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Data integrated application service

WukongEdge

Edge + Configuration +PLC+ Network

Edge computing, network management

PLC - integrated, built-in configuration

Rich protocols, simple configuration

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Your Trustworthy Smart Industrial IoT Partner

Directory

1.Product Introduction

WukongEdge one-stop integrated edge application architecture, with data processing as the core, integrates edge computing, configuration management, PLC programming, network management and other functions, providing comprehensive support for industrial control and IoT industries. The application is simple to use, widely applicable, and can seamlessly interface with the existing system architecture of various industries, bringing efficient and intelligent one-stop comprehensive application services to the industrial control and Internet of Things industries.

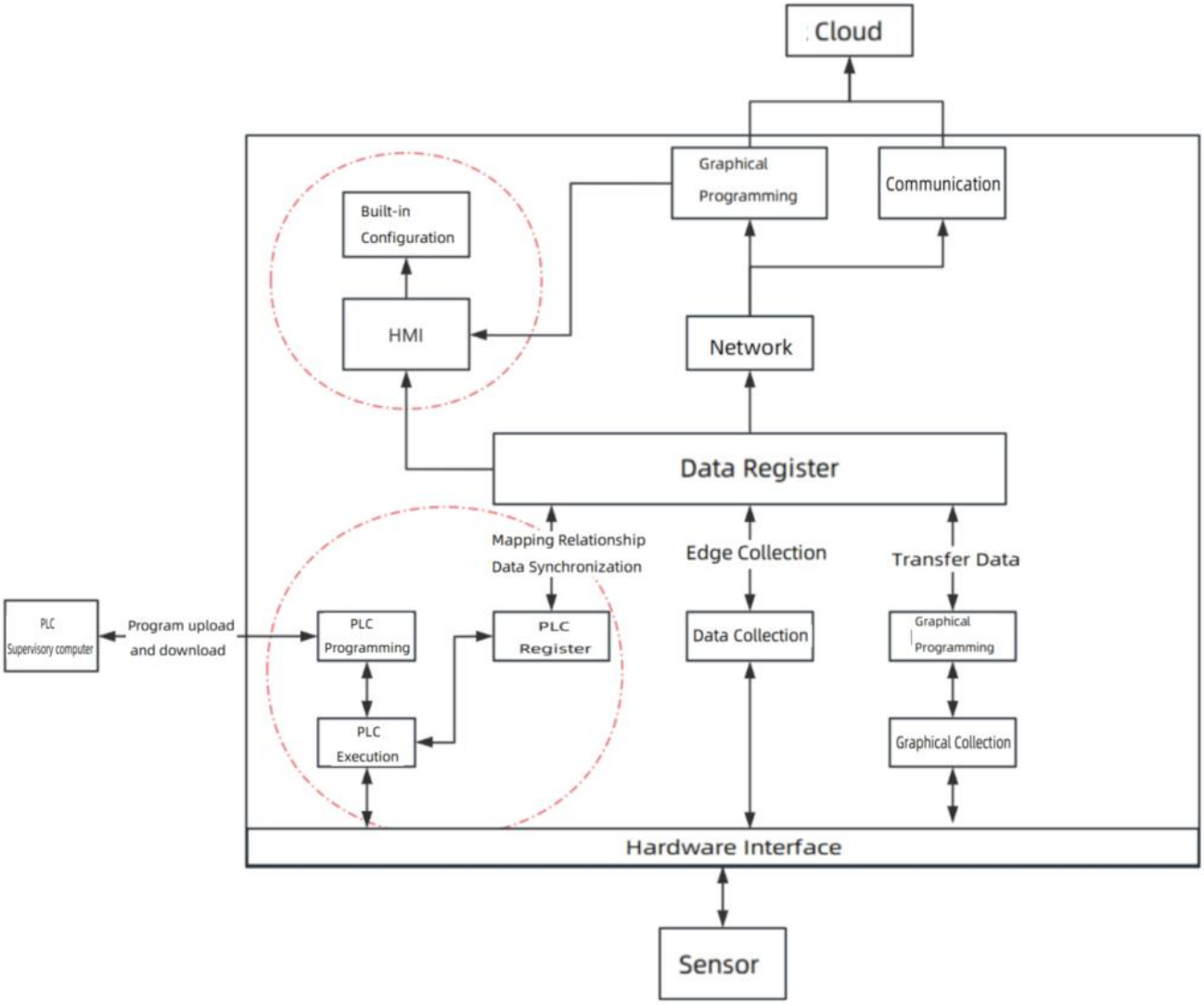
2.Product Feature

- Comprehensive functions: data processing as the core, integrated edge acquisition, calculation, reporting, protocol conversion, linkage control, network management, IO management, configuration management, PLC programming and many other functions.
- Rich collection: Support more than 100 kinds of PLC protocols, as well as industry-specific protocols such as power, water conservancy, building, electricity meter, etc., such as 104, 61850, SL651, Bacnet, DL/T645, etc.
- Flexible reporting: Active reporting methods such as change reporting, scheduled reporting, periodic reporting and custom JSON are provided.
- Link diversity: Support multi-link, including MQTT, TCP, HTTP, TLS/SSL and other multi-link transmission protocols.
- Wide point support: Support 10K points, and can configure protocol conversion for various types of data at will.
- Convenient networking: support 4G/5G, Ethernet and WiFi networking methods, a variety of network backup, built-in routing, VPN, firewall, network diagnosis and other functions, with the cloud can achieve remote networking.
- Flexible configuration: local operation is convenient, no complex network configuration is required; with multi-configuration design, real-time control of data, the screen can be customized independently.
- Efficient programming: Built-in OpenPLC run-time, comply with IEC61131-3 standard, support 5 kinds of PLC programming design, embedded Node-red to achieve low-code programming, parameter configuration is simple and fast, built-in IO expansion management.
- Convenient remote management: With cloud access function, remote management can be realized through cloud.

3.Functional Framework

WukongEdge application framework integrates five core modules: edge acquisition, configuration management, PLC programming, network management and general functions. Each module communicates efficiently through its own API and cooperates with each other to form an organic whole. It is with this close collaboration mechanism that WukongEdge edge applications can achieve comprehensive processing of multi-source data, ensuring stable and efficient operation of the system and meeting the diverse needs of complex industrial scenarios and IoT applications.

In addition to the above five core modules, WukongEdge is uniquely integrated into the built-in web features. The web page integrates all parameter configuration options of the five functional modules, so users do not need to switch and search in different interfaces or tools. On this unified web page platform, all kinds of parameter settings can be completed in one stop, which is simple and convenient to operate, greatly improving the user's work efficiency and experience.

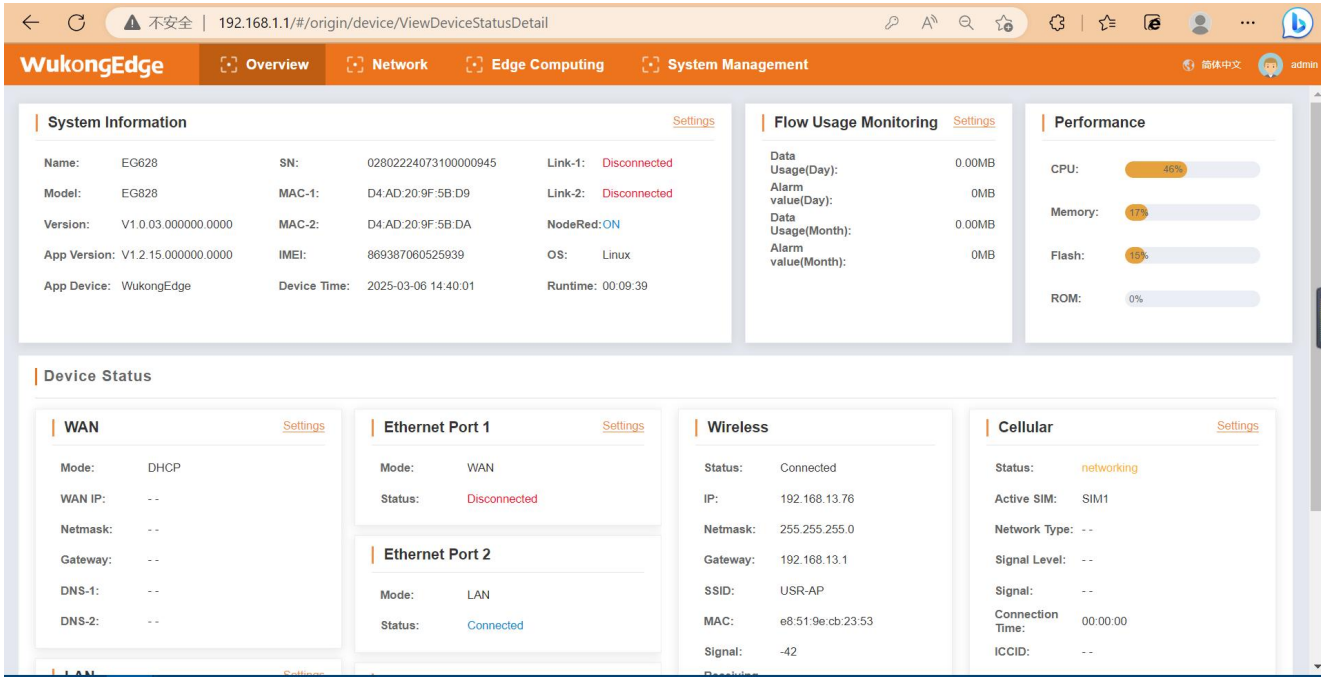


4.Application Guidance

This section provides an in-depth and comprehensive introduction to the WukongEdge app's features, along with detailed app how-to guides for each feature to help you quickly master and use them.

4.1.Web page configuration

WukongEdge's web configuration system is designed with extreme convenience as its core concept, simplifying complexity and eliminating redundant steps. Users do not need complex operation process, only need to click and set on the intuitive web interface, you can quickly complete various configurations, greatly shorten the time cycle from deployment to actual application, help users integrate WukongEdge into business processes faster, and efficiently achieve the expected application goals.



Operation steps:

- After the device is powered on, connect the computer and hardware devices through the LAN port, and WukongEdge's built-in routing will assign IP addresses to the computer.
- Open "192.168.1.1" through the computer browser, enter the login interface, enter the default user name and password interface to enter. The default username and password is admin/admin.
- After entering, the overview interface will be displayed first, which will show the status of WukongEdge's network and important information of the device.

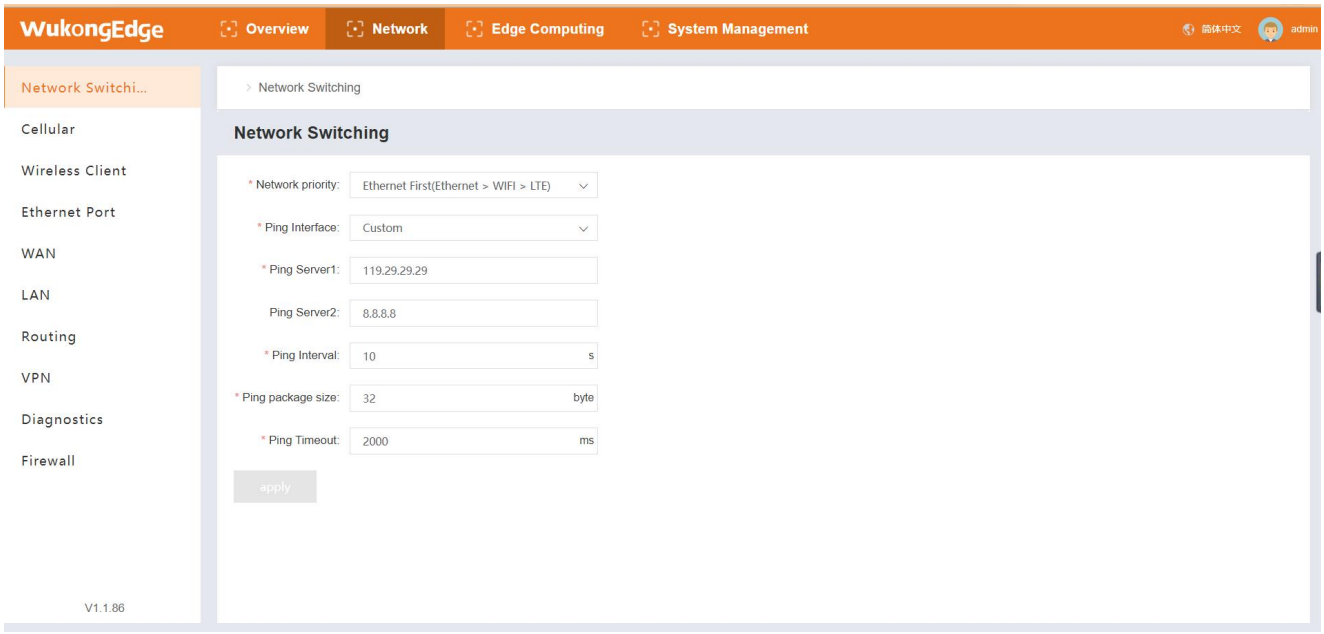
4.2.Network management

The WukongEdge app is fully integrated in terms of network functionality, providing users with the ultimate in network flexibility and stability.

Cellular network, Ethernet and WiFi access methods are available to meet the network connection needs of different scenarios. Whether you rely on cellular networks to maintain data communication in mobile work environments or high-speed and stable network access via Ethernet or WiFi in fixed locations, it is easy to achieve.

More importantly, its integrated routing, VPN and firewall functions build a strict network security protection system. Routing function ensures efficient data transmission, VPN helps users to establish Private Cloud connection safely in public network, firewall monitors network traffic in real time, resists all kinds of potential network attacks, and comprehensively protects users 'network security.

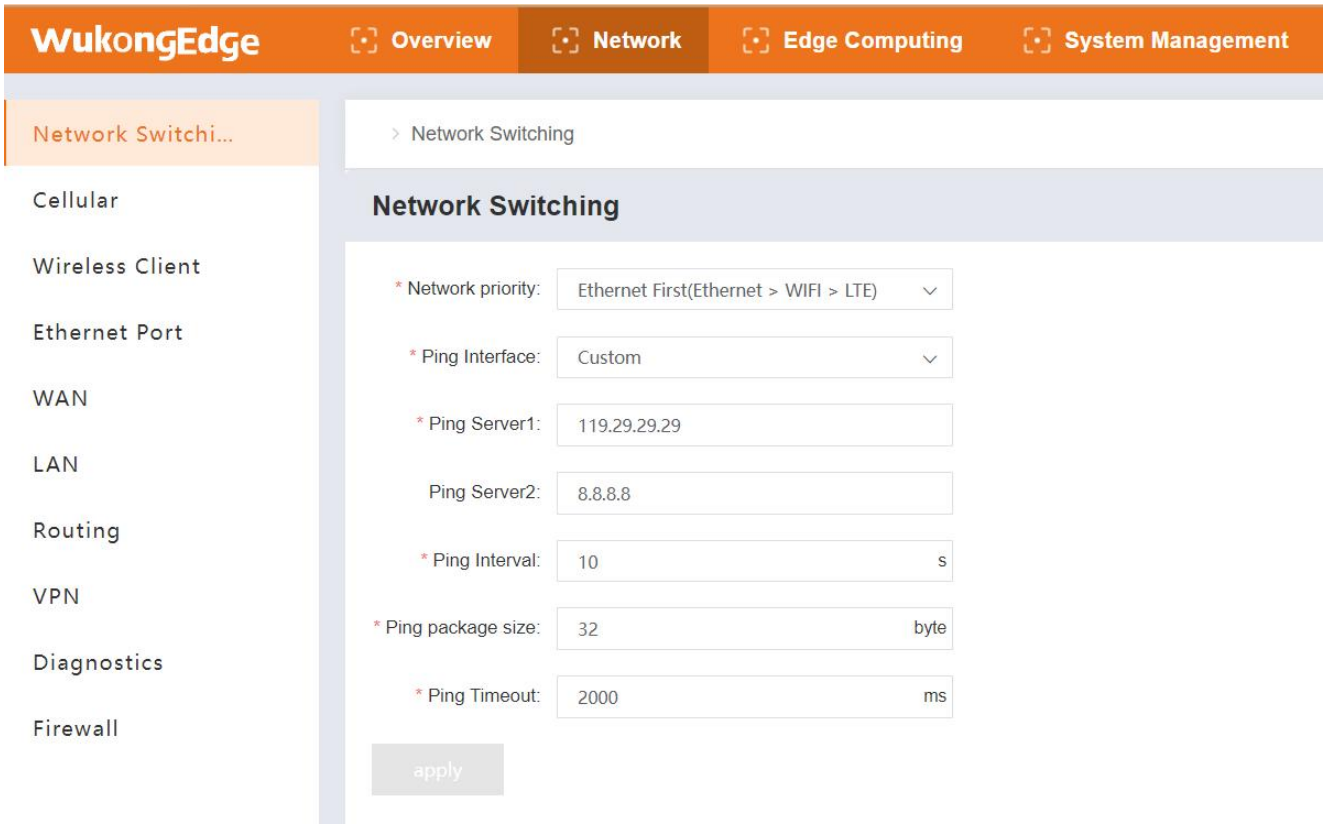
Not only that, WukongEdge app is also equipped with powerful network diagnostics, support for multi-network backup and multi-link Internet access. When the primary network fails, the system can automatically switch to the backup network link to ensure continuous stability of the network connection. At the same time, the network diagnosis function can monitor the network status in real time, quickly locate the fault point, greatly improve the network operation and maintenance efficiency, and provide a solid guarantee for the service continuity of users.



