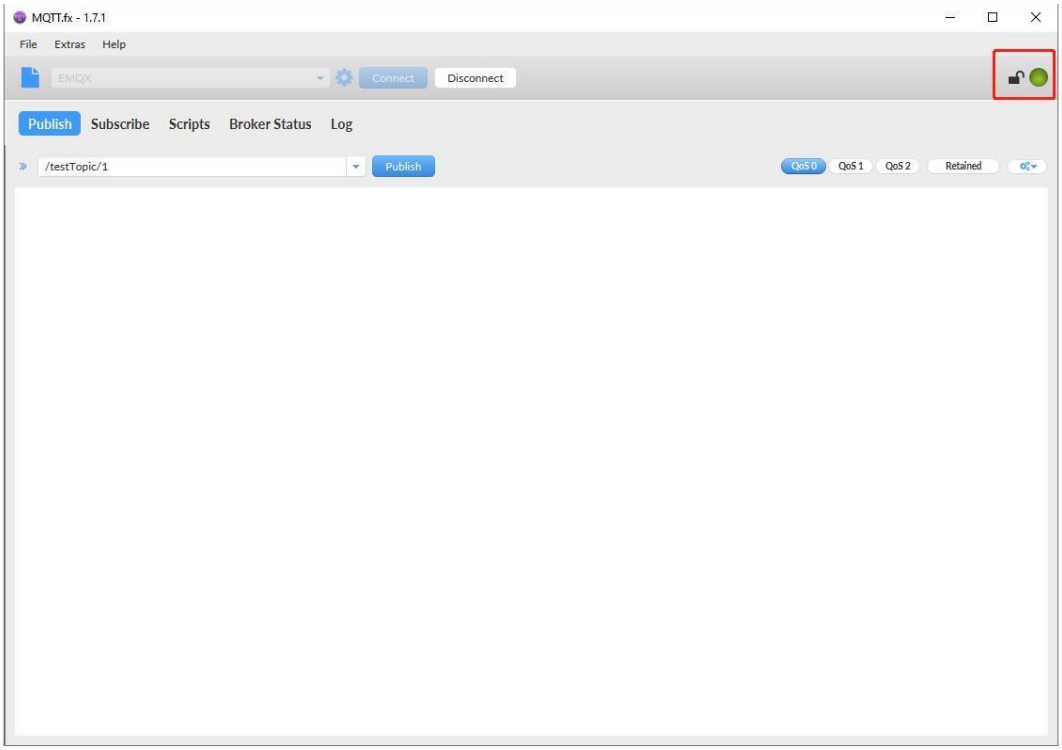


Fig.123 Successful connection

8.2.2 Transparent transmission

In the Publish field, select Publish topic1, enter the topic, bind to the Port1, select Qos 0, uncheck retained message. We use the /PubTopic1 as an example to describe the process. After finishing configuring the Publish topic1, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot.

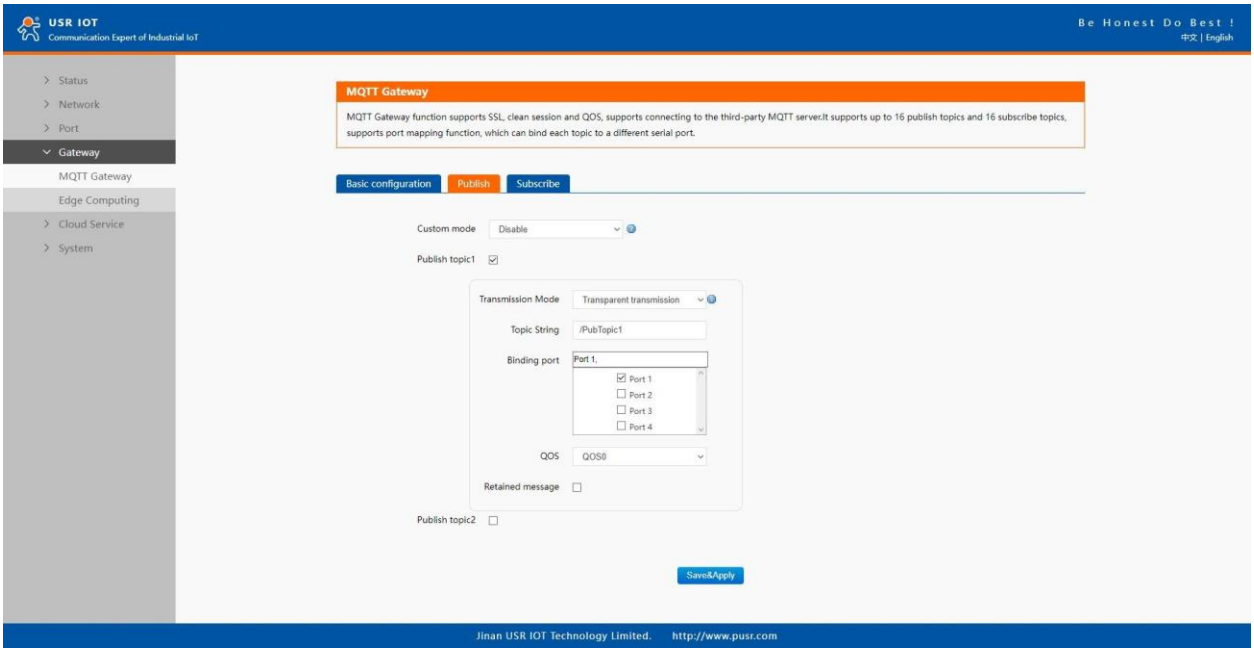


Fig.124 Add publish topic

Click to enter the Subscribe Tab to enter /PubTopic1 in the topic box. Then, select a QoS level, click the Subscribe button, and the list of subscribed topics will appear on the left. The current number of subscribed topics is 0, as shown in the following figure:

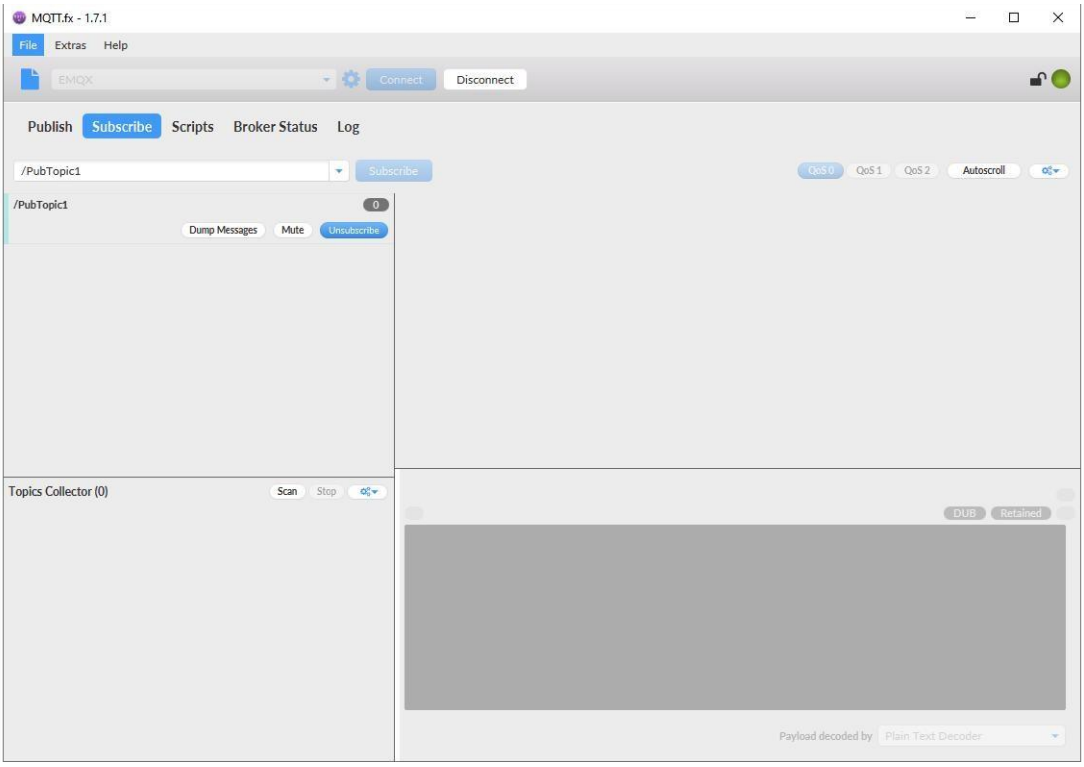


Fig.125 Subscribe to the N5X0 topic

Launch serial debug assistant on PC, and open COM port with the N5X0's serial default settings as below:

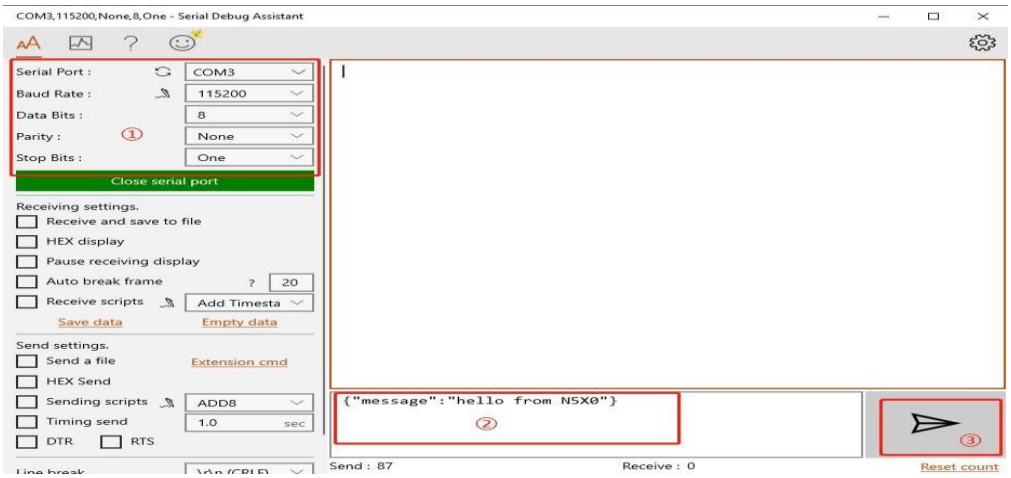
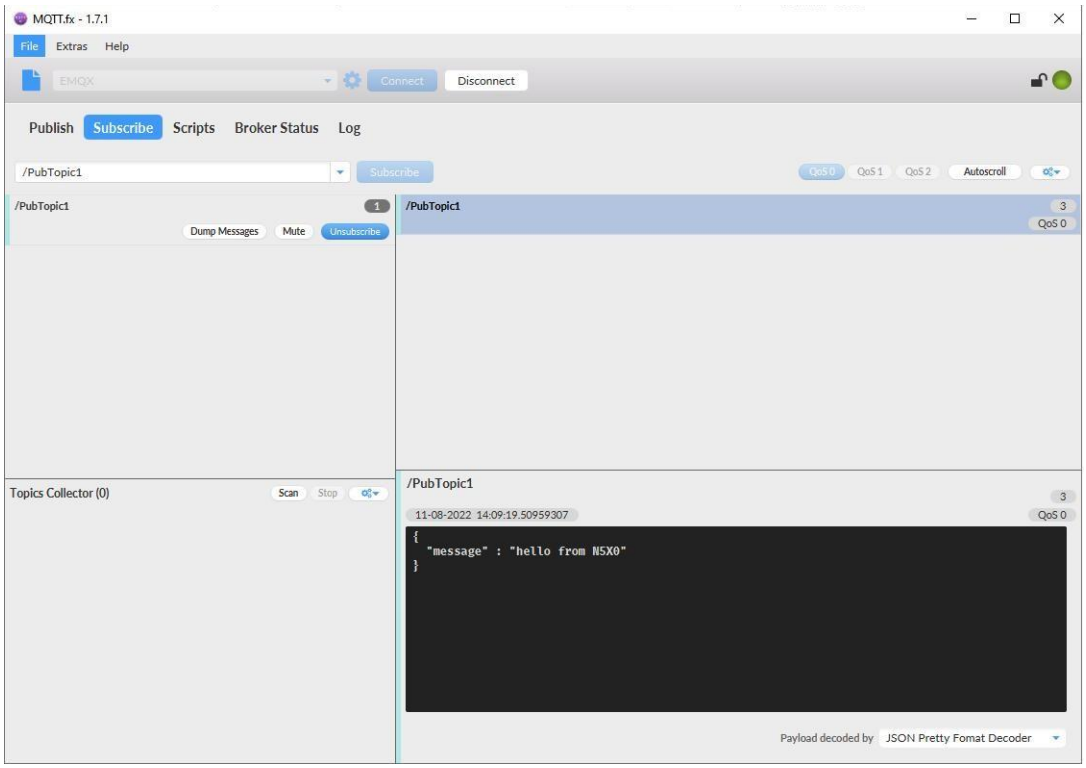


Fig.126 Serial debug assistant setting

Click send button. On the MQTT.fx page, you will receive a message from the cloud that was sent from the N5X0. For Payload decoded by select "JSON Pretty Format Decoder" to show the message.

Fig.127 Receive message from N5X0



8.2.3 Topic distribution

In the Publish field, select Publish topic2, enter the topic, topic name, bind to the Port1, select Qos 0, uncheck retained message. We use the /PubTopic2 as an example to describe the process. After finishing configuring the Publish topic2, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot.

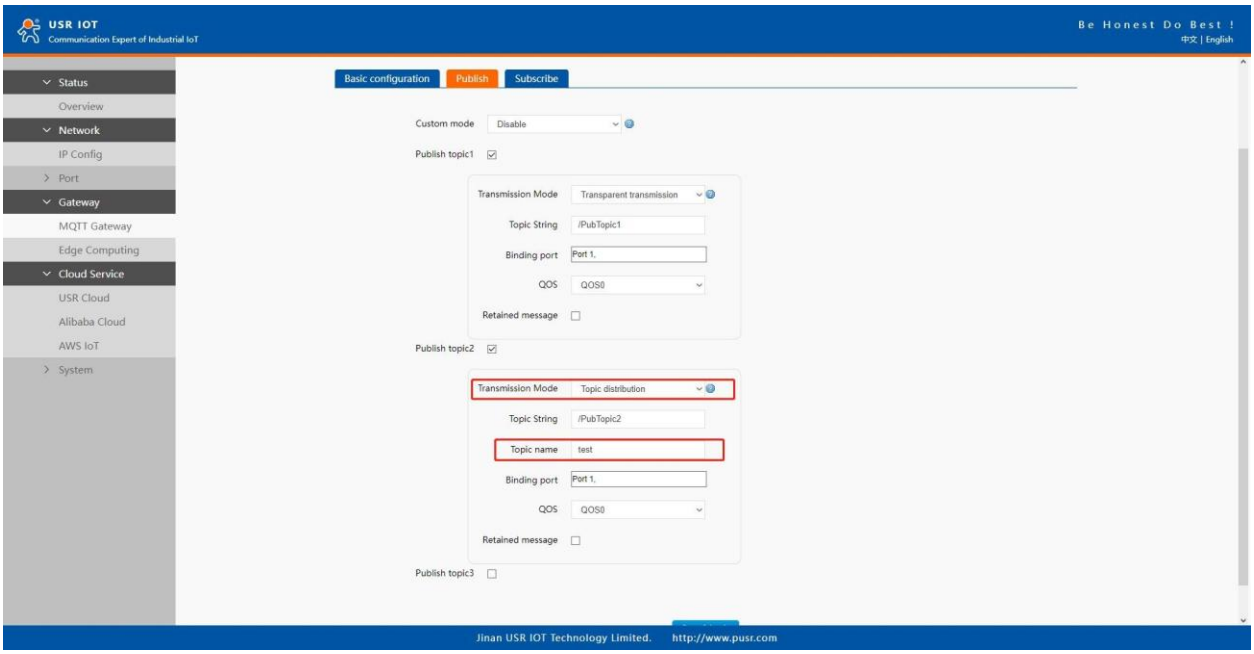


Fig.128 Topic distribution mode

Click to enter the Subscribe Tab to enter /PubTopic2 in the topic box. Then, select a QoS level, click the Subscribe button, and the list of subscribed topics will appear on the left. The current number of subscribed topics is 0, as shown in the following figure:

