PUSR®
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Industrial Edge Gateway

USR-M300

User Manual

V2.0

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Content

1. Introduction

1.1. Overview

USR-M300 is a high-performance and scalable edge IOT gateway. This device integrates edge collection, data calculation, data reading and writing, active reporting, linkage control, IO collection and control and other functions. The collection protocol includes standard Modbus protocol and a variety of common PLC protocols, as well as industry-specific protocols. At the same time, the product also has routing and VPN as well as graphical programming functions to ensure data transmission security. Using graphical programming, users can develop independently to achieve the required functions.

USR-M300 is embedded in Linux kernel, with a main frequency of up to 1.2Ghz. It can access the Internet via Ethernet port, ADSL and LTE cat4 cellular network to achieve easy network deployment.

It is widely used in various industrial intelligent solutions such as industrial robot, smart factories, smart agriculture, smart water management system etc.

1.2. Features

- Dual-core professor with ultra-high performance, the main frequency is up to 1.2Ghz, providing high-performance processing resources for edge computing.
- Supports Python development, for developing user custom applications.
- Supports graphical programming to facilitate user development.
- LTE 4G and Ethernet network serve as backups for each other to ensure stable network transmission without downtime.
- Integrated 1*WAN/LAN and 1*LAN Ethernet port, VPN（PPTP,L2TP,OpenVPN） and firewall（Port mapping, port forwarding） protection to ensure safe data transmission.
- Integrated 2 serial ports: 1*RS232/485, 1*RS485, which can transform traditional serial devices into IOT devices.
- Comes with IO interface: 2*DI, 2*DO, 2*AI, flexible expandable IO module is supported.
- Powerful edge gateway function: supports edge collection, edge computing, group reporting, and supports real-time collection of up to 2000 points.
- Supports major industrial protocols including Modbus TCP/RTU, PLC protocols and OPC UA Server.
- Support 2 socket channels, each channel supports TCP(SS)/UDP, MQTT(S) protocols.

Cloud support: MQTT via AWS IOT, Alibaba Cloud, and PUSR Cloud.

The PLC acquisition protocols supported by M300:

Protocol	PLC brand	PLC model or description
Modbus	Delta, ABB, HollySys, Modicon	Delta DVP/AH500/AS200 series,

		AC500 (ABB), LK series (HollySys)
PPI	Siemens	S7-200
S7comm	Siemens	S7-200 smart，S7-1200，S7-1500， S7-300，S7-400
FX Protocol	Mitsubishi	FX2N (1N)/FX3U (Mitsubishi) FX5U Ethernet port, FX3U-ENET-ADP, Q series
MC 3C/3E	Mitsubishi	FX5U serial port
FINS TCP	Omron	CP series
FINS COM	Omron	CP series
DVP Series	Delta	DVP Series RTU

Other acquisition protocols supported by M300:

Protocol	description
DL/T645-2007	Meter protocol
IEC104（southbound and northbound）	Power protocol
BACnet（southbound and northbound）	Building protocol

2. Get Started

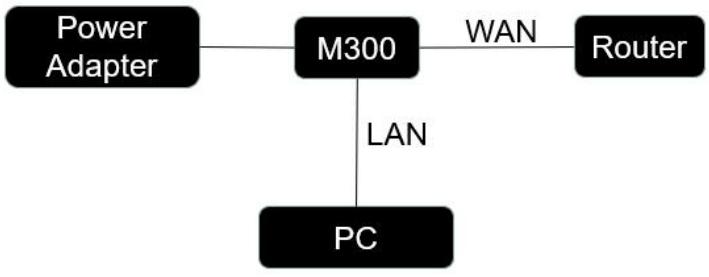
2.1. Hardware connection

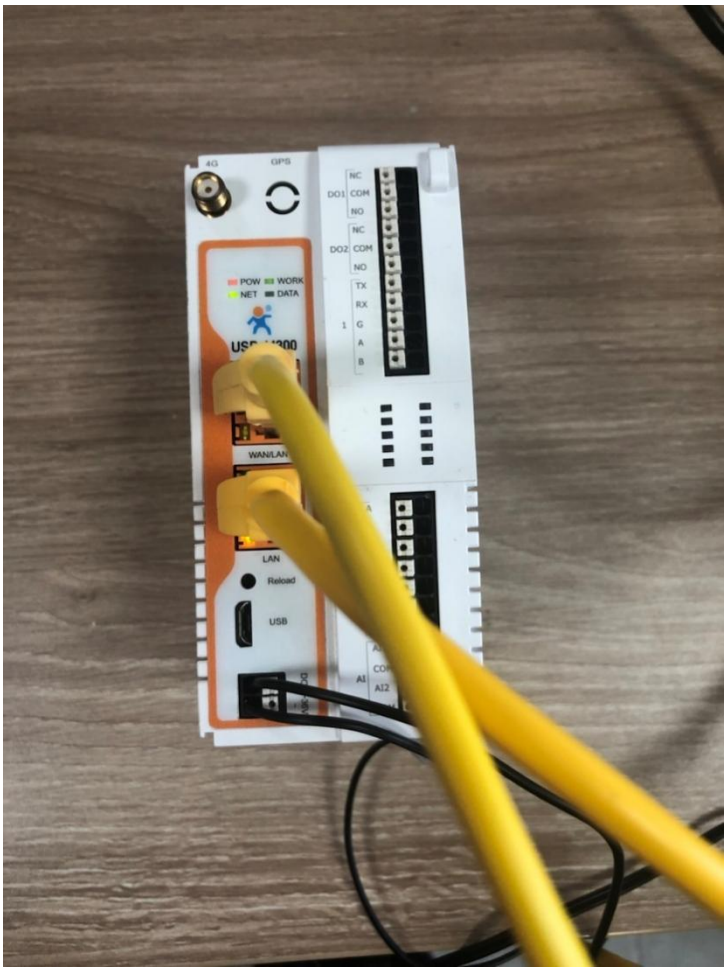
Preparation:

Power adapter 12V/1A * 1

Network cable * 1

The hardware connection diagram is like the following:





2.2. Login Gateway

Power on the USR-M300, connect PC to M300 via LAN port, users can login the gateway via Chrome or the other browser. The default network parameters are shown in the following table:

Table 1. Default network parameters

Parameter	Default value
LAN IP	192.168.1.1
Username	admin
Password	admin

Open the browser, enter 192.168.1.1 in the URL blank, and press Enter, it will navigate to the following webpage. After entering the login password, clicking login, the web page will show configuration page of USR-M300.

Figure 1. Login webpage

2.3. Brief introduction of the webpage

There are several tabs on the top of the webpage, users can set parameters of USR-M300 on the tab pages.

- Overview: On this page, users can quickly learn about the running status of the gateway, like system information, device status, cellular information and etc.
- Network: In this interface, there are many categories related to network connection. Users can set parameters such as WAN port, LAN port and cellular network.
- Edge Computing: With this functionality, the M300 gateway serves as host and actively sends the polling acquisition command to periodically obtain the point data of the serial and Ethernet devices and the data collected by the I/O interface.
- System Management: In this webpage, users can check the log information, and set the system time and so on.
- Python Application: With this functionality, users can deploy Python applications.

3. Overview Information

In this page, it includes system information, device status, cellular information, flow usage monitoring and performance of processor chipset.

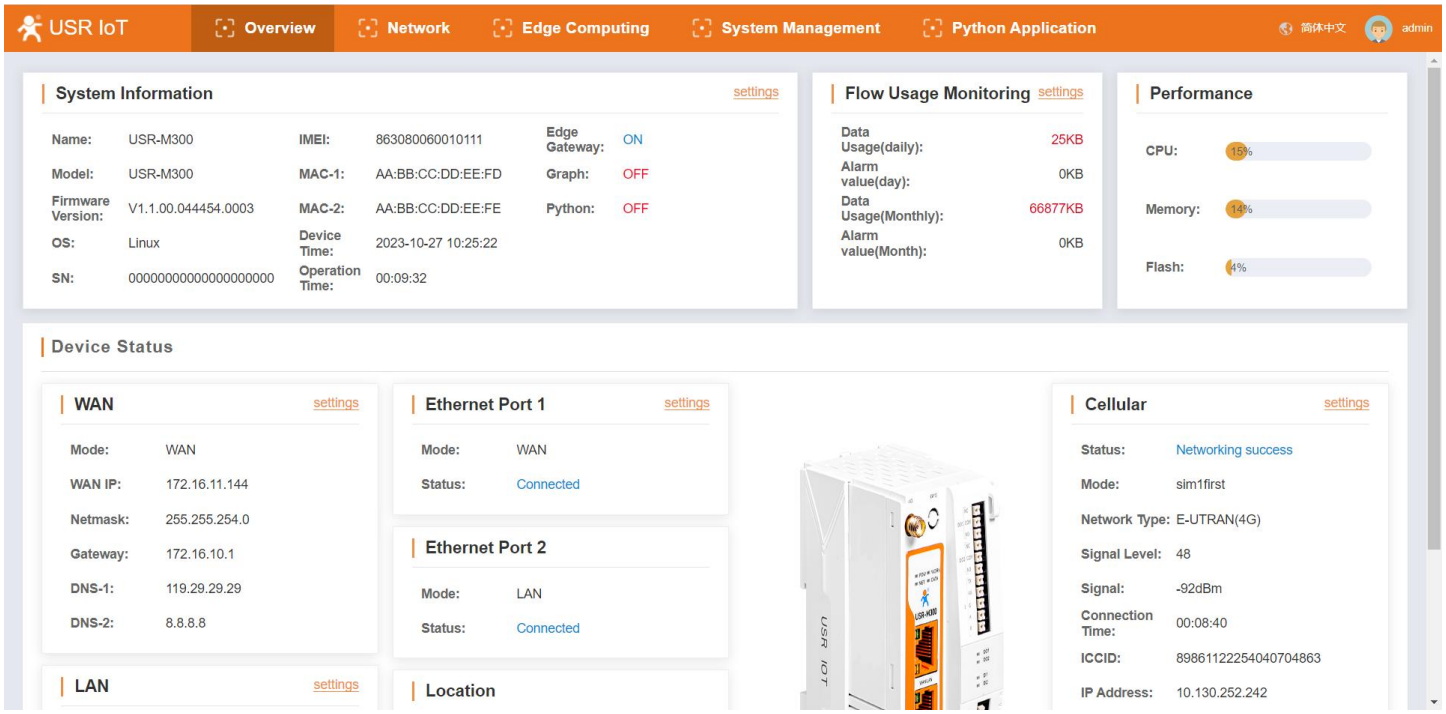
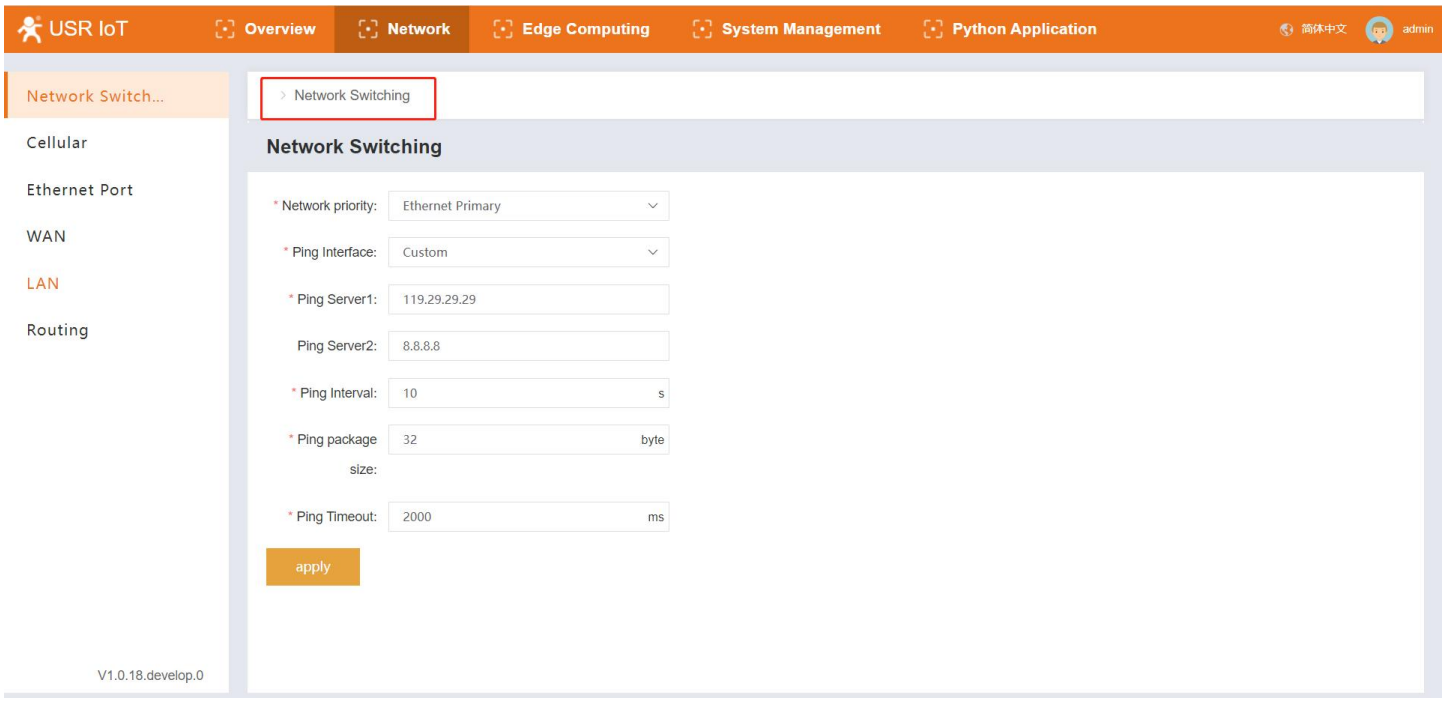


Figure 2. Status webpage

4. Network

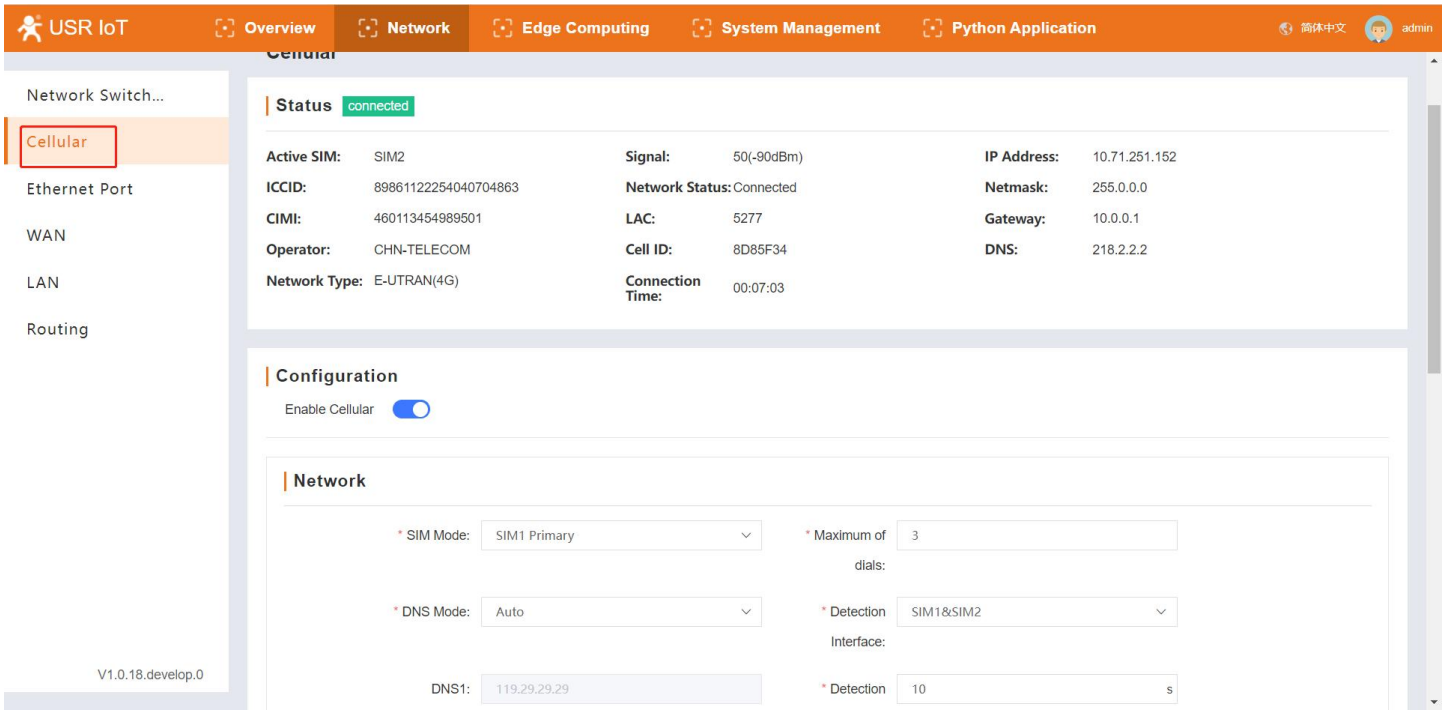
4.1. Network switching

On this page, users can select the Internet connectivity priority, and can also set the information of PING detection.



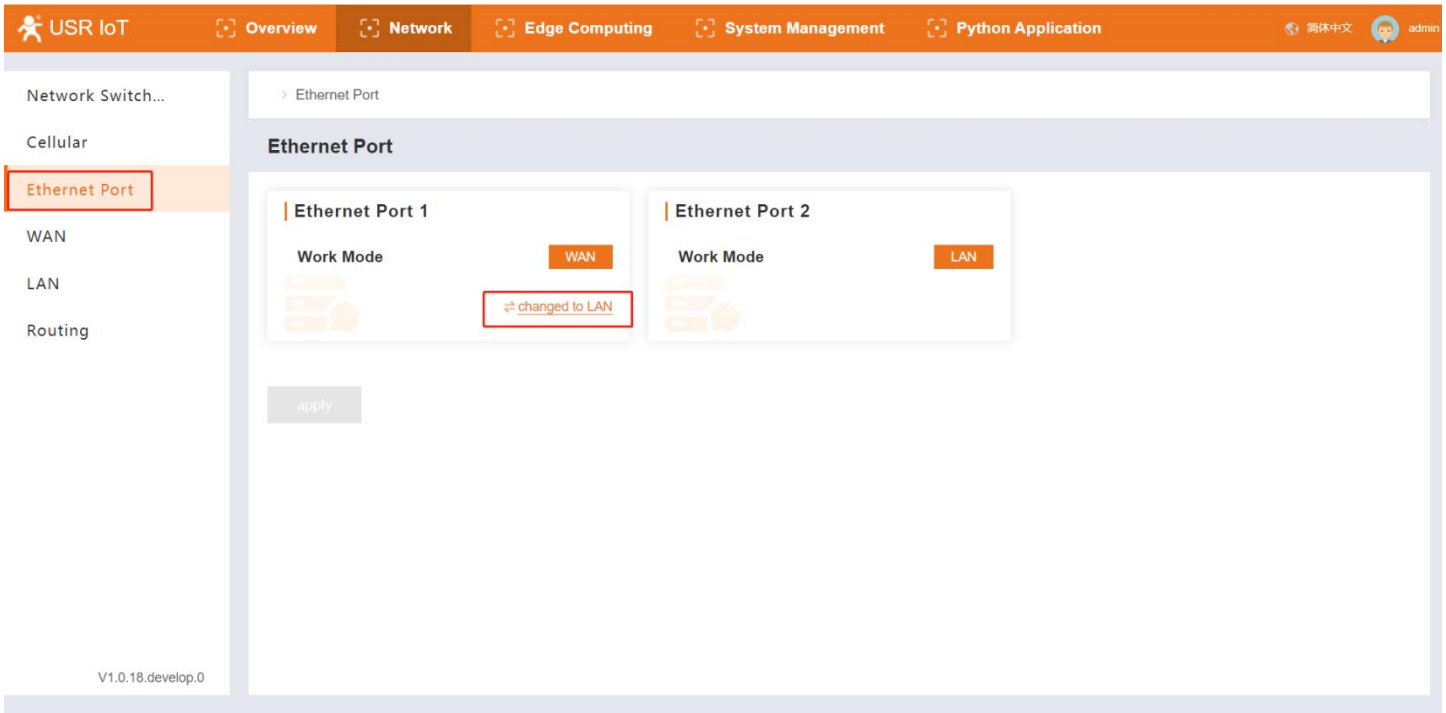
4.2. Cellular

On this page, users can check the cellular information like the signal strength, IP address and so on. The APN information can be set in this page also.