4.2.1.Network switching

The network switching function is mainly used to set the priority order of network use in multi-network mode. With this feature, the higher priority networks are enabled first. Once a high

priority network is disconnected, the system will automatically switch to a lower priority network according to the preset order, so as to ensure the stability and continuity of the network connection.



Parameter introduction:

Name	Parametric description	Default parameters
Network priority	Priority network, automatic switch to alternate network when priority network cannot be connected	Ethernet first
Detection mode	Custom: Determine network status based on custom probe addresses Gateway: Probes WAN gateway addresses to determine network status	Custom
Probe Address 1	When the probe mode is customized, ping this address for communication probe is preferred. If there is a reply, the network is normal. If there is no communication, the probe fails.	119.29.29.29
Probe Address 2	When the probe mode is customized, when the probe address 1 fails to detect, the ping operation will be performed using address 2. Ping generally means that the network is normal.	8.8.8.8
Sounding period	Set link detection interval: 1-600s can be set	10s

Ping packet size	ping packet data size when detecting link: 32-1024 bytes can be set	32 bytes
Ping timeout	Ping timeout time: 100-20000ms can be set	2000ms

The network priorities are described as follows:

Network priority	Description
Ethernet priority (Ethernet->WIFI-> Cellular)	The device is preferentially connected to Ethernet networking. If Ethernet detection fails, switch to WiFi for networking. If WiFi detection fails, connect to cellular network for networking. The three networks are tried in turn.
Ethernet priority (Ethernet->WIFI-> Cellular)	The device is preferentially connected to Ethernet networking. If Ethernet detection fails, switch to cellular network for networking. If cellular network detection fails, connect to WiFi for networking. The three networks are tried in turn.
WiFi priority (WiFi-> Ethernet-> Cellular)	Same Ethernet priority, only different priority order
WiFi priority (WiFi-> Cellular-> Ethernet)	Same Ethernet priority, only different priority order
Cellular priority (Cellular-> Ethernet->WIFI)	Same Ethernet priority, only different priority order
Cellular priority (Cellular->WIFI-> Ethernet)	Same Ethernet priority, only different priority order
Ethernet only	Communication only via Ethernet, other networks disabled
Cellular only	Communicate only over cellular networks, disable other networks
WiFi only	WiFi only, disable other networks

4.2.2.Cellular network

4G/5G support: WukongEdge can support 4G/5G networks, which enables it to use high-speed mobile networks for data transmission and other operations, providing users with faster data transmission speeds and lower latency to meet the network performance requirements in different scenarios.

Adapting module: Quectel EG25, Fibocom NL668

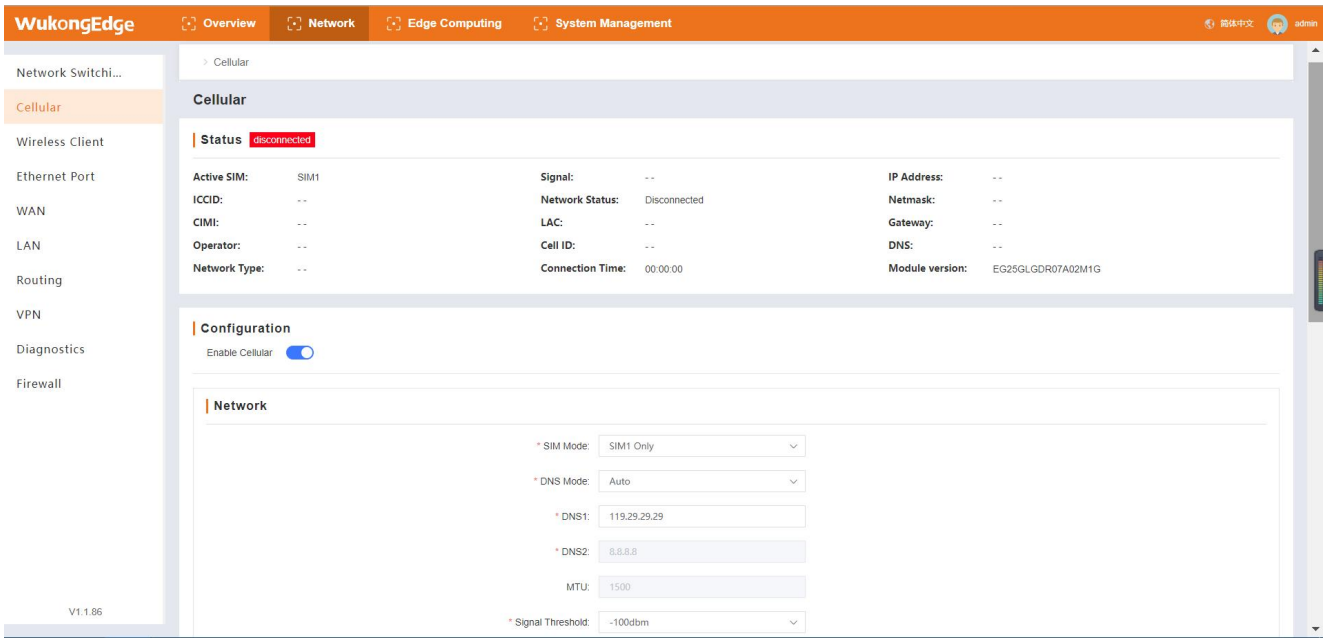
Dual SIM Single Standby: Dual SIM single standby design means that the device can be inserted into two SIM cards, but only one of the cards can be used at the same time. This design

allows users to flexibly choose which card to use for network services according to different needs, such as different package traffic, different network coverage, etc.

Automatic identification: With network detection and signal detection mode, it can automatically identify the currently available network type and signal strength. This allows the device to make intelligent decisions based on the actual situation of the network, such as automatically trying to switch to the 5G network when the signal of the 4G network is not good (if it supports and has signal).

Automatic handover: With automatic handover function, WukongEdge can seamlessly switch between different networks or between different signal sources of the same network to ensure stable connection of cellular network, reduce connection interruption caused by network signal fluctuation or failure, and improve user's network experience.

This design and functional features enable WukongEdge to have high flexibility, stability and adaptability in cellular network connectivity, and can better meet the network requirements of various application scenarios.



Application Configuration:

- Go to the built-in web page, find "Network-> Cellular Network", and turn on cellular network.
- Configure dual card mode and configure detection;
- Configure parameters such as APN of SIM1 and SIM2. If single card mode is selected, only the selected SIM card needs to be configured.
- After the configuration is completed, click the "Apply" button to complete the configuration, and it will take effect immediately after application.

Parameter introduction:

Name	Parametric description	Default parameters
Dual SIM mode	First dial with priority SIM card, four modes supported, SIM1 only and SIM2 only for single card mode	SIM1 priority
DNS acquisition Method	Automatic acquisition: automatically acquire DNS server address from base station Manual setting: manually set the address of DNS resolution server	automatic acquisition
DNS1	DNS server IP can be set	119.29.29.29
DNS2	DNS server IP can be set	8.8.8.8
MTU	Maximum transmission unit, in bytes, range 128~1500	1500
Signal threshold	if that average value of the current SIM signal detect within a certain period of time is less than a set threshold, switching to another card for network connection	-100dbm
Signal query interval	The interval time between two signal queries of the current SIM, ranging from 1 to 3600	60s
Maximum number of dialling	When the priority SIM fails to dial successfully within the set maximum number of times, the device will switch to another SIM for dialing.	3
Link probing	Ping to check if the link is open	SIM1&SIM2
Probing interval	Ping interval, range: 5~86400s	10s
Detection times	Continuous failure peak, redial after reaching this number, range 1~100	4
Detection timeout	The maximum time for a single probe to wait for a reply. If no reply occurs after timeout, the probe will fail.	5s
Probe Address 1	Ping address 1. If you can ping this address, the network is unblocked.	119.29.29.29
Probe Address 2	Ping address 2. If you can ping this address, the network is unblocked.	8.8.8.8

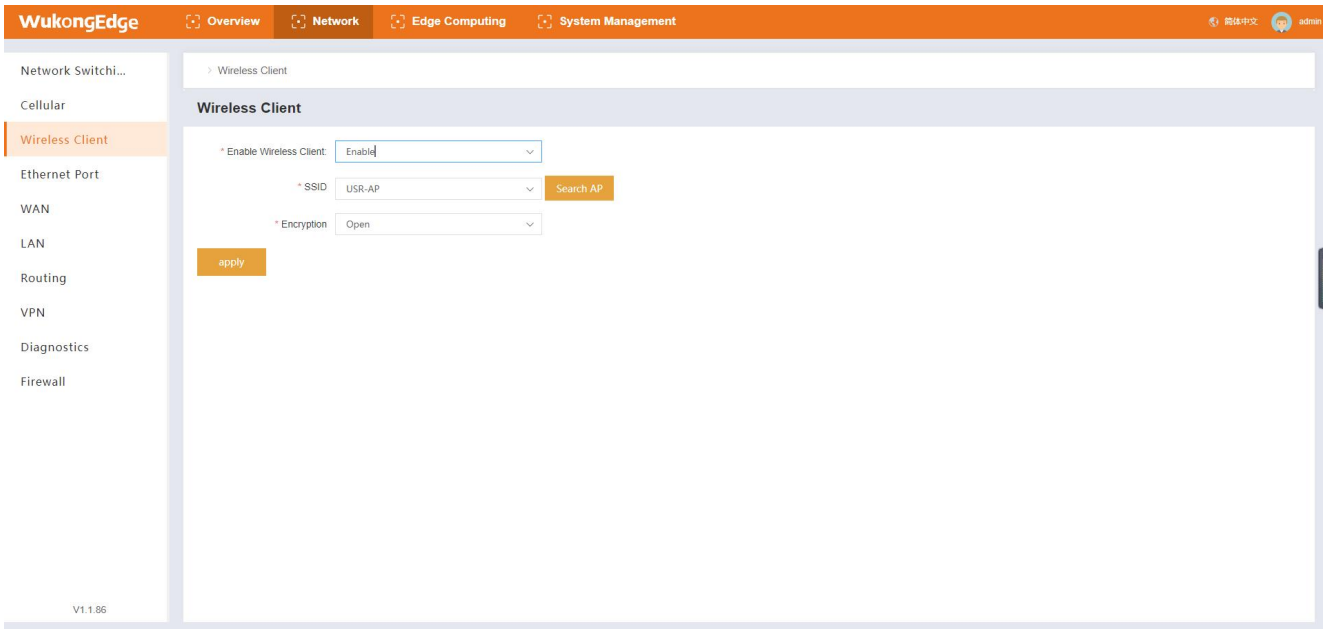
SIM card setting parameters are as follows:

Name	Parametric description	Default parameters
APN	Used to identify the service type of WCDMA/LTE network, ranging from 0 to 62 characters	empty

User name	Specifies the user name of the user accessing the external PDN network, ranging from 0 to 62 characters	empty
Password	Specifies the password of the user accessing the external PDN network, ranging from 0 to 62 characters	empty
Authentication mode	Authentication mode: NONE,PAP,CHAP,PAP CHAP	NONE
Type of network	Auto, 4G, 3G and 2G networks supported	Auto
PIN Code	PIN code is the personal identification code of SIM card. After it is enabled, it is necessary to set correct PIN code to dial normally. PIN code range is 4~8 characters.	close
Network mode	Auto, 4G, 3G and 2G networks supported	Auto

4.2.3.WiFi network

WukongEdge integrates WiFi network management function, supports STA mode, and can easily connect to hot spots.



Name	Parametric description	Default parameters
Wireless Client Switch	WiFi enabled	open
WiFi name	Search first, then select WiFi hot spots within the search range	not have

	to connect	
encryption method	Dual option, no encryption/Mixed-psk	no encryption
password	When Mixed-psk is selected as encryption method, the corresponding password needs to be input for hot spot authentication.	empty

WiFi network operation is simple, the operation steps are as follows:

- Enter the built-in web page and find the "Network-> Wireless Client" interface;
- Enable WiFi network, click Search and wait for search to complete;
- Select the WiFi AP found, and choose whether to encrypt, and configure the corresponding password according to the requirements.
- Click on the application, and it will take effect immediately after application.

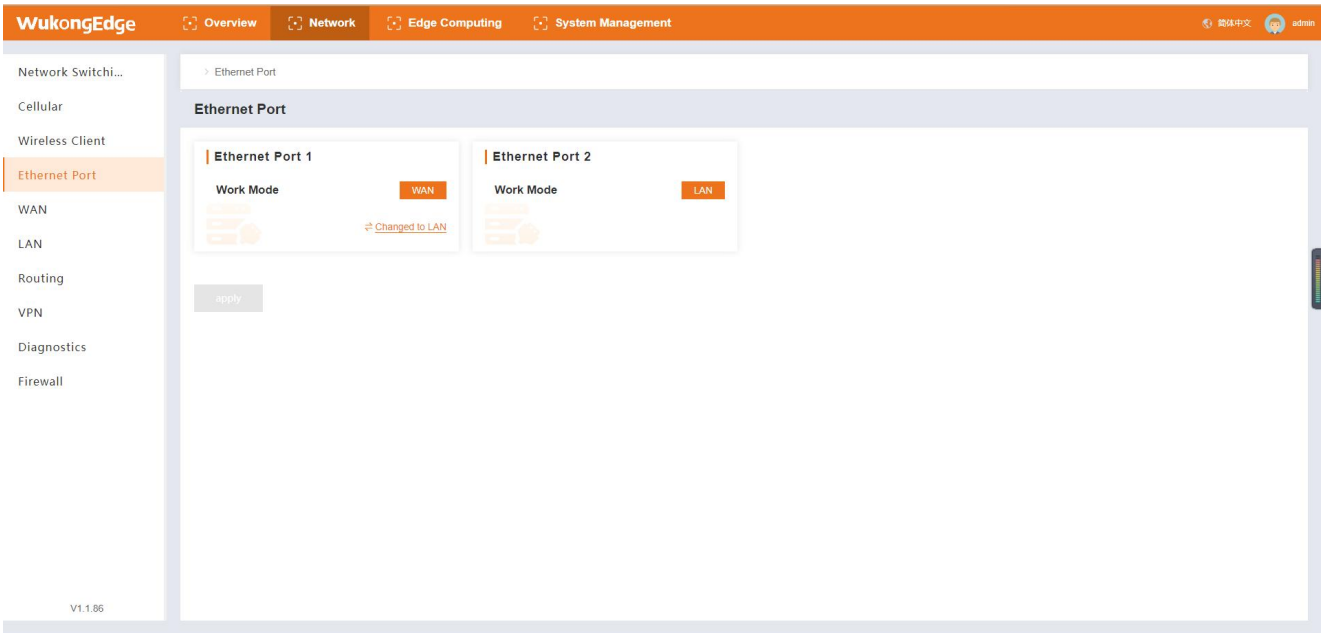
4.2.4.Ethernet

Ethernet management covers network port mode management, WAN port configuration management and LAN port management. Due to different hardware adaptation, the interface adaptation is flexible, and the network port mode can realize WAN and LAN mode switching. WAN interface is responsible for connecting external networks, such as Internet service providers, to ensure that equipment access to the wide area network, to achieve external data transmission and reception. LAN port is used to build a local local area network, which facilitates the interconnection of internal devices, such as computers and printers, and realizes the rapid sharing and exchange of data. Under WukongEdge management, WAN and LAN work together to meet the needs of different network application scenarios.