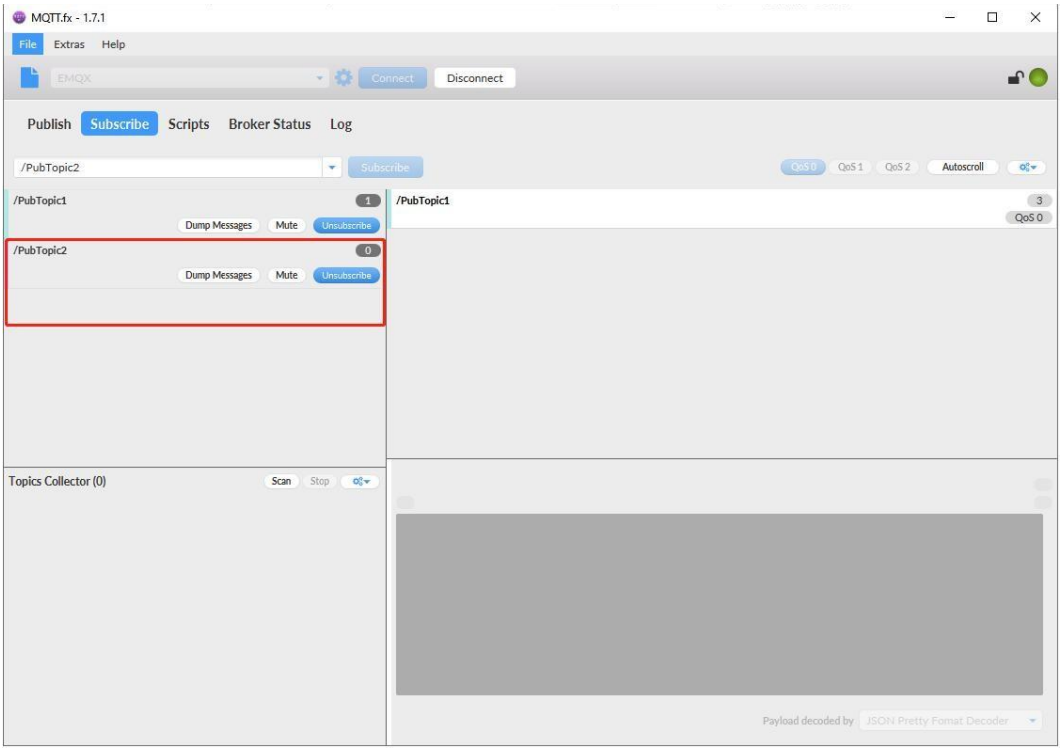


Fig.129 Subscribe to the N5X0 topic

Launch serial debug assistant on PC, and open COM port with the N5X0's serial default settings as below:

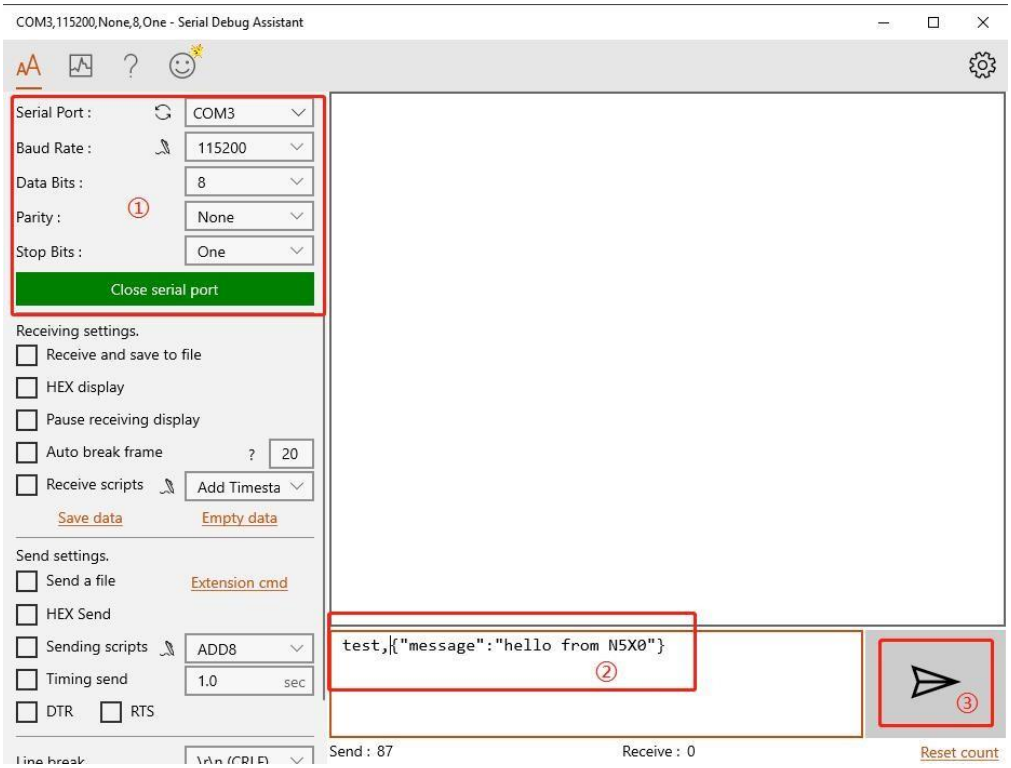


Fig.130 Serial debug assistant setting

Enter the correct serial data format test,{"message":"hello from N5X0"}, Click send button. On the MQTT.fx page, you will receive a message from the cloud that was sent from the N5X0.

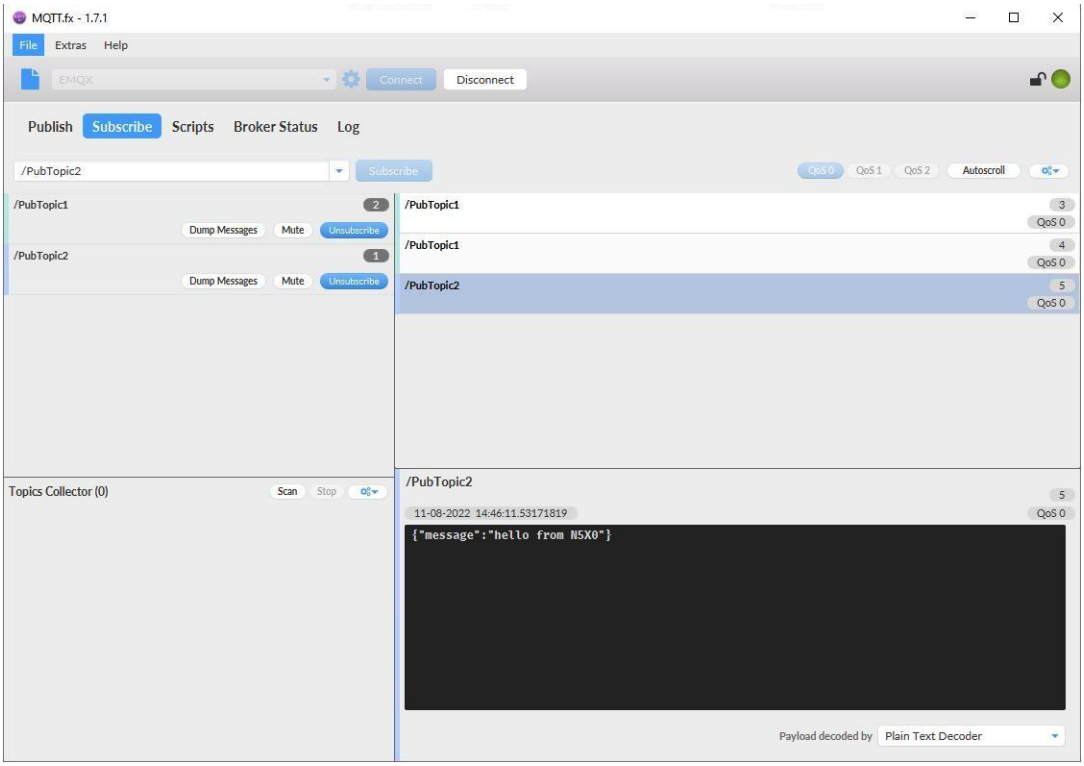


Fig.131 Receive message from N5X0

8.2.4 Custom node

In the Publish field, select Custom mode, bind to the Port1. Click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot.

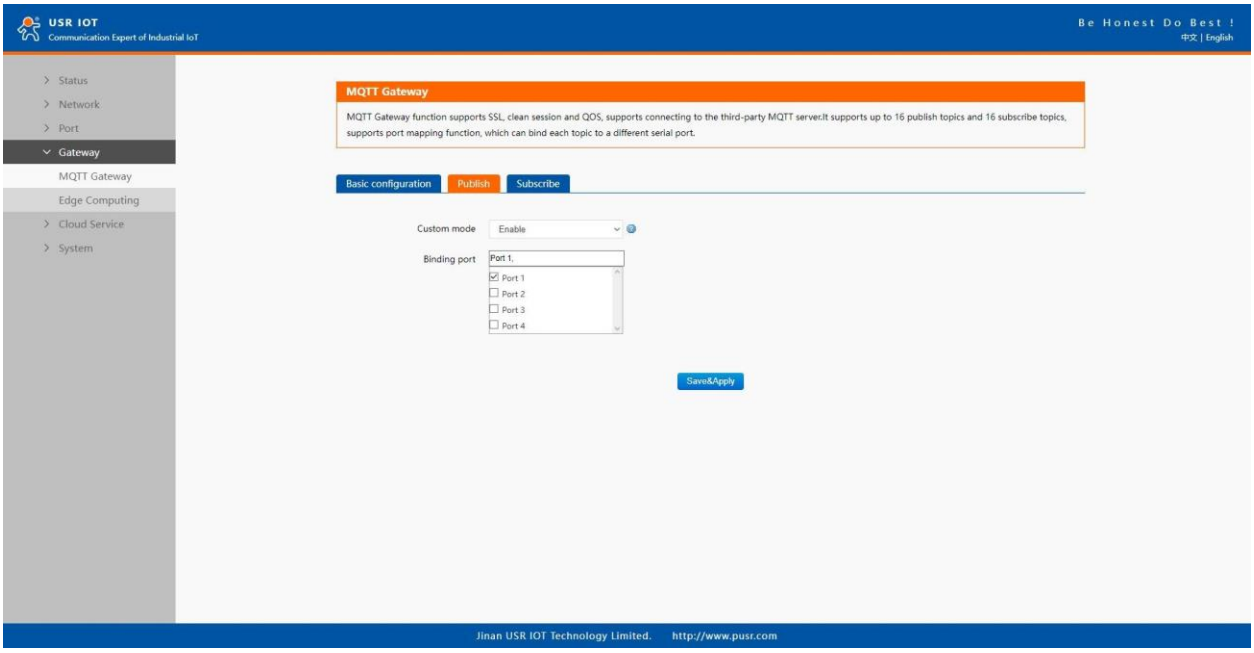


Fig.132 Custom node

Click to enter the Subscribe Tab to enter /PubTopic3 in the topic box. Then, select a QoS level, click the Subscribe button, and the list of subscribed topics will appear on the left. The current number of subscribed topics is 0, as shown in the following figure:

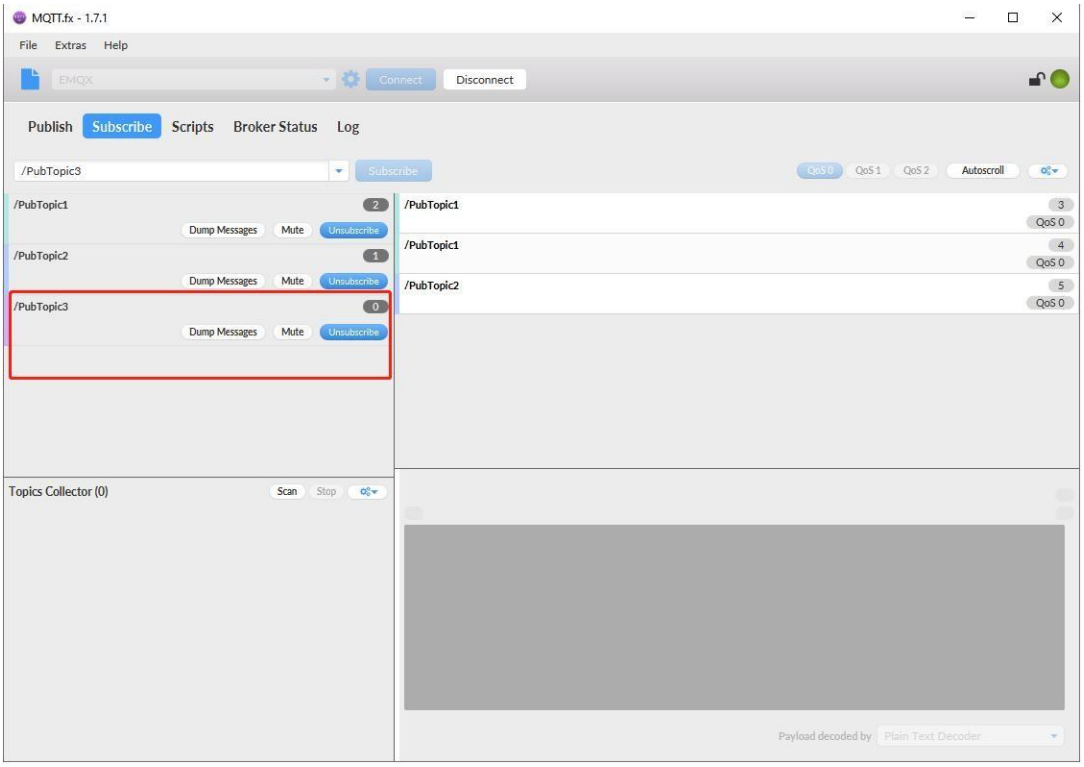


Fig.133 Subscribe to the N5X0 topic

Launch serial debug assistant on PC, and open COM Port with the N5X0's serial default settings as below:

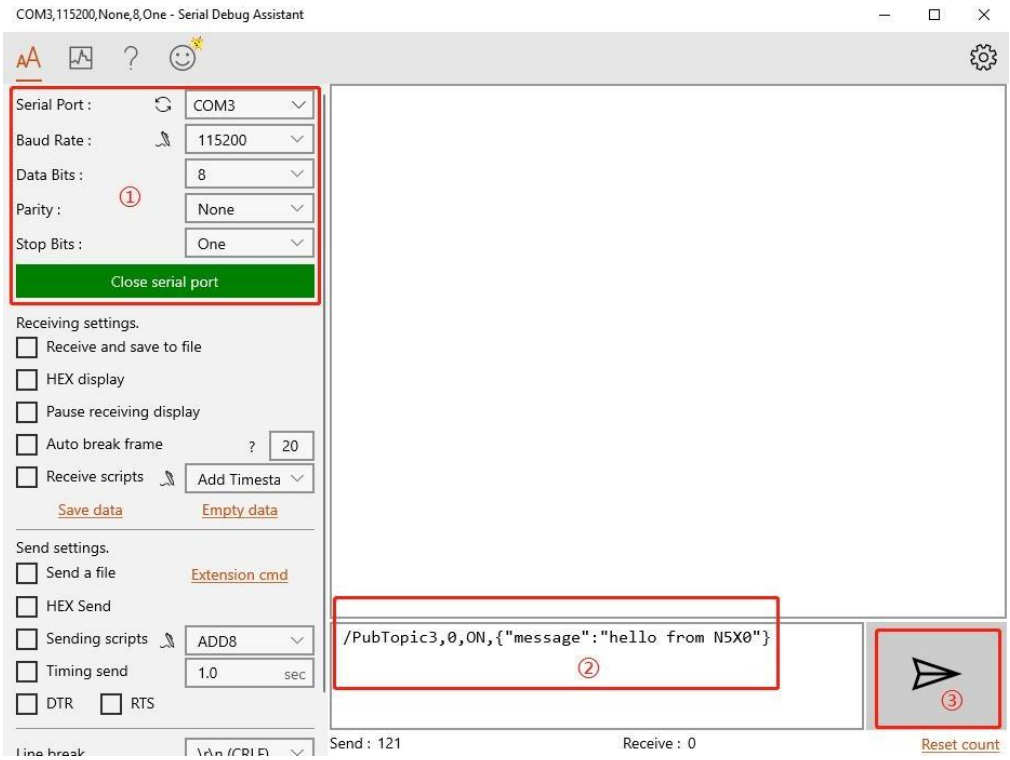


Fig.134 Serial debug assistant setting

Enter the correct serial data format /PubTopic3,0,ON,{"message":"hello from N5X0"}, Click send button. On the MQTT.fx page, you will receive a message from the cloud that was sent from the N5X0.

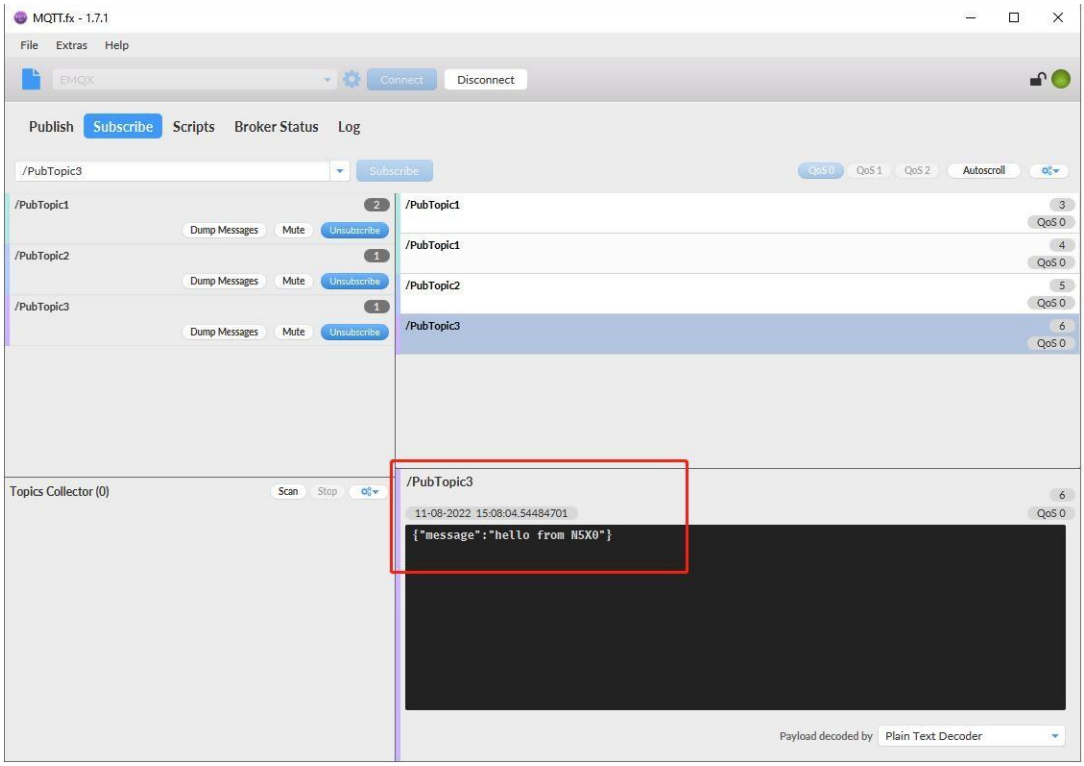


Fig.135 Receive message from N5X0

8.3 Subscribe to a topic

In the Subscribe field, select Subscribe topic1, enter the topic, bind to the Port1, select Qos 0. We use the /SubTopic1 as an example to describe the process. After finishing configuring the Subscribe topic1, please scroll down to the bottom of the page and click on "Save & Apply" button to save all the changes that you have made. All configurations take effect after a system reboot.