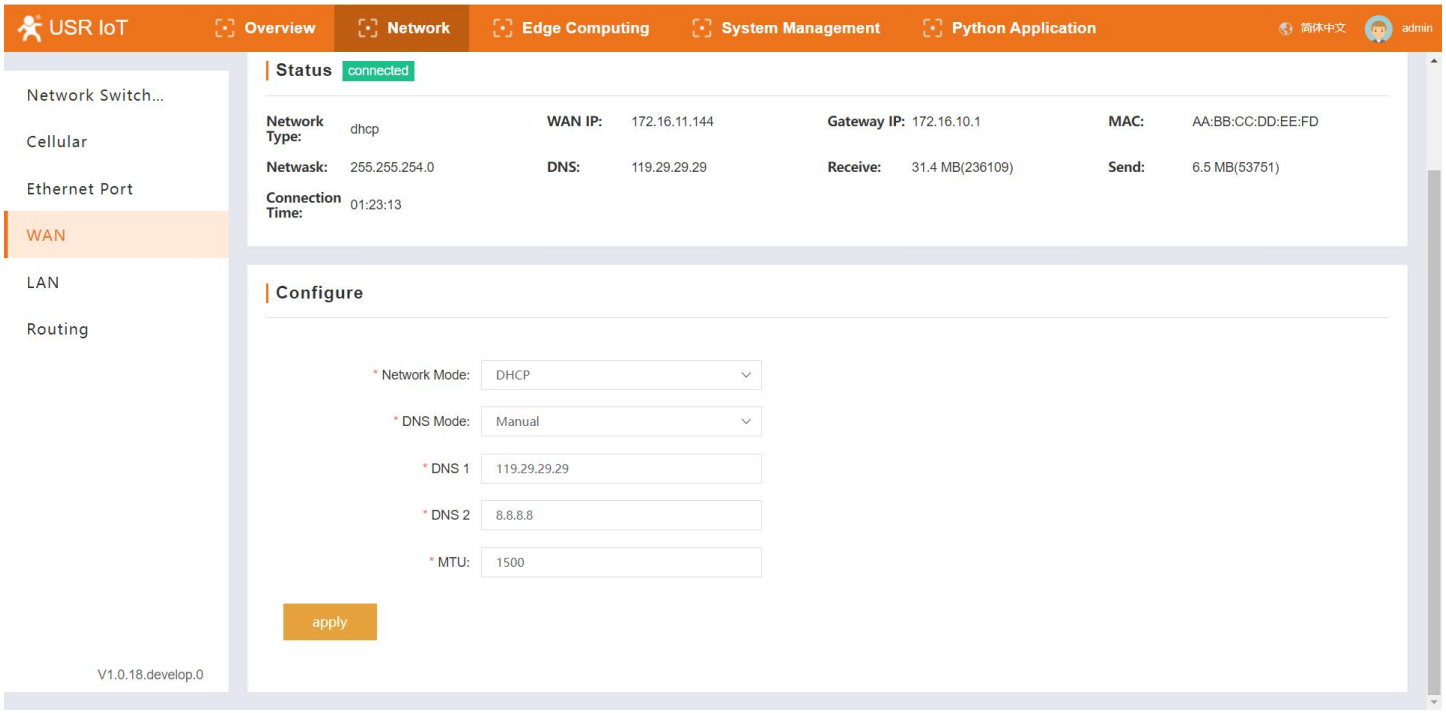
4.3. Ethernet Port

On this page, users can change the work mode of Ethernet Port1. This port is WAN mode by default. And it can be changed to LAN mode. Then the users can get 2 Ethernet ports.



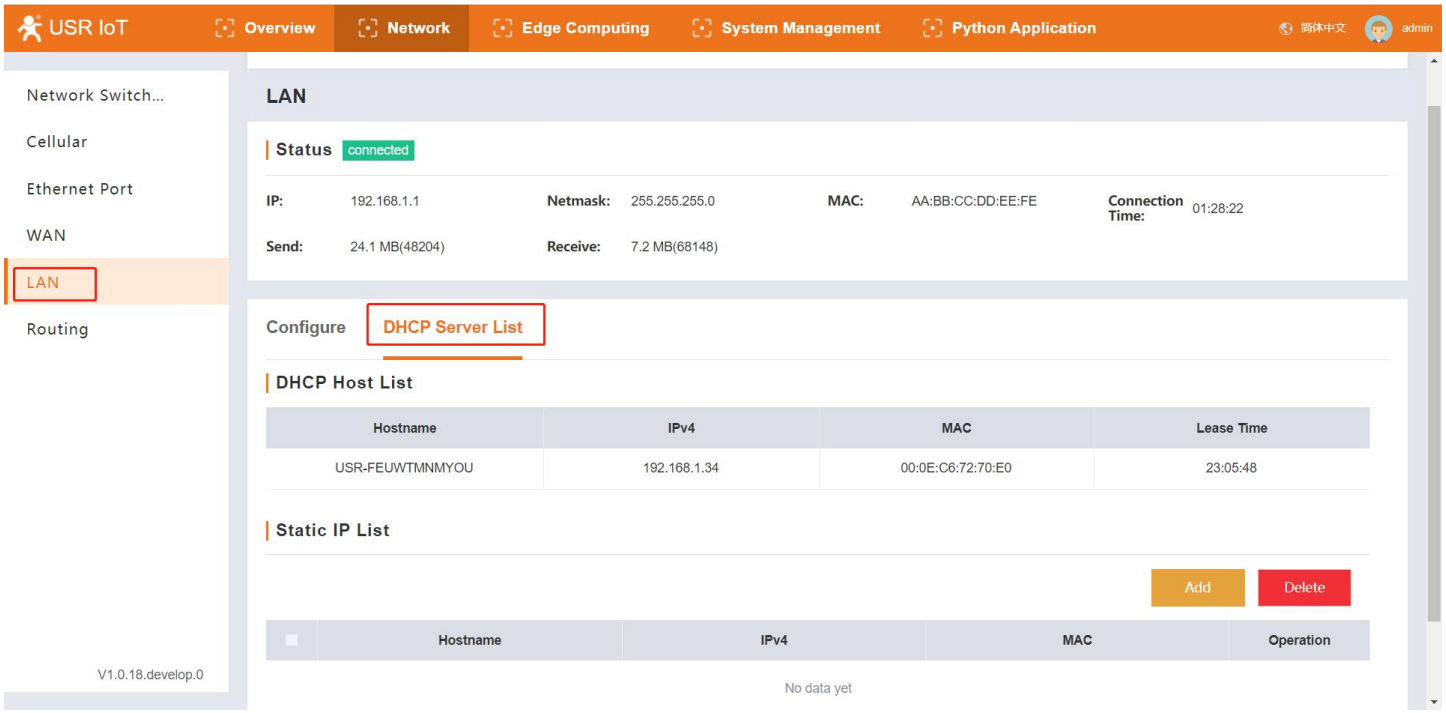
4.4. WAN Interface

User can set the parameters of WAN port like network mode, DNS mode and MTU.



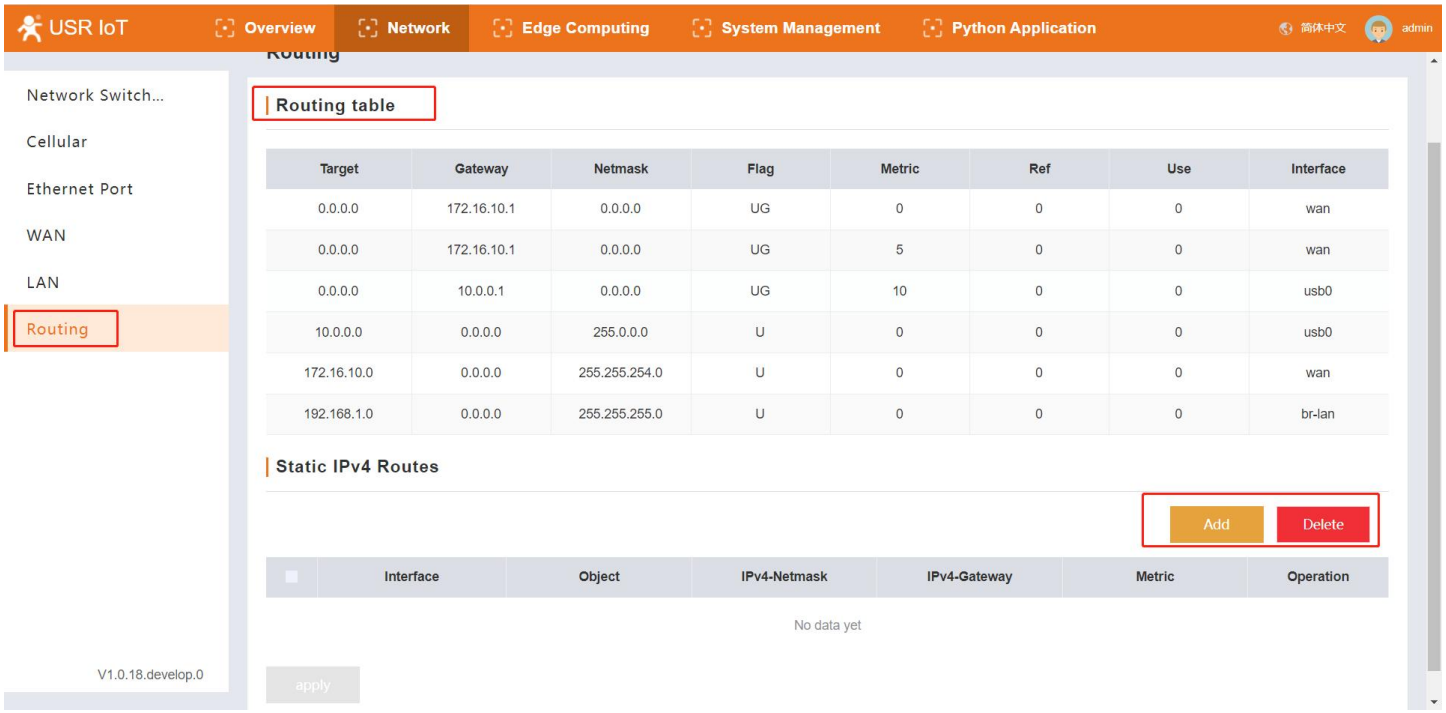
4.5. LAN Interface

Users can set the basic information of LAN port like IP address, netmask and DHCP service. When the M300 enables the DHCP service, it can assign IP address to the terminal device connected to M300 via LAN port.



4.6. Routing

On this page, users can check the routing table and add needed static routing to USR-M300.



5. Edge Computing

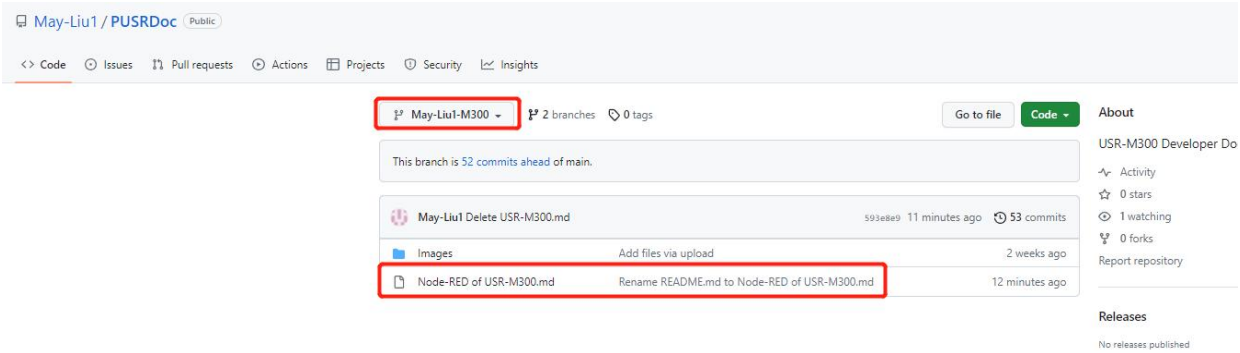
5.1. Edge Mode

The edge mode is edge gateway by default. User can change the mode to Graphical Programming mode. The Graphical Programming is based on Node RED, in this mode, user can develop the application about the edge computing that they need.

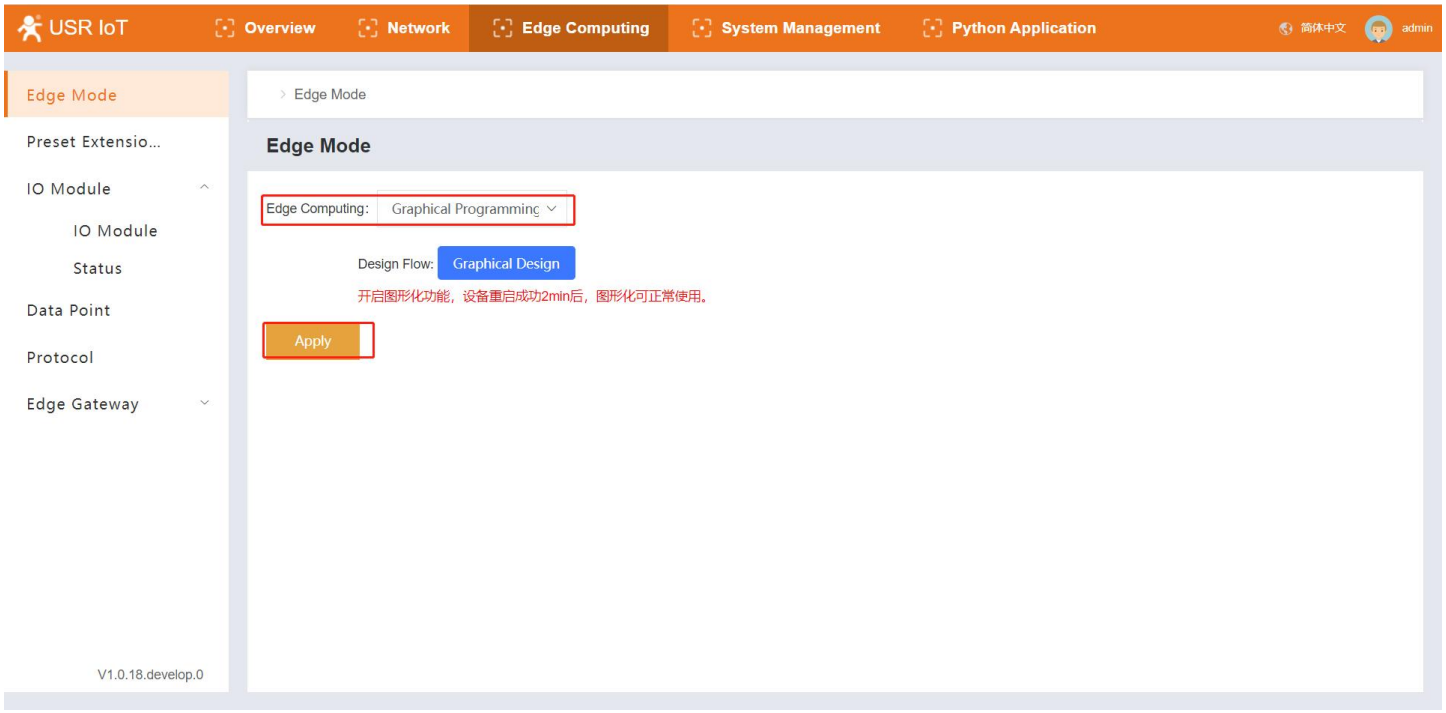
How to use Node-RED, please refer to:

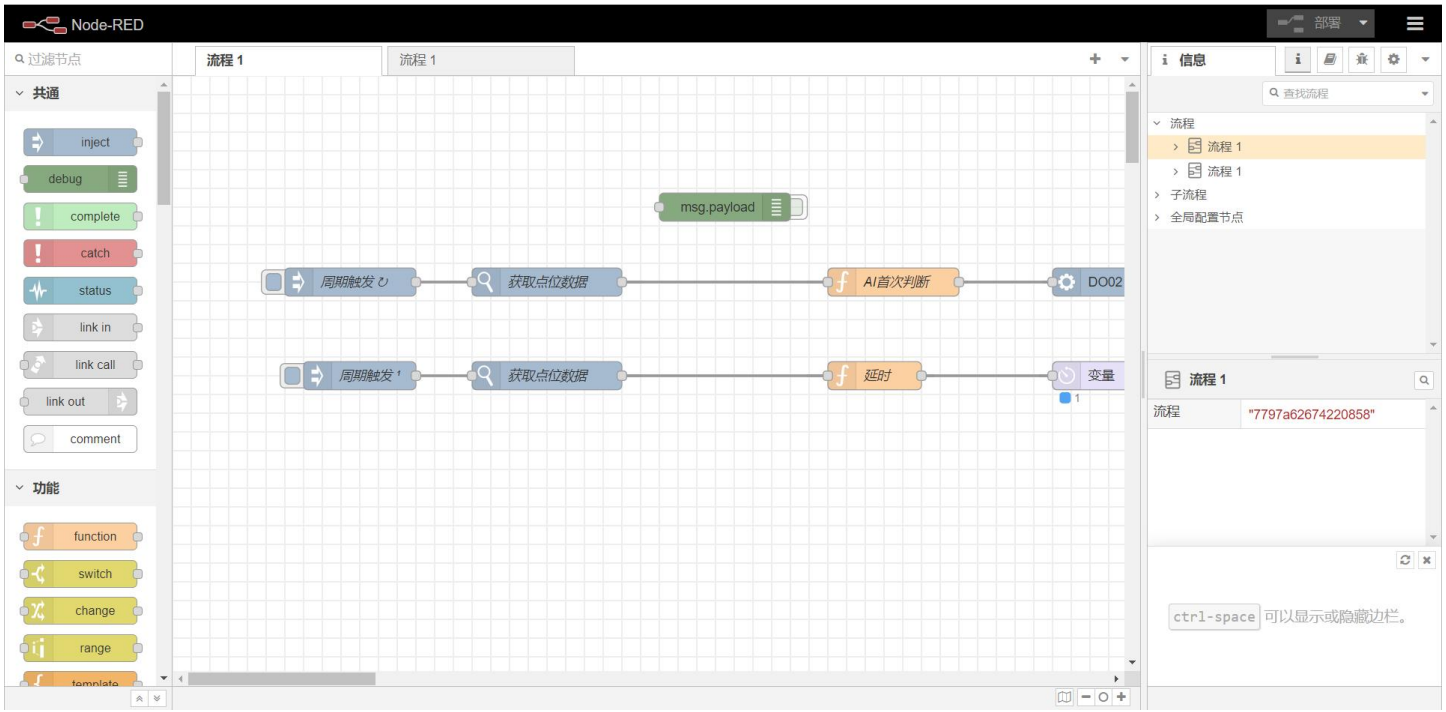
https://github.com/May-Liu1/PUSRDoc/blob/May-Liu1-M300/Node-RED%20of%20USR-M300.md

The file is in Branch May-Liu-M300.



Note: This setting needs to reboot the M300 gateway. Waiting another 2 minutes after the M300 starting, then the Graphical Design page can be opened.