4.2.4.1.Network port mode switching:

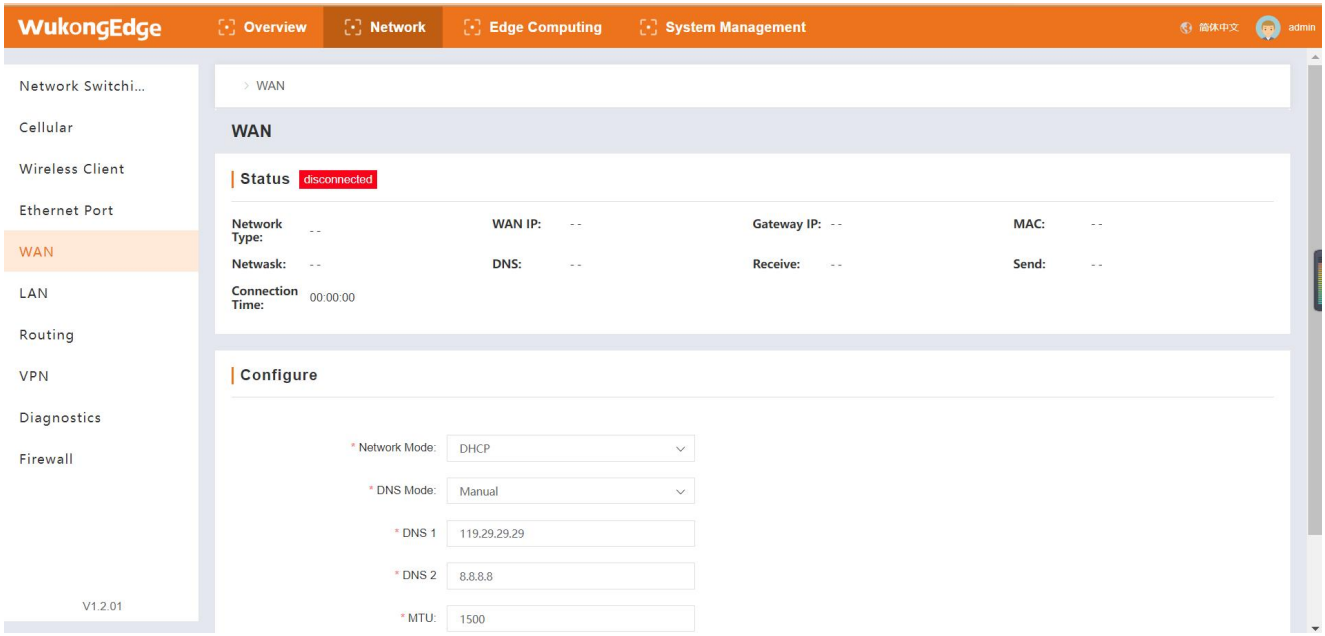
The default port 1 is WAN port, which can be switched to LAN port.

In the built-in web page, switch in the "Network-> Gateway Management" interface. After switching, click the application, and there will be a restart pop-up window. This function needs to be restarted to take effect. (The function switching of hardware network port needs to be reinitialized to ensure normal network port communication).



4.2.4.2. WAN port management

WAN port management built-in interface is divided into status management and parameter configuration. The former displays key information such as connection status and IP address, while the latter is used to set the way to obtain IP address and address configuration. Once the parameters are set, click Apply and it will take effect immediately.

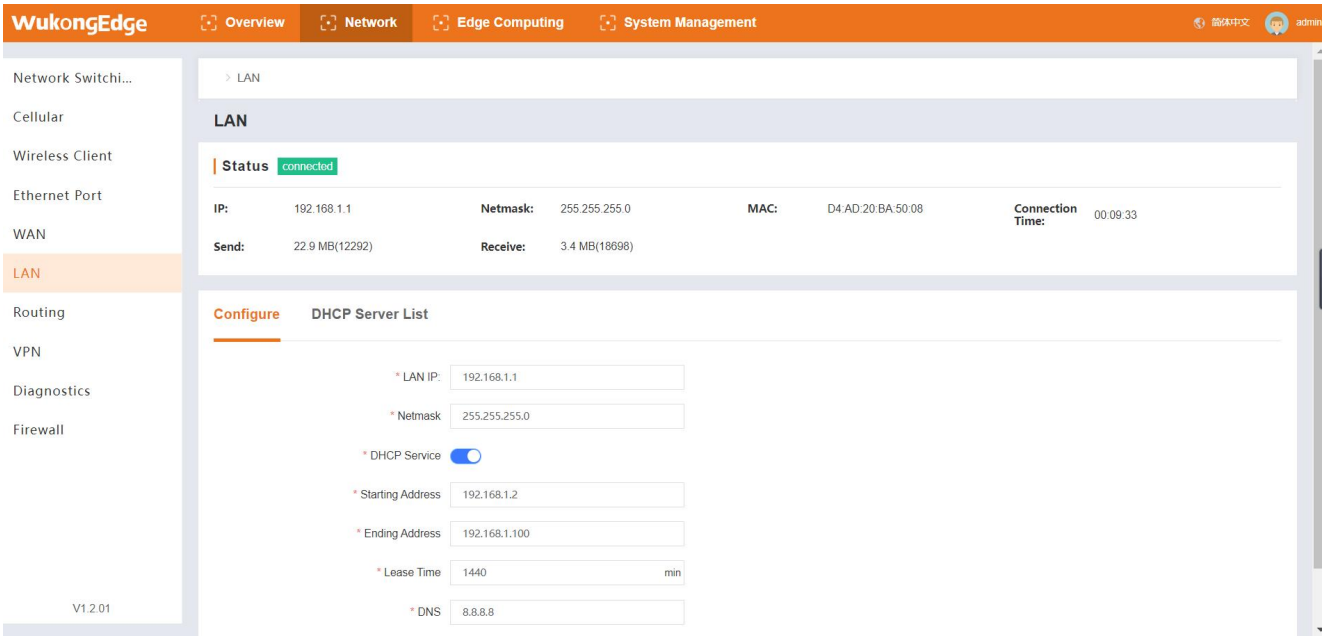


Parameter Description:

Name	Parametric description	Default parameters
Network mode	DHCP (Dynamic IP): WAN as DHCP client, using DHCP to obtain IP address and subnet mask information Static IP: Manually configure information such as IP addresses and subnet masks for Ethernet interfaces	DHCP
Static address	In Static IP mode, manually configure the IP address of the device for network identification of the device	192.168.0.7
Subnet mask	WAN subnet range in Static IP mode	255.255.255.0
Gateway	WAN gateway address in Static IP mode	192.168.0.1
DNS acquisition method	Automatic configuration: automatically obtain DNS resolution server address from public network Manual configuration: Manually set DNS server address for local area network communication	manual configuration
DNS1	DNS server IP can be set	119.29.29.29
DNS2	DNS server IP can be set	8.8.8.8
MTU	Maximum transmission unit, in bytes, range 128~1500	1500

4.2.4.3. LAN port management:

LAN port management covers three parts: status display, parameter configuration and DHCP server. Status display presents real-time status; parameter configuration can set relevant parameters as needed;DHCP server allocates IP for lower end devices and displays them in a list, and can also match fixed IP for fixed MAC address devices through static address allocation. All LAN port configurations are effective immediately after application.



Parameter Description:

Name	Parametric description	Default parameters
LAN IP	LAN IP address, which can be used as gateway of LAN port to access local area network formed by client	192.168.1.1
Subnet mask	LAN subnet range	255.255.255.0
DHCP service	The function of assigning addresses to connected clients through the LAN port is enabled by default and can be disabled.	open
Initial address	Sets the starting IP address assigned to the client device in the address pool	192.168.1.2
End address	Sets the end IP address assigned to the client device in the address pool	192.168.1.100
Period of validity	Set the validity period of the assigned IP address. DHCP server will reclaim the IP address assigned to the client and reallocate the IP address after the expiration date. Cannot be empty.	1440min
DNS server address	LAN port client domain name resolution server address, changed to gateway, default to WAN port proxy DNS	8.8.8.8

4.2.5.Route

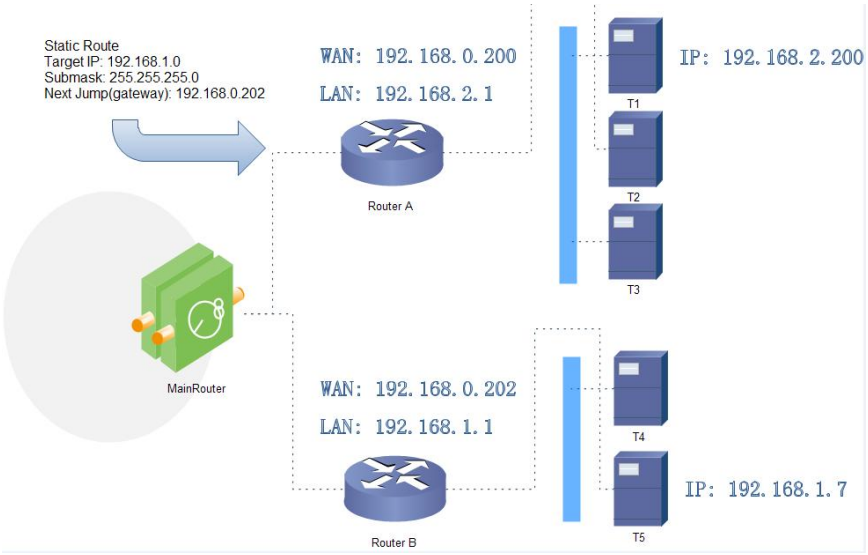
Static routing is a key feature of routing function. It is easy to operate. Users do not need complex professional knowledge. They only need to fill in basic information such as destination network address, subnet mask and next hop address on the built-in web page of the device

according to their own network requirements, and then they can easily complete configuration and put into use.

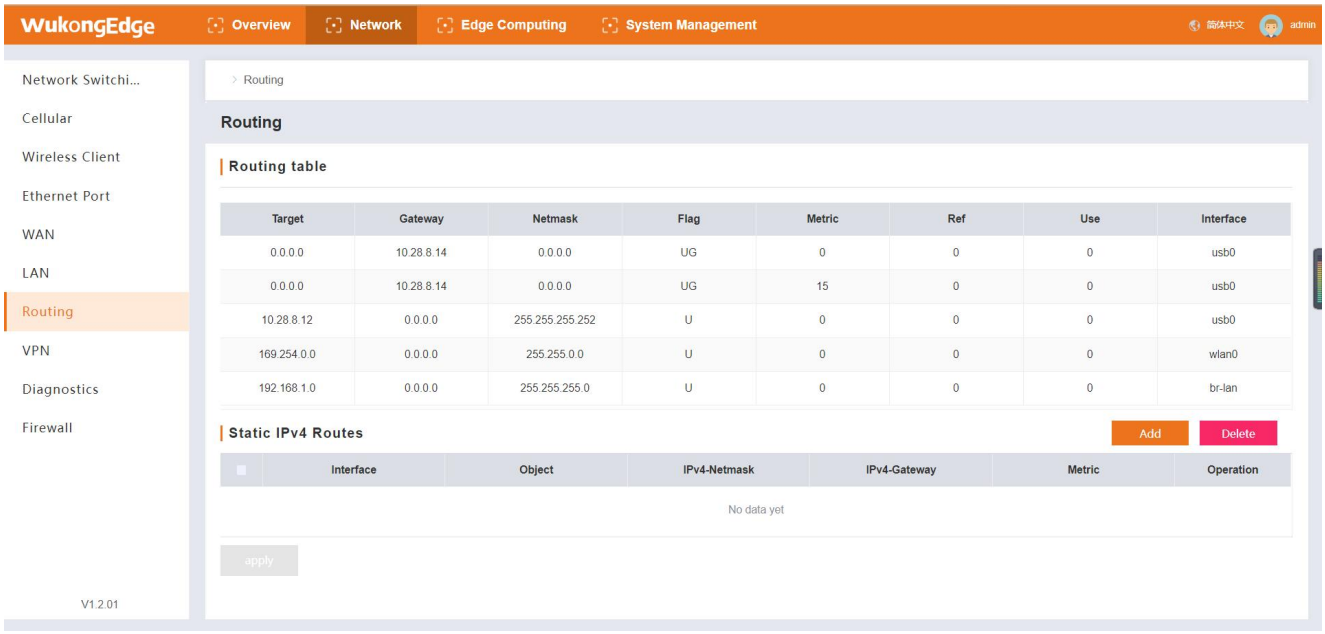
Parameter Description:

Name	Parametric description	Default parameters
port	The interface used by the destination network for data to arrive	empty
target network	Destination IP address to reach	empty
IPv4 subnet mask	Subnet mask of destination address to be reached	empty
IPv4 gateway	The IP address of the next router through which data needs to pass before reaching its destination	empty
hop count	That is, priority, the smaller the value, the higher the priority, ranging from 0 to 255	0

A static route can be illustrated by the following example:

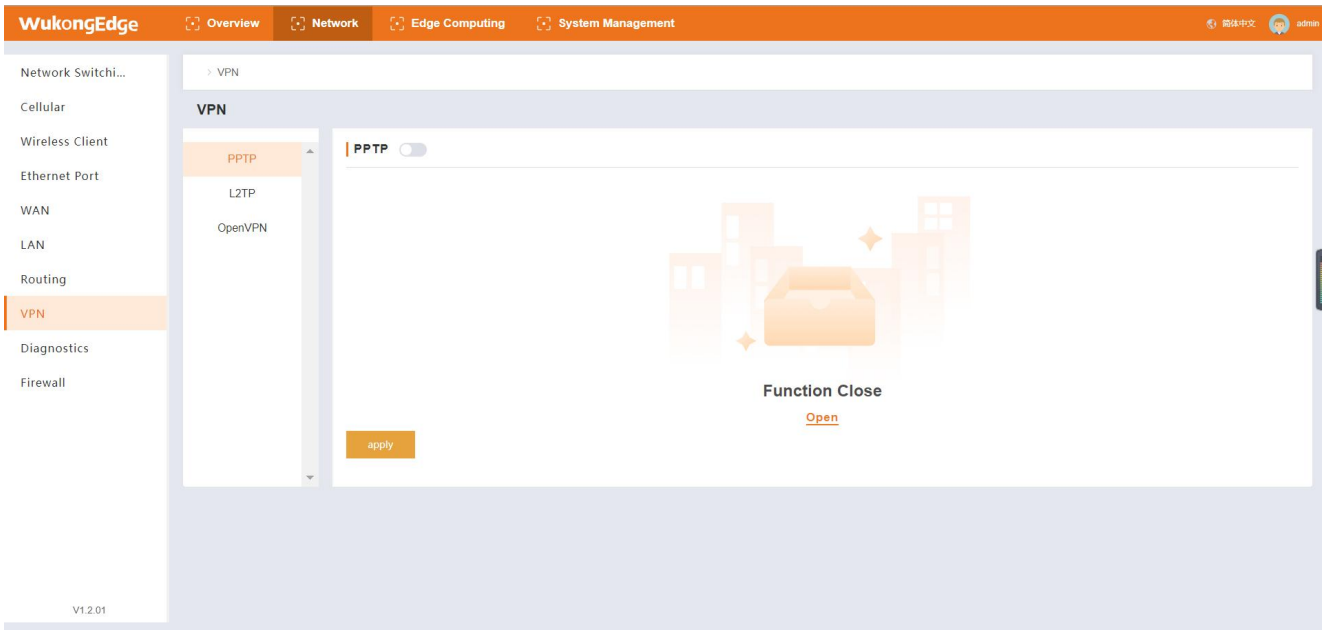


Routers A and B both have WAN ports connected to the 192.168.0.0 network, router A has LAN ports on the 192.168.2.0 subnet, and router B has LAN ports on the 192.168.1.0 subnet. Now, if we want to make a route on router A that allows us to access the 192.168.1.x address, it will automatically be transferred to router B. Because it is to be forwarded to all 192.168.1.x segments, when adding routes, the subnet mask is set to 255.255.255.0. If the destination IP is set to a fixed IP address, such as 192.168.1.7, the subnet mask is set to 255.255.255.255.