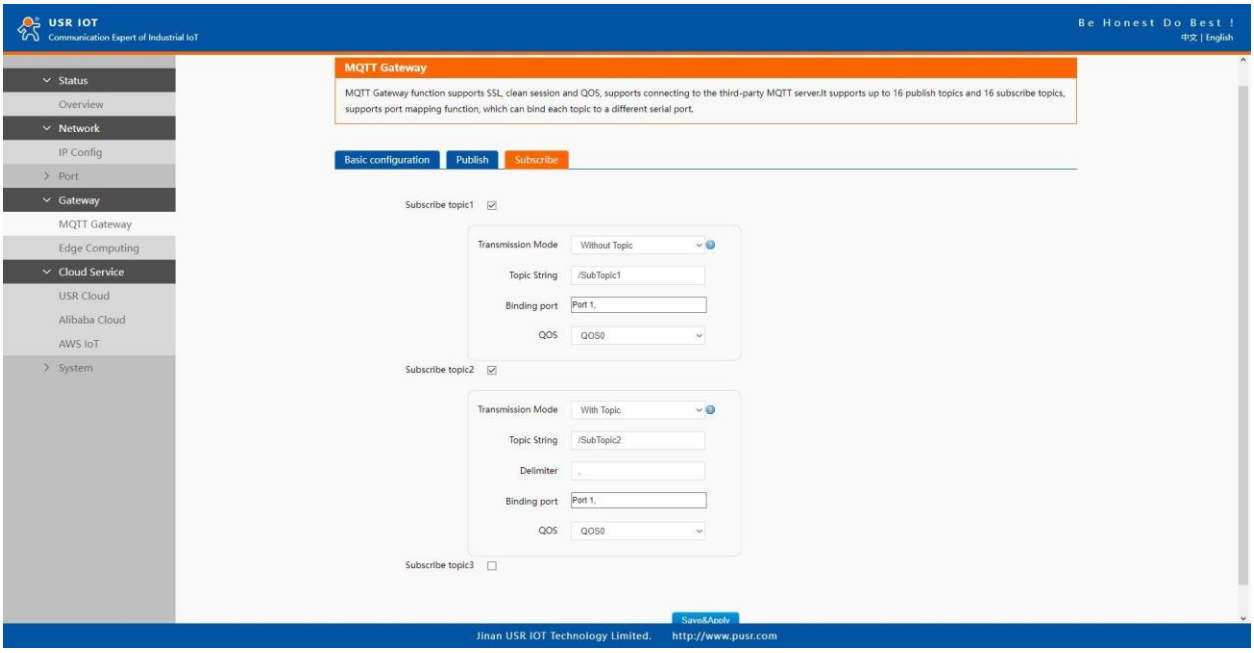


Fig.136 Add subscribe topic

Click to enter the Publish Tab to enter /SubTopic1 in the topic box, and enter the message of "hello world" in the message input box, select a QoS level, and click Publish to publish the message, as shown in the following figure:

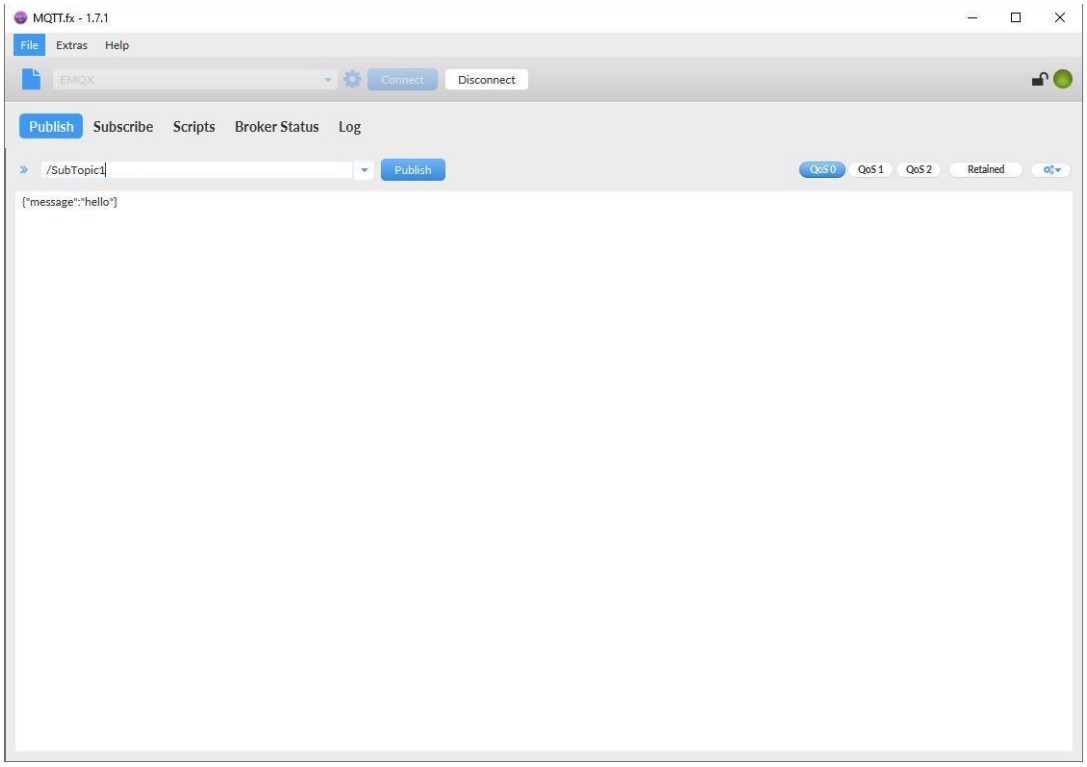


Fig.137 Publish message to N5X0

Click Publish to send the messages and return to the serial debug assistant. We can find that the serial port has received the message, as shown in the following figure:

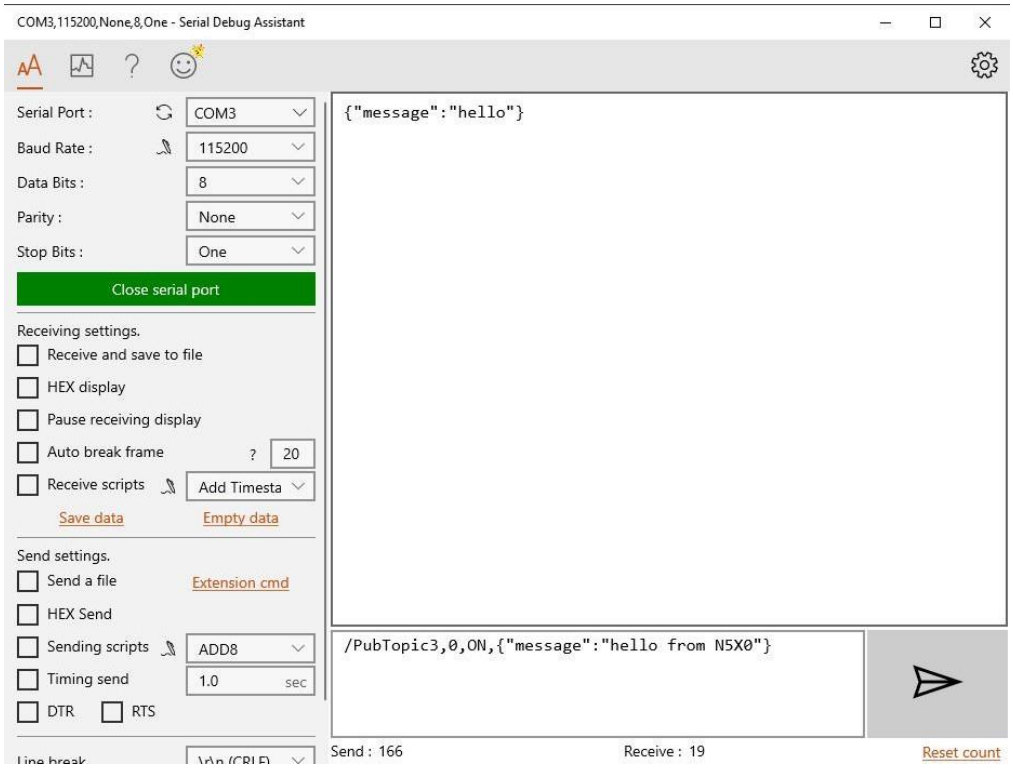


Fig.138 Receive message from cloud

9. Edge computing

The USR-N5X0 supports Modbus RTU Master for retrieving field site data from serial meters. After collecting data, users can convert serial data to MQTT json format data, allowing users to get field site data. This two-in-one design reduces system complexity and the amount of space required in the network topology, as well as overall installation time. In addition, you can extend the useful life of legacy devices by connecting them to Ethernet and accessing the devices using a preferred protocol,TCP/UDP , HTTP , MQTT. First,users need to enable edge computing function.

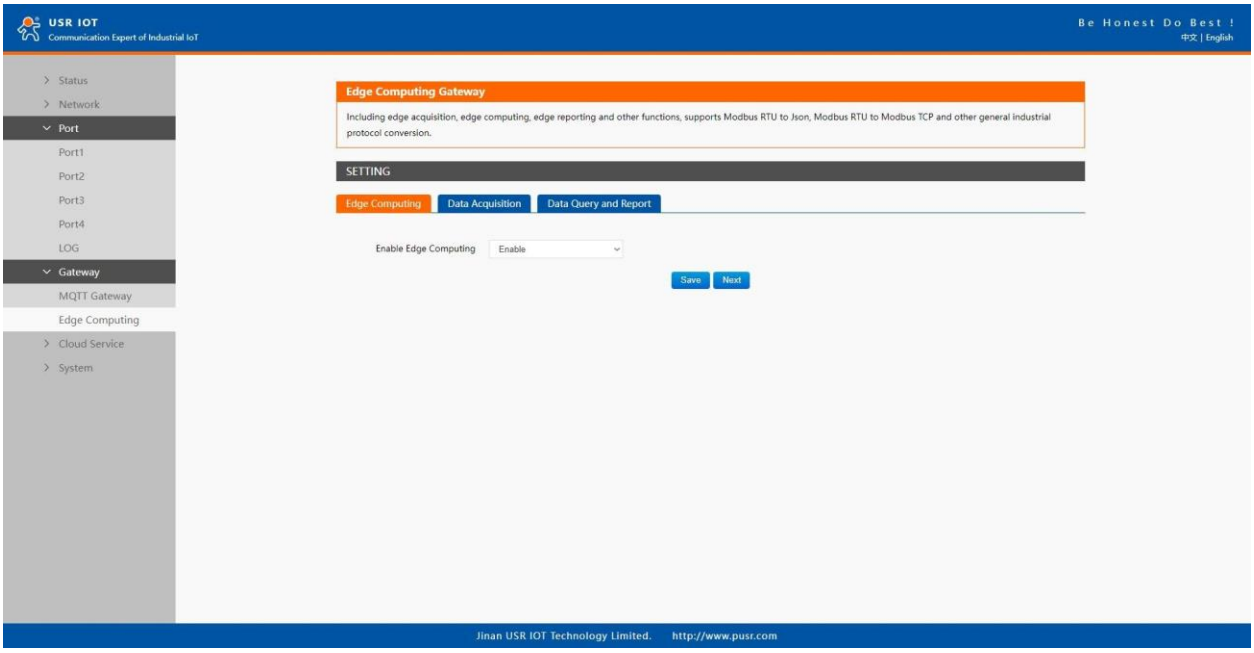


Fig.139 Enable Edge computing

9.1 Add Modbus slave device

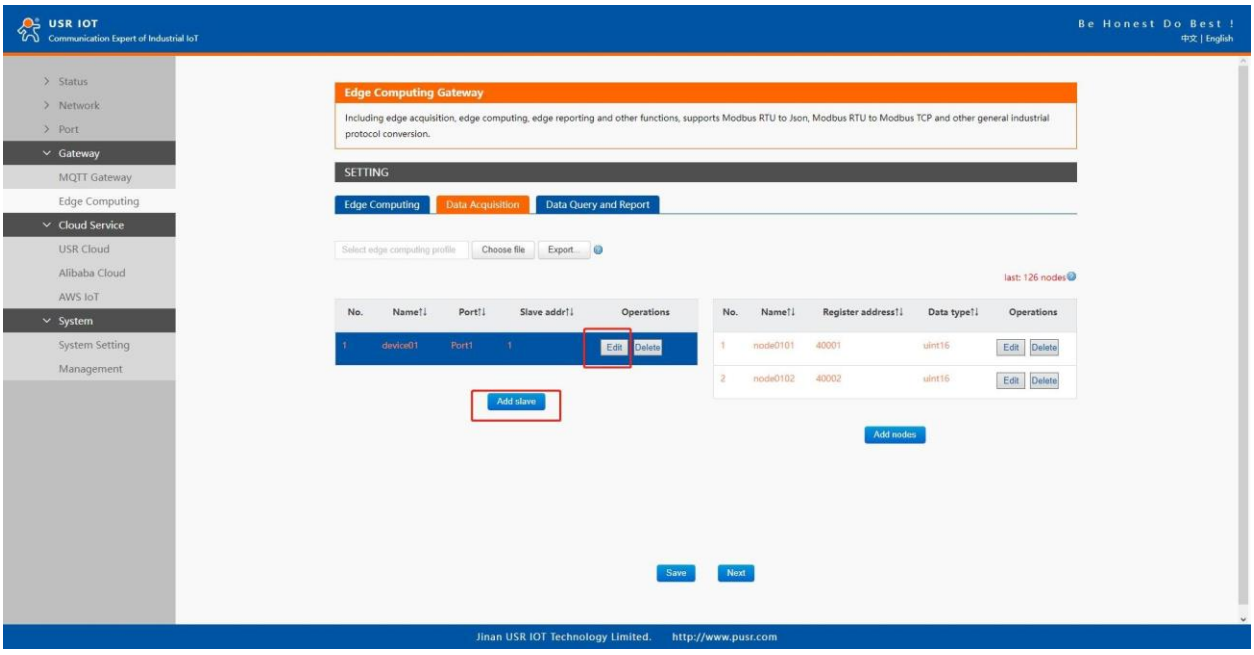


Fig.140 Add a slave device

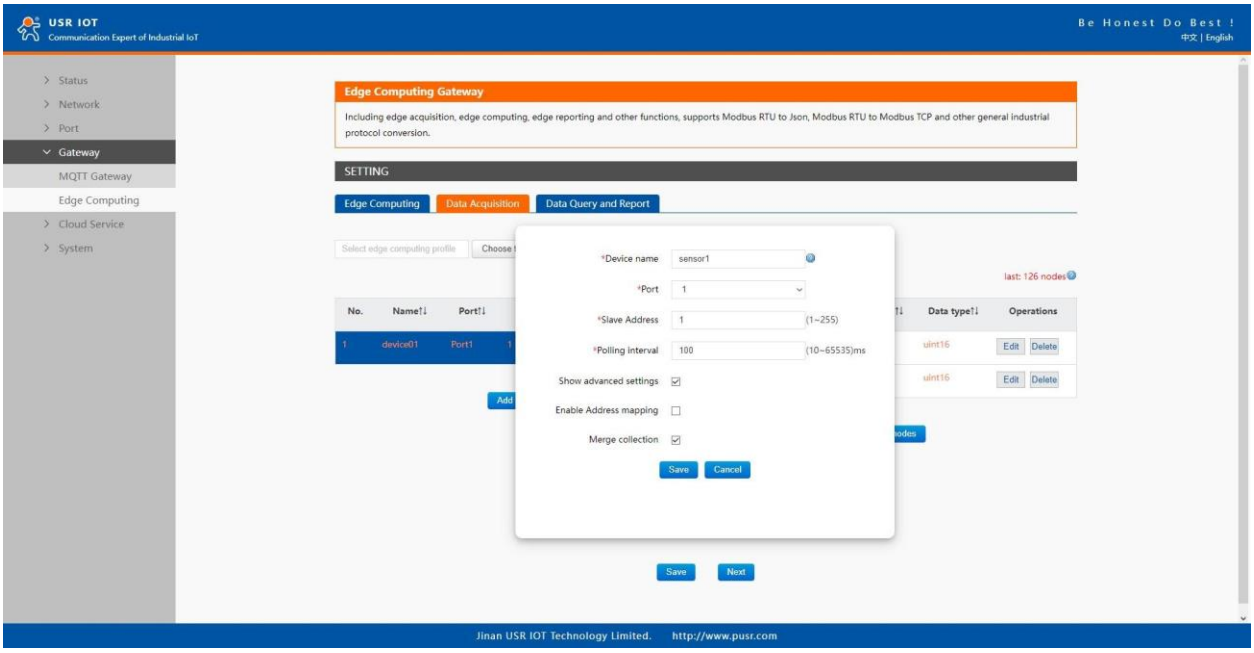


Fig.141 Polling slave device configuration

In the slave property, enter the device name, bind to the Port1, enter the slave address and polling interval, enable merge collection function, the description of the configuration parameters on this interface is shown in table 18. We use the temperature and humidity sensor1 as an example to describe the process. After finishing configuring the slave device, please scroll down to the bottom of the page and click on "Save" button to save all the changes that you have made. All configurations take effect after a system reboot.