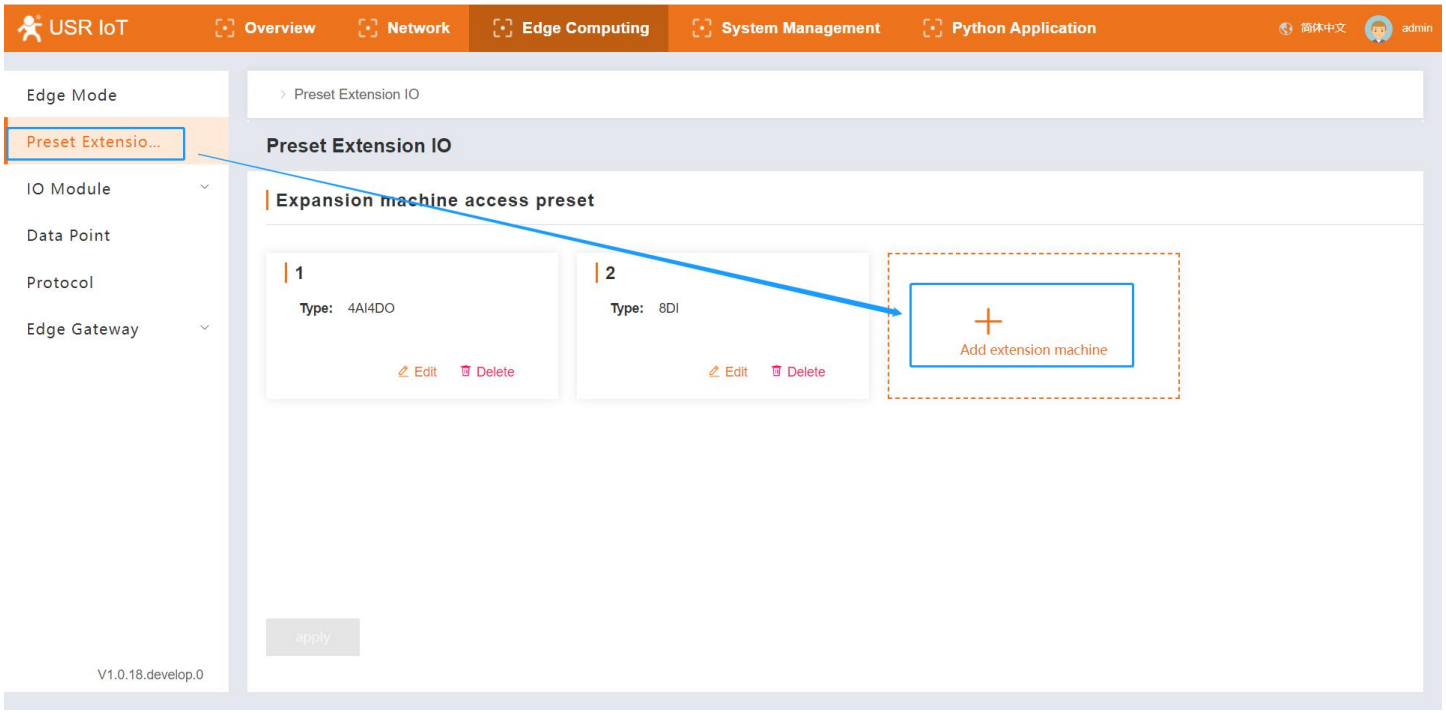




5.2. Preset Extension IO

As we all know, the M300 can work with extendable IO module to extend the IO numbers. If the extendable IO modules are connected to M300, users need to preset the IO modules on webpage. The IO modules sequence should be kept the same with the actual hardware sequence.

If the sequence on webpage is different from the hardware sequence of extendable IO modules, the work indicators on M300 will fast blink, and the work indicators on IO extendable modules will blink 4 times/s, then keep off for 2s.



5.3. IO Module

There are 2 parts in this function, the detail information and the status of IO modules.

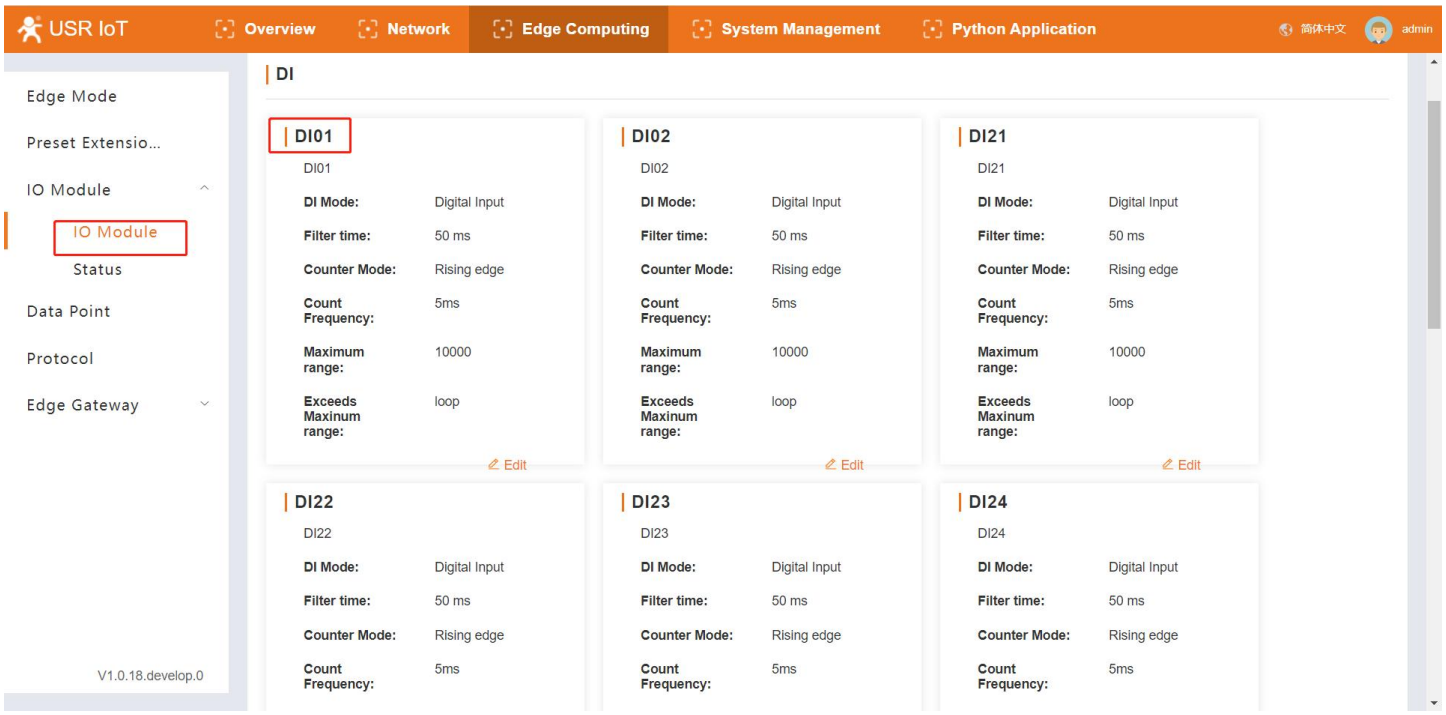
5.3.1. DI Interface

On this page, users can check the settings of digital input interfaces, and can also set the work mode of DI interfaces.

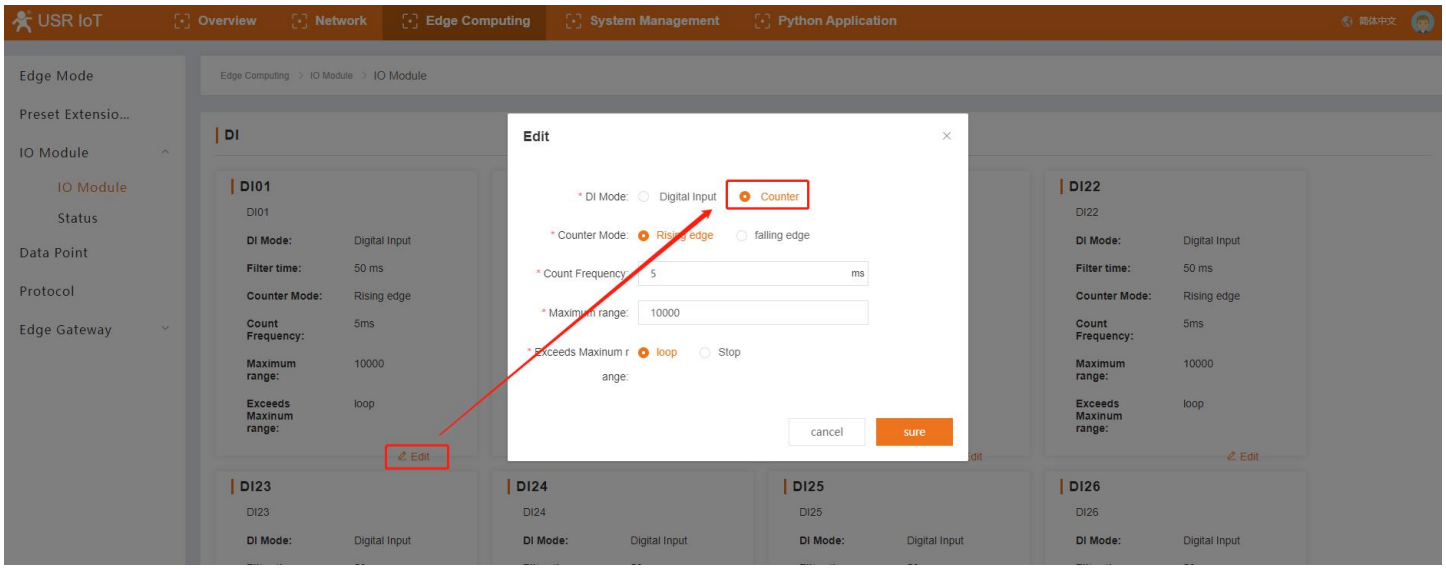
DI01: It means the first DI interface of USR-M300

DI22: It means the second DI input of the second extendable IO module.

DI27: It means the seventh DI input of the second extendable IO module.

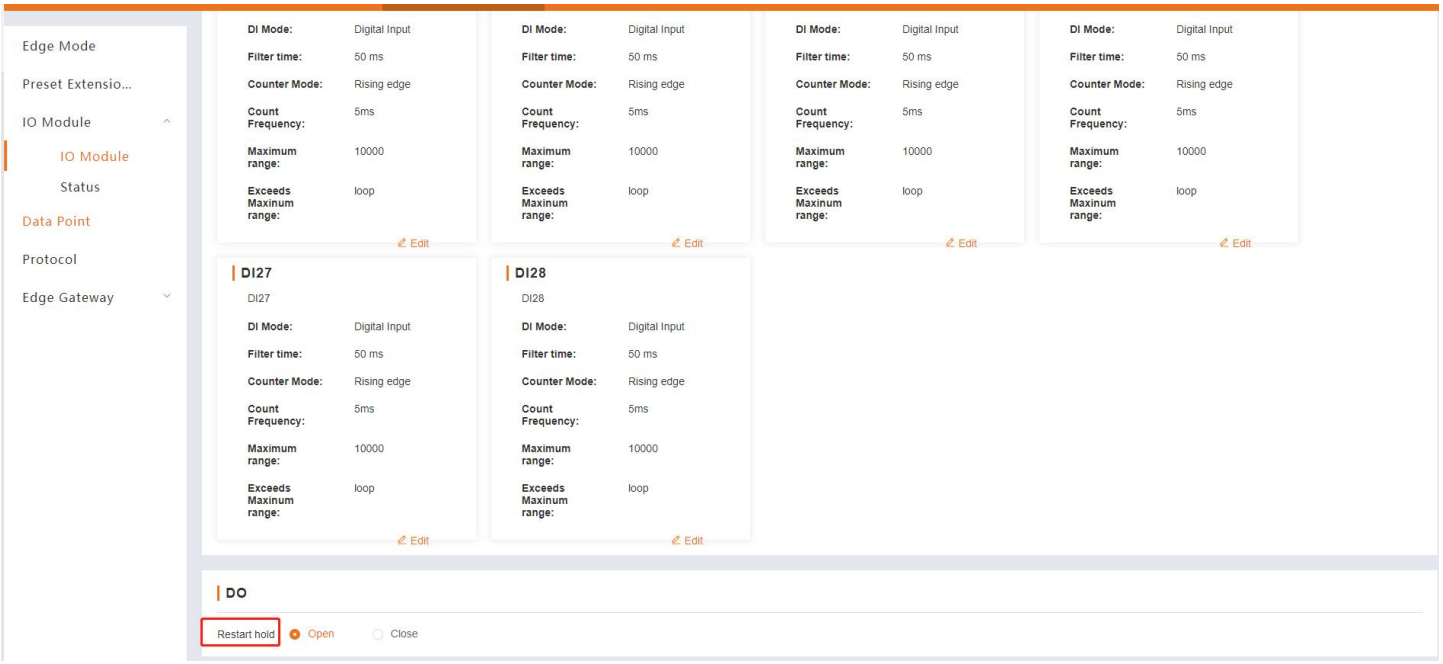


The default DI mode is Digital Input, users can click “Edit” to modify the settings.



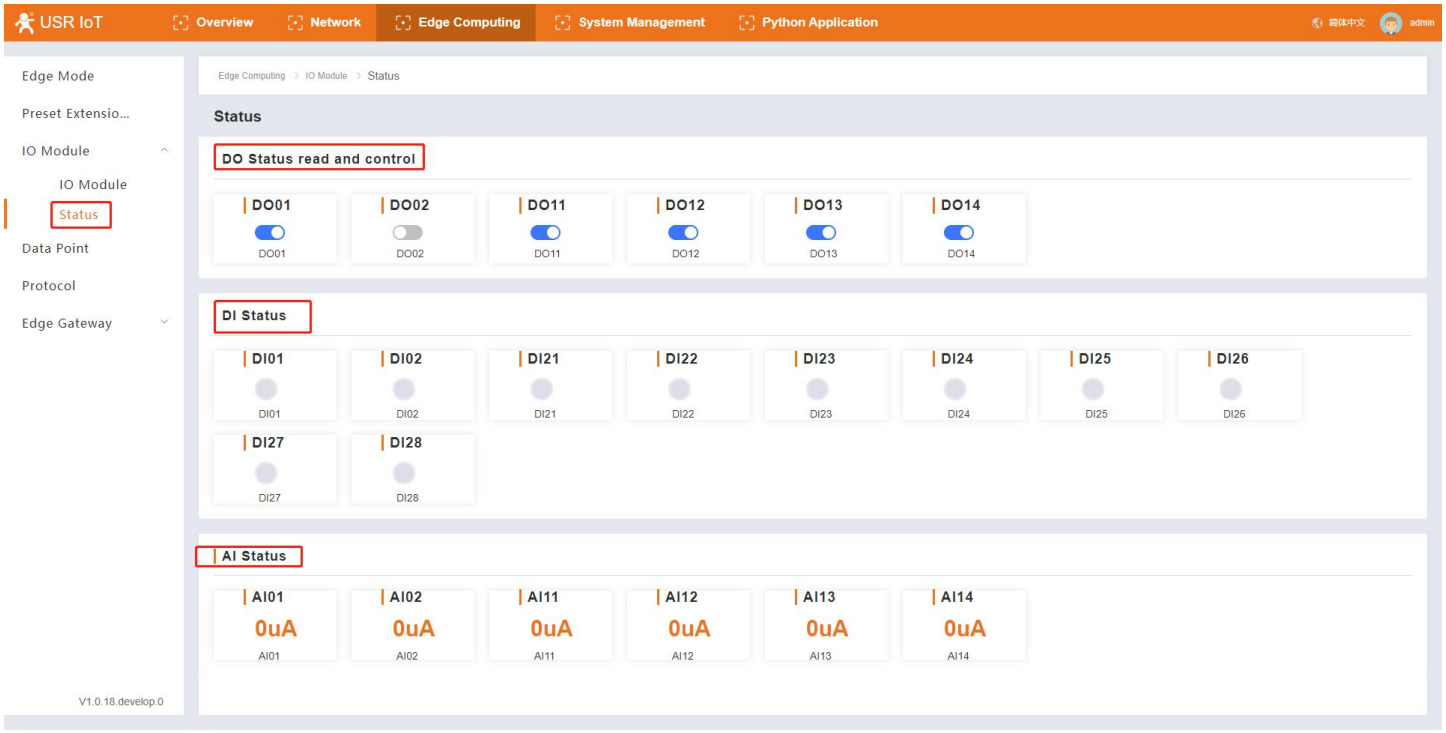
There is another function can be set on this page: Restart Hold of DO. This function is closed by default.

If the Restart Hold function is enabled, when we restart the M300, the DO will remain in the state before the power outage.



5.3.2. Status of IO modules

On this page, users can check the status of IO interface. And can also control the DO interface. Click the DO button, the indicators of DO will turn on or turn off.



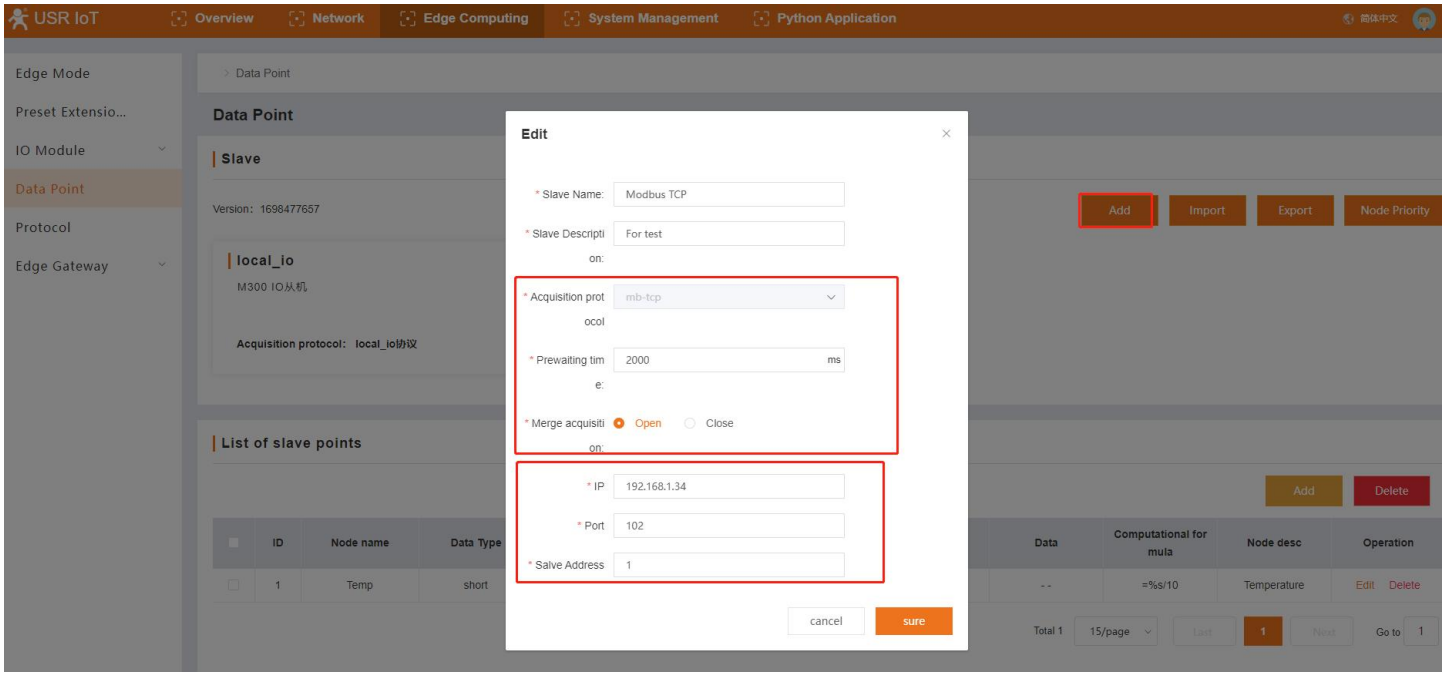
5.4. Data Point

Data Point Table is the core database of the edge computing gateway. The data and data-related information used by the edge gateway for acquisition, reporting, data reading and writing, protocol conversion and linkage control are all obtained from this point table. Therefore, during use, it is very important to add the data point table correctly and in detail.

The data point table contains two main elements: slaves and data points. Up to 20 slaves can be added, IO slaves and virtual slaves are fixed. The remaining 18 Slaves can be added as needed. Corresponding data points can be added to each slave. Except for the virtual slave, the total number of data points of all other slaves is up to 2000. The data points of each slave are actively polled and collected from the corresponding interface according to the protocol specified when adding the slave, and the collected data is correspondingly stored in the virtual register in the product.

For virtual slaves, up to 500 points can be added.