4.2.6.VPN

VPN functions play a key role in networking scenarios, supporting PPTP, L2TP and OpenVPN. Each protocol has its own advantages and meets the diverse networking needs of different users for network security, stability and compatibility.



Operation steps:

- Enter the built-in web page, find the "Network->VPN" interface, and select the corresponding VPN Connections mode.
- For example, select PPTP, then select PPTP, enter PPTP parameter interface, first align to enable.

- After enabling, the status information bar and parameter configuration will appear. Fill in the corresponding parameters to be configured, and then click the "Apply" button.
- After application, it will take effect immediately. Check the connection status in the status bar and display the corresponding connection information to prove that the VPN connection has been successful.

4.2.6.1.PPTP Client

PPTP as a point-to-point tunneling protocol, with a TCP (port 1723) connection to maintain the tunnel, using generic routing encapsulation (GRE) technology to encapsulate data into PPP data frames, through the tunnel transmission, and can encapsulate PPP frame payload data encryption or compression, like MPPE with MS-CHAP V2 authentication generated encryption key encryption PPP frame.

Before use, you need to obtain the VPN server address, username, password and encryption method, etc. After enabling the PPTP client function, accurately fill in these parameters. After the VPN is in effect, you can view its status in the status information.

Parameter Description:

name	parametric description	default parameters
server address	Enter the VPN server IP or domain name to connect to	192.168.0.2
port	Automatic, WAN and LTE 4G are available depending on the networking mode.	voluntarily
username/password	Get this information from the VPN server, limit it to 1 - 50 characters	username/password
terminal net mask	If the NAT function is enabled, the subnet inter working function under VPN can be directly realized.	192.168.55.0/255.255.25.0
NAT	Replace internal addresses with public addresses when content needs to communicate externally. If this item is turned off, the network address translation function cannot be realized.	close
MPPE encryption	Data between the parties can be encrypted and decrypted to prevent unauthorized access and alteration.	close
MTU	Maximum transmission unit, in bytes, range	1500

	128~1500, same as VPN server	
additional configuration	PPPD parameters, magic words, etc. are added. By default, no operation is required. 0~500 characters	empty
Static Tunnel IP Address	Server side automatically assigns IP, you can fill in static tunnel IP here	close
Ping to check	Real-time VPN online detection and reconnection mechanism. Ensure stable connection by means of cyclic ping custom IP. Not enabled by default	close

4.2.6.2. L2TP Client

L2TP is a Layer 2 tunneling protocol, similar to PPTP. In the M300 device, it supports multi-element authentication methods such as tunnel password authentication and CHAP, and the encryption method adopts pre-shared key encryption of L2TP OVER IPSec. Users only need to enter the "network"-"VPN"-"L2TP" path, fill in the corresponding settings, wait for VPN to take effect, you can view the VPN status in the status information section.

Parameter Description:

name	parametric description	default parameters
server address	Enter the VPN server IP or domain name to connect to	192.168.0.2
port	Automatic, WAN and LTE 4G are available depending on the networking mode.	voluntarily
username/password	Get this information from the VPN server, limit it to 1 - 50 characters	username/password
Tunnel name/password	Fill in correctly after obtaining from VPN server	empty
terminal net mask	If the NAT function is enabled, the subnet interworking function under VPN can be directly realized.	192.168.55.0/255.255.25.0
NAT	Replace internal addresses with public addresses when content needs to communicate externally. If this item is turned off, the network address translation function cannot be realized.	close
MTU	Maximum transmission unit, in bytes, range 128~1500, same as VPN server	1500
additional	PPPD parameters, magic words, etc. are added.	empty

configuration	By default, no operation is required. 0~500 characters	
Static Tunnel IP Address	Server side automatically assigns IP, you can fill in static tunnel IP here	close
Ping to check	Real-time VPN online detection and reconnection mechanism. Ensure stable connection by means of cyclic ping custom IP. Not enabled by default	close

4.2.6.3. OpenVPN

OpenVPN is an application-layer VPN solution based on OpenSSL library, which innovatively integrates virtual network card and SSL protocol. This unique design not only easily achieves networking goals, but also greatly improves connection security through the encryption features of SSL protocol, and the operation process is extremely simple, easy for users to use, and highly practical.

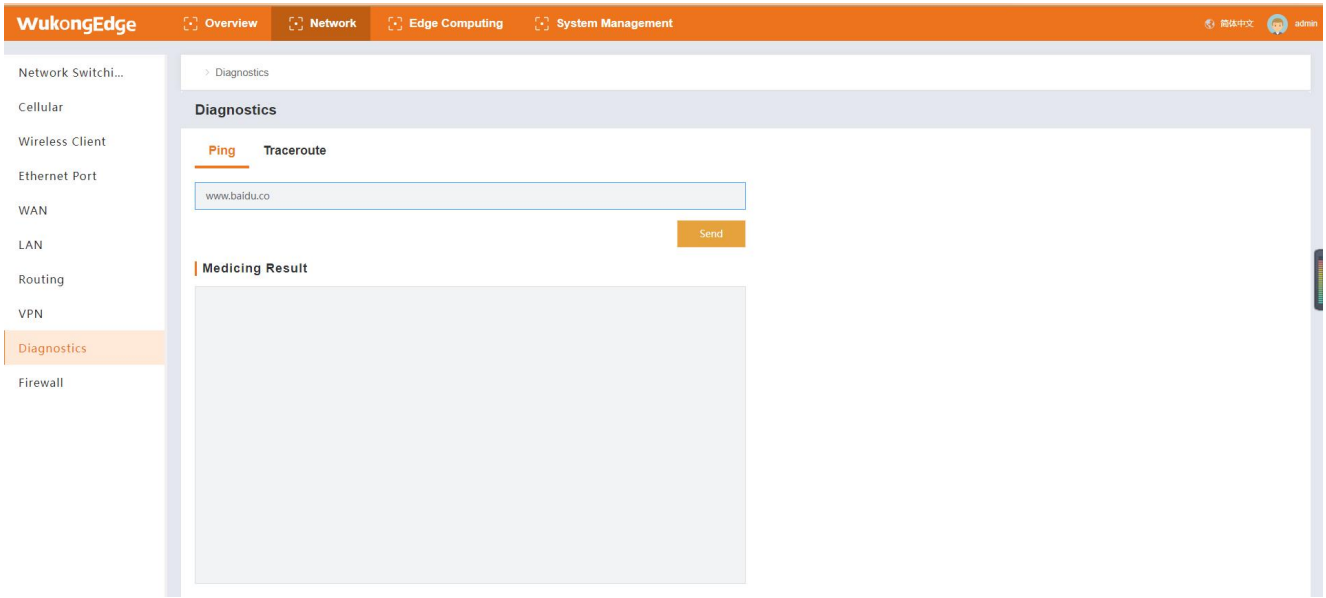
Parameter Description:

name	parametric description	default parameters
channel protocol	TCP，UDP	UDP
Remote host IP address	OpenVPN Server IP/Domain Name	192.168.1.102
port	OpenVPN server listening port	1194
authentication type	NONE, username/password, pre-shared key, SSL/TLS, SSL/TLS+ username/password	
topology	Subnet, Point-to-Point, Net30	subnet
port	Network port, 4G, automatic according to different networking methods	voluntarily
redirect gateway	PPPD parameters, magic words, etc. are added. By default, no operation is required. 0~500 characters	empty
NTA	This function is enabled by default. Replace internal addresses with public addresses when content needs to communicate externally. If this item is turned off, the network address translation function cannot be realized.	open
Keepalive	On by default. You need to set the detection interval and timeout.	open
LZO	Enable or disable data transfer using LZO compression	self-adaption

encryption algorithm	None/Blowfish-128/DES-EDE/DES-EDE3/AES-128/AES-192/AES-256	Blowfish-128
Hash algorithm	None/SHA1/SHA256/SHA512/MD5	SHA1
TLS Method	tls-auth/tls-crypt/OFF	OFF

4.2.7.Network diagnosis

Network diagnostics include Ping tools and route resolution tools. The Ping tool on the router side allows you to ping a specific address directly to determine network connectivity and latency. Traceroute, as a routing analysis tool, can obtain the routing path through which data transmission passes when accessing the address, and help to troubleshoot network faults.



4.2.8.Firewall

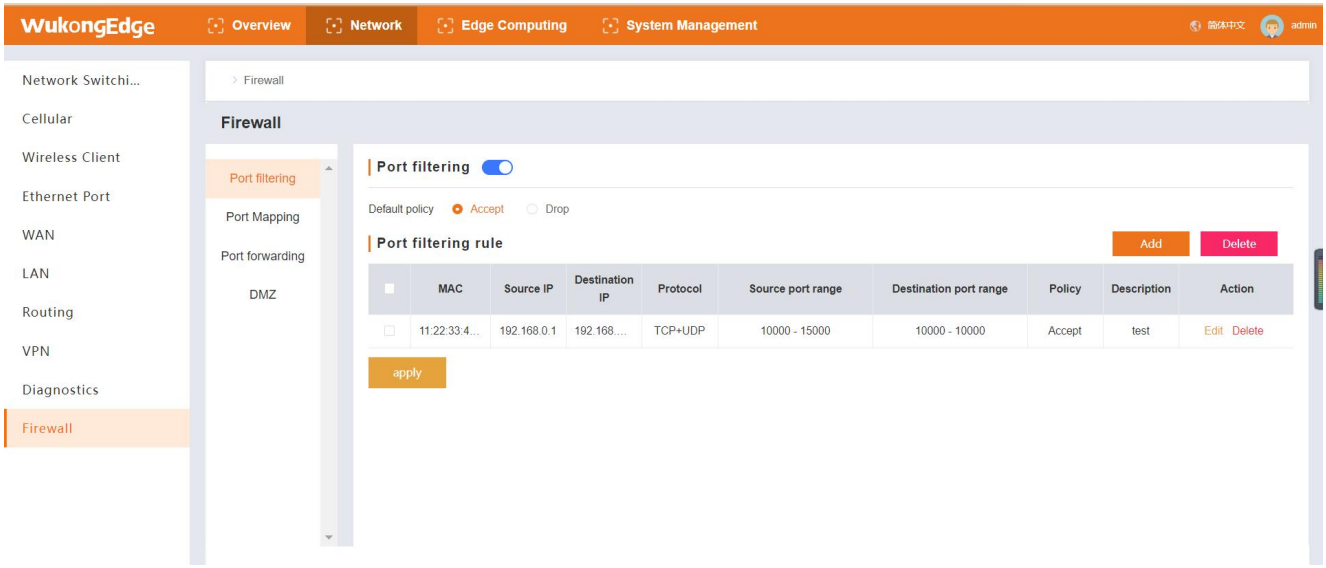
Firewall is the key line of defense to ensure network security. It skillfully integrates various security management and screening tools to build a relatively isolated protective barrier between the intranet and the extranet of the gateway, thus effectively protecting the data security in the gateway. It has the following main tools:

Port filtering:fine control can be carried out on ports entering and leaving the network according to preset rules, allowing only qualified port communication to pass through, blocking illegal port access and greatly reducing the risk of network attack.

Port mapping: By mapping a specific port of the intranet to a designated port of the external network IP, the external network users can access the intranet services, and the real IP of the intranet is hidden to enhance network security.

Port forwarding: It can forward the network traffic of a specific port to other specified IP addresses and ports, flexibly adjust the network data flow direction, and meet the needs of different service scenarios.

DMZ (Quarantine Zone): Establish a special zone between the intranet and the extranet to place servers that need to provide external services, both to ensure external access to these services and to restrict access to the internal network, effectively isolating potential threats.



Operation steps:

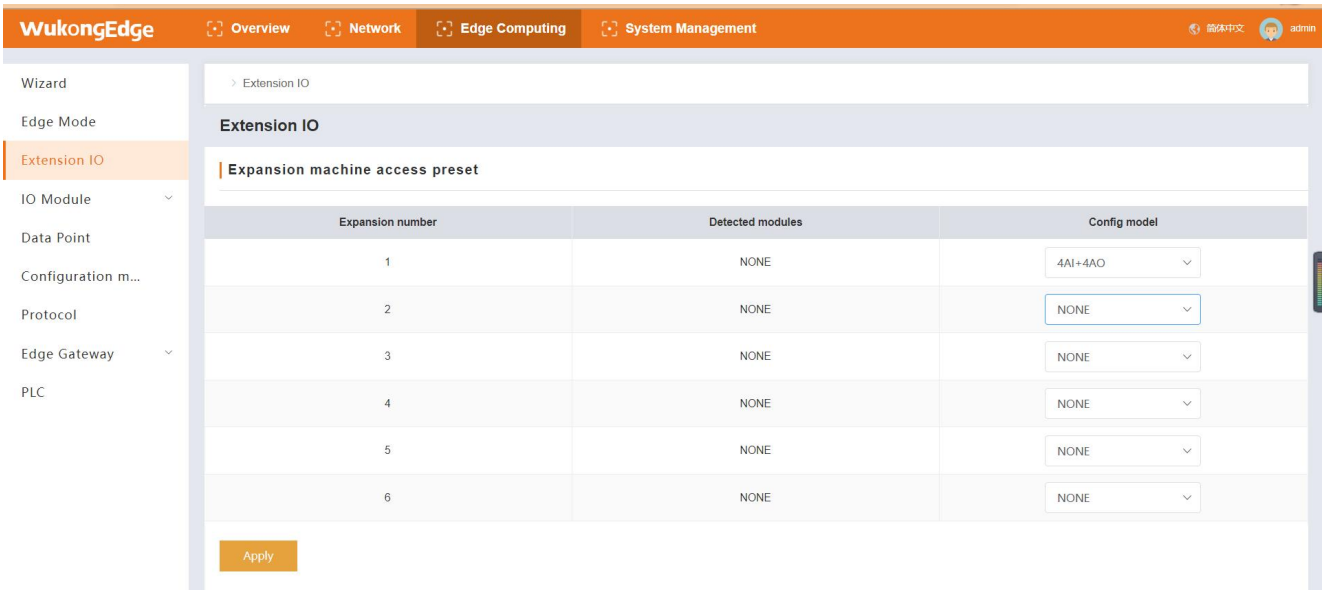
- Enter the built-in web page, find the "Network-> Firewall" interface, and select the firewall option to be configured;
- For example, configure port mapping, select port mapping, enter the interface, first enable, pop up the rule adding interface.
- In the parameter configuration interface, click Add to add mapping rules;
- After adding parameters, click OK to complete adding a rule, and add multiple rules in the same way;
- Once all rules are set, click the Apply button and the application takes effect immediately.

4.3.IO Management

WukongEdge application is highly integrated in design, and its internal IO expansion management function is deeply integrated, which can be flexibly applied to various industrial scenarios as distributed IO. At the communication protocol level, the private communication protocol is integrated, which greatly simplifies the communication process. When hardware is connected, the IO access mode is extremely simple. Just complete the hardware connection, and the built-in web page of WukongEdge application will quickly and automatically identify the

connected personal expansion machine without complicated manual intervention.