9.2 Add modbus data points

9.2.1 Register type and offset

Table 25 Typical register tables

Register Type	Address range	Description
Coil points	00001-09999	Read, function code 0x1, bool values.
Discrete inputs	10001-19999	Read, function code 0x2, bool values.
Input registers	30001-39999	Read only, function code 0x4, int,uint,float values
Holding registers	40001-49999	Read only, function code 0x3, int,uint,float values

The Modbus register addressing starts with register 0, but some device manufacturers start with the number 1 in the device documentation. In this case, the number minus 1 should give the correct register address. Offsets can be represented in different ways. Sometimes as Hex values and sometime the offset will also contain the register type. For example Offsets in the Holding Register range might start with a 4 such as 411001, in the SCADA this would be entered as 11001.

9.2.2 Raw data types and byte order

A standard Modbus Holding Register or Input Register is a 16 bit (2 Byte) value. Often this is not enough so different equipment will utilize multiple modbus registers to hold a larger value. Here is a list of Data Types supported in the N5X0 gateway.

Table 26 Data Types

Type	Function code	Objects count	Note
Bool	1-2	1+	Bool
int8	3-4	1+	Integer 8 bit
uint8	3-4	1+	Unsigned integer 8 bit
int16 uint 16	3-4 3-4	1 1	Integer 16 bit. Big-endian.high byte first. Unsigned integer 16 bit-endian.
int32(ABCD)	3-4	1	Integer 32 bit. Big-endian
int32(CDAB)	3-4	2	Integer 32 bit. Little-Endian byte swap
uint32(ABCD)	3-4	2	Unsigned integer 32 bit. Big-endian.
uint32(CDAB)	3-4	2	Unsigned integer 32 bit. Little-endian byte swap.
float32(ABCD)	3-4	2	Float 32 bit. Big-endian.
float32(CDAB)	3-4	2	Float 32 bit. Little-endian byte swap.
float64	3-4	4	Float 64 bit.

Note that these could be referred to in different ways. for example a 4 Byte Signed Integer might be referred to as a 32 bit Integer in equipment documentation. For binary values we also need to know what "bit" of the register to look at for the binary value. For this reason a single 16 bit modbus register could represent up to 16 individual binary data points. Sometimes the Data Type is inferred by listing the number of registers. For example 2 registers might mean a 4 byte value.

9.2.3 Data points configuration

First select the slave device, click add nodes to add a data point, click edit to configure the data point, click delete to delete a data point.

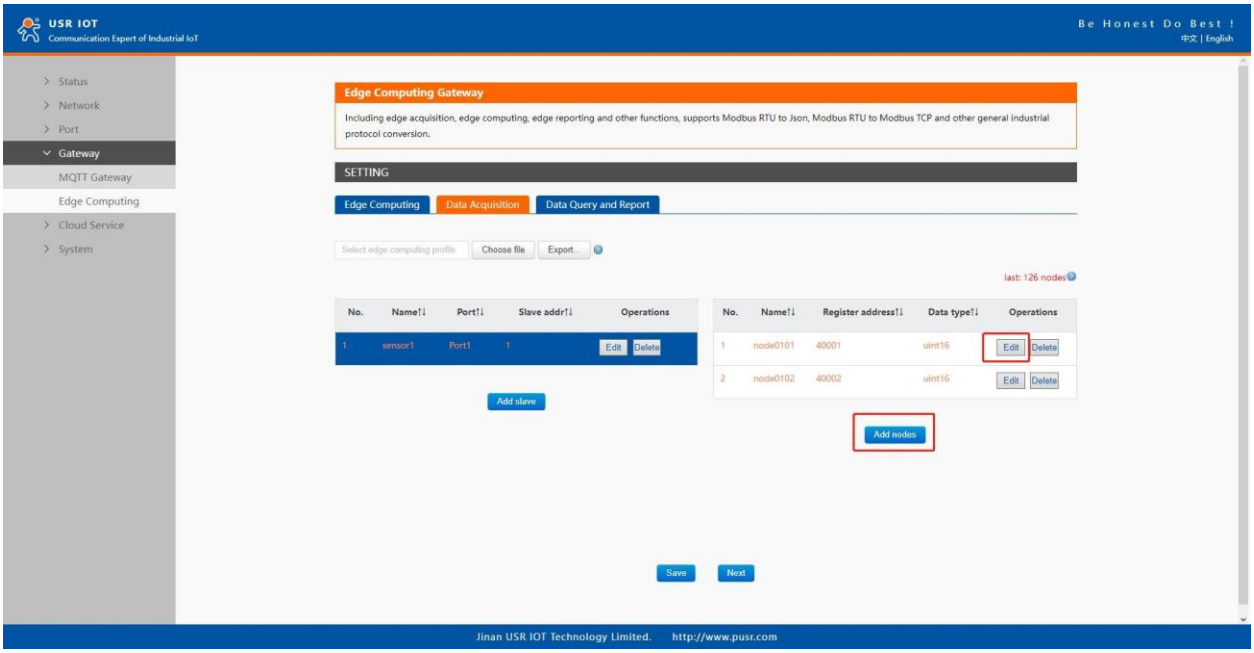


Fig.142 Add modbus data point

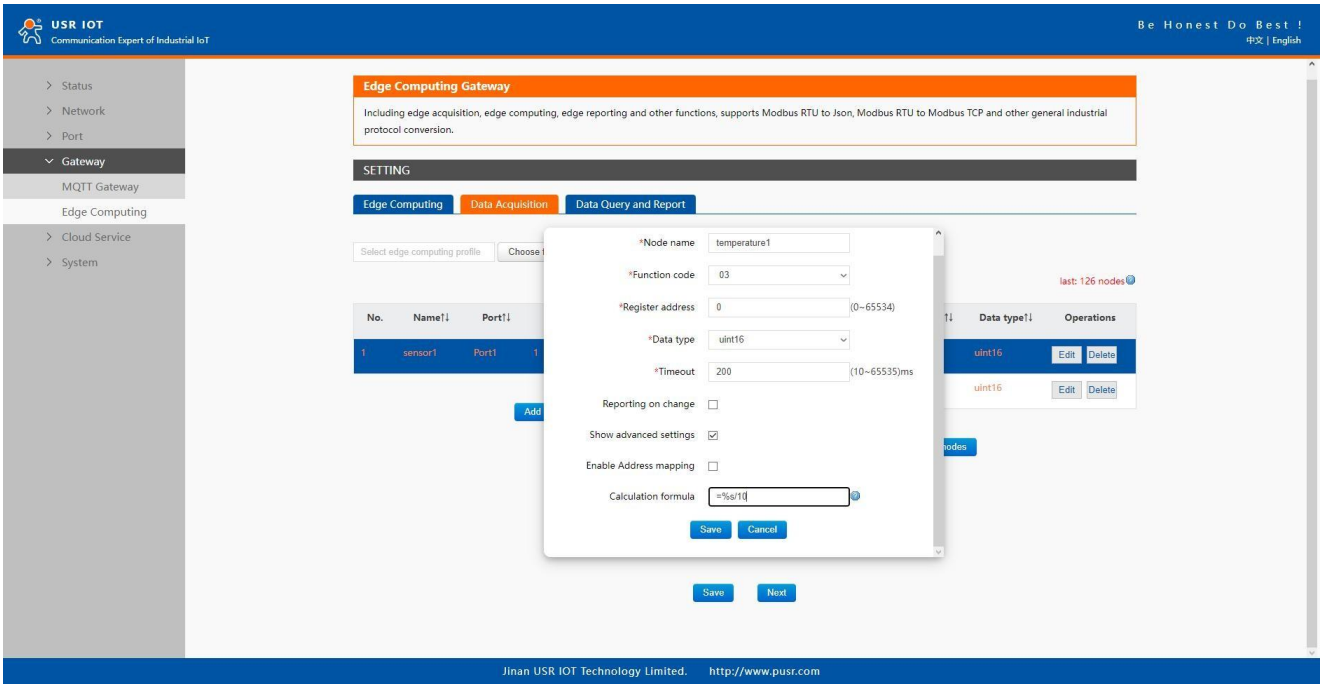


Fig.143 Data point configuration

In the data point property, enter the node name, select modbus function code, enter the register address and response timeout, select the right data type, input the calculation formula, the description of the configuration parameters on this interface is shown in table 19. We use the temperature and humidity data points as an example to describe the process. After finishing configuring the data points, please scroll down to the bottom of the page and click on "Save" button to save all the changes that you have made. All configurations take effect after a system reboot.

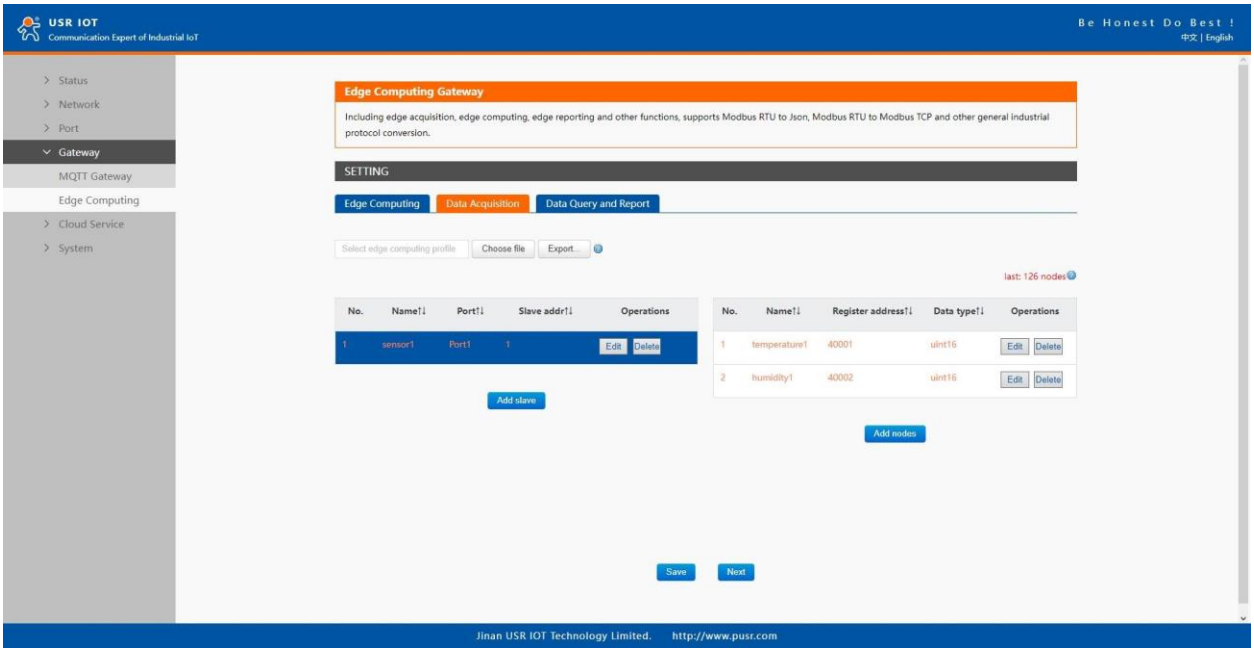


Fig.144 Sensor register reading

After the correct slave and data points configuration, the modbus polling command will print on the corresponding serial port regularly, as shown in Fig.145

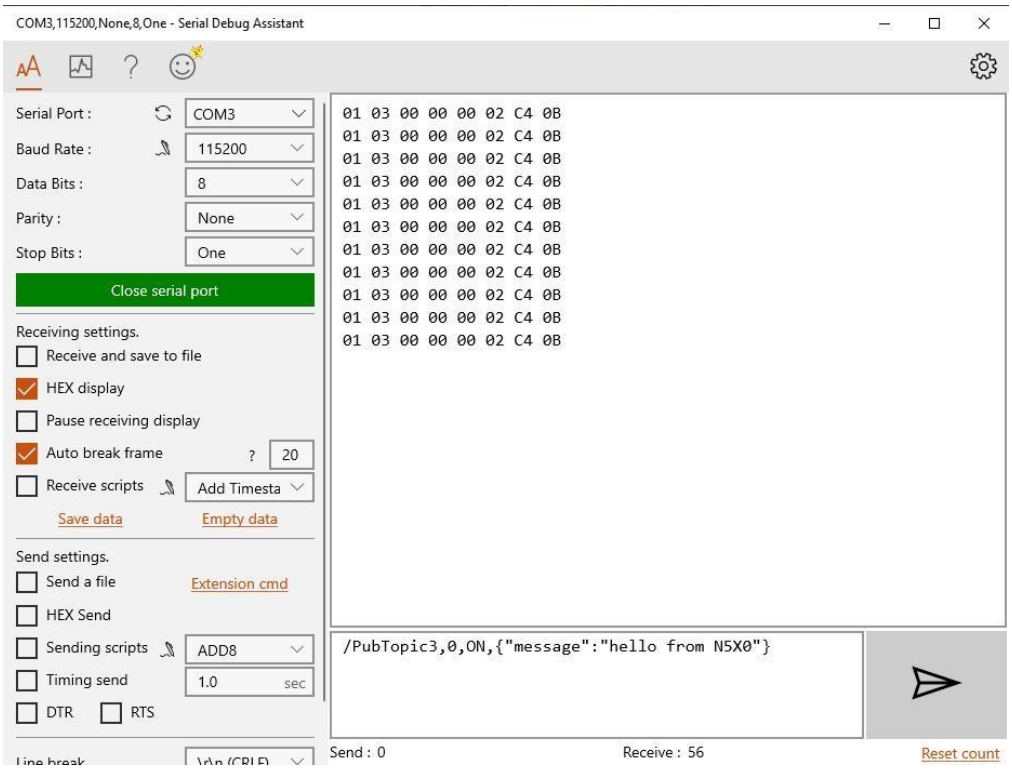


Fig.145 Modbus polling command

9.3 Export and Import configuration

There are three main reasons for using the Import and Export functions.

- Applying the same configuration to multiple units. The Import/Export configuration function is a convenient way to apply the same settings to units located in different sites. You can export the configuration as a file and then import the configuration file onto other units at any time.
- Backing up configurations for system recovery. The export function allows you to export configuration files that can be imported onto other gateways to restore malfunctioning systems within minutes.
- Troubleshooting. Exported configuration files can help administrators to identify system problems that provide useful information for Technical Service Team when maintenance visits are requested. The export function saves all the configuration settings and parameters of the data acquisition in a *.csv file. To begin, click the Export button.