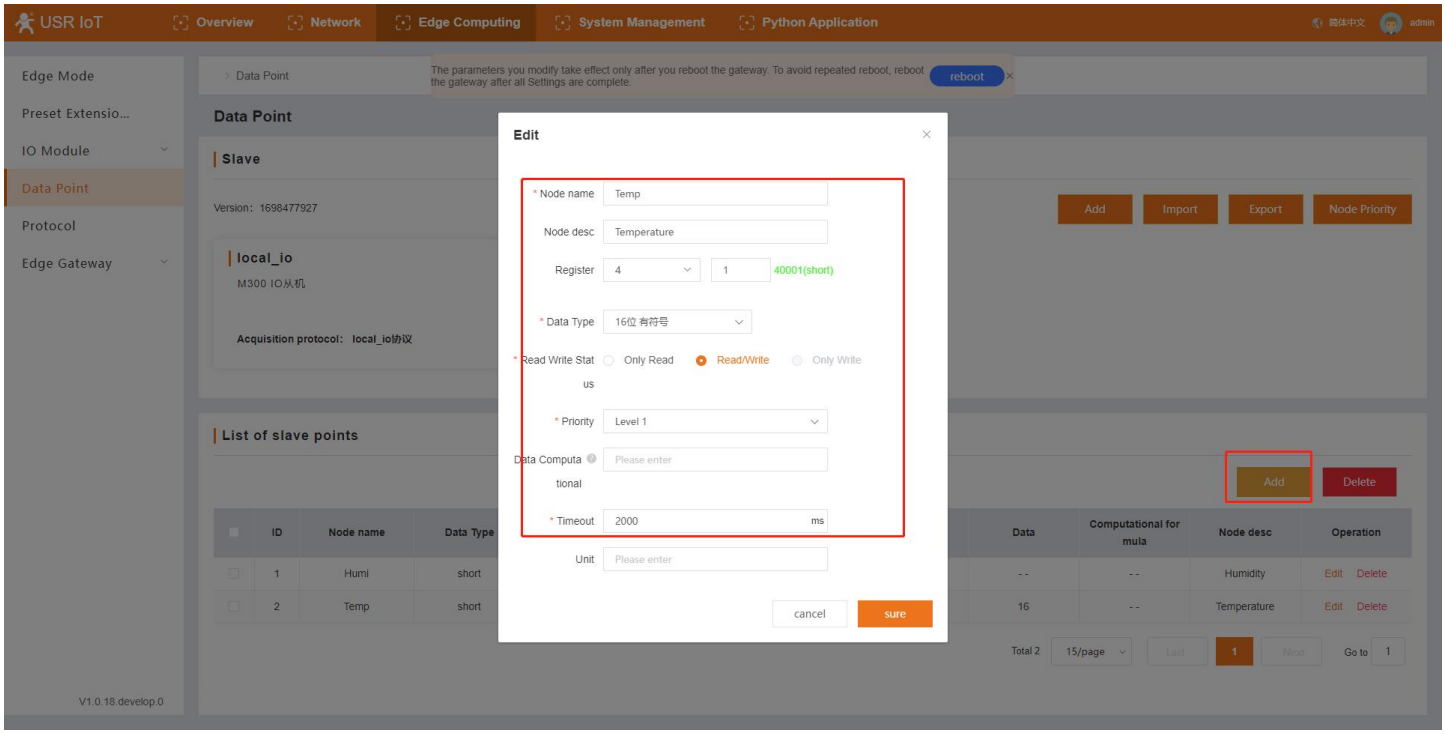
Let's add a slave first, the Modbus TCP protocol is used in this case.



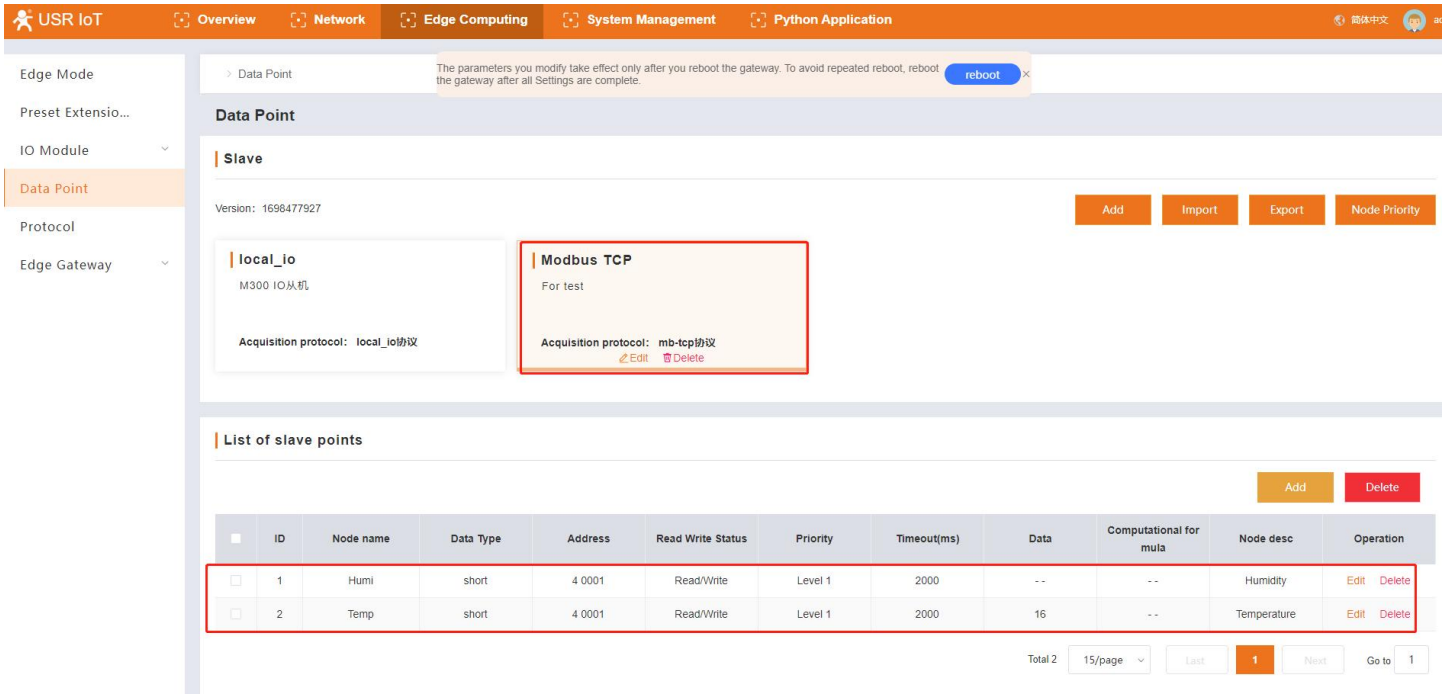
Then add the data points of the Modbus TCP slave:

1>Click the Modbus TCP Slave

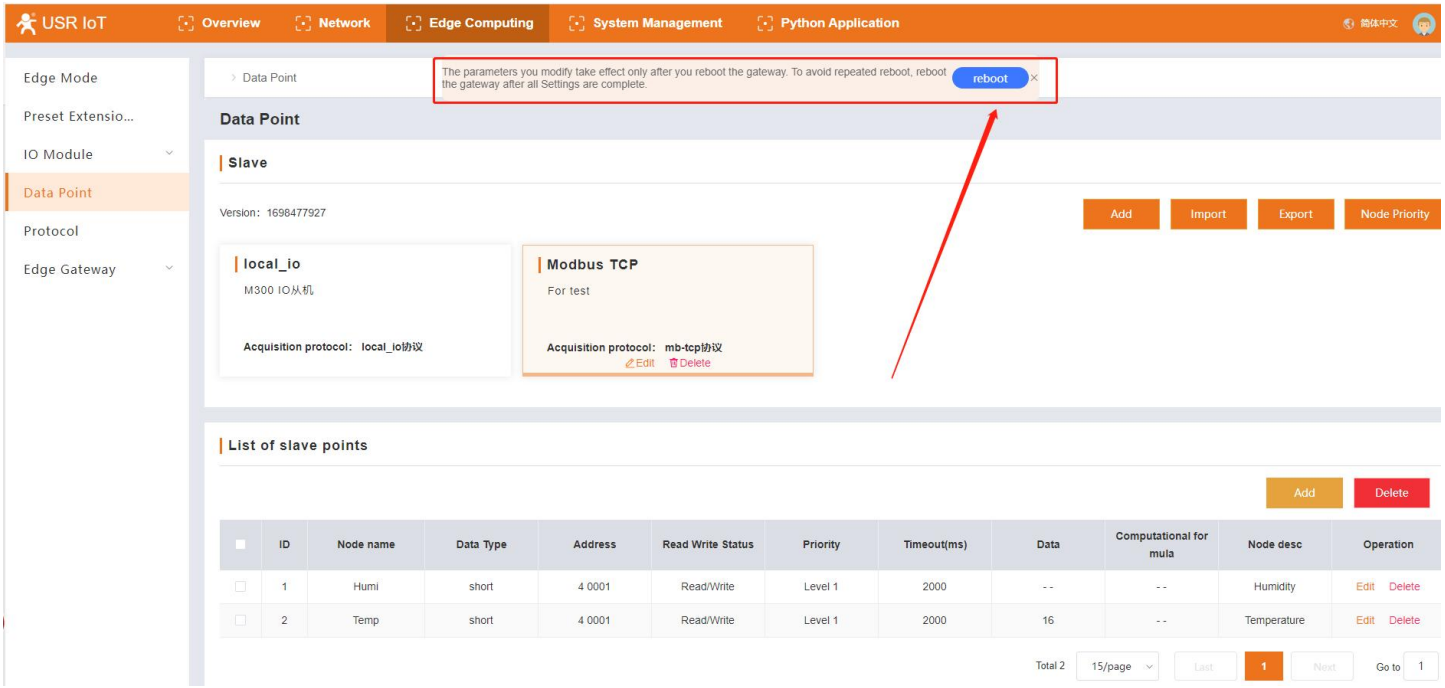
2>If we didn't add the data points before, the list of slave points is blank. Click the "Add" button to enter the point information.



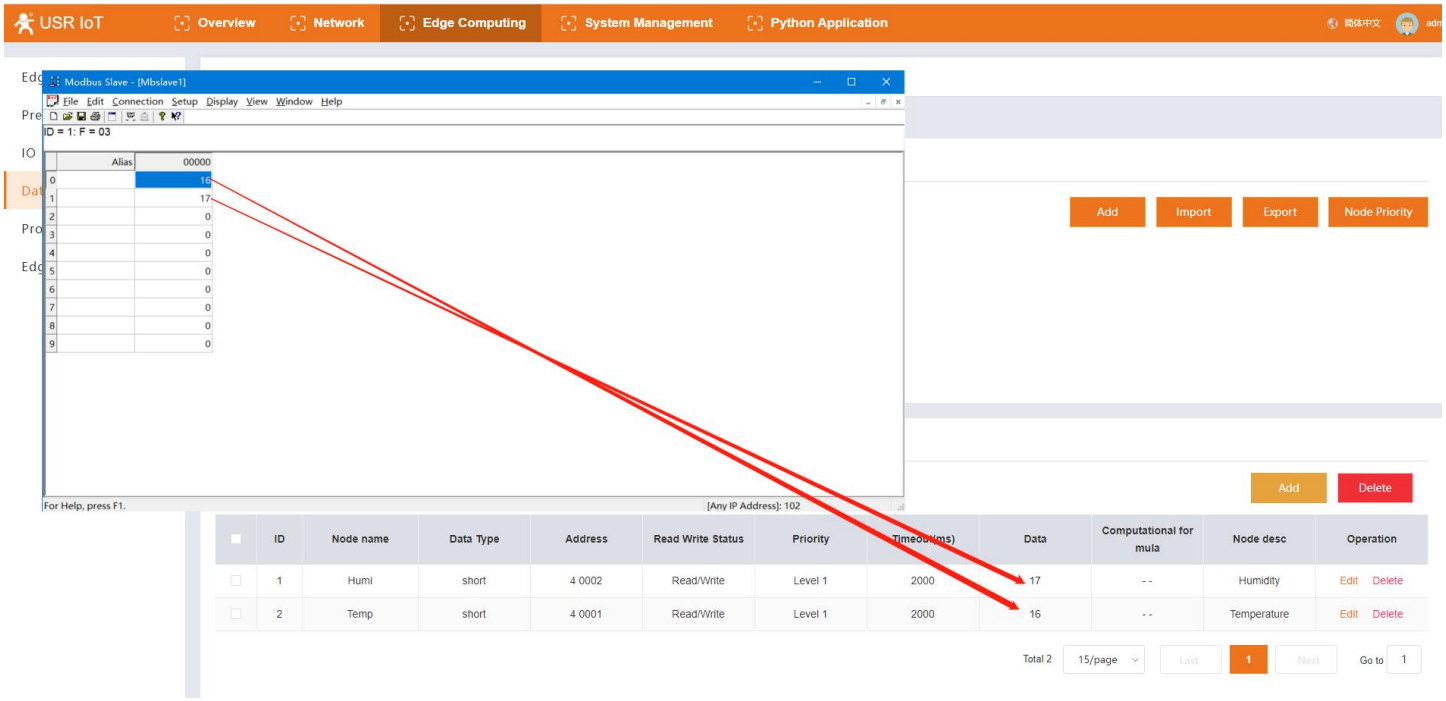
3>Added slave and data points:



4>After all the slave and data points are added, and other settings are ok, please reboot the M300 to make the changed parameters take effect.



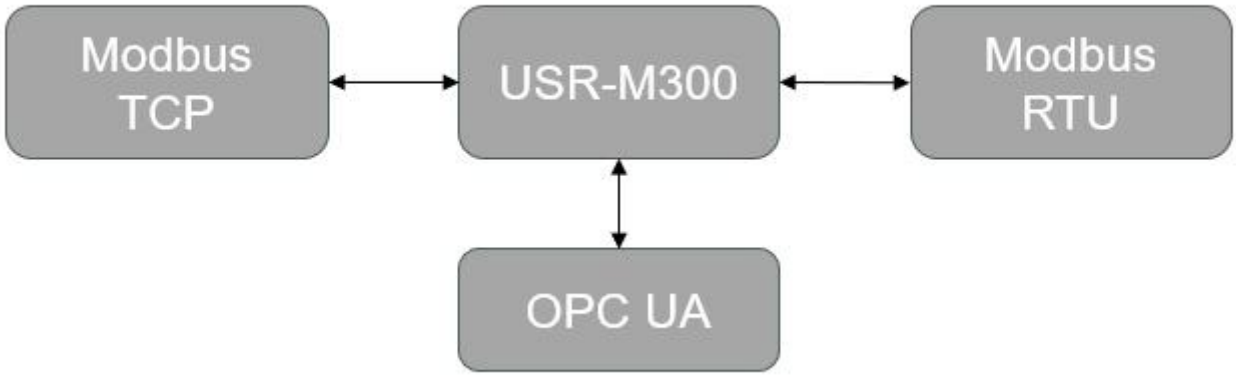
5>Check the collected data.



5.5. Protocol

USR-M300 supports mutual conversion between different protocols, such as Modbus RTU/TCP, Modbus TCP and OPC UA, Modbus RTU and OPC UA， BACNET（Northbound transmission）， IEC104 (northbound and southbound),IEC61850 (northbound),SL651(northbound).More protocol conversions are in development.

With this function, users no need to worry about being unable to communicate due to different protocols between the terminal device and the server, because the M300 will convert the point data of all slave devices into a unified protocol format, making it easier for the server to issue and collect data using a unified protocol.



We have added Modbus TCP slave in section 5.4. In this section, will convert Modbus RTU to Modbus TCP using the protocol conversion function.

➢Basic settings:

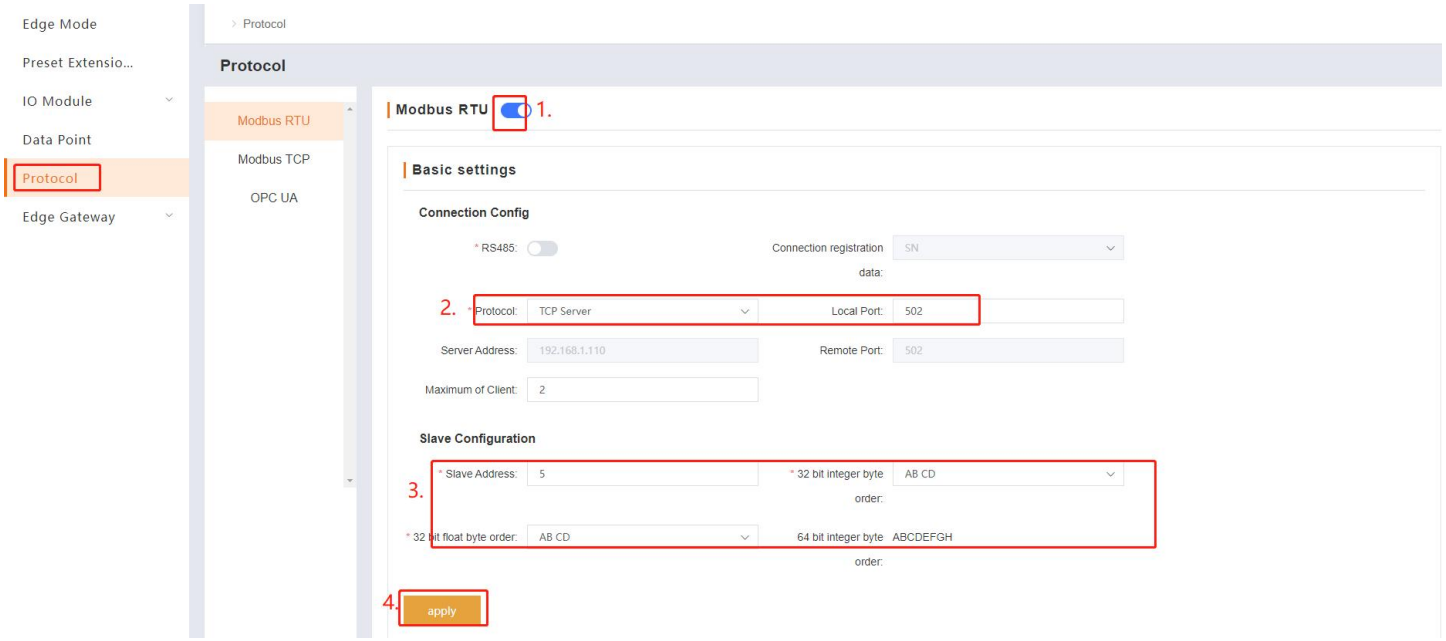
1>Enable Modbus RTU function,

2>Set protocol and local port, in this case, keep them the default patameters

3>Set the Slave address to 5, we add the 16 bit points in Section 5.4, so keep the 32 bit data the default parameters.

4>Click “Apply” , then the window will pop up prompting you to reboot M300 device. We can reboot device after setting all parameters.

Then continue to set mapping point table parameters.