In addition, WukongEdge app also carefully set up a sequential error correction mechanism. Users can configure the expansion machine access sequence in advance in the system. When the actual access expansion machine sequence is inconsistent with the set sequence, the system will immediately trigger error processing, accurately locate errors and timely feedback, ensuring the accuracy and stability of system construction, providing a simpler and more reliable solution for industrial automation deployment.



After the expansion machine is connected, the corresponding IO function management can also be configured in the built-in web page, mainly including the following functions:

- **IO status management**: Through IO status interface, you can view current IO status and output debugging of DO and AO;
- **DI function:**including DI mode (digital quantity detection and counting function switching), filtering time and other configurations;
- **AO function:**output mode switching (current mode and voltage mode switching);
- **DO function:**soft restart hold function;
- **Timing function:**Specify DO timing output.

4.4.Edge computing

In the industrial field, edge computing plays an irreplaceable key role, covering four core functions: data acquisition, real-time calculation processing, result reporting and visual display.

In terms of data acquisition, edge computing equipment can quickly and accurately collect massive data from various sensors and production equipment on the industrial production site, whether it is temperature, pressure, vibration and other operating parameters, or product quality

data on the production line.

Real-time calculation and processing link, relying on the local powerful computing power, the collected data can be analyzed instantly. For example, real-time monitoring and analysis of equipment operation data is carried out to predict potential equipment failures in advance, to achieve preventive maintenance, to ensure the continuity and stability of production, and to greatly reduce downtime losses caused by equipment failures.

The processed key data will be reported to the industrial cloud platform or enterprise management center system in time to provide decision-making basis for the management. Finally, through the intuitive visual interface, key information such as production progress, equipment status, quality indicators, etc. is clear at a glance, which is convenient for managers to grasp production dynamics in real time, make scientific decisions quickly, optimize production processes, and improve overall production efficiency and quality.

The WukongEdge application integrates these powerful edge computing functions. With its highly integrated and efficient processing capabilities, it greatly meets the current industrial data processing requirements and provides solid and powerful technical support for the digital transformation of industrial enterprises.

4.4.1.Serial port management

Edge computing relies on hardware interfaces to achieve data acquisition, mainly network ports, serial ports and IO interfaces. Network ports and IO have been introduced in the above chapter. Hardware interfaces in this chapter mainly introduce serial ports. Parameter configuration operations are as follows:

1、Enter the built-in web page, select the serial port used in the interface of "Edge Computing-> Edge Gateway-> Serial Port Management";

2、After selecting serial port configuration interface to configure serial port enable, set baud rate, data bit, stop bit and check bit;

3、Once configured, click Apply and restart the device to take effect.

When the hardware device is connected to the serial port screen, the protocol interaction between the screen and the hardware device is often required to obtain the data in the data point table through the serial port. At this time, the serial port will be used as the uplink communication interface. WukongEdge also reserves a string of "serial port function" options at the exit end. Users can freely switch the communication direction of the serial port to meet the data transmission requirements.

Uplink communication interface:mainly used in combination with protocol conversion

function, providing serial port channel for northbound protocol acquisition;

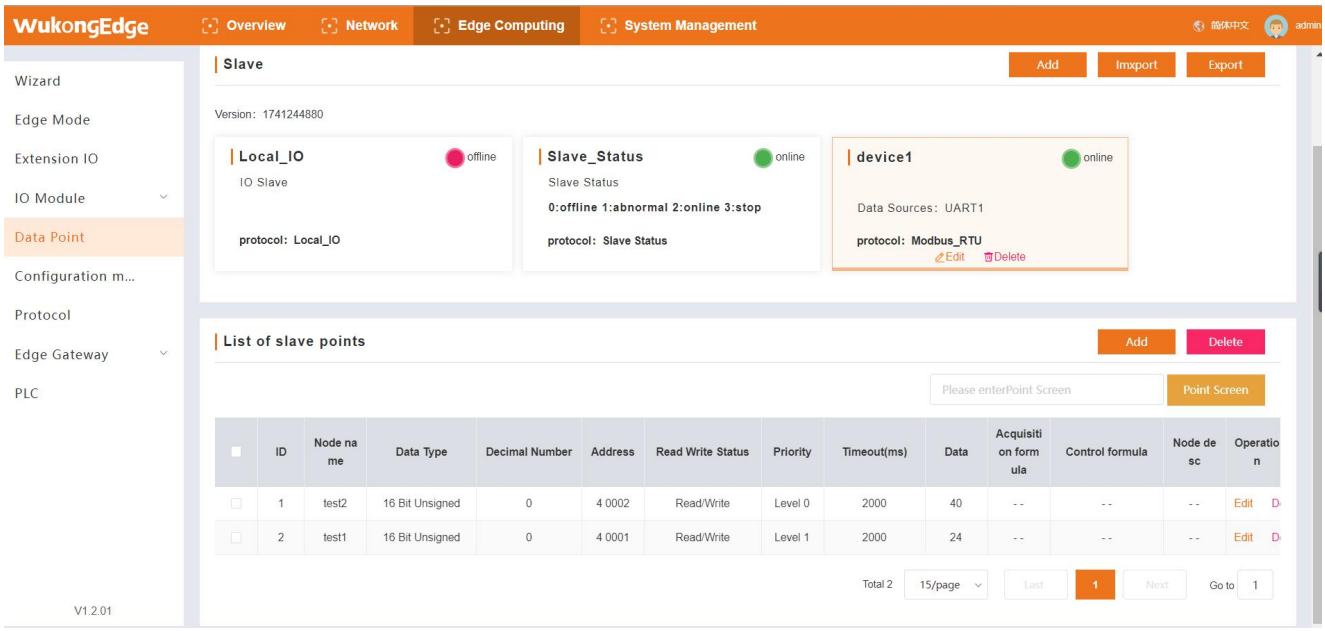
Downward edge acquisition:mainly used in combination with edge acquisition function, providing serial port channel for southward data acquisition.

4.4.2.Data point table

As the data cornerstone of gateway, data point table occupies the core position in the whole data acquisition and transmission system. It is like a detailed information network, and each data point is a key node of this network. The number of data points directly determines the breadth and depth of gateway data collection. The more dense the points are, the more massive the data can be captured by the gateway, which provides rich raw materials for subsequent analysis and processing.

As the demand for data access increases, the performance of the gateway increases significantly. A large amount of data not only enriches the information reserve of the gateway, but also enables the gateway to have a richer judgment basis when analyzing the data. At the same time, the gateway can make more accurate judgments in terms of equipment status monitoring, production process control or abnormal situation warning, so as to ensure the efficient and stable operation of the entire industrial system.

WukongEdge application integrates point table system, which can flexibly adjust the number of point data according to different hardware adaptation. At the same time, the configuration interface is simple, and it adapts to many acquisition protocols, which is suitable for more data acquisition scenarios.



4.4.2.1.Slave and Point

As a key part of data acquisition, point table system includes two important components: slave and point. The slave represents the collected equipment, such as various production equipment, sensors, etc., while the point represents the specific data in the collected equipment, such as the temperature and speed of the equipment. Detailed information is configured in the slave and point, which is like accurate navigation, helping the gateway to accurately obtain data from the collected equipment through a fixed interface, providing a solid data foundation for subsequent data analysis and processing. The slaves of point table system are divided into fixed slaves and configurable slaves.

The point data obtained by the fixed slave is mainly the parameters of the equipment itself, so it does not need to be configured. There are mainly the following types:

System slave:mainly obtains system parameters of gateway itself, and stores and displays each parameter as a point;

IO slave: When the gateway is connected to the IO expansion machine, the point table system will automatically match the IO point information and realize data acquisition.

Status Slave: Each time a configurable slave is added, an online status point will be automatically generated under the slave.

The slave can be configured to represent the acquired equipment, so the user needs to manually add, configure the hardware interface corresponding to the acquired equipment, collect relevant information such as protocols, and add corresponding point information under the slave. Configurable slave supports multi-protocol selection, with different parameters for each protocol. Specific parameters are described as follows:

name	parametric description	default parameters
Slave Name	1-64 byte, used as unique identification of slave, non-repeatable, supporting Chinese	device1
slave description	Support 1-64 bytes, including alphanumeric, Chinese, underscore and connector	empty
acquisition protocol	Protocols used for slave point active polling acquisition, Modbus and multiple PLC protocols supported	virtual slave
polling interval	The waiting time before each point acquisition command is sent, ranging from 0 to 65535ms	0ms
combined	Several consecutive address points in a single slave are	open

acquisition	combined into one command for acquisition, and a maximum of 32 commands are used for acquisition.	
slave switch	When it is closed, all points under the slave will stop active rotation training and data updating.	open
slave address	Slave code of lower equipment, partial protocol settings	1
Serial serial number	Point acquisition command sends serial serial port serial	1
IP	When collecting the network port, M300 is used as a Client, so it needs to fill in the target IP and some protocol settings.	192.168.1.1
port	When collecting network port, M300 is used as Client, so it needs to fill in target port and some protocol settings.	102

Slave acquisition protocol list:

acquisition protocol	protocol description	range of application
Virtual-point (Virtual Slave)	Calculation points independent of acquisition points	Virtual points can also be called calculation points, which are new data obtained after calculation of multiple collection points in the point table system. Virtual points can store up to 500.
Modbus RTU	Universal Serial Bus Protocol	485/232 serial communication bus acquisition Delta, ABB, Hollysys, Modicon and other models PLC applicable
Modbus TCP	Universal Network Bus Protocol	Suitable for network interface and other network protocol bus acquisition
DVP_RTU	Delta PLC Protocol	Delta DVR series PLC acquisition
FATEK_COM	FATEK PLC Protocol	FATEK Fatek series (serial port)
FX protocol	Mitsubishi PLC Protocol	FX2N（1N）/ FX1S /FX3U
FX5U	Mitsubishi PLC Protocol (MC3C/3E)	Mitsubishi FX5U Series (Net and Serial)
FX3U_ADP_TCP	Mitsubishi PLC Protocol (FX3U_MC_ADP)	FX3U-ENET-ADP
Q_TCP	Mitsubishi PLC Protocol	Mitsubishi Q Series PLC

	(MC_TCP)	
S7_200 Smart	Siemens PLC protocol	S7-200 Smart
S7_200_PPI	Siemens PLC protocol	S7-200
S7_1200	Siemens PLC protocol	S7-1200
S7_1500	Siemens PLC protocol	S7-1500
S7_300	Siemens PLC protocol	S7 - 300 (net port)
S7_400	Siemens PLC protocol	S7-400 (net port)
FINS_TCP	Omron	CP Series
FINS_COM	Omron	CP Series
DL/T 645-2007	Communication protocol for multifunctional electric energy meter	Various types of meters
IEC104	electric power protocol	power data transmission
Bacnet IP	Building Automation Control Network Data Communication Protocol	Building sensors

After the slave is added, add the corresponding point information under the corresponding slave. The point parameters are described as follows:

name	parametric description	default parameters
Point name	1-64 byte, unique identifier of a point, not repeated with any other point	empty
Point Description	1-64 bytes, supporting characters, numbers and Chinese	empty
register	The storage type and storage address of the point	
data type	Selection of Data Type for Point Collection	
Number of points	Add the total number of consecutive address points at a time under the same slave, add in batches	1
number of decimal places	The number of decimal data displayed when the calculated result of collected data is decimal	0
read-write state	Read/write status of points. Different point types support different read/write types.	read and write

:: Priorities	When polling all points, the high-priority points shall be preferentially collected according to periodic polling, and the real-time collection of high-priority points shall be ensured.	empty
acquisition formula	Point calculation formula, the collected data is stored and provided to other functions after calculation according to the formula inside the equipment.	empty
control formula	When writing to this point, the result will be written to the terminal device after calculation by the control formula	empty
timeout	In the process of point polling acquisition, the longest waiting time for reply after issuing the command. The acquisition will be automatically abandoned after timeout, and the historical data will not be updated and the next acquisition command will be executed. Range: 10~3000ms	2000ms
unit	Non-mandatory parameters, set as needed	empty

Note: Priority functions are under development.

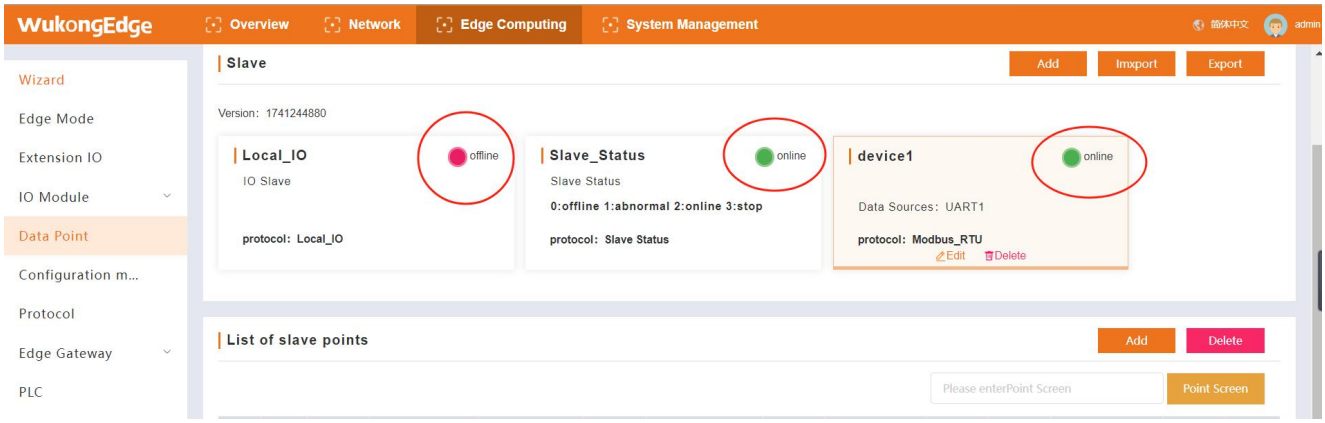
4.4.2.2.Slave status

The status display function of data points allows users to intuitively view the online status of slaves from the built-in web page. The slave status is divided into online, offline and abnormal.

On-line: All data collection of slave internal points is successful, and the corresponding slave status point value in slave status is 2;

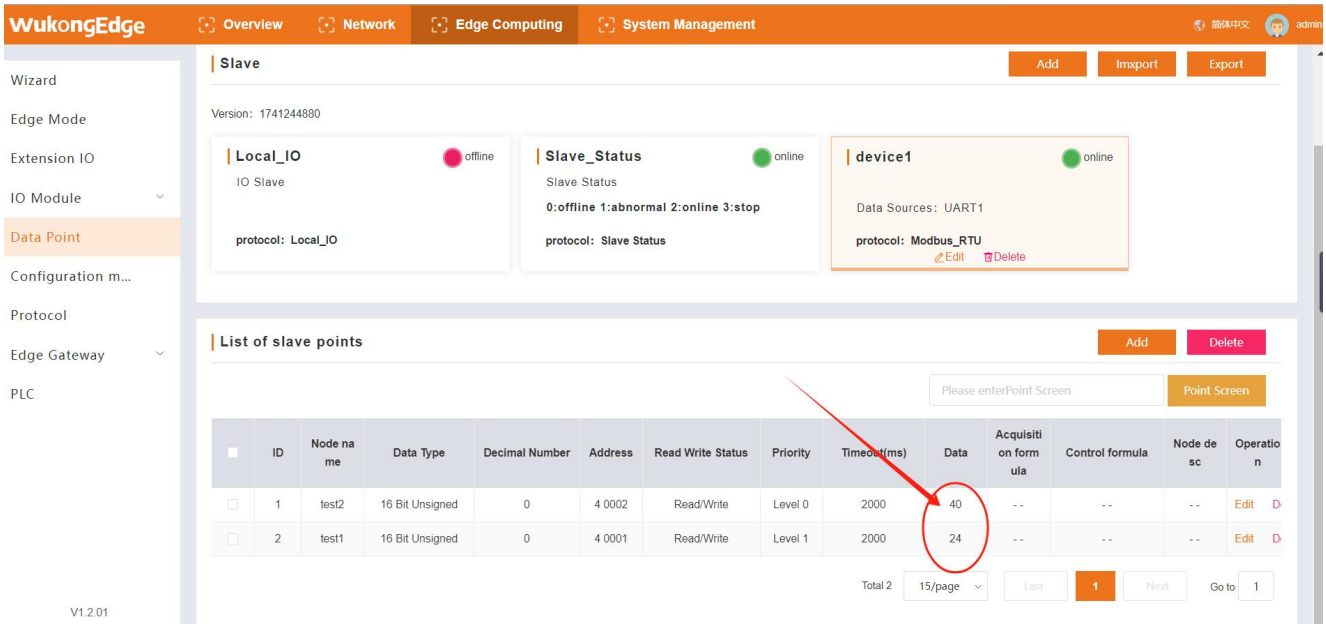
Off-line: all data acquisition failed at slave internal points; status slave internal corresponding slave status point value is 0;

Abnormality: partial data acquisition of slave internal points is successful; status slave internal corresponding slave status point value is 1.