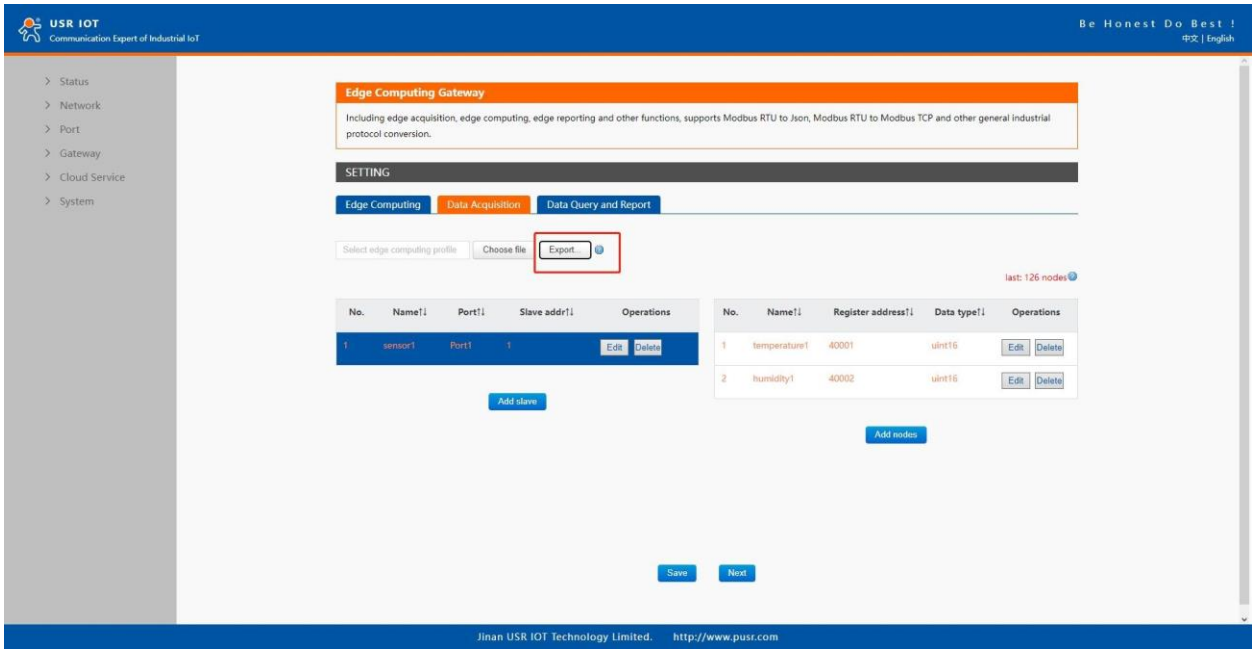
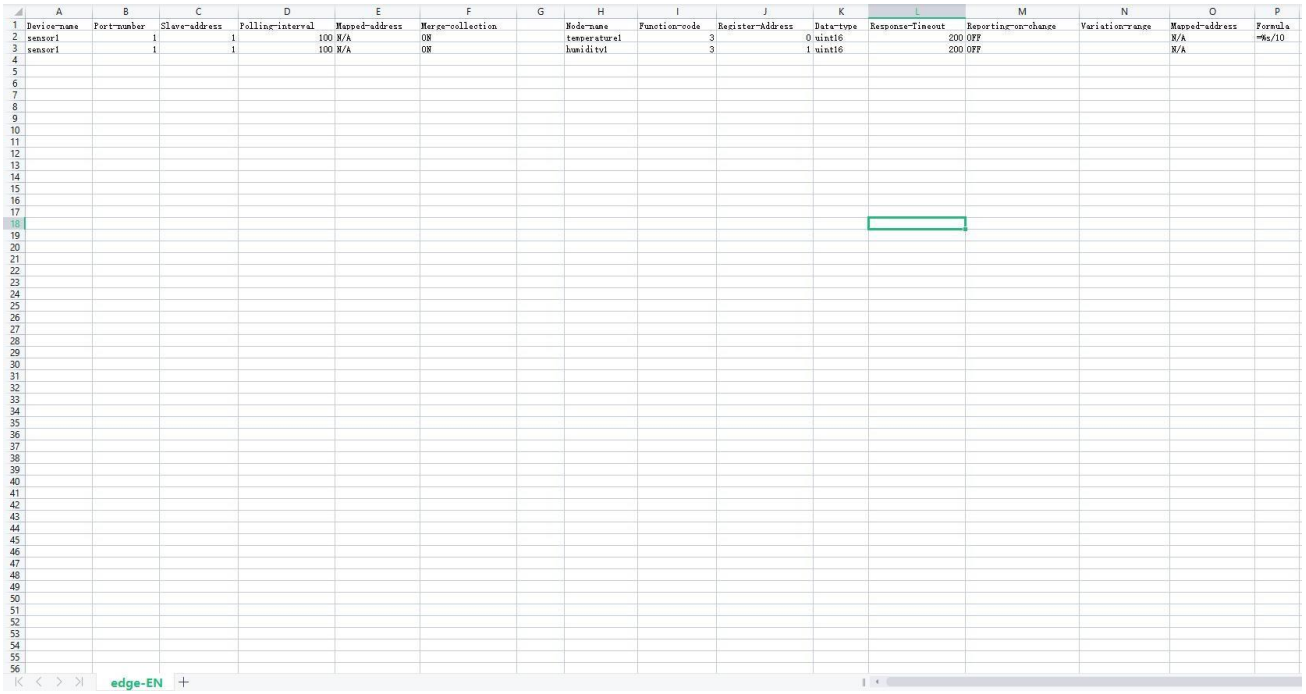


Fig.146 Export the configuration file



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Device-name	Port-number	Slave-address	Polling-interval	Mapped-address	Merge-collection		Node-name	Function-code	Register-Address	Data-type	Response-Timeout	Reporting-on-change	Variation-range	Mapped-address	Formula
2	sensor1	1	1	100	N/A	ON		temperature1	3	0	uint16	200	OFF		N/A	=Ws/10
3	sensor1	1	1	100	N/A	ON		humidity1	3	1	uint16	200	OFF		N/A	

Fig.147 Configuration file

Once the file is saved, it can be imported into your target unit to duplicate the same settings. Select the target unit first and click the choose file button to import. Select the file you want to import, and then click the open button. The data points setting will display on the webpage. After finishing importing the configuration file, please scroll down to the bottom of the page and click on "Save" button to save all the changes that you have made. All configurations take effect after a reboot.

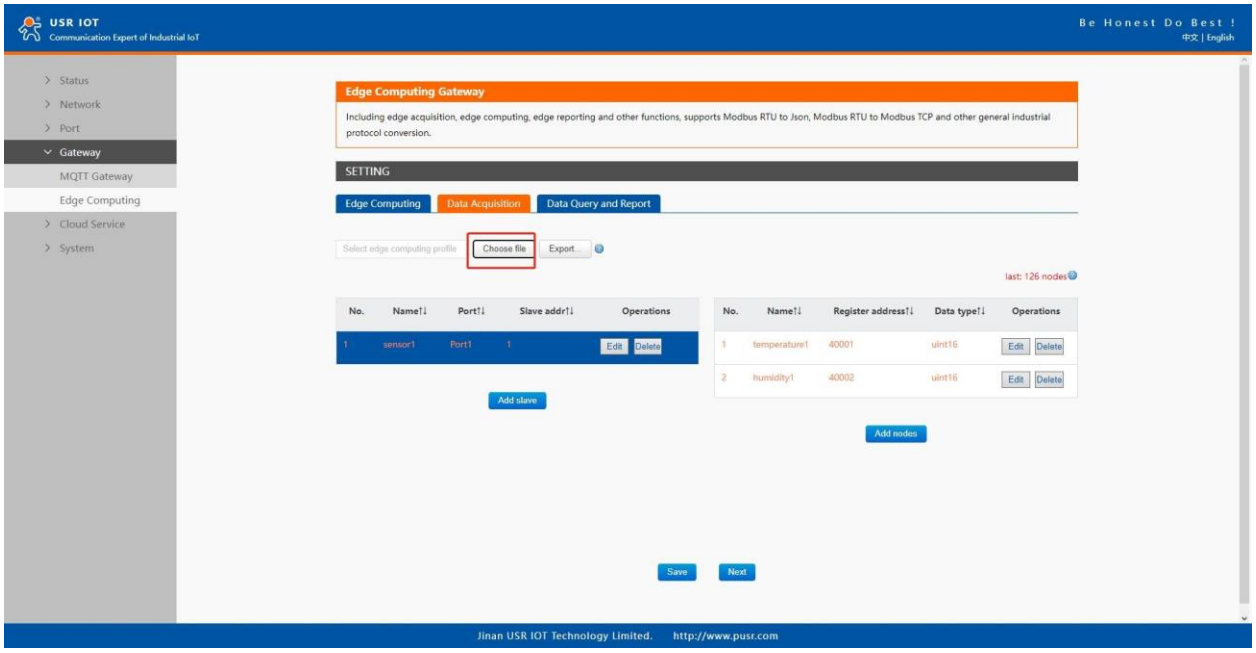


Fig.148 Import the configuration file

9.4 Data report

9.4.1 Communication channel

Users can select TCP/UDP/HTTP in socketA of each serial port, MQTT Gateway, or AWS IOT service as the communication channel. When select MQTT or AWS IOT channel, user need configure the MQTT broker parameters in MQTT Gateway tab or Cloud service tab at first, and setting the report topic in the Fig.149.

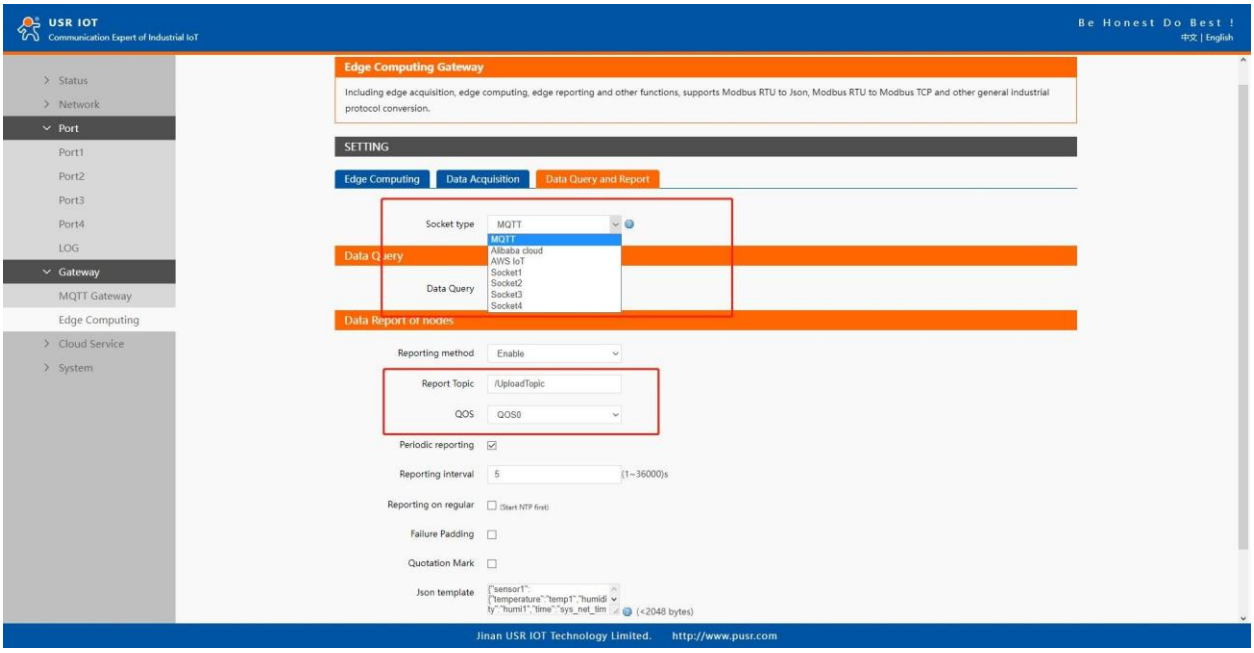


Fig.149 Communication channel set

9.4.2 Report Method

There are three ways to report the data acquired to the communication channel: on change, interval, timer. The description of the configuration parameters on this interface is shown in table 20. After finishing parameter setting, please click on “save” button to save all the changes that you have made. All configurations take effect after a system reboot.

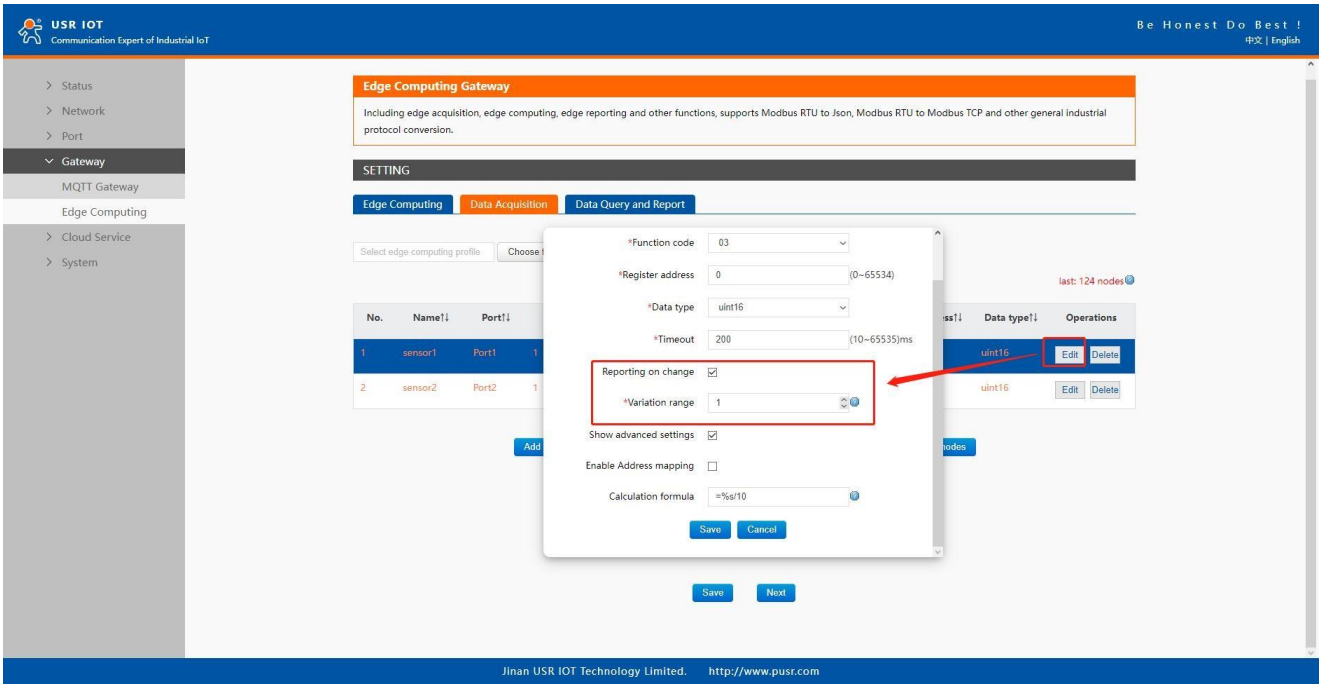


Fig.150 Report on change

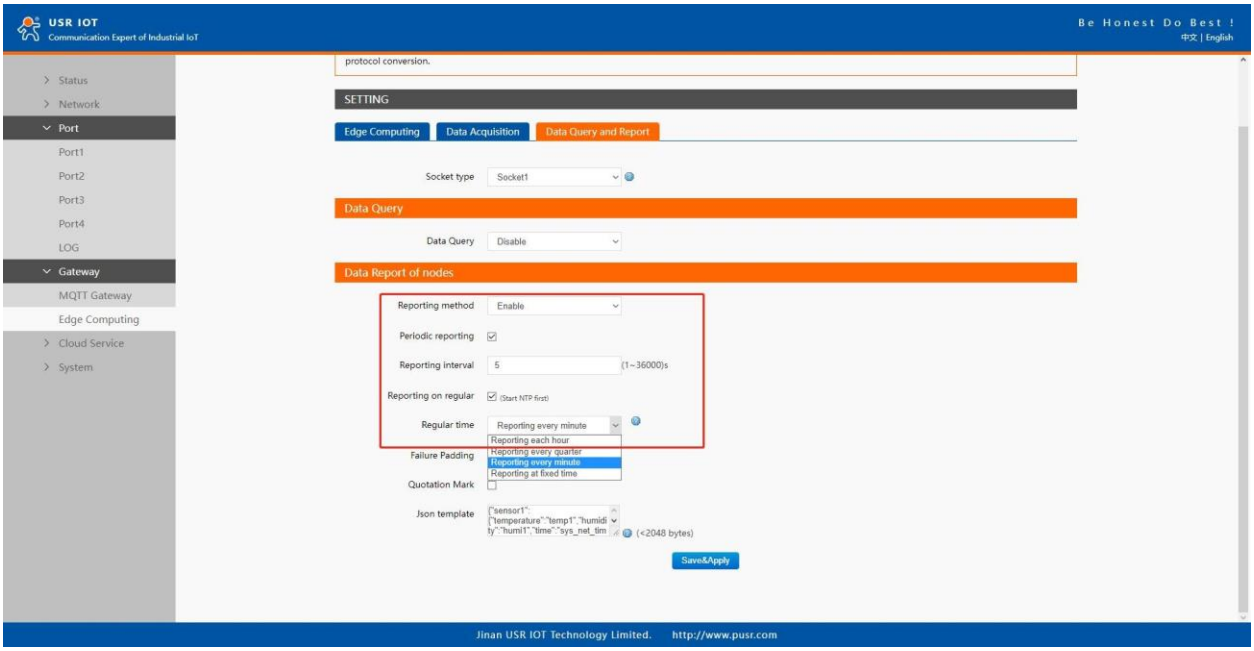


Fig.151 Interval and timer report

9.4.3 Payload-Json template

A JSON object contains zero, one, or more key-value pairs, also called properties. The object is surrounded by curly braces {}. Every key-value pair is separated by a comma. The order of the key-value pair is irrelevant. A JSON array contains zero, one, or more ordered elements, separated by a comma. The JSON array is surrounded by square brackets [ ]. A key-value pair consists of a key and a value, separated by a colon (:). The key is a string, which identifies the key-value pair. The value can be any of the following data types: string(surrounded by quotation marks (" ")),number,float,array(JSON array),object(JSON object (can be nested)),boolean(true or false),empty.

Example 1


```
{
"sensor1": {
"temperature": "temperature1",
"humidity": "humidity1",
"user_define": "bedroom"
},
"sensor2": {
"temperature": "temperature2",
"humidity": "humidity2",
"user_define": "living room"
},
"time": "sys_net_time"
}
```


Example 2


```
{
"service":[{
"sensor1": {
"temperature": "temperature1",
"humidity": "humidity1",
```

"user_define": "bedroom"

},

"sensor2": {

"temperature": "temperature2",

"humidity": "humidity2",

"user_define": "living room"

},

"event_time": "sys_net_time"

}],

"device_id":"sys_mac"

}

We can use a tool to compact it. Below is a free online tool: https://jsonformatter.org/. Paste the message in the column on the left and then, click Minify JSON. It will show a compact JSON format message in the column on the right. Click Copy to Clipboard.