➢Node mapping table

1>Click “Add” button,

2>Select the register type and enter the initial register address,

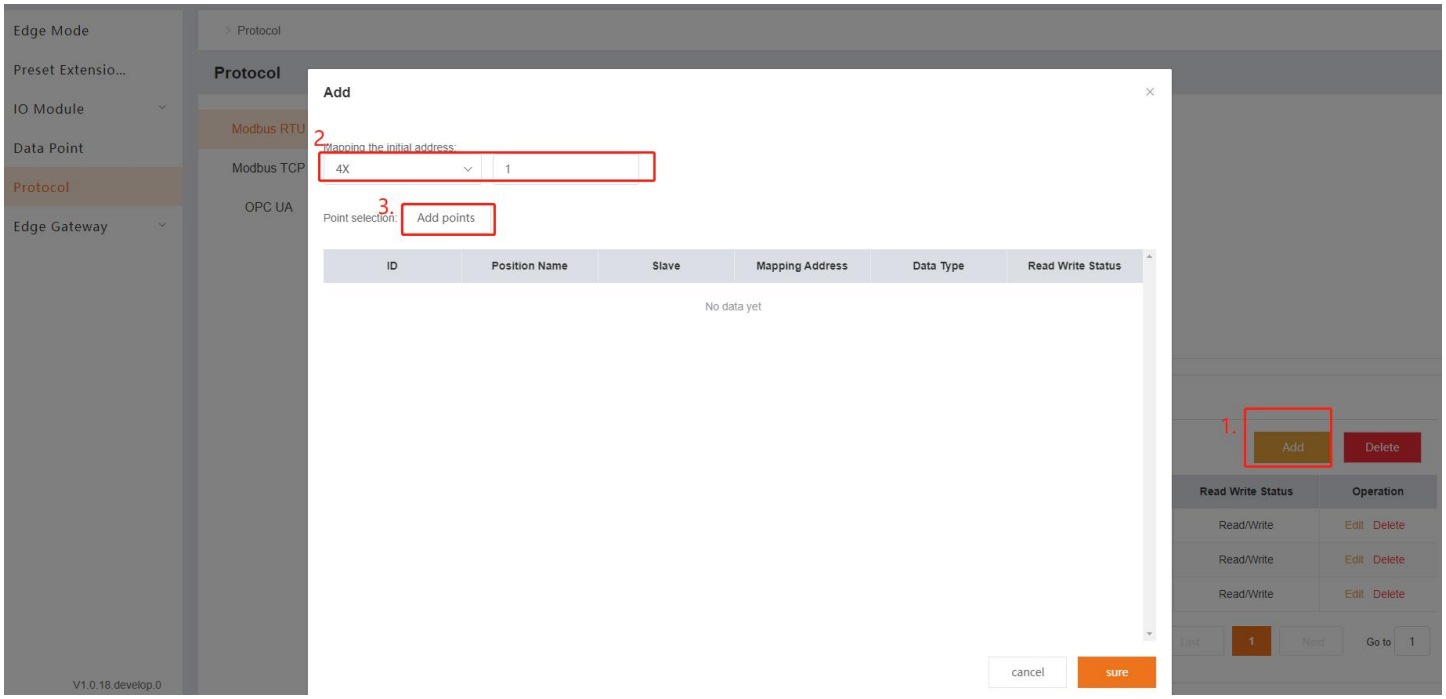
3>Click “Add points” ,

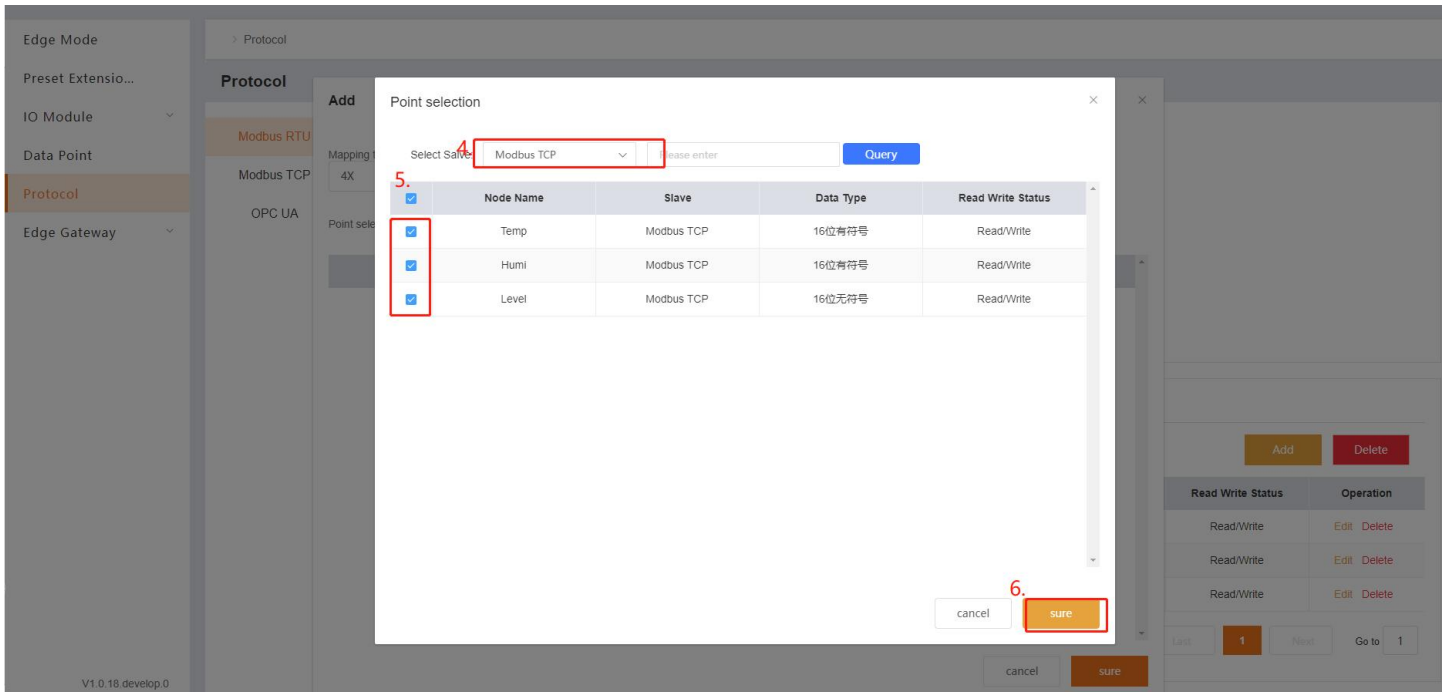
4>Select the slave just added: Modbus TCP,

5>Select the needed data points,

6>Click “Sure”

7>Reboot USR-M300


Edge Mode
Preset Extensio...
IO Module
Data Point
Protocol
Edge Gateway
V1.0.18.develop.0
Protocol
Protocol
Modbus RTU
Modbus TCP
OPC UA
Add
2.
Mapping the initial address:
4X
1
Point selection:
3.
Add points
ID
Position Name
Slave
Mapping Address
Data Type
Read Write Status
No data yet
cancel
sure
1.
Add
Delete
Read Write Status
Operation
Read/Write
Edit Delete
Read/Write
Edit Delete
Read/Write
Edit Delete
Last
1
Next
Go to
1


Edge Mode
Preset Extensio...
IO Module
Data Point
Protocol
Edge Gateway
V1.0.18.develop.0
Protocol
Protocol
Modbus RTU
Modbus TCP
OPC UA
Add
Point selection
Select Slave
4.
Modbus TCP
Please enter
Query
5.
Node Name
Slave
Data Type
Read Write Status
Temp
Modbus TCP
16位有符号
Read/Write
Humi
Modbus TCP
16位有符号
Read/Write
Level
Modbus TCP
16位无符号
Read/Write
6.
cancel
sure
cancel
sure
Add
Delete
Read Write Status
Operation
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Edit Delete
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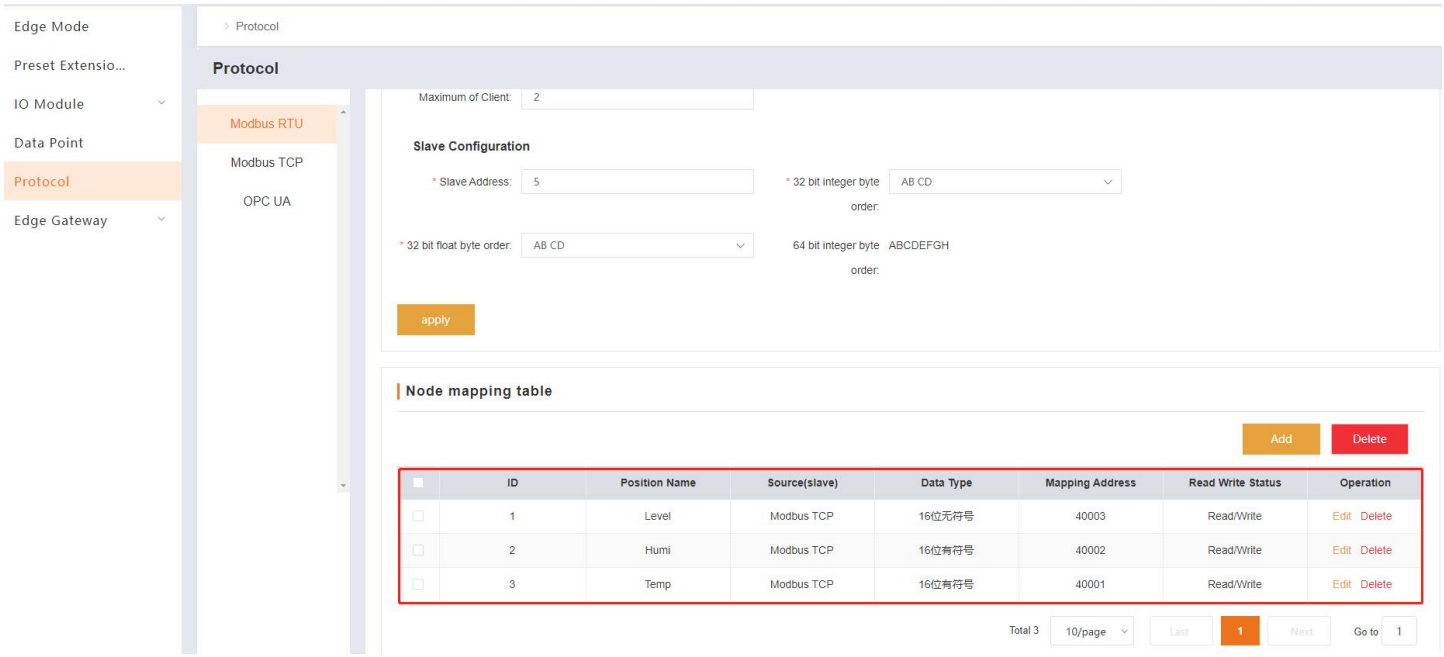
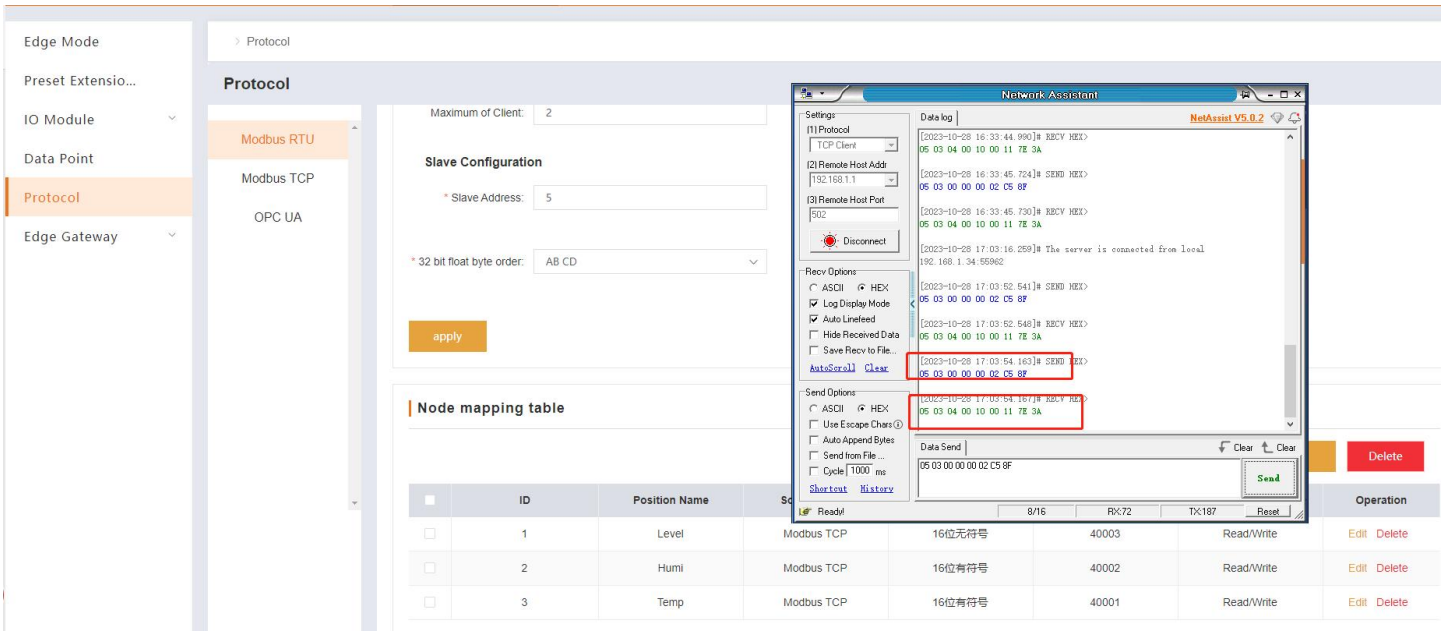
Edit Delete
Last
1
Next
Go to
1



➢To test the function

Send Modbus RTU command to query data point, and the green part is the response from M300.



5.6. Edge Gateway

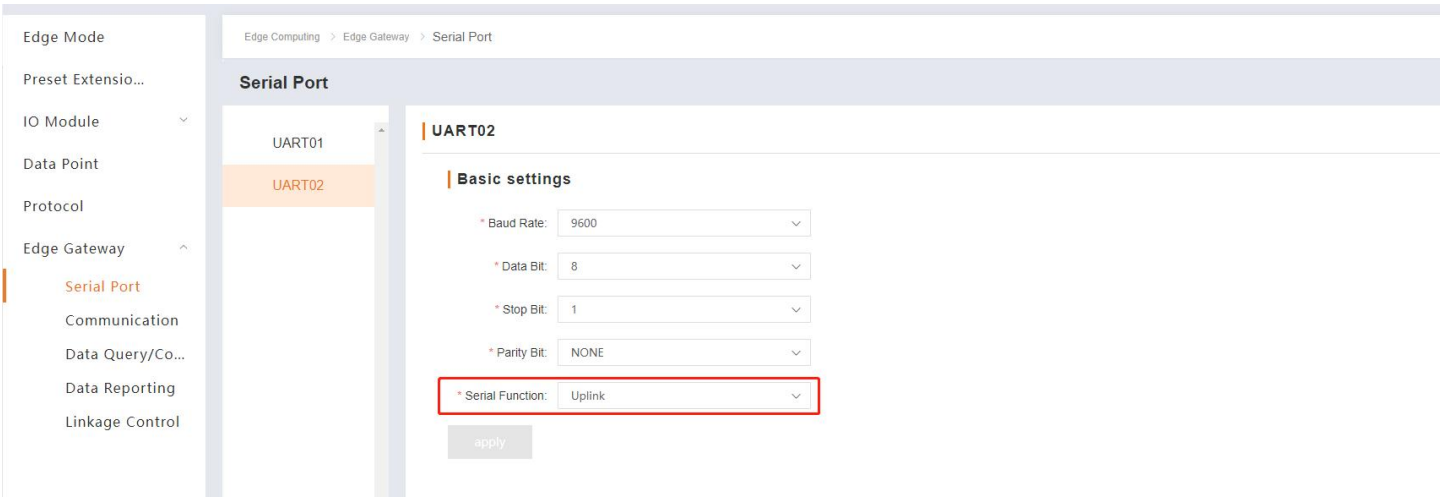
5.6.1. Serial Port

On this page, users can set the basic parameters of UART, like baud rate, data bit, stop bit and parity bit.

For UART2, it has one more parameter: Serial Function. The default is “Downlink”.

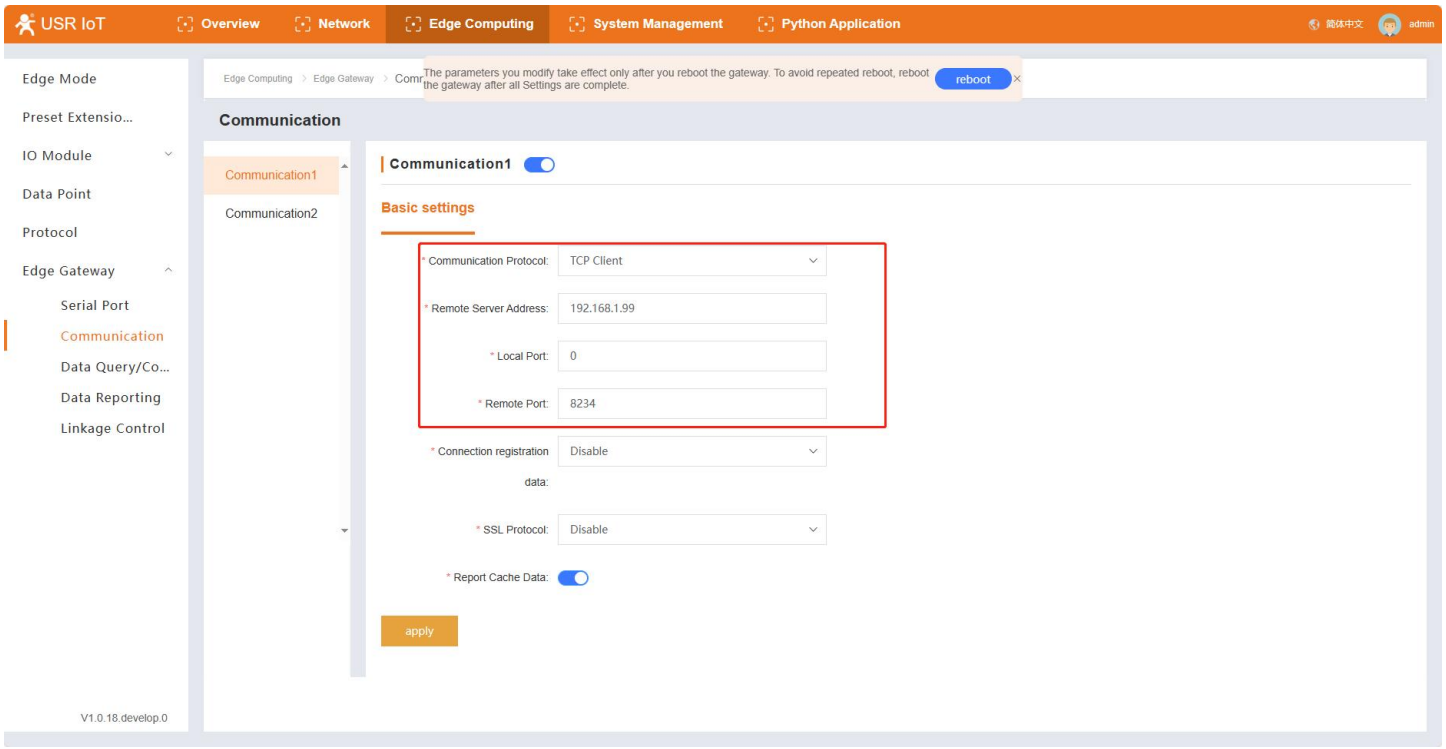
Downlink: The device connected to the serial port is Slave device,

Uplink: The device connected to the serial port is Master device.



5.6.2. Communication

USR-M100 supports 2 independent communication channels. It provides multiple communication modes like TCP client/TCP server/UDP/MQTT client/http client. It has the AWS cloud built-in, users can use it conveniently. In this case, we set the communication parameters like the following picture.