4.4.2.3.Point location data

After the slave point in the data point table obtains the data, it can be displayed on the built-in web page, and the data is continuously updated along with the collection, so that it is convenient for users to directly observe the data in the device.



4.4.2.4.Import and export

In Wukong Edge's point system, the point information of the data point table needs to be added manually. When only part of the information of some points is different, editing with Excel and other tabular tools can greatly improve efficiency. For this reason, WukongEdge's point system integrates point export and import functions. Users can export the point template first, quickly edit the point information in the familiar table environment, and then import the edited file into the equipment. In this way, the point addition work can be completed more efficiently and conveniently, greatly saving labor and time costs.

Operation steps:

1、When using for the first time, it is recommended to add a slave and point to the equipment before exporting. The corresponding addition example will be displayed in the file;

2、Find the "Edge Calculation-Data Point" interface, find the "Export" button, click to download the point table template file;

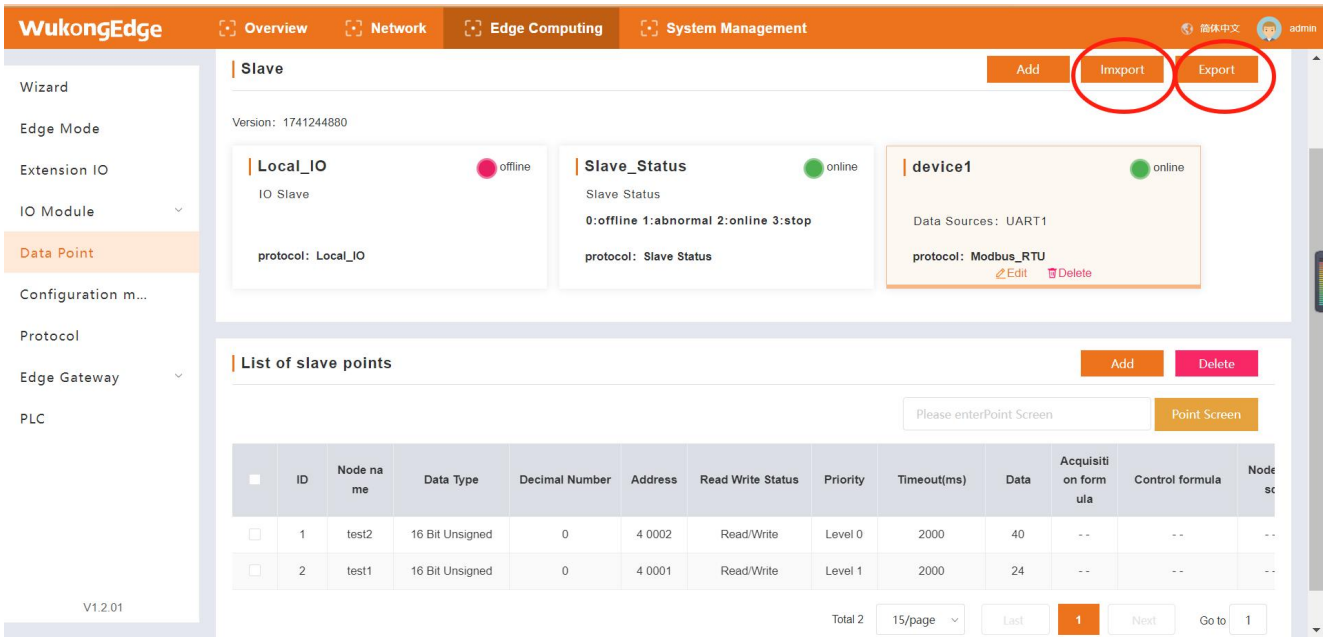
3、In the downloaded CSV file, fill in the relevant parameters of the slave machine and the point according to the header, and save the file after filling in;

4、Find the "Edge Calculation-Data Point" interface, find the "Import" button, click and select the saved file to upload;

5、After the equipment identifies the file, it will automatically pop up the corresponding slave

and point, and prompt to restart the equipment;

6、The device restarts and performs data acquisition functions after startup.



4.4.3.Edge acquisition

The edge acquisition function is mainly realized by hardware gateway equipment. When actively collecting sensor data, the gateway device first needs to input the data information of the collected device, that is, the addition of the data point table, and then the gateway can automatically obtain data from the collected device according to this information, and store the obtained data.

The edge acquisition process involves configuration of the point table, configuration of the acquisition interface. The active collection operation steps are as follows:

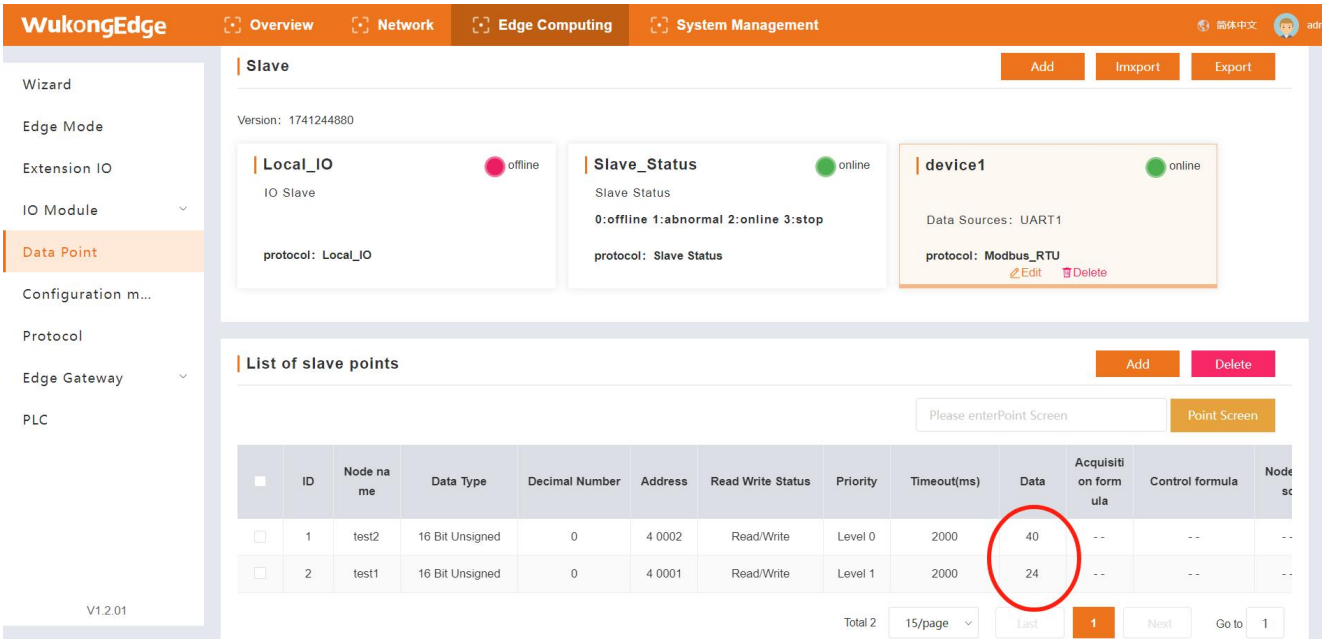
1、Enter the built-in web page, add slaves in the "Edge Calculation-> Data Points" interface, and select the corresponding communication interface;

2、Add the corresponding point information under the added slave machine to complete the addition of all points;

3、After configuration, restart the device;

4、After the equipment restarts, the equipment will actively send data acquisition commands from the corresponding interface to the acquired equipment, receive the reply content, and analyze the data;

5、In the point table system, the most recently acquired data for each point will be displayed.



4.4.4.Edge computing

After the data acquisition is completed, with the chip's high-speed computing ability, preliminary data processing is carried out, which significantly speeds up the data processing speed. Moreover, the data is processed locally, which reduces the exposure risk of data during network transmission and effectively guarantees data security. In addition, a large amount of data is initially processed locally, reducing the amount of data uploaded to the server, thereby reducing the load pressure on the server and making the entire system run more efficiently and stably.

WukongEdge integrates two ways of data single-point calculation and data multi-point calculation, both of which are realized through calculation formulas, and supports five operations: addition, subtraction, multiplication and division and (). The data calculation is to configure each point separately directly when adding points to the point table.

- **Single-point calculation**: The single-point calculation object is the collection point, and the data is obtained through active collection. When adding acquisition points, fill in the corresponding formula in the point acquisition calculation and control calculation parameters, pull only the current point data in the single point calculation formula, and fill the data calculated according to the formula into the storage position of the point.

Parameter	Function	Formula Style	Parameter specification
acquisition formula	calculating the collected data to obtain a result, storing the result and waiting for reporting to the server	=(%s+10)/2	%s represents the point data before the point
control formula	Receive the control data sent by the server, calculate the result and send	=(%s*2)-10	%s represents the point data before the point

	it to the acquired equipment to realize parameter control.		

- **Multi-point calculation**: You need to add a virtual slave, and add a virtual point under the virtual slave. When adding, fill in the corresponding formula in the collection formula. In the multi-point calculation formula, the data of multiple collection points will be pulled for calculation, and the calculated result will be filled into the virtual point.

Parameter	Function	Formula Style	Parameter specification
acquisition formula	calculating the collected data to obtain a result and storing the result to wait for reporting to the server	=(%s+10)/%s,node0101, node0102	The first %s represents the data after acquisition at node0101 The second %s represents the data after acquisition at node0102

Virtual slaves and virtual points are added as follows:

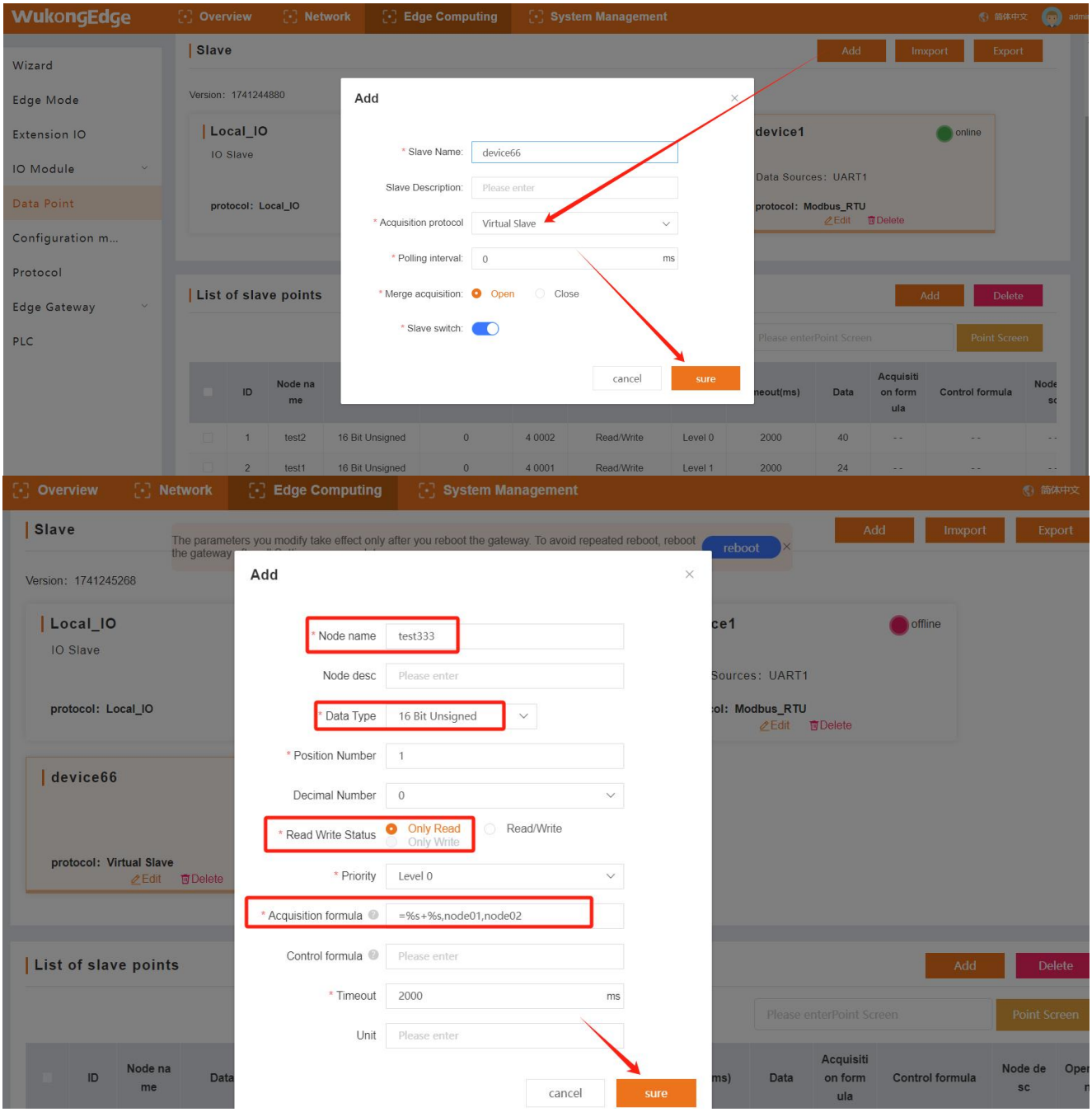
1、Enter the built-in web page, and add slave machines in the "Edge Computing-> Data Points" interface, where "Virtual Slave Machine" is selected for the acquisition protocol;

2、After adding slave machine, select virtual slave machine and add virtual point, set data type and collection formula;

3、The control formula of virtual point can be set to null, and the read-write status can be set to read-only;

4、After configuration, restart the device;

5、After the equipment is restarted, when the data acquisition of the points involved in the virtual point acquisition formula is completed, the corresponding virtual points will also display the calculated data;



4.4.5.Actively report

Escalation is a critical finishing touch for edge computing. After data collection and local calculations are completed, the resulting data results are transmitted to the server. These data processed by edge computing provide the basis for the server to carry out more complex analysis, processing and visualization. Active reporting is that after the edge calculation is completed, the system will actively encapsulate the data according to the Json format, and then report the data to the server accurately through the network. This method not only ensures the standardization of the data transmission format, but also improves the autonomy and efficiency of data transmission,

and strongly supports the deep data application of the server side.

In WukongEdge application, the active reporting function is divided into two parts: communication link and data reporting, which will be introduced separately.