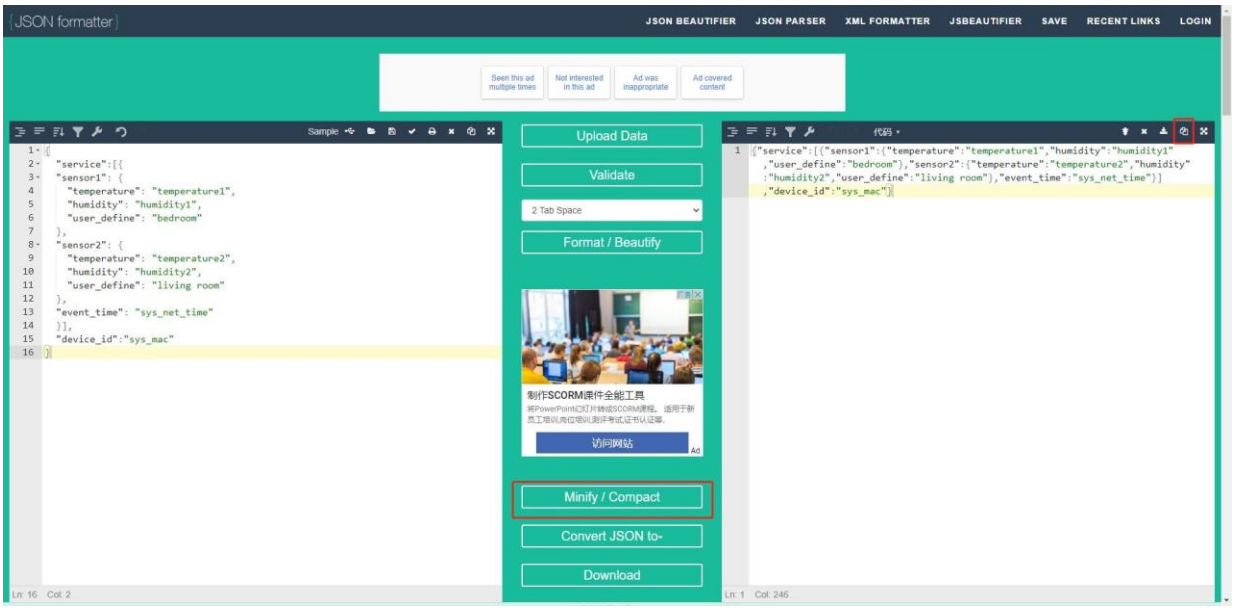


Fig.152 Json Formatter

Paste the message in the Json template on the page and click on "Save&Apply" button to save all the changes that you have made. All configurations take effect after reboot.

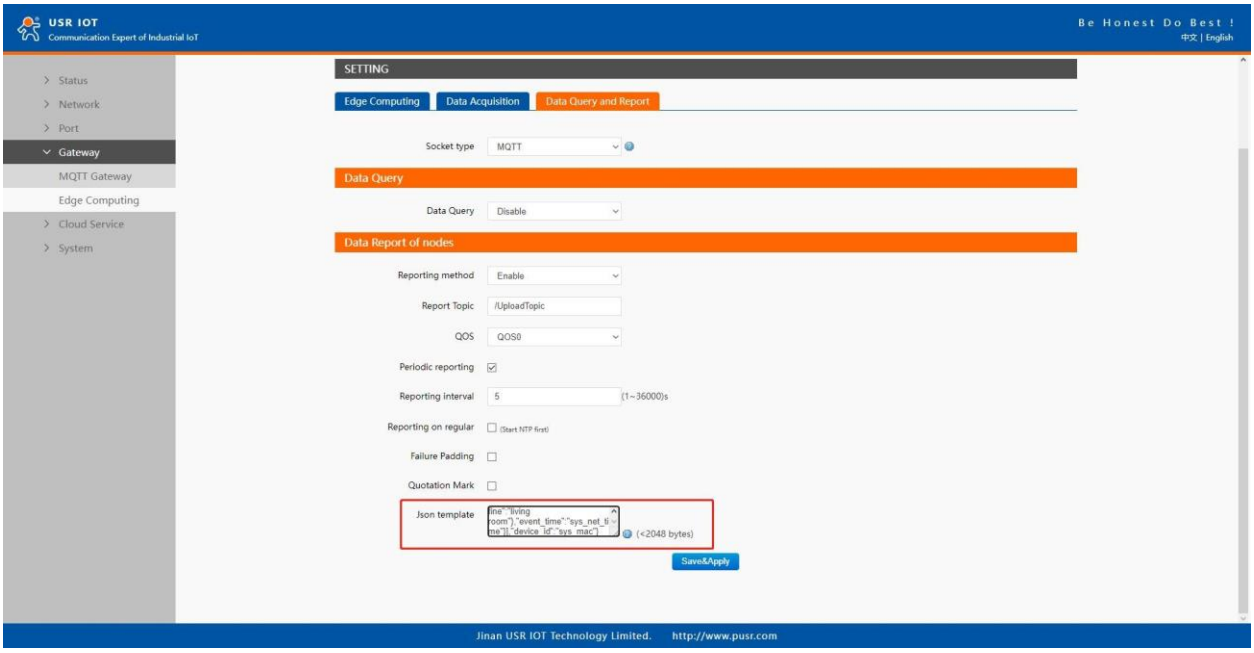


Fig.153 Json template setting

There are three type data point, user define, system,and register value in a Json template.

➔ System data points

The system data points defined by N5X0 gateway is shown in table 2.

Table 27 System data points

System data points	Description
Sys_sn	SN number
Sys_mac	MAC address
Sys_hard_ver	Hardware version
Sys_soft_ver	Software version
Sys_dev_name	Product name
Sys_net_time	GMT time
Sys_unix_time	Unix time
Sys_ip	Local IP address
Sys_dev_name	Product running time

➔ Modbus register value data points.

The node name configured in the section 9.2.3 is register value data points.

➔ User define

In addition to the above two types of data points, users can also define your own data points. Such as "user_define": "living room."

9.4.4 Test

We now use modbus slave software to simulate two modbus slave device. The connection and and parameters settings are show in Fig.155. Two USB to RS485 converters are connecting PC with serial Port 1 and 2 of N540 gateway. We use MQTT.fx to connect to the same broker and subscribe the report topic of N540, we can see the message transmitted at the specified interval.

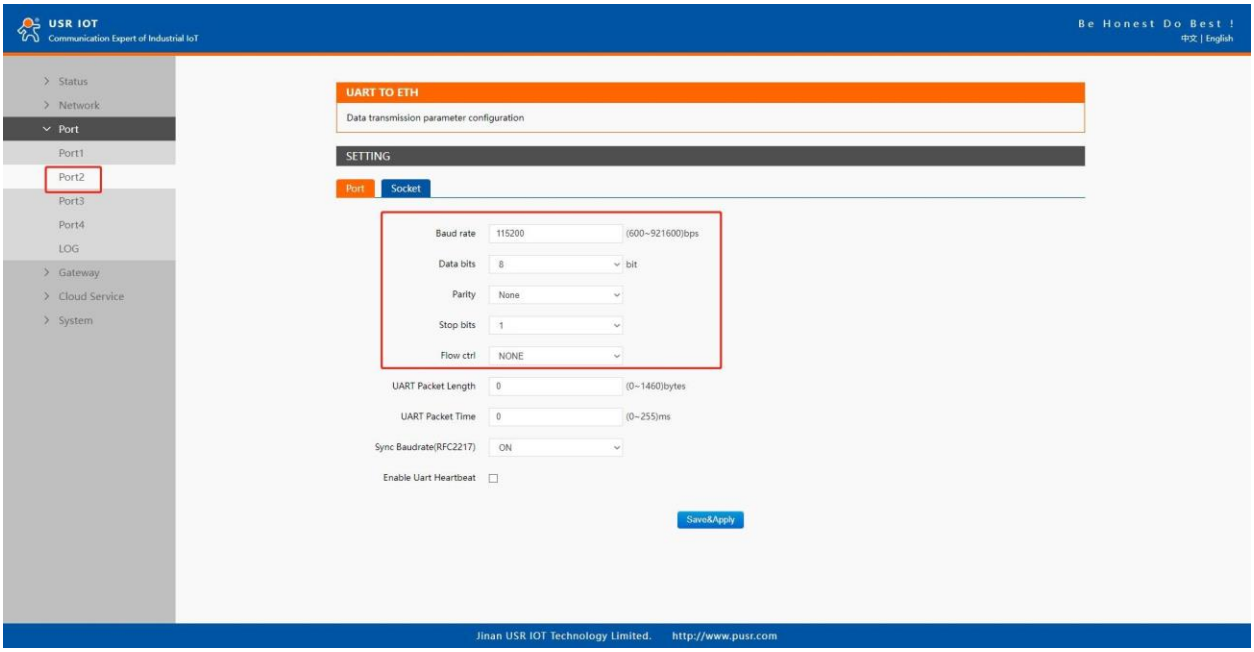


Fig.154 Serial Port Parameters

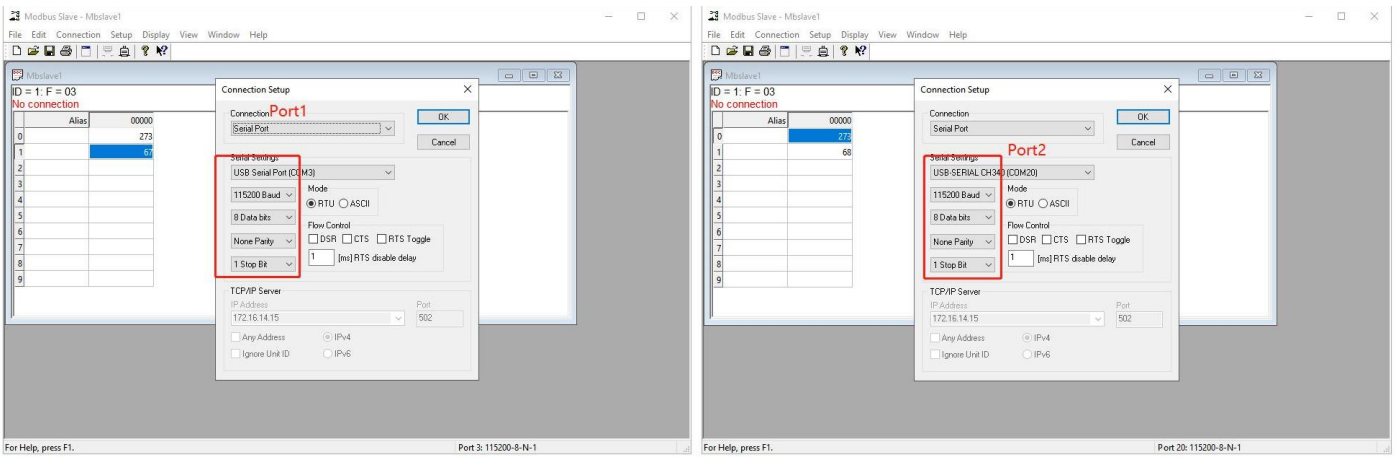


Fig.155 Modbus slave simulation

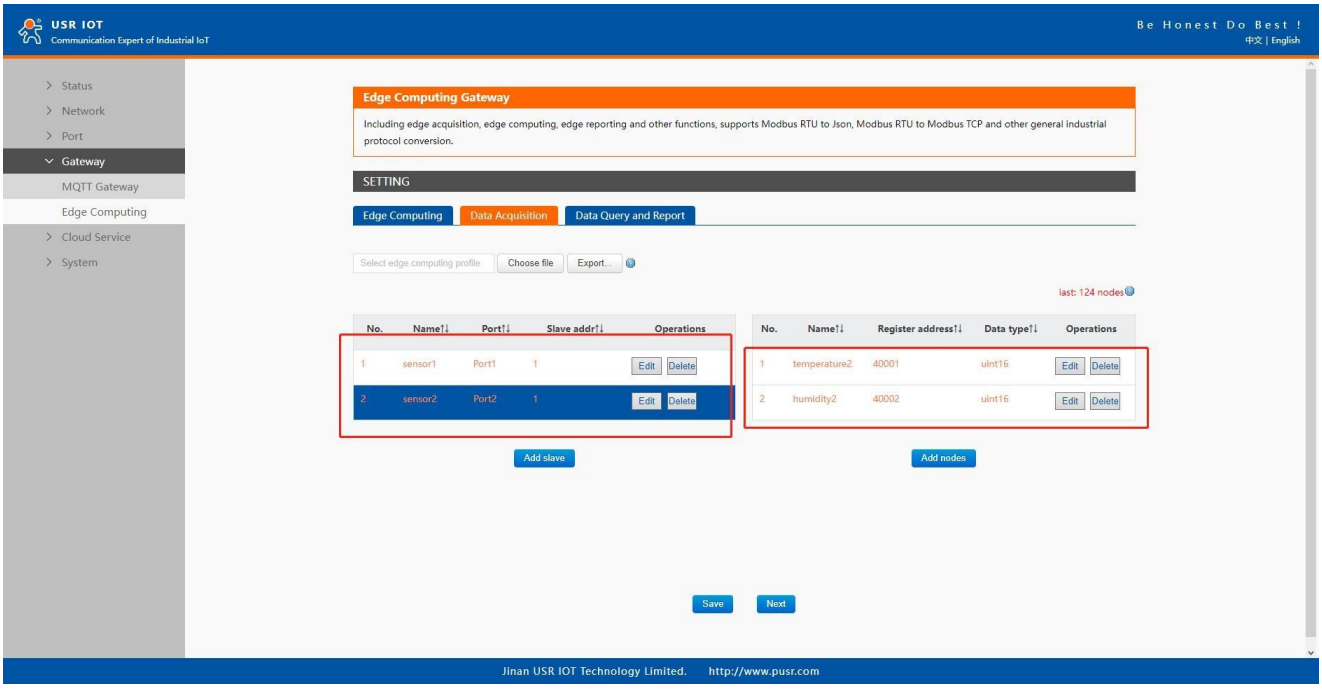


Fig.156 Data Acquisition setting

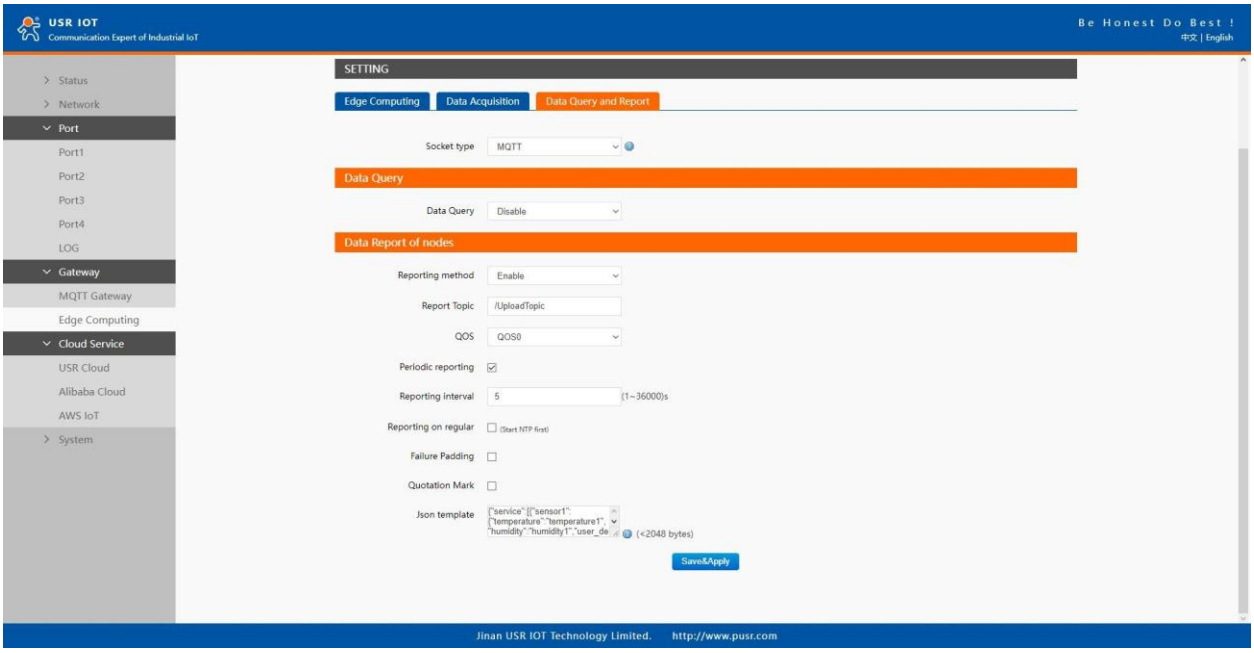


Fig.157 Data report setting

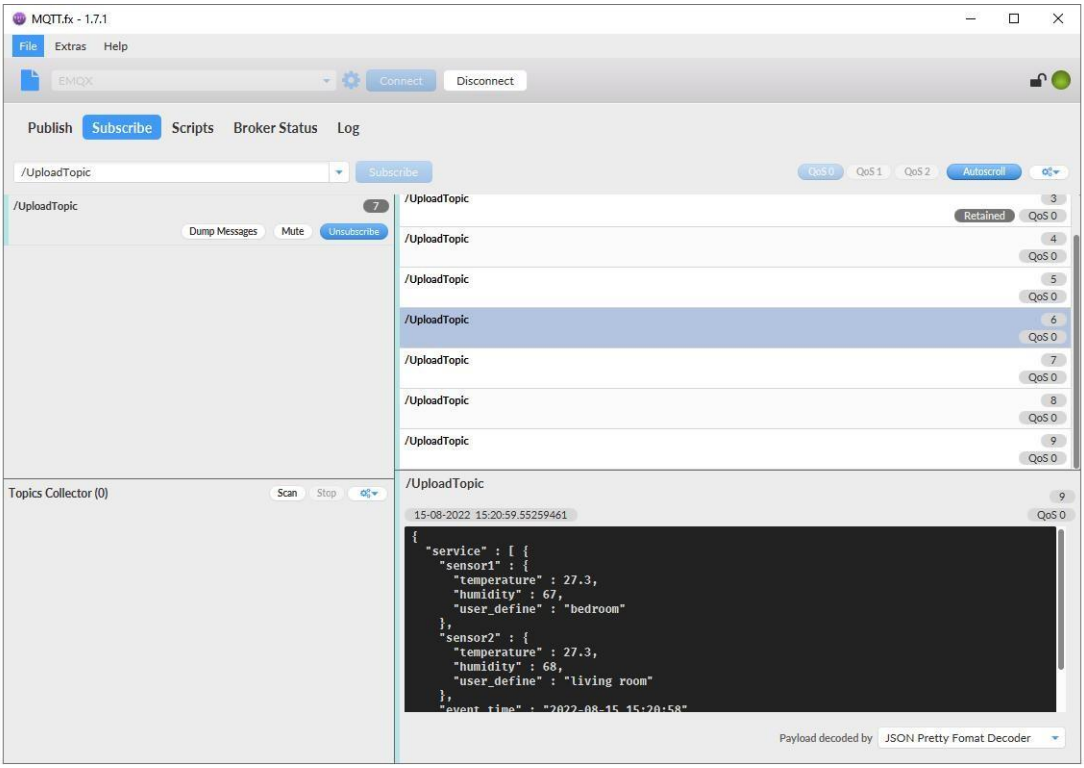


Fig.158 Data reported

9.5 Data Query

There are three methods to actively query the data collected through the serial port from the communication channel: Json format, Modbus TCP, Modbus RTU. Firstly, user need enable the data query function.