5.6.3. Data Query/Control

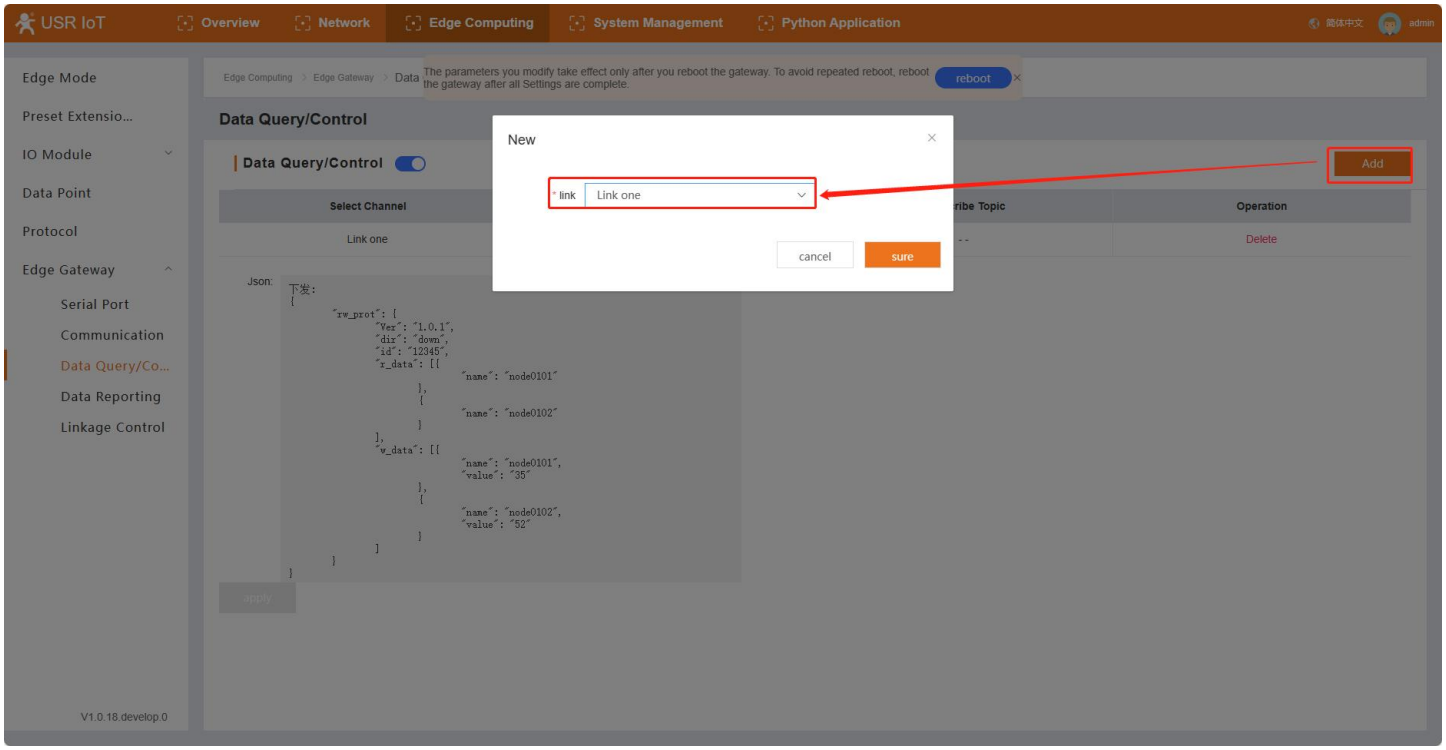
With this function, users can query and control data points via Json format. Click “Add” to add link channel, in this case, we choose the Link1.

The Json command format is like the following:

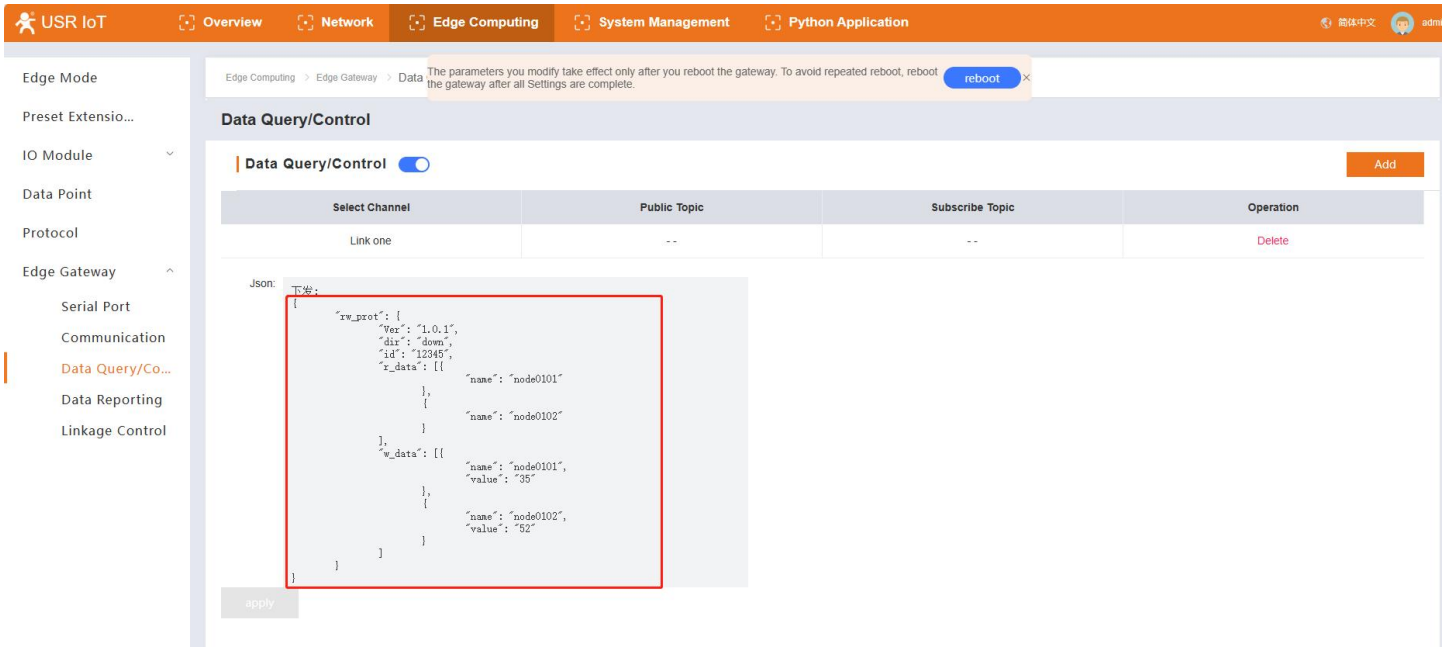
{"rw_prot": {"Ver": "Protocol Version","dir": "Data Direction","id": "Information ID","r_data": [{"name": "Node Name"}],"w_data": [{"name": "Node Name","value": "data"}]}}

Description of items:

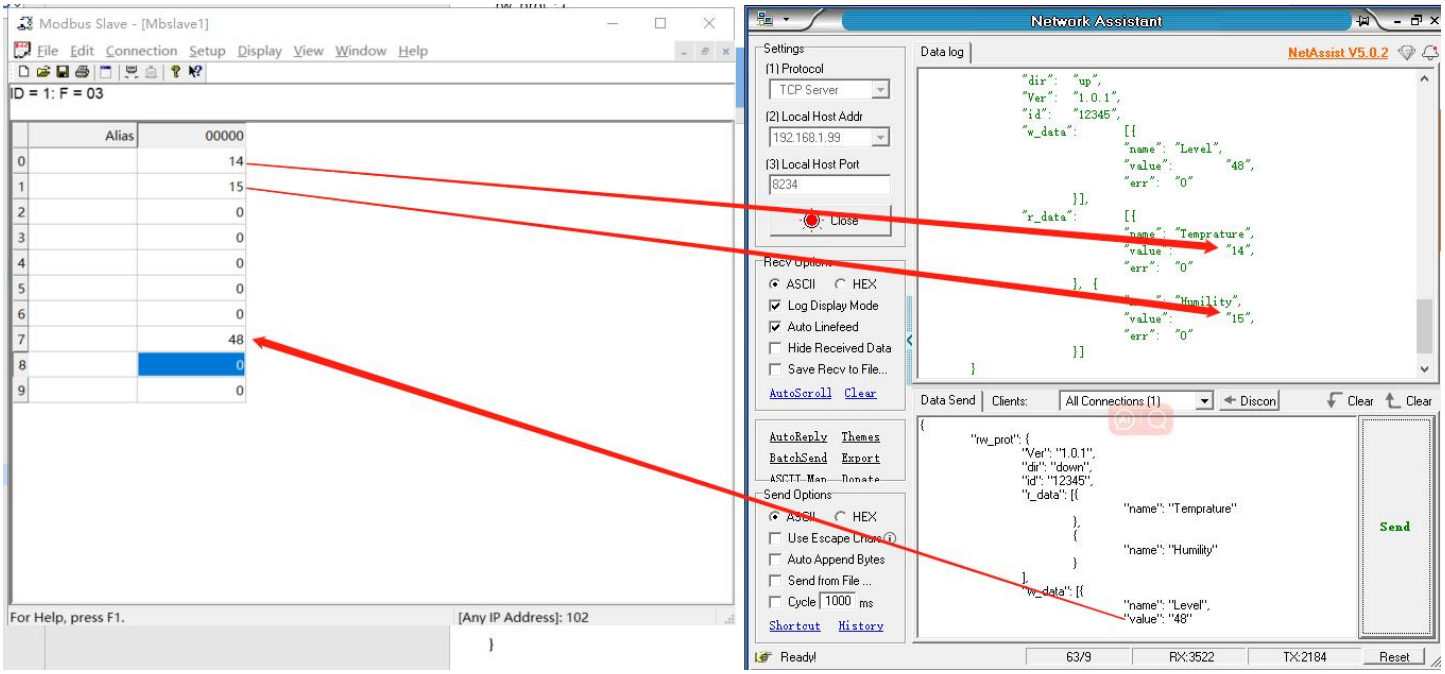
Field Name	Description
rw_prot	Protocol Header
Ver	Protocol Version
dir	Data Direction
id	User defined parameter. The id is same in query/control and response data. Sometimes, the query/control data is high frequency, the response data may be disordered. The program in network can confirm the relevant response data by the id.
r_data	The data load for querying data
w_data	The data load for controlling data
name	The node name descripted on section 5.4
value	Means the data need to be sent to the data points described



In section 5.4, the added data points have data already, now we can collect the data to the server. Set the Network Assistant as TCP server, the local port is 8234, USR-M300 work as TCP client to connect the TCP server. Then send Json command to collect the temperature and Humidity data, to control the level data at the same time. User can copy the Json command sample and change the query and control command based on the sample.

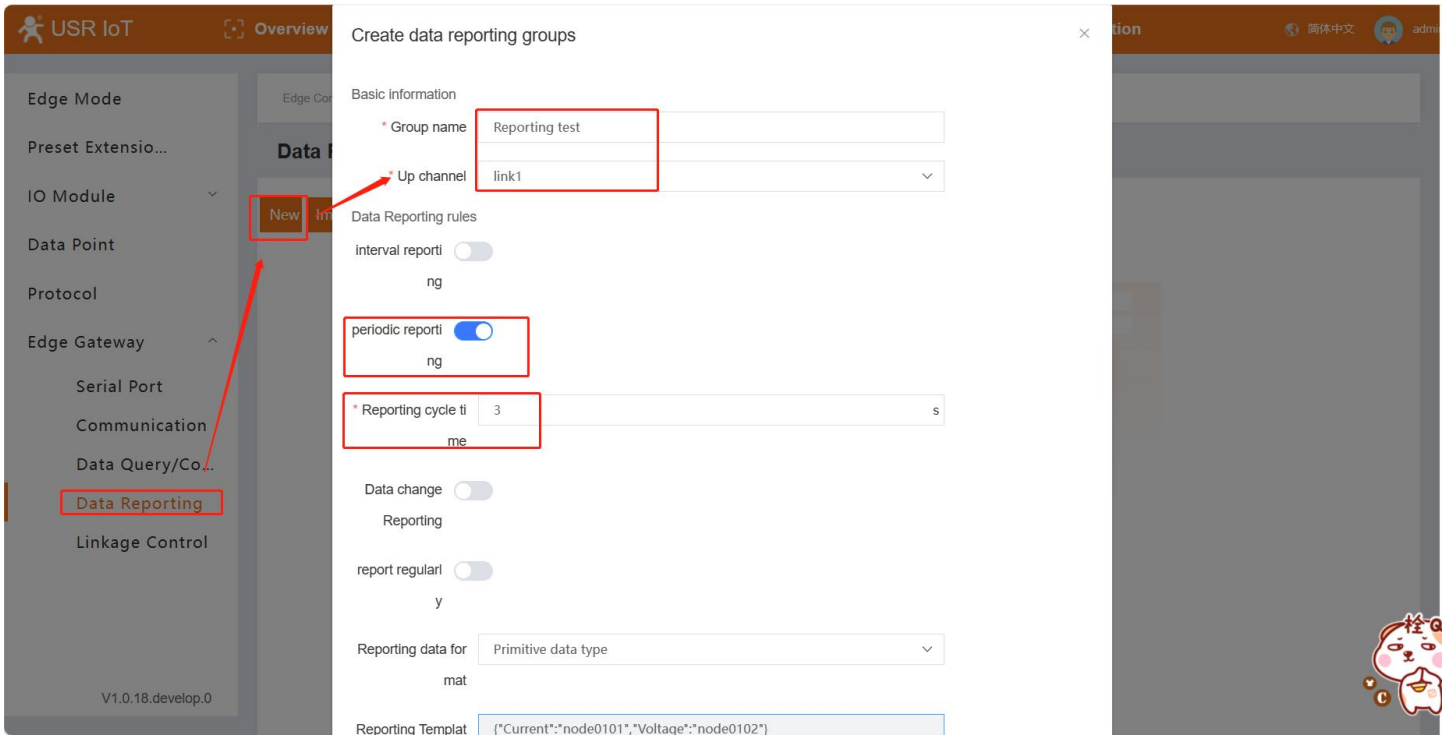



```
{
"rw_prot": {
"Ver": "1.0.1",
"dir": "down",
"id": "12345",
"r_data": [{
"name": "Temprature"
},
{
"name": "Humidity"
}
],
"w_data": [{
"name": "Level",
"value": "48"
}
```

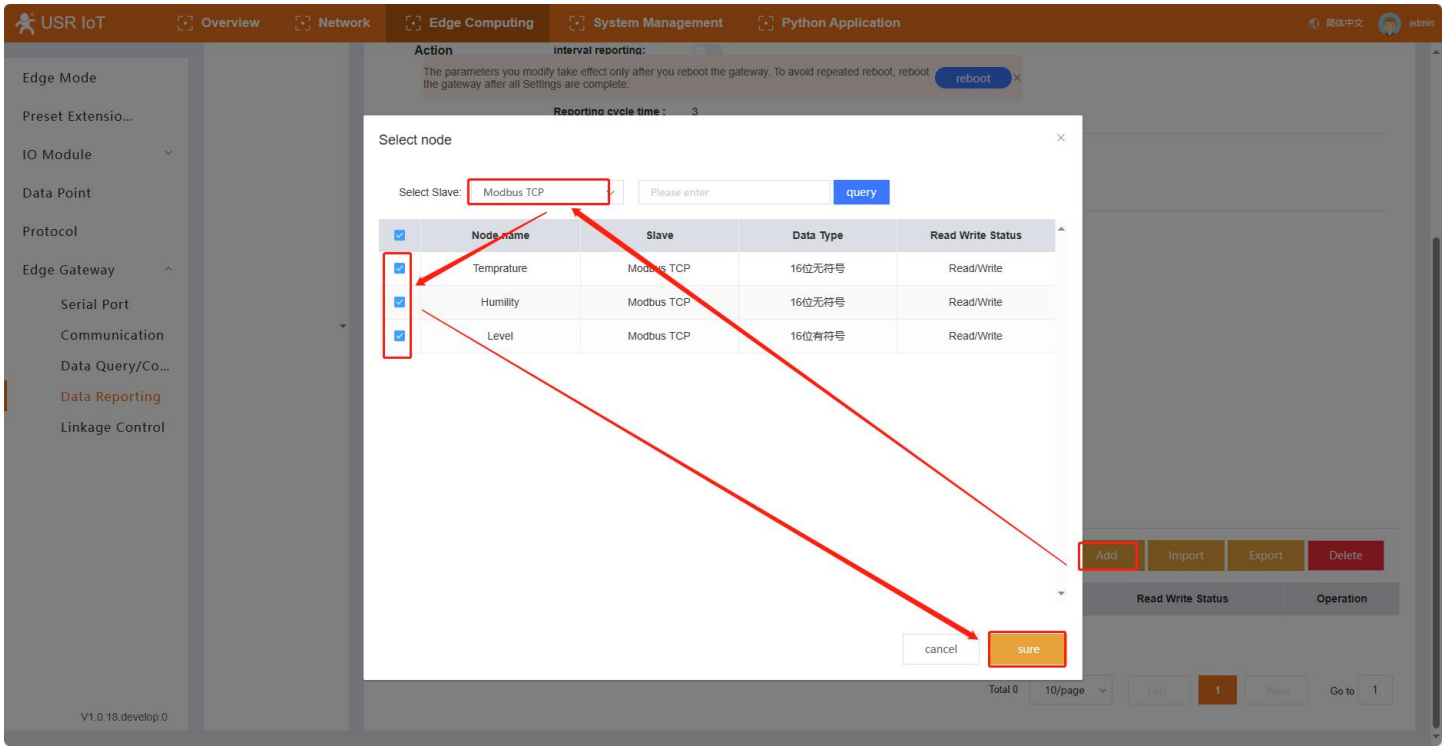


5.6.4. Data Reporting

The data reporting function will report the collected data on data point page to server actively. Users can send the data in different methods. The Reporting Template will be introduced later.



Then add the data points that need to be reported.



Json Template:

The data reporting function will upload point data to the server in Json format. Customers can customize the Json template according to the server's requirements to ensure that the uploaded data format meets the server's parsing requirements. The actual data points can be defined in the Json template.

In addition to data points, the Json template can also add some specific identifiers, such as the product's firmware version, SN, MAC and other parameters. These parameters can be processed as the unique identifier of the device. Directly add the relevant identification name in the value position of the Json template. During the reporting process, the device will substitute the data corresponding to the identification name and report it. For example, to report timestamp, set the Json template to {"time":"sys_local_time"},

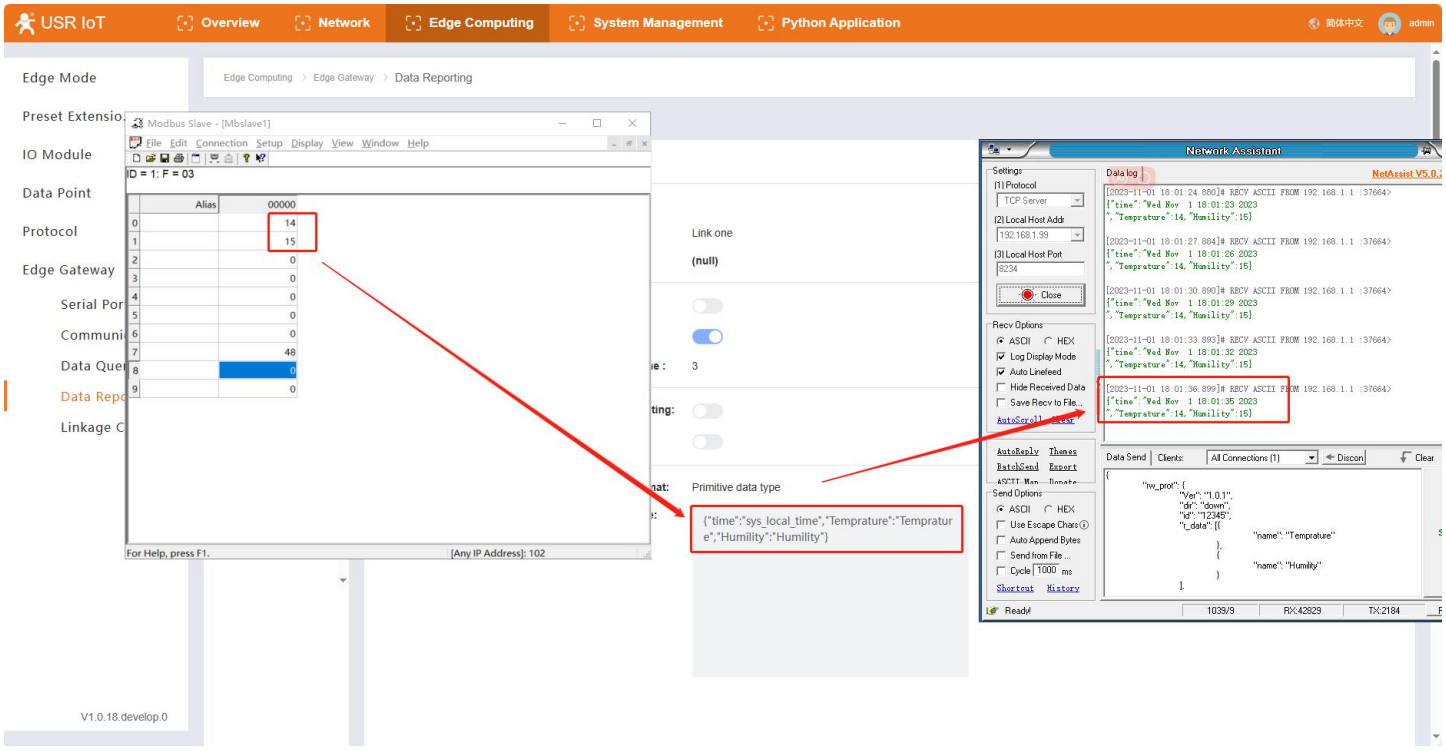
Items	Description	Example
sys_ver	Firmware version	V1.0.14.000000.0000
sys_imei	IMEI	864452061930390
sys_sn	SN	02700122093000012356
sys_mac	MAC	D4AD20474662
sys_iccid	ICCID	89861122219045577705
sys_local_time	Local time	2023-05-27,22:35:44
sys_utc_time	UTC time	2023-01-12T18:15:02Z
sys_unix_time	Timestamp	1681985788