4.4.5.1.Communications link

The communication link serves as a network channel for reporting data to the server, providing a variety of connection modes to meet the needs of different users. It supports TCP connection, MQTT connection, HTTP connection, users can choose the appropriate connection method according to their own business needs. In addition, in order to ensure the security of data transmission, the communication link also supports TLS/SSL encryption, and provides a variety of encryption methods for users to choose independently, further enhancing the confidentiality and integrity of data transmission. In the process of configuring the report packet, the corresponding communication link needs to be selected,so the configuration of the communication link needs to be completed first. The specific operations are as follows:

1、Enter the built-in web page, and enable the required communication link in the "Edge Computing-> Edge Gateway-> Communication Link" interface;

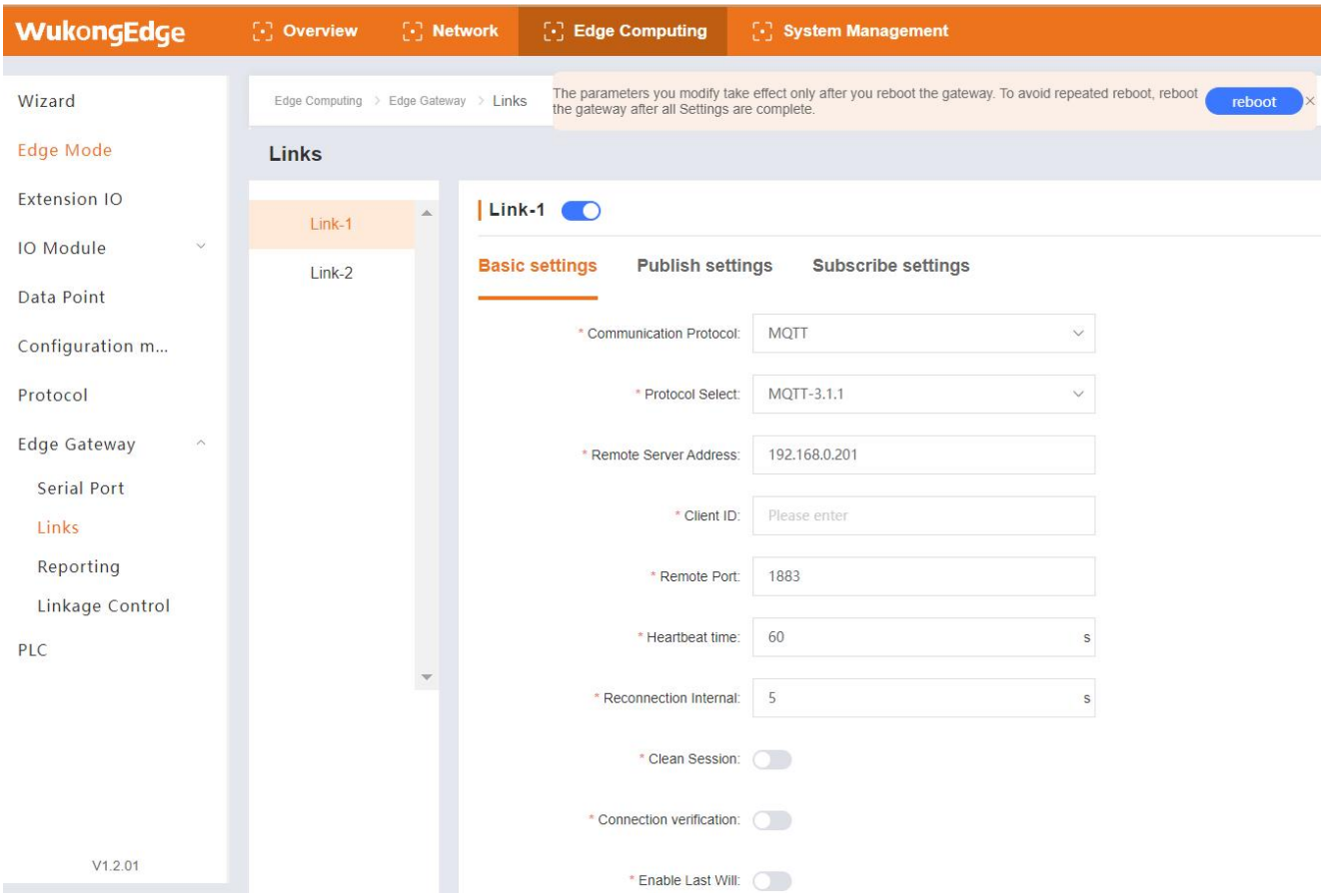
2、Configure the enabled communication link parameters. TCP,MQTT and HTTP can be selected as communication protocols.

3、Configure encryption method and upload certificate, and configure network disconnection cache enable;

4、After configuration, click the "Apply" button to save;

5、If MQTT communication is selected, configure corresponding publishing topics and subscription topics after basic parameter configuration is completed;

6、After all communication link parameters are configured, the device needs to be restarted to take effect.



4.4.5.2.Network disconnection cache

WukongEdge has a very critical feature of having a network break cache built into the communication link. In the event of a network failure, it can quickly store the data being reported properly to ensure that the data is not lost due to network disconnection. When the network returns to normal, it will automatically report the cached data to the server accurately, thus ensuring the integrity of the data in all aspects.

The network disconnection cache function stores the complete data packets reported actively instead of single data. After the network replies, the cache data is reported to the server according to the first-in-first-out principle to achieve fast and accurate reporting.

4.4.5.3.Json template

The reporting data format of active reporting is Json custom template, so before introducing active reporting, first understand the configuration method of Json template for reporting.

The active reporting data format can be configured as long as it conforms to the Json format, which is generally configured by the client according to the server requirements. However, Json template configuration needs to pay attention to the following points:

1、Json template in grouping is empty by default. You can design it yourself and meet the requirements of Json format.

2、Value in Json template is character type, which needs to be filled in data point name. When data is reported, the actual acquisition value corresponding to point name will be substituted for replacement;

3、Example: The acquisition values of node0101 and node0102 at the edge are 30 and 20 respectively; the Json template is set to {"Current":"node0101","Voltage":"node0102"}; the actual report data format is {"Current":30,"Voltage":20}.

4、System points can be reported as data points.

Identification	Implication	Example of Reporting Content
sys_ver	Product firmware version number	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_timestamp	timestamp	1706167861
sys_timestamp_ms	millisecond timestamp	1601196762389

4.4.5.4.Actively report

WukongEdge's built-in proactive reporting adopts grouped reporting mode. Users can independently select different communication links and points for different groups according to actual needs, so that they can flexibly report data to different servers respectively, and easily achieve multi-link and multi-platform data sharing.

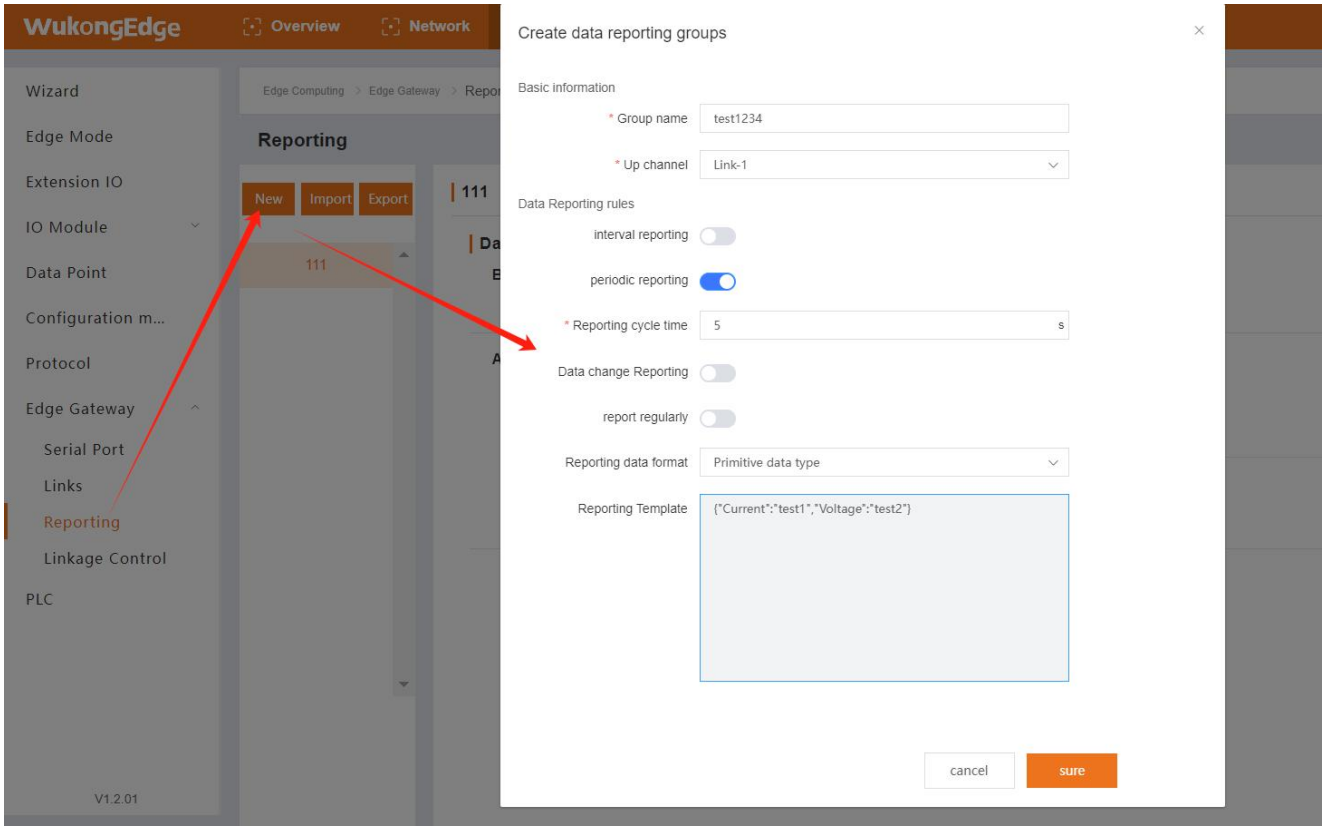
The specific operation of group active reporting is as follows:

1、Enter the built-in web page, click the "Create" button in the "Edge Computing-> Edge Gateway-> Data Reporting" interface to create a reporting group;

2、Select the reporting channel and configure parameters such as reporting Json template and reporting conditions;

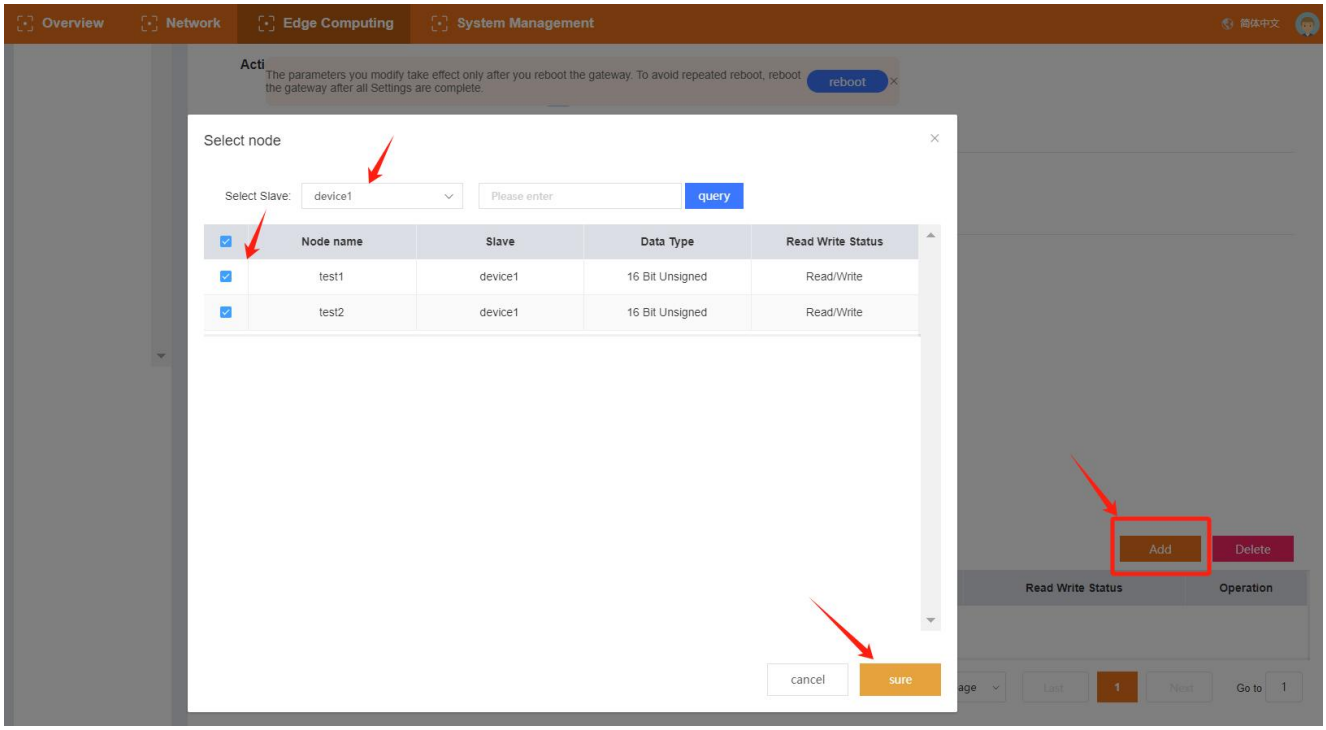
name	parametric description	default parameters
upward channel	For actively reported data network channels, you can select cloud/link 1/link 2	empty
Reporting Rules	Support four reporting conditions	empty

	(interval/cycle/change/timing reporting), support multiple choices	
Reporting data format	Original type: Point data is reported to the server according to the original type. Digit to character: if the point data is of digital type,"" will be added when reporting, and the digital format will be converted into character string format, and then reported to the platform.	empty
Submission template	Custom Json, need to comply with the Json format specification, template maximum 8K bytes.	empty
table of points	Each active reporting group is taken as an independent individual, and the points to be reported in this group are pulled from the overall data point table as the point table used by this group alone.	empty



3、After completing the group addition, find the point list in the group and click the "Add" button, and the pop-up window will pop up;

4、Select the corresponding slave machine and point, click OK (when there are many points in the slave machine, you can select the slave machine and directly search for the point name);



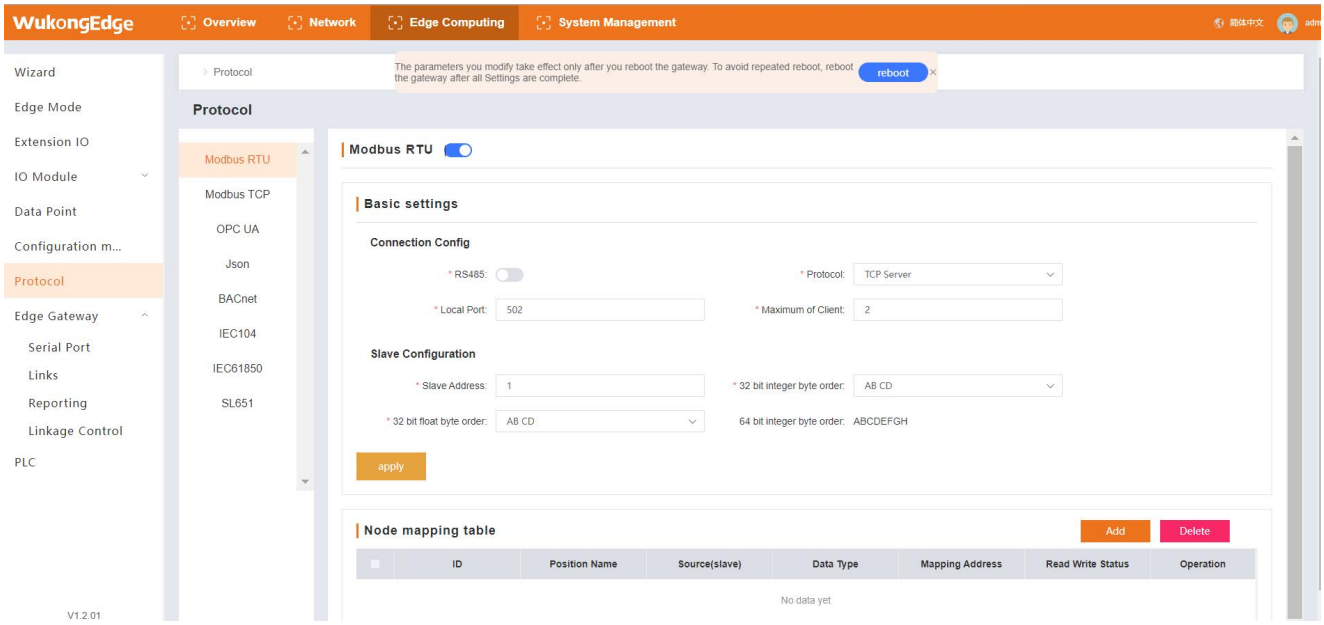
5、After the selection is completed, complete the addition of the report group, and restart the equipment to make the report group effective;

6、Wait for the device to connect to the server successfully, and then check the data report status.