9.5.1 Json

When select MQTT or AWS IOT channel, user need configure the MQTT broker parameters in MQTT Gateway tab or Cloud service tab at first, select Json query type and setting the query topic in the Fig.159. The report topic is same as described in section 9.4.1.

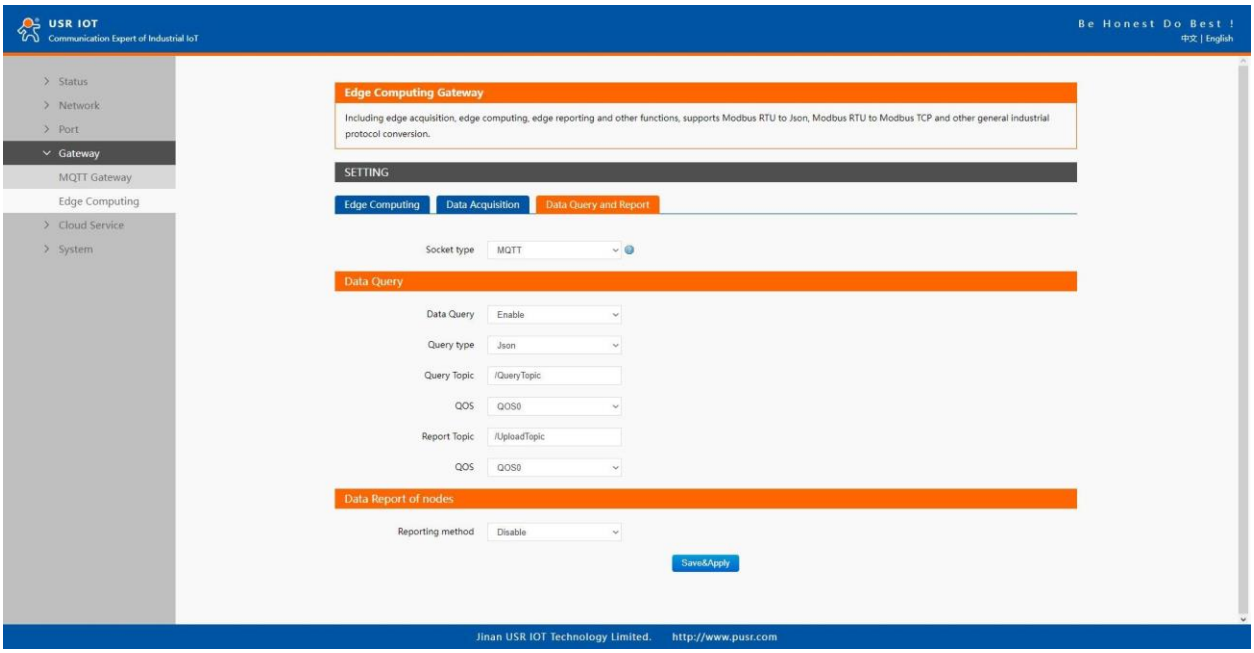


Fig.159 Json Query Type

The Json content need conform to template described in section 9.4.3.

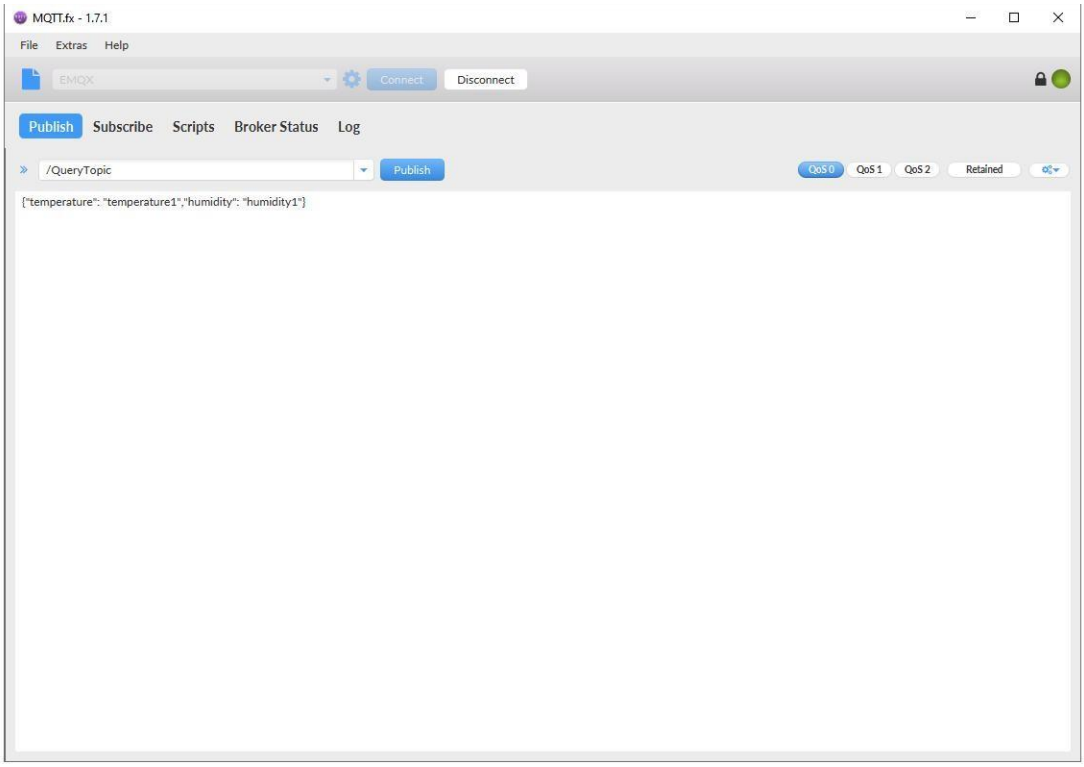


Fig.160 Json Query message

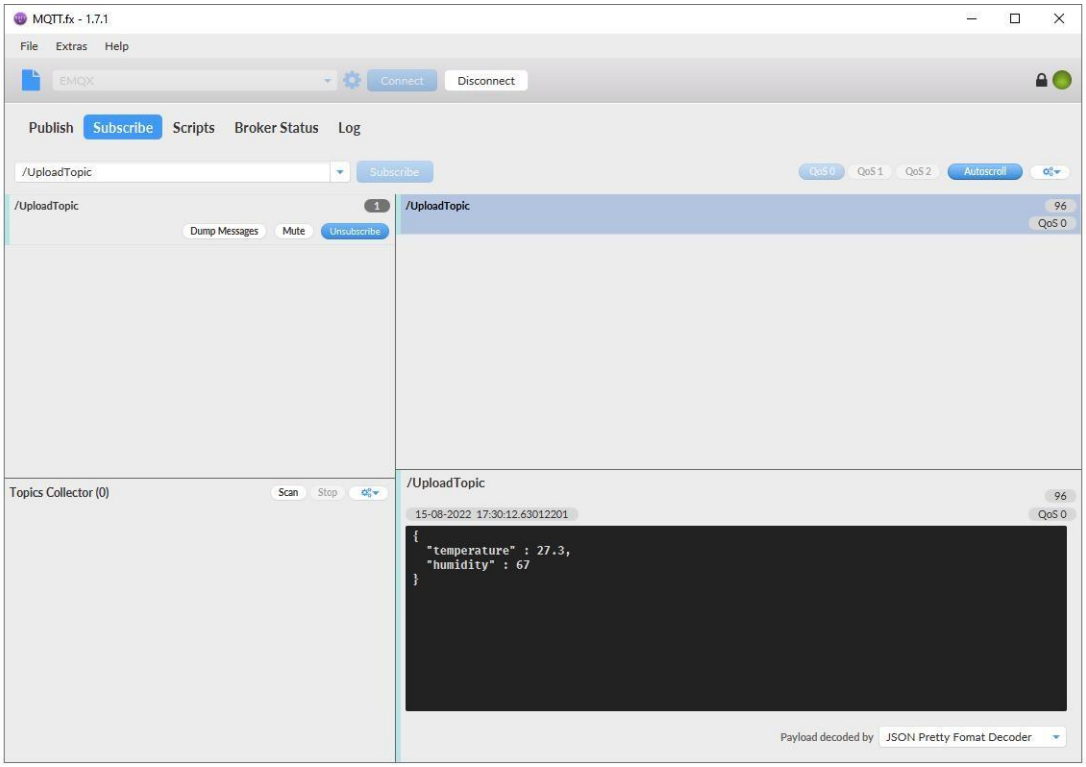


Fig. 161 Json response message

9.5.2 Modbus slave address and register mapping

This function is very useful in data query and only used in modbus TCP/RTU query type. When user select Modbus TCP/RTU query type to get data, the N5X0 gateway will be confused if there are the same slave address in different serial port or same register address in different slave devices. All slave devices and registers on a gateway are planned and managed in a unified manner. For example, user can map slave address 1 in Port1 to slave 1 in N5X0 gateway, map slave address 1 in Port2 to slave 2 in N5X0 gateway.

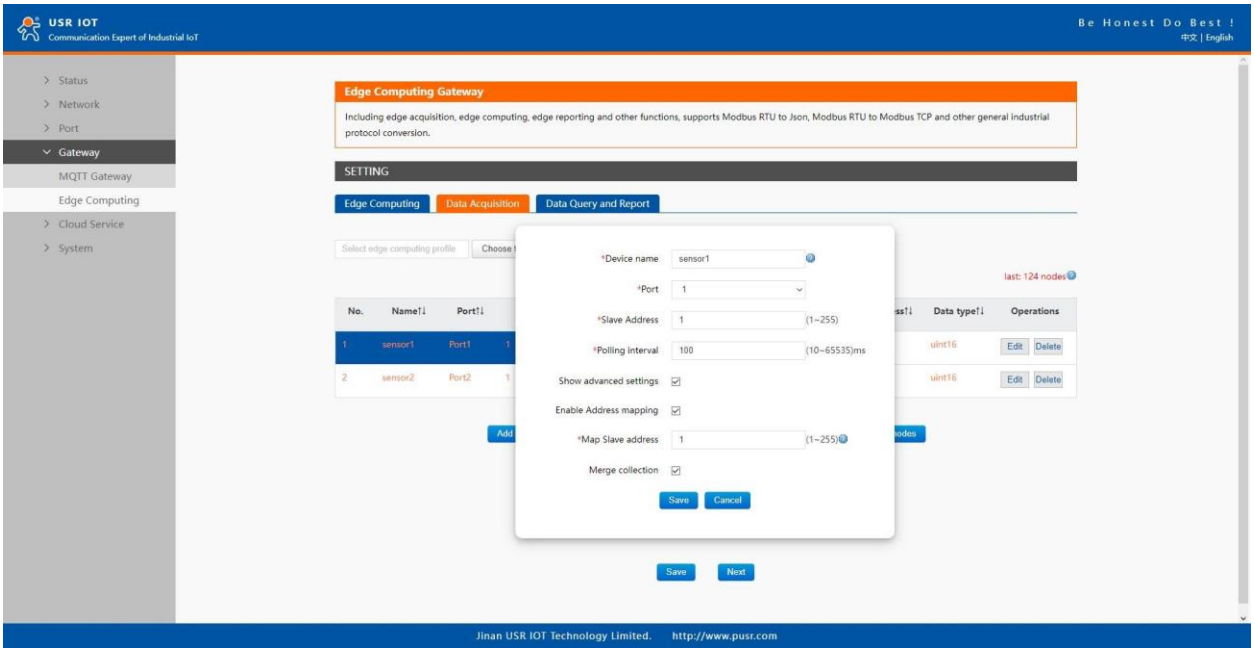


Fig.162 Slave address mapping

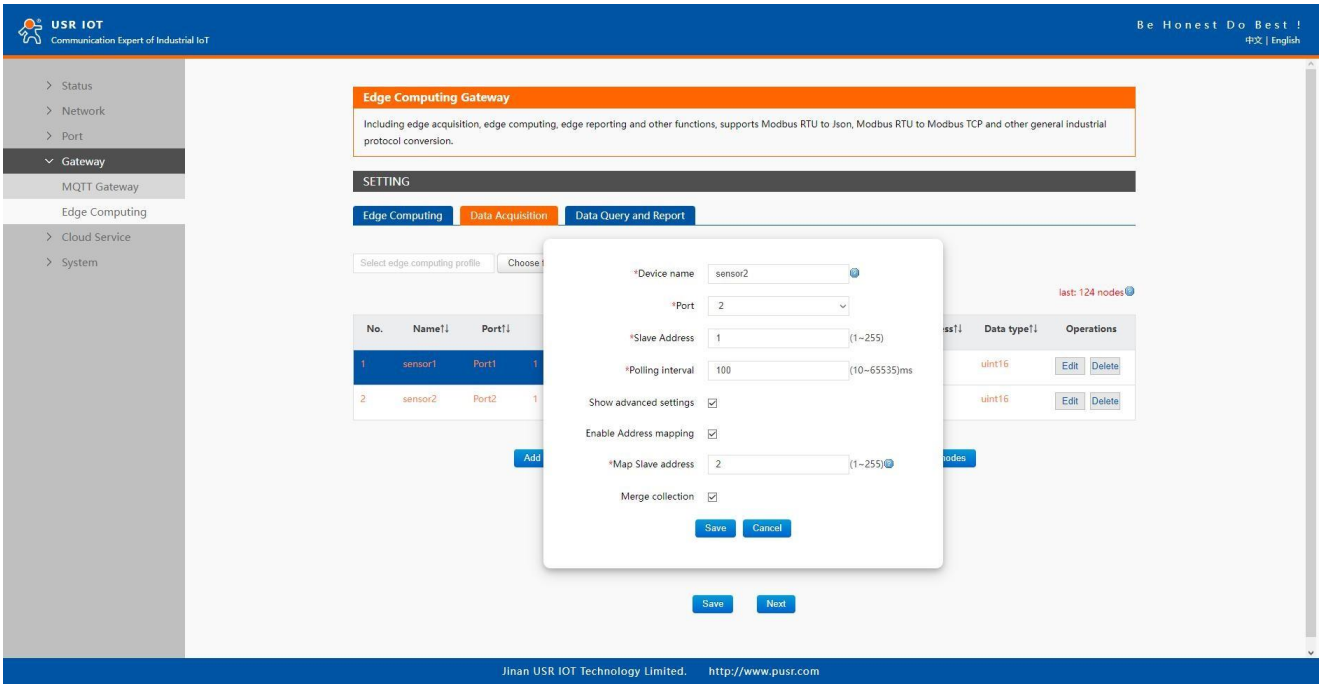


Fig.163 Slave address mapping

9.5.3 Modbus TCP

When select socket channel, user need configure the socket A parameters in PORT tab at first, then select Modbus TCP query type. We use slave address mapping here for illustration.