1

Data Reporting rules

Basic information	Up channel:	Link one
	Public topic:	(null)
Action	interval reporting:	
	periodic reporting:	
	Reporting cycle time :	3
	Data change Reporting:	
	report regularly:	
	Reporting data format:	Primitive data type
	Reporting Template:	{"time":"sys_local_time","Temprature":"Temprature","Humility":"Humility"}

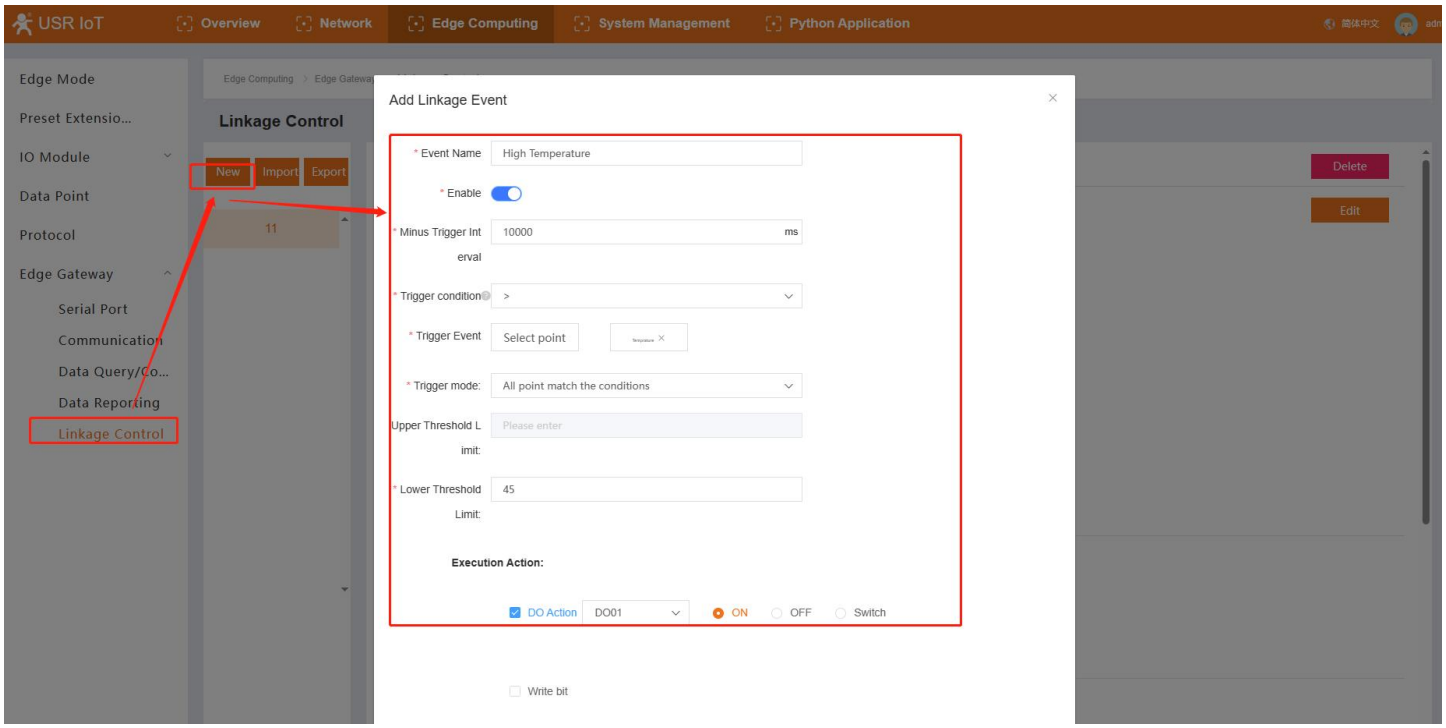
The test result: USR-M300 reports the collected data according to the period cycle time and the content of the Json template.



5.6.5. Linkage Control

The linkage function is mainly used to realize local closed-loop management, rapid alarm and emergency

applications. The product can support 50 linkage events internally.

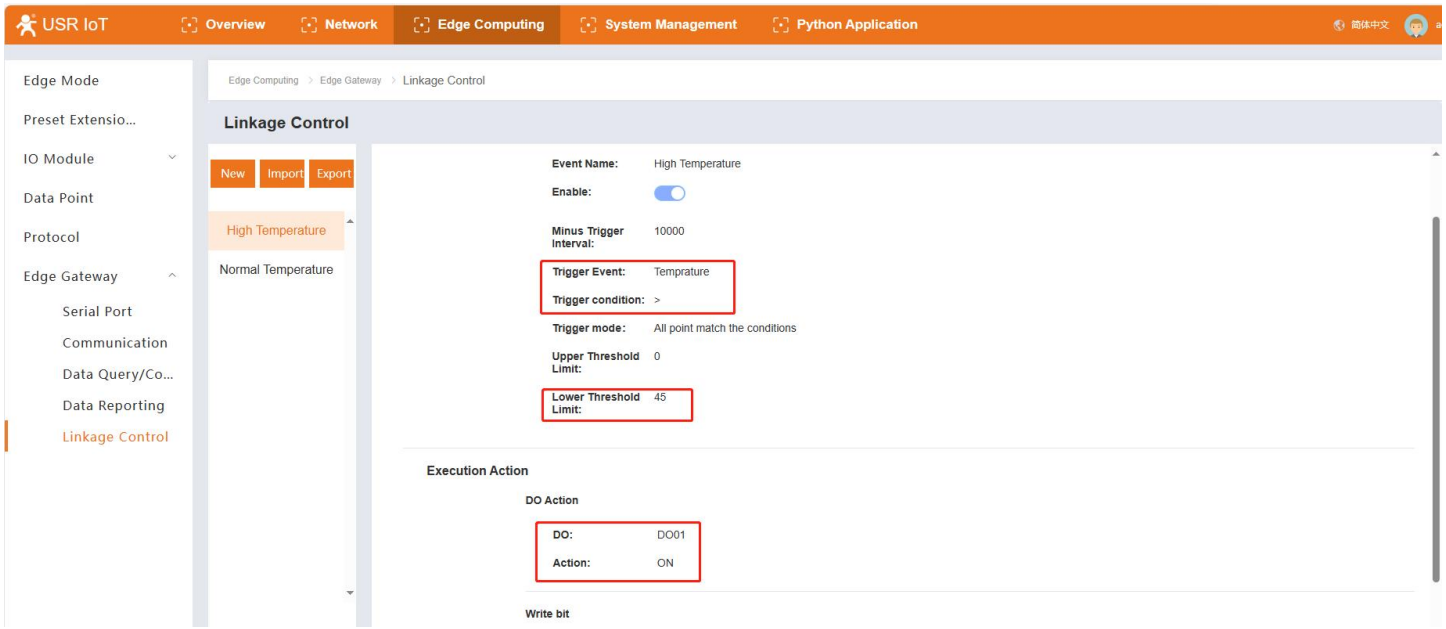


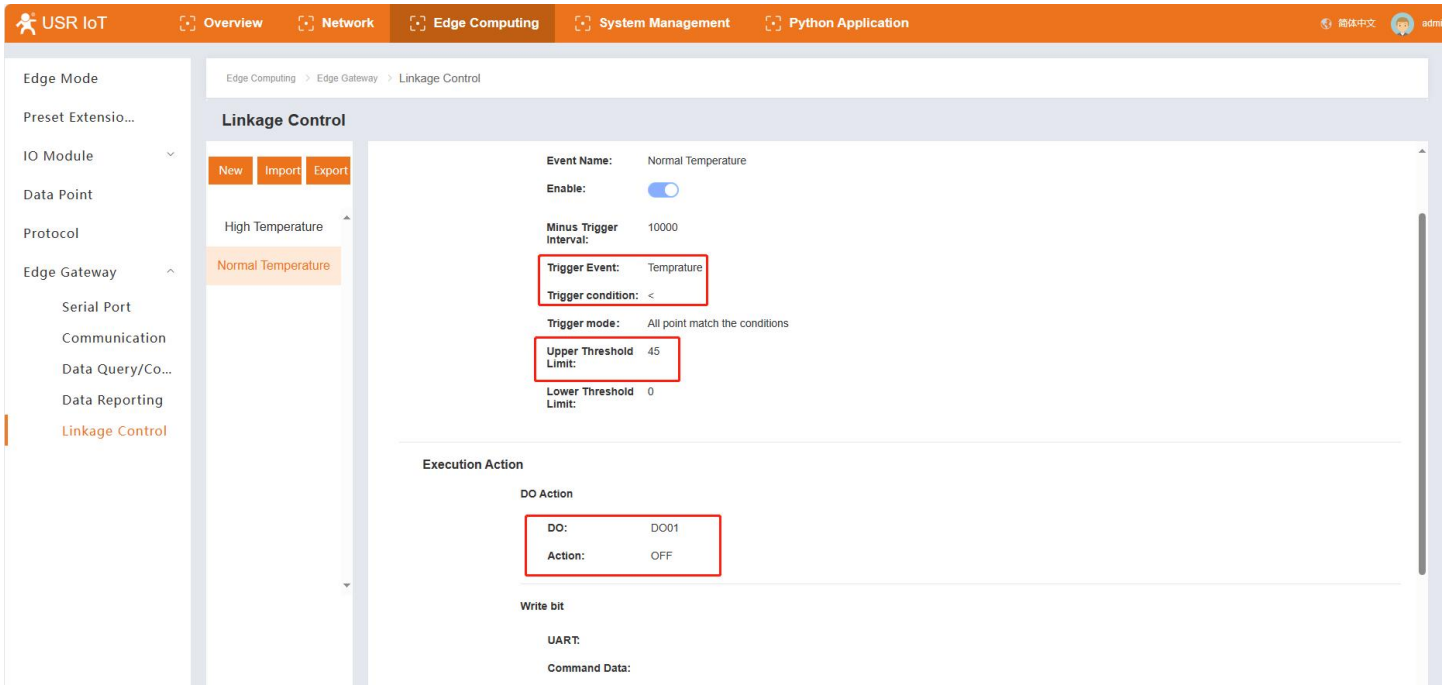
Items	Description	Default Parameter
Event Name		None
Enable	Weather to enable the linkage control	Off
Minus Trigger Interval	When the trigger condition is met for several times in a short period, the trigger takes effect only when the interval between two triggers is greater than the set value.	None
Trigger condition	The action can be executed if the conditions are met, A total of 10 conditions are supported.	None
Trigger Event	Select the data point to start the trigger event.	
Trigger mode	All points match the conditions Any point matches the conditions	None
Upper Threshold Limit	The value range: 0~20000	None
Lower Threshold Limit	The value range: 0~20000	None

Description of trigger condition:

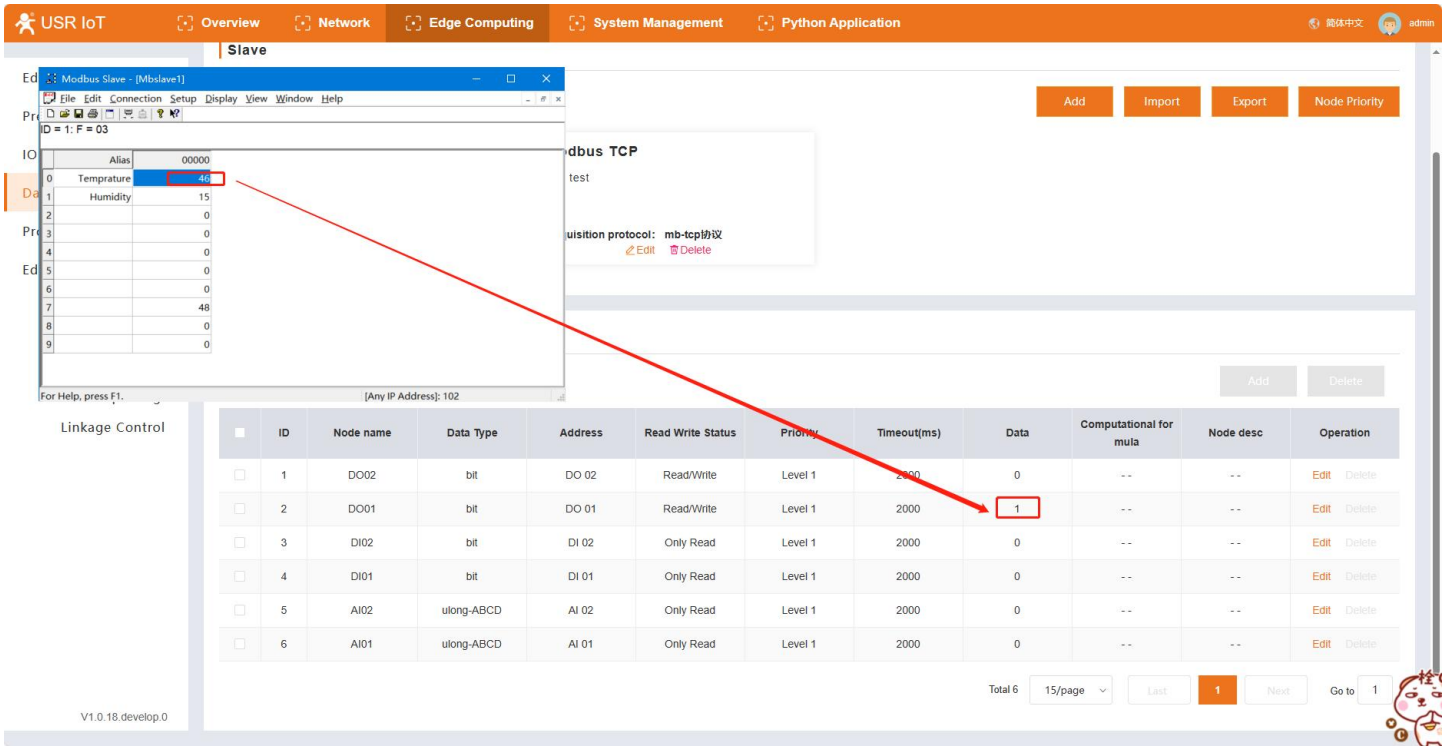
Trigger condition	Description	Extro
Forward Follow	If DI is high level, DO outputs high level. If DI is low level, DO outputs low level.	Only available for coil value.
Reverse Follow	If DI is high level, DO outputs low level. If DI is low level, DO outputs high level.	Only available for coil value.
Greater than	The collected value exceeds the threshold, an action is triggered.	Only the lower of the thresholds need be set.
Equal or greater than	The collected value is greater than or equal to the threshold, an action is triggered.	Only the lower of the thresholds need be set.
Less than	The collected value is less than the threshold, an action is triggered.	Only the upper of the thresholds need be set.
Equal or less than	The collected value is less than or equal to the threshold, an action is triggered.	Only the upper of the thresholds need be set.
In the Range (Including boundary data)	An action is triggered when the collected value is within the threshold range, and an action is triggered each time the collected value is within the range.	Upper and lower limits of the thresholds need be set.
In the Range (Excluding boundary data)	An action is triggered when the collected value is within the threshold range, and an action is triggered each time the collected value is within the range.	Upper and lower limits of the thresholds need be set.
Out of the Range(including boundary data)	An action is triggered when the collected value is outside the threshold range, and an action is triggered each time the collected value is outside the range.	Upper and lower limits of the thresholds need be set.
Out of the Range(excluding boundary data)	An action is triggered when the collected value is outside the threshold range, and an action is triggered each time the collected value is outside the range.	Upper and lower limits of the thresholds need be set.

In this case, we add 2 events: High Temperature and Normal temperature,

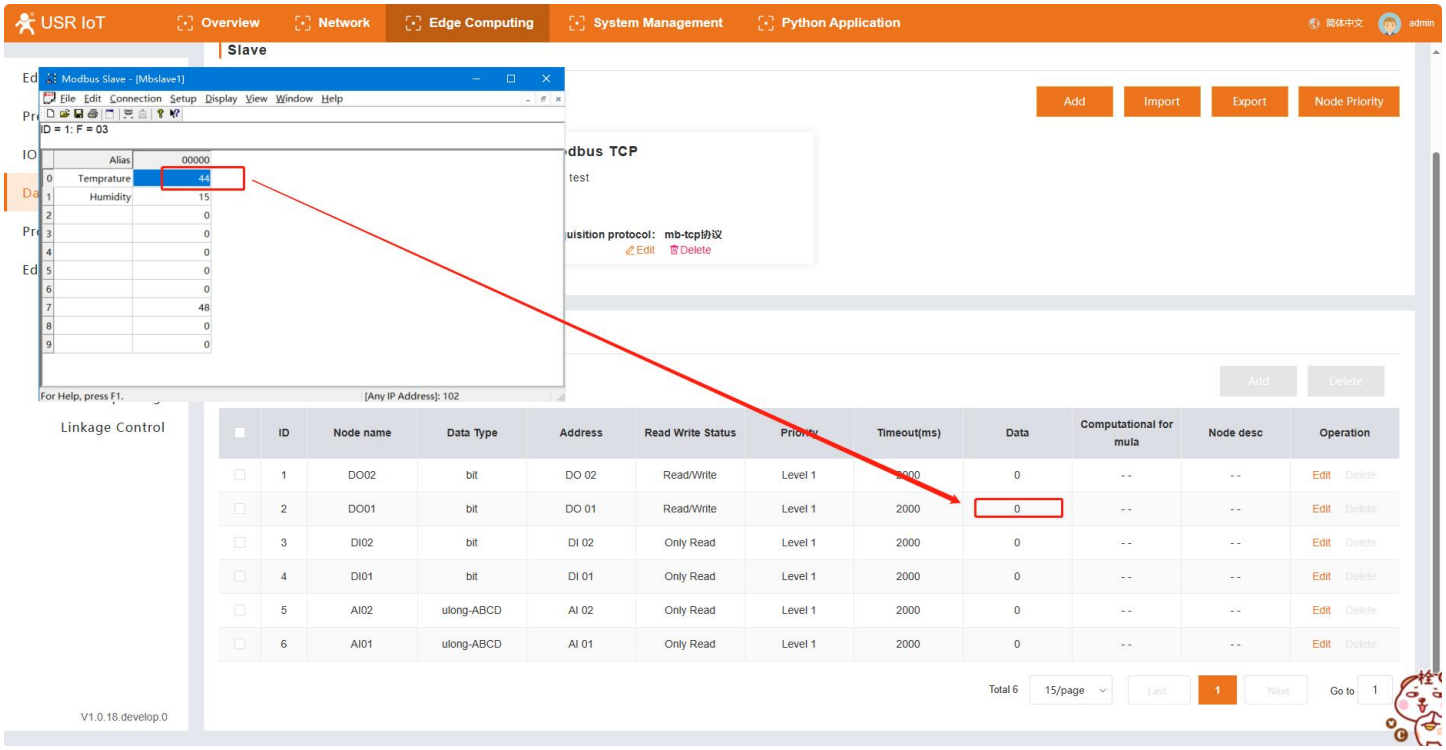




In High Temperature, if the value of temperature is higher than 45, then turn on DO1.