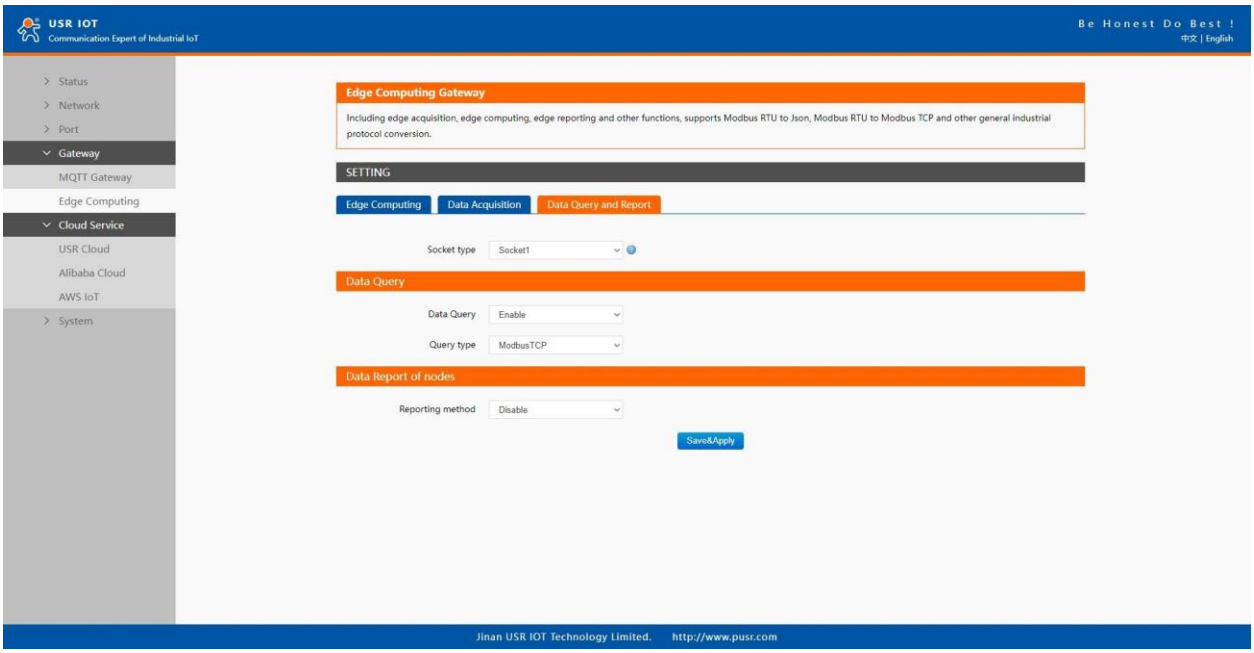


Fig.164 Modbus TCP query type

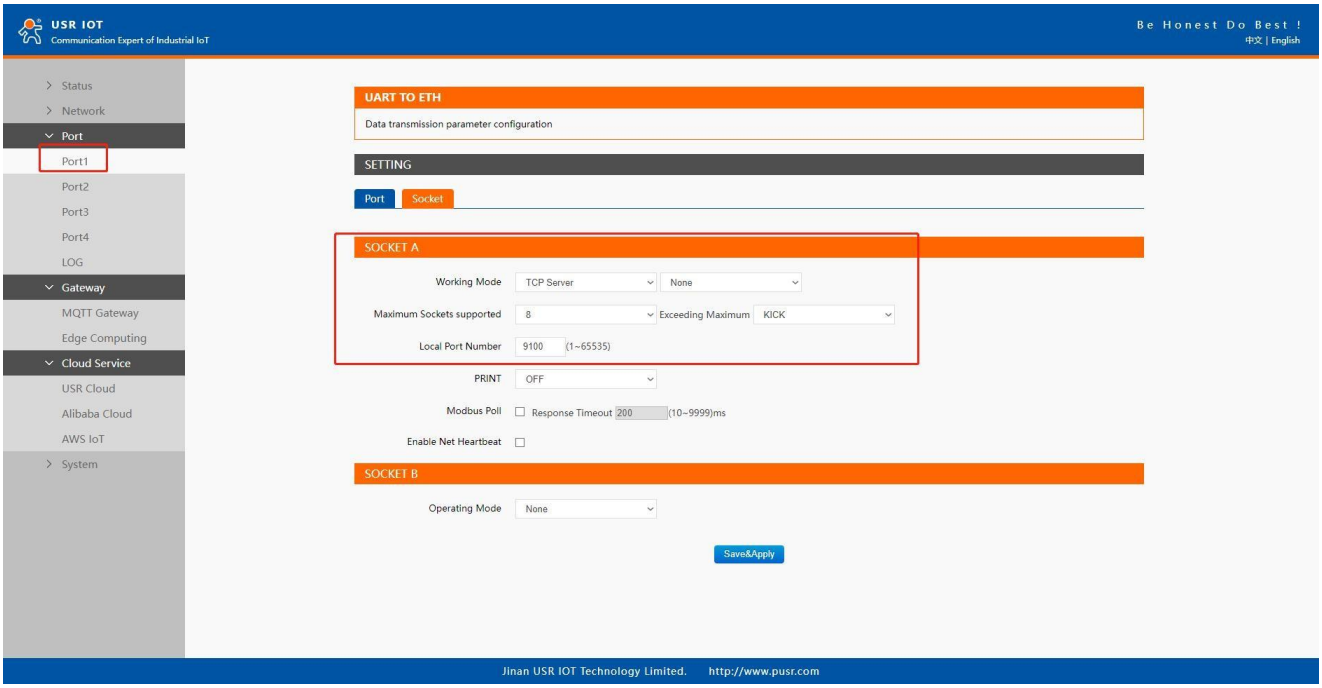


Fig.165 A socket parameters setting

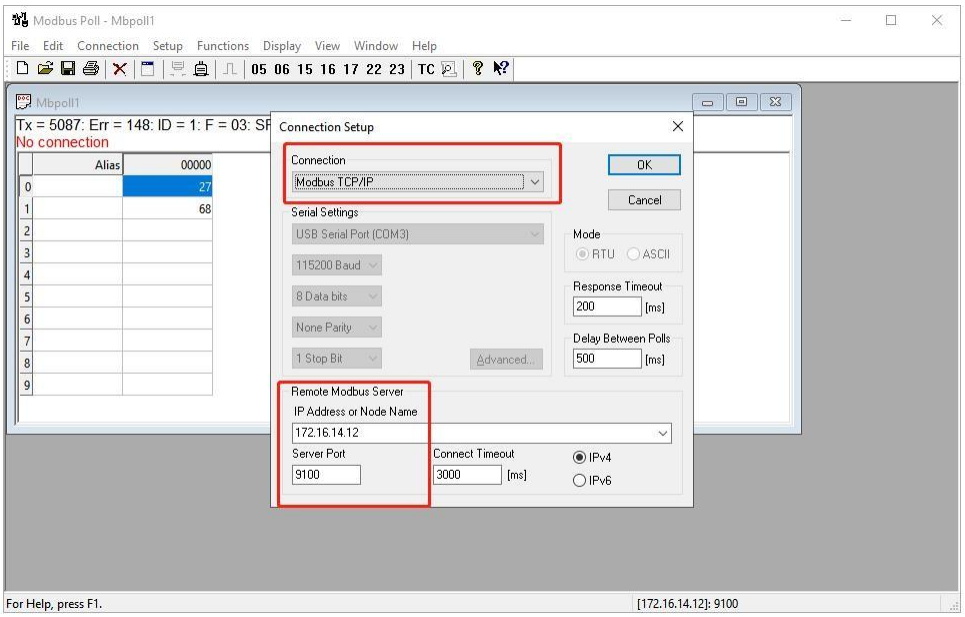


Fig.166 Modbus TCP simulator

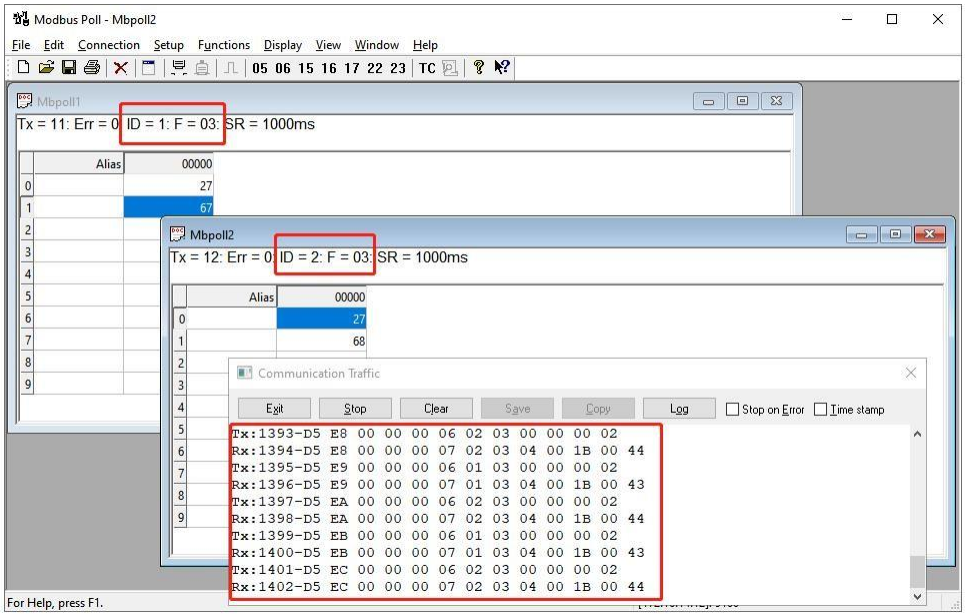


Fig. 167 Modbus TCP response

9.5.4 Modbus RTU

When select socket channel, user need configure the socket A parameters in PORT tab at first, then select Modbus RTU query type. We use slave address mapping here for illustration.

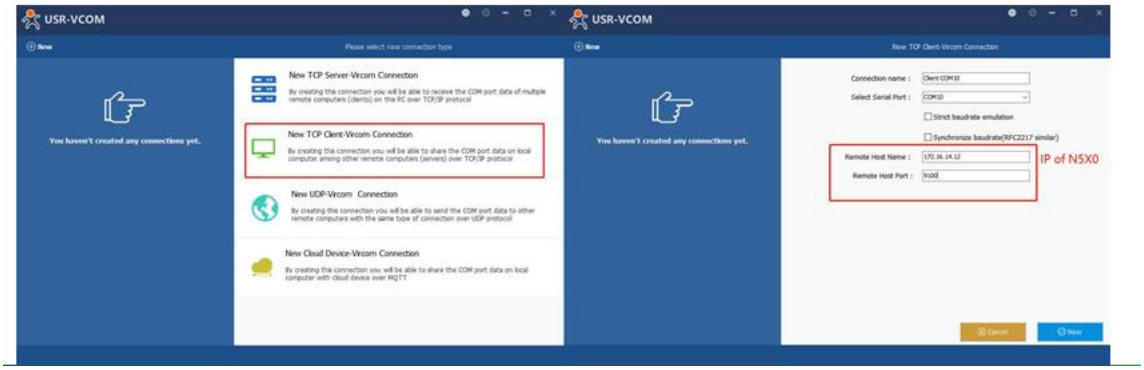


Fig.168 Build a virtual COM10

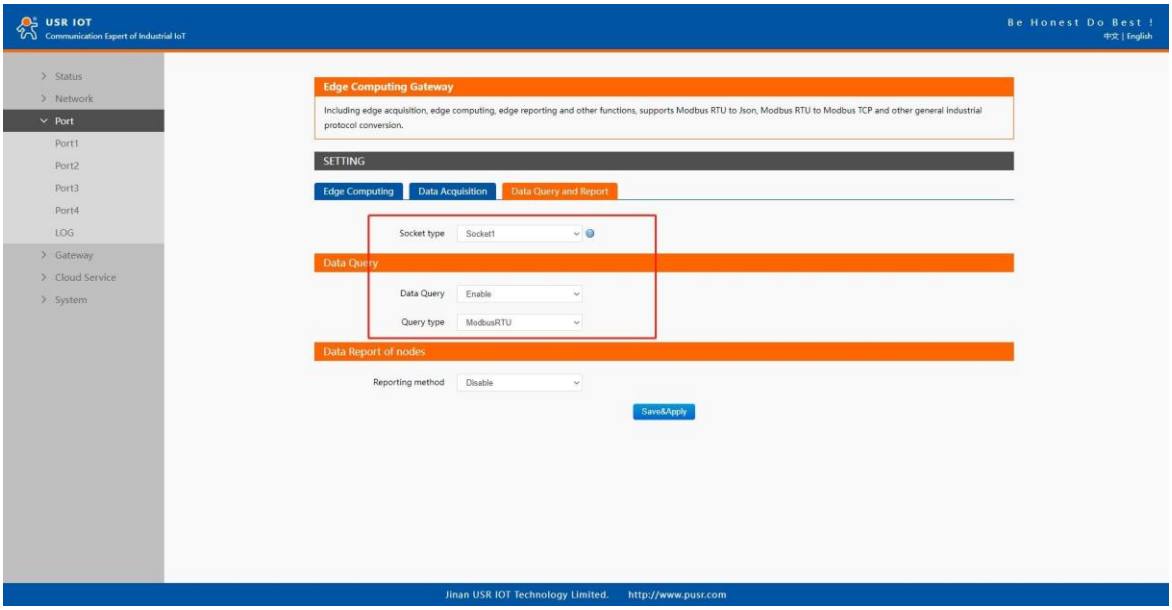


Fig.169 Modbus RTU Query Type

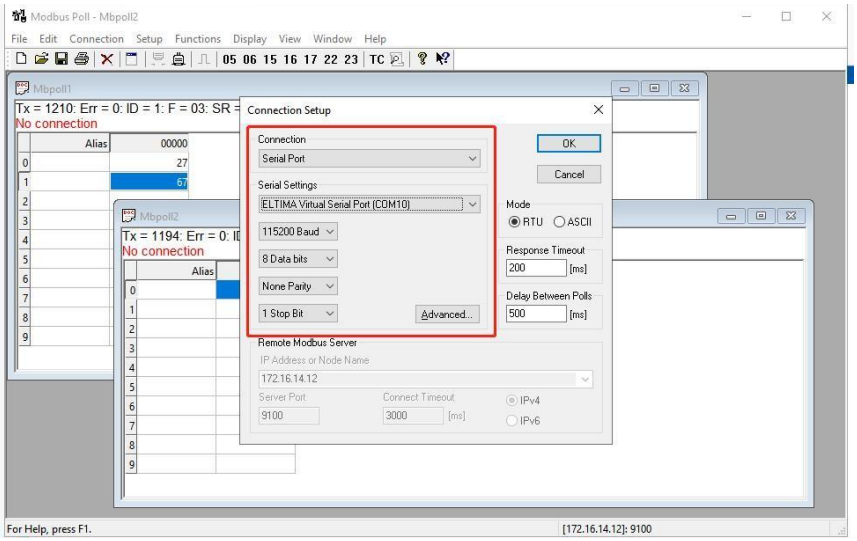


Fig.170 Modbus RTU Simulator

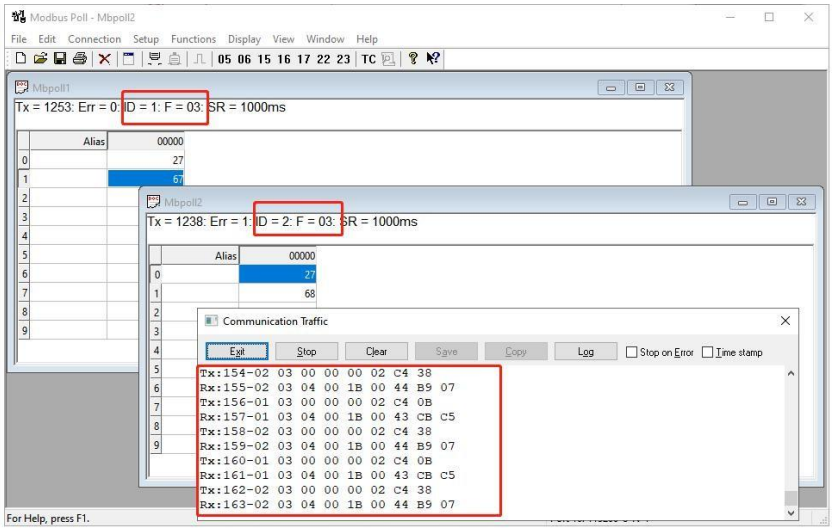


Fig.171 Modbus RTU response

10. AWS IOT Service

In order to reduce the length of this document, we have organized this section into a special document. Please refer to "USR-N5X0 Quick Start Guide with AWS IoT" for detail.

11. PUSR Cloud service

In order to reduce the length of this document, we have organized this section into a special document. Please refer to "USR-N5X0 Quick Start Guide with PUSR cloud" for detail.

12. Warranty

13. Contact US

Jinan USR IOT Technology Limited

Address: Floor 12 and 13, CEIBS Alumni Industrial Building, No. 3 Road of Maolingshan, Lixia District, Jinan, Shandong, China

Official website: https://www.pusr.com

Official shop: https://shop.usriot.com

Technical support: http://h.usriot.com/

Email: sales@usriot.com

Tel: +86-531-88826739

Fax: +86-531-88826739-808

14. Disclaimer

The information in this document provided in connection with Jinan USR IoT technology ltd. and/or its affiliates' products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of USR IoT products. EXCEPT AS SET FORTH IN THE TERMS AND CONDITIONS AS SPECIFIED IN THE LICENSE AGREEMENT FOR THIS PRODUCT, USR IoT AND/OR ITS AFFILIATES ASSUME NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL USR IoT AND/OR ITS AFFILIATES BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT

LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF USR IoT AND/OR ITS AFFILIATES HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. USR IoT and/or its affiliates make no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. USR IoT and/or its affiliates do not make any commitment to update the information contained in this document.

15. Revision History

Version	Date	Author	Description
1.0.0	2022.7.30	Dean,Gao	Initial