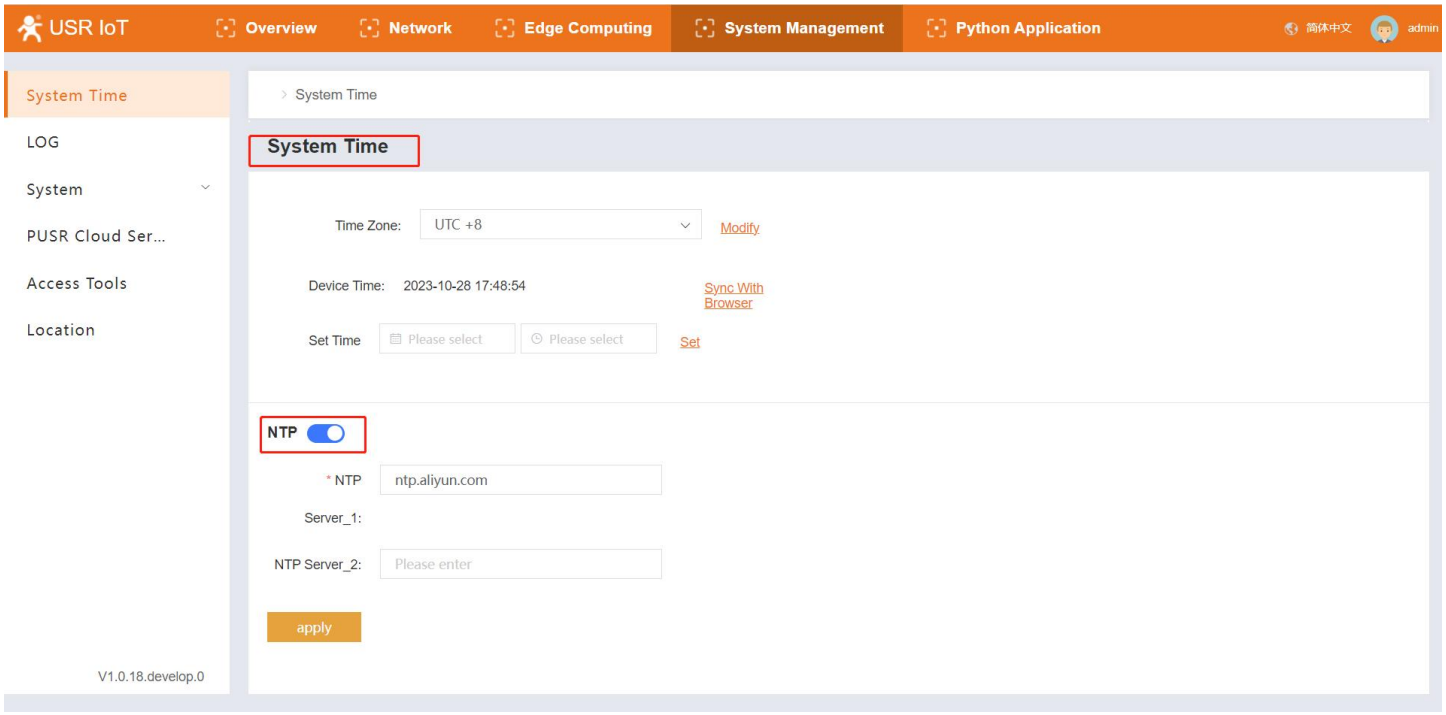
In Normal temperature, if the value of temperature is lower than 45, then turn off DO1.



6. System Management

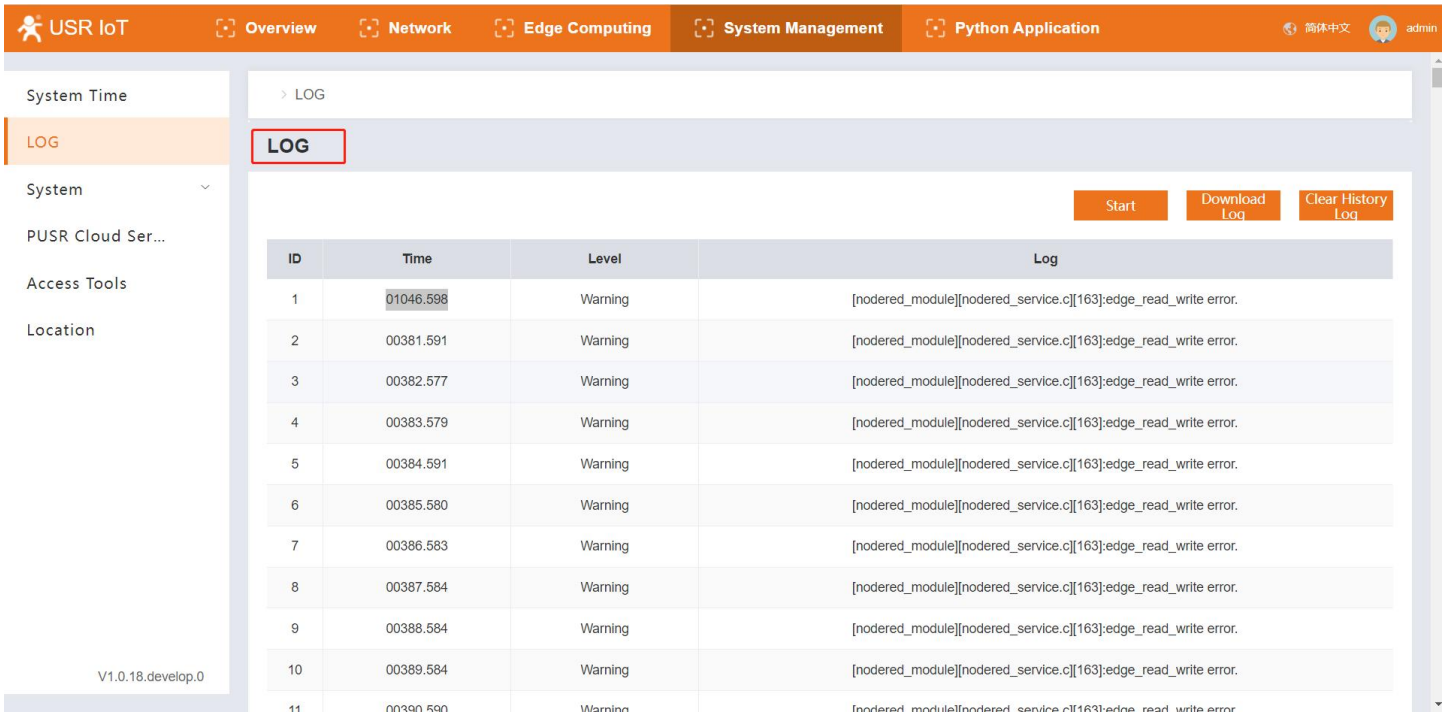
6.1. System Time

On this page, users can select Time Zone or set time manual. And can also set the NTP server.



6.2. Log

Users can check and download log information on this page.



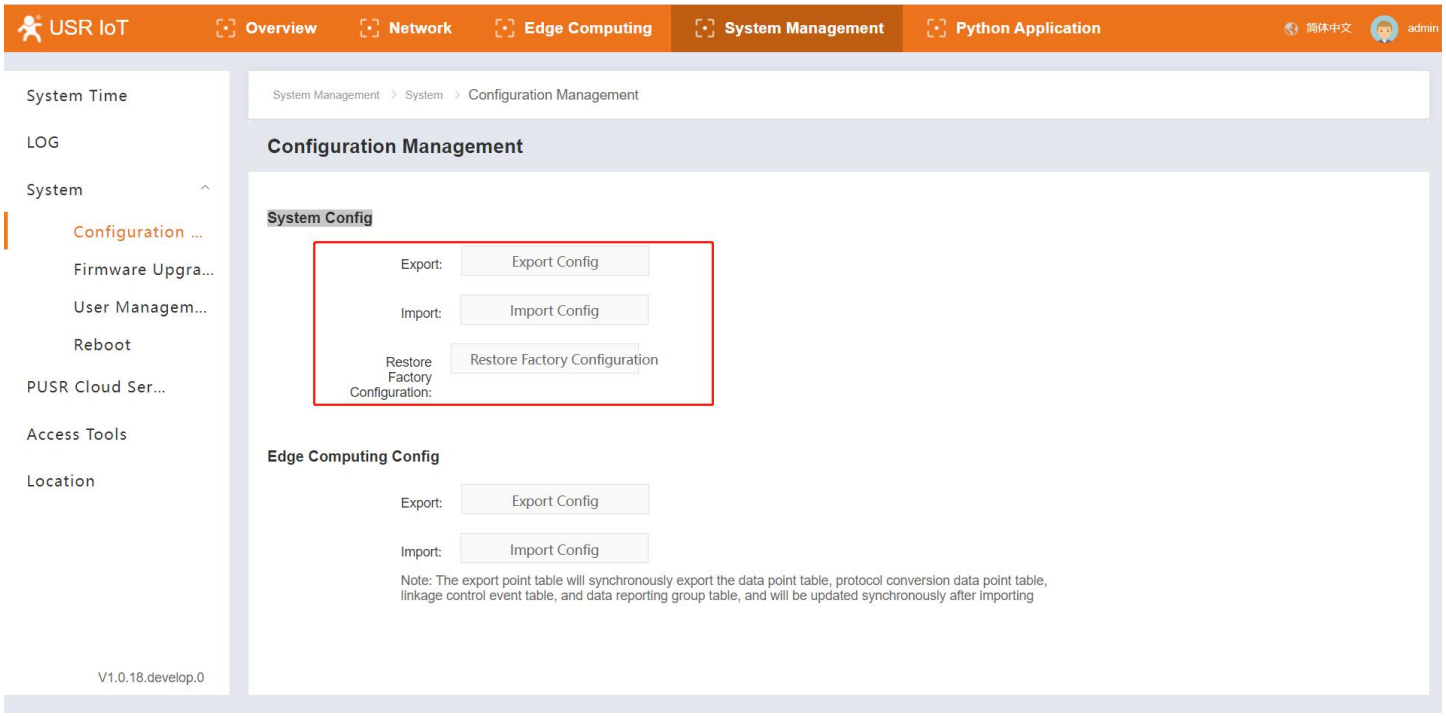
6.3. System

6.3.1. Configuration Management

➢System Config

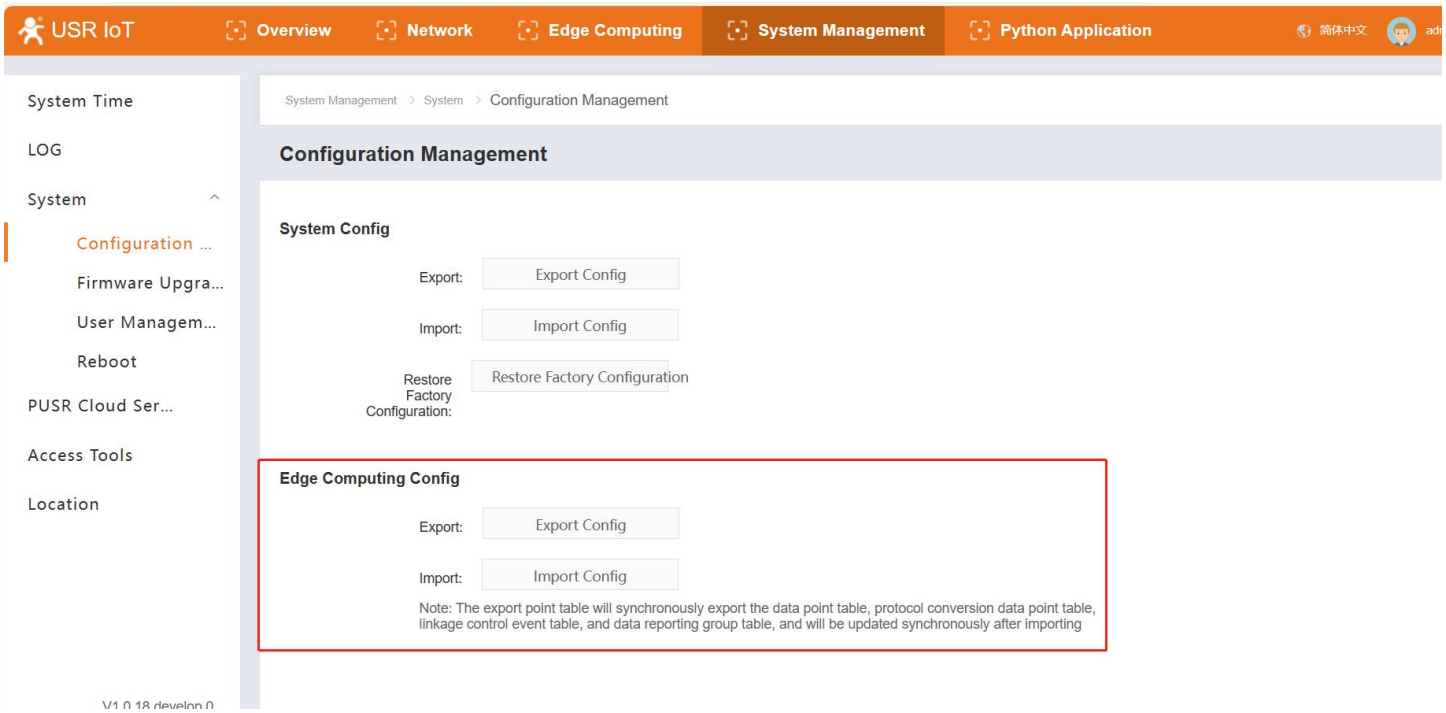
This function mainly includes parameter export, import, and restore to factory settings. Using this

function, users can quickly copy product parameters.



➢Edge Computing Config

The export point table will synchronously export the data point table, protocol conversion data point table, linkage control event table, and data reporting group table, and will be updated synchronously after importing.



6.3.2. Firmware Upgrade

On this page, the current firmware version is displayed, and it provides firmware upgrade operations. Select a valid firmware and click Start Upgrade to wait for the automatic upgrade of the product.

6.3.3. User Management

This function is mainly to set the username and password for logging in to the built-in web page. The username supports 4-30 characters, and the password supports 1-30 characters.

6.3.4. Reboot

Users can restart the device immediately or add a scheduled restart task and set the restart time on the same day. Restart tasks can be performed in 24 hours, accurate to the minute.

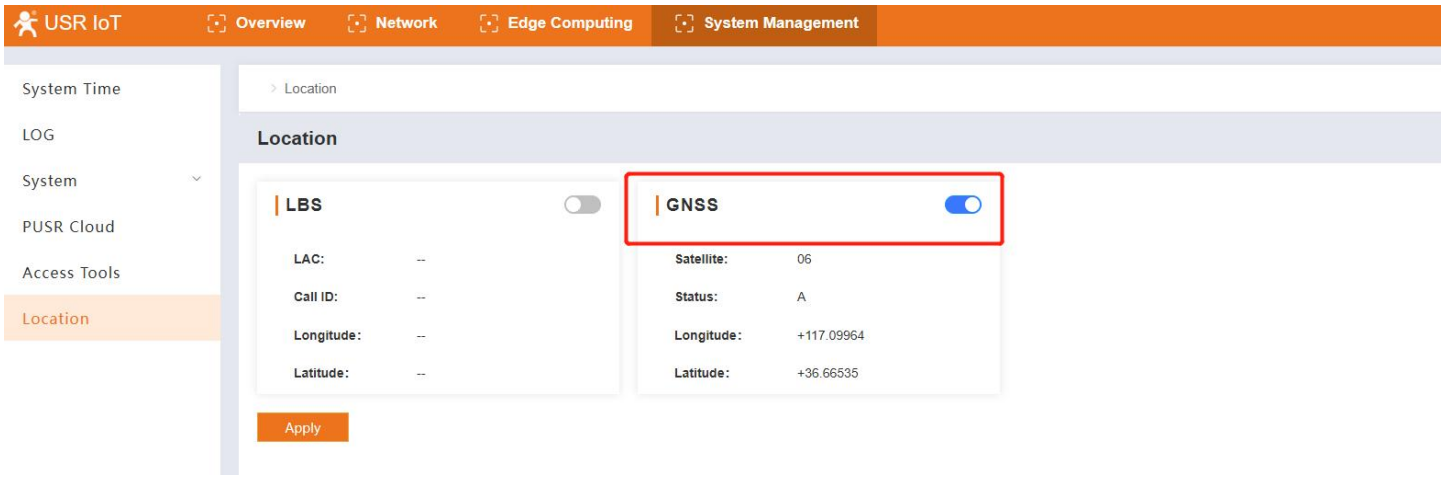
6.4. PUSR Cloud Service

This function is to facilitate customers to quickly connect to the public PUSR platform, through which equipment maintenance can be carried out. If it is a private deployed PUSR platform, users can enable the private deployment button and fill in the private IP address and port to connect.

6.5. Location

USR-M300 supports both LBS location and GPS location. The location function is not enabled by default. Users can enable the LBS location or GPS location manually.

6.5.1. GNSS



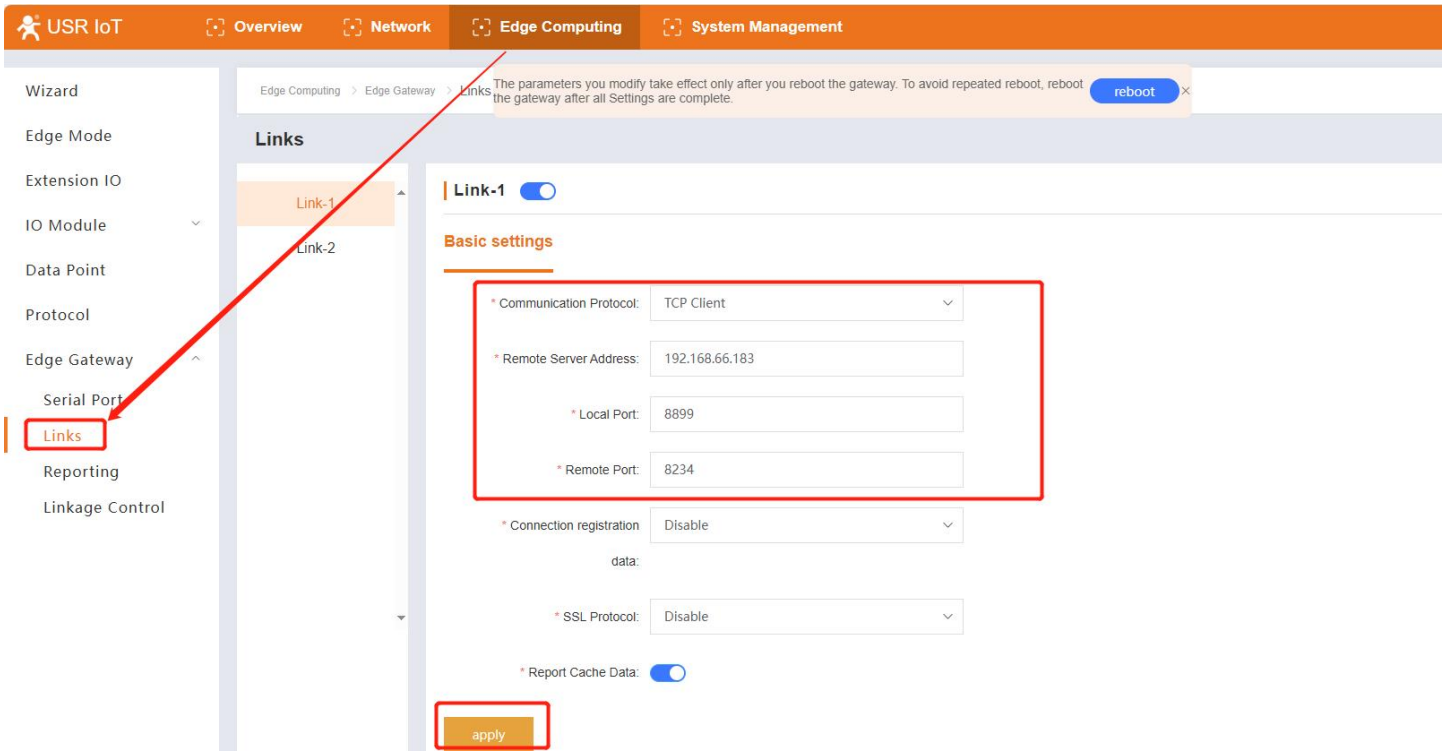
Satellite: The number of satellites simultaneously observed by GPS system.

Status: “A” means successful GPS positioning, “V” means GPS positioning failure.

Longitude: The longitude of the device's location.

Latitude: The latitude of the device's location.

Users can also send the GPS information to remote servers to achieve real-time monitoring of the USR-M300 device.



7. Contact Us

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