4.4.6.Protocol conversion

WukongEdge's protocol conversion function constructs standardized protocol interaction channels between data and servers. Through edge computing capabilities, hardware interfaces are able to collect data for a variety of different protocols. These data will be uniformly converted into a fixed protocol under the operation of the protocol conversion function, thereby achieving smooth interaction with the server.

The protocol conversion function supports multiple protocols, including Modbus RTU, Modbus TCP, OPC UA, JSON, Bacnet, IEC104, IEC61850, SL651. The protocol conversion function allows multiple protocols to communicate in parallel at the same time, and each protocol has an independent operating mechanism without interference with each other. In addition, there is an independent data mapping table under each protocol, which ensures the stable and efficient operation of the protocol conversion process and provides a solid and reliable technical guarantee for various complex industrial scenarios and diversified data interaction requirements.



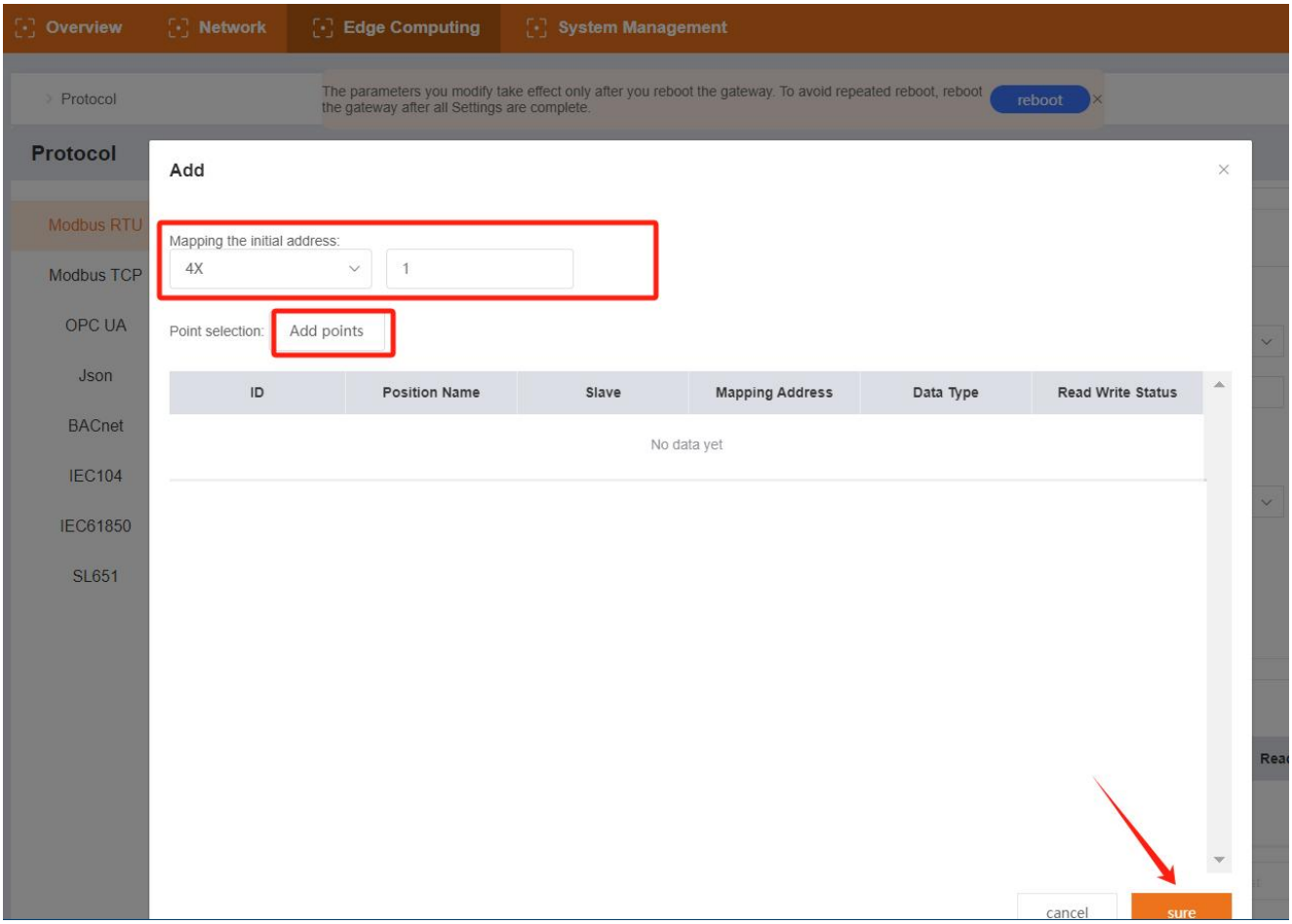
The logic used by the protocol conversion function is to perform the following operations on the basis of the completion of the configuration of the data point table:

1、Go to the built-in web page, select the matching protocol to configure in "Edge Computing-> Protocol Conversion"

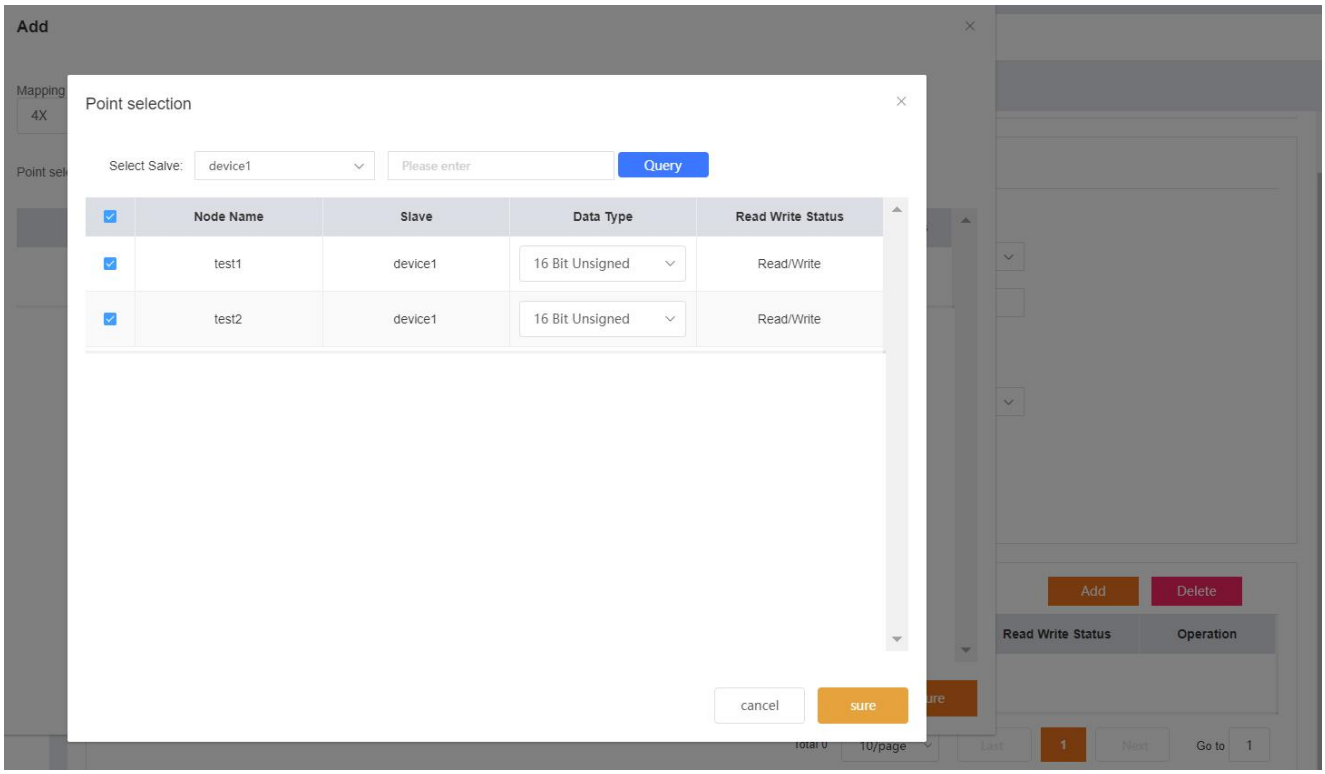
2、Enter the selected protocol interface, configure the protocol enable, and set the relevant parameters;

3、After parameter configuration is completed, click "Apply" button to save parameters;

4、To add a point mapping, find the "Point Mapping Table" on the selected protocol interface, click the "Add" button, and a pop-up window pops up;



5、Set the mapping address in the pop-up window, click the "Add Point" button, and pop up the point selection pop-up window;



6、Select slave and point, configure the point data type, and click OK to return to the next level

after confirmation;

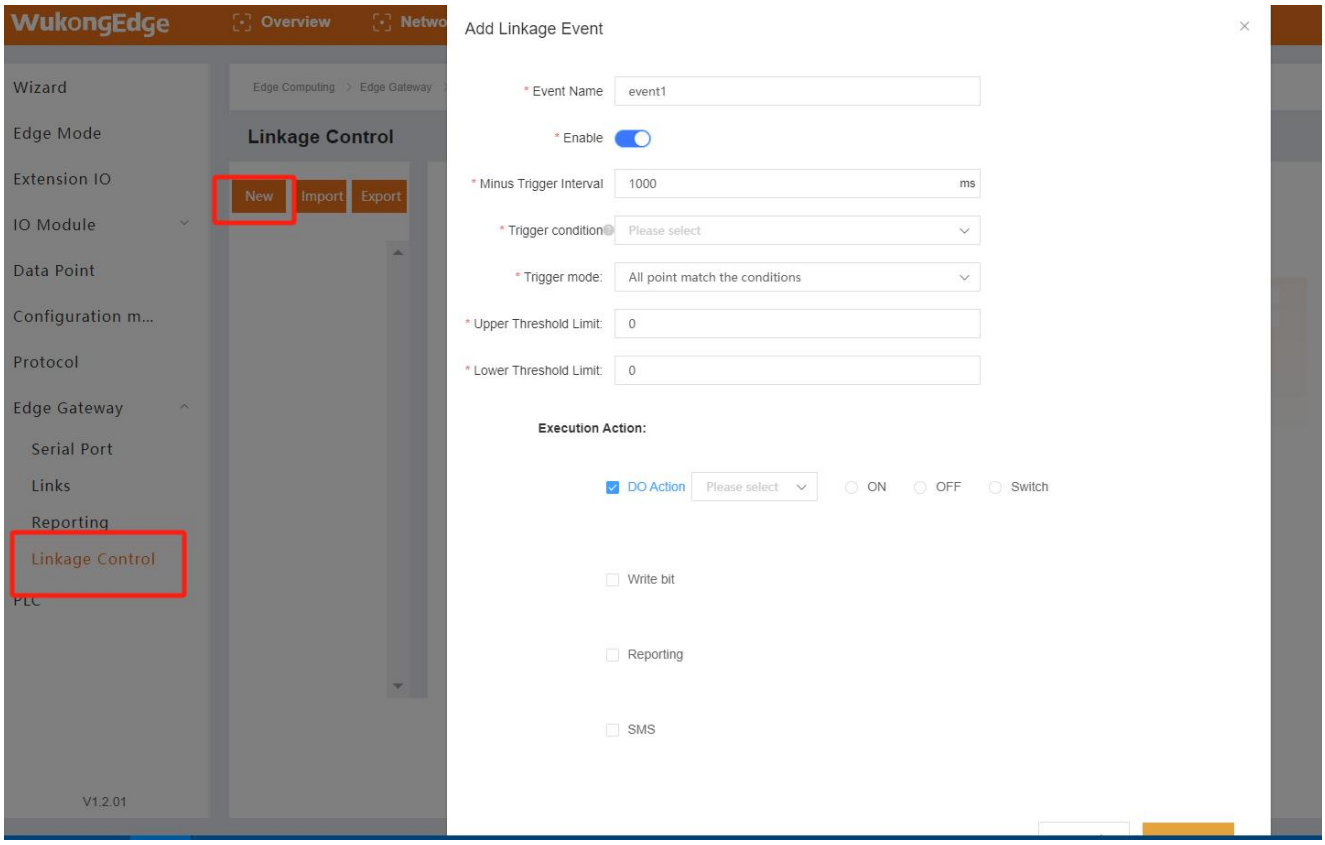
7、After returning to the mapping address configuration pop-up window and confirming that there is no error, click the "OK" button to complete the mapping address addition;

8、After basic parameters and point mapping are all set and saved, it will take effect after restarting the equipment;

9、After the device restarts, wait for the device to connect to the server, and then normal protocol communication can be realized.

4.4.7.Linkage control

WukongEdge's linkage control function is dedicated to achieving local closed-loop management and rapid response to alarm and emergency needs. It relies on local edge acquisition technology to acquire data in real time, and then efficiently complete data processing and judgment within the application. The whole process quickly executes corresponding actions according to preset conditions. Because there is no need to rely on the network to transmit data, it effectively avoids the interference of external factors such as network delay, realizes quick response, greatly improves the timeliness and accuracy of local management, and provides reliable technical guarantee for various scenarios with high real-time requirements.



Linkage control exists in the form of events, and the upper limit of linkage control events set in the application is 50. On the premise of edge acquisition and data acquisition, linkage control can

be configured by referring to the following steps:

1、Enter the built-in web page, click the "Create" button to add in the "Edge Computing-> Edge Gateway-> Linkage Control" interface;

2、Configure corresponding parameters such as event name. The parameters are introduced as follows:

name	parametric description	default parameters
event name	Linkage event name, user-defined	event1
event switch	Enabling of linked events	open
minimum trigger interval	When the linkage event meets the trigger condition for many times in a short time, the minimum interval of trigger execution is executed, and the trigger within the minimum trigger time does not execute the action and is directly discarded.	1000ms
trigger condition	The judgment conditions of linkage events are met, and the actions are executed. There are 10 conditions in total.	empty
trigger point	Linkage conditions judge the source of the required data, support multi-point selection	empty
trigger mode	Trigger logic between multiple points when multiple trigger points are selected	All points meet the conditions
the upper threshold	Maximum range of threshold conditions, range 0~20000	0
the lower threshold	Range minimum of threshold condition, range 0~20000	0
perform an action	Actions to be executed after linkage event meets trigger conditions	empty

3、Configure trigger conditions and select trigger points. Trigger conditions are described as follows:

trigger condition	describe	explain
forward following	DI closed, DO closed; DI open, DO open	Trigger points only support switching values
reverse	DI closed, DO open; DI open, DO closed	Trigger points only

following		support switching values
greater than or equal to	Trigger action when detection value is greater than or equal to set threshold	Set lower threshold only
greater than	Trigger action when detection value is greater than set threshold	Set lower threshold only
less than or equal to	Trigger action when detection value is less than or equal to set threshold	Set only the upper threshold
less than	Trigger action when detection value is less than set threshold	Set only the upper threshold
Within the interval (including boundaries)	The detection value triggers an action within the threshold interval, and triggers an action within each entry interval.	Set upper and lower thresholds
Within the interval (excluding boundaries)	The detection value triggers an action within the threshold interval, and triggers an action within each entry interval.	Set upper and lower thresholds
Outside the interval (including boundaries)	The detection value triggers an action outside the threshold range, and the outgoing interval triggers an action once	Set upper and lower thresholds
Outside the interval (excluding boundaries)	The detection value triggers an action outside the threshold range, and the outgoing interval triggers an action once	Set upper and lower thresholds

4、Configure execution actions, and execute actions simultaneously and in parallel;

trigger action	describe	explain
DO action	Select DO interface of equipment and output corresponding actions (close, open and flip)	DO is single choice
write data point	Write pre-set data to pre-selected points	Data points pulled from the data point table

reporting platform	Cloud platform that uploads customized alarm information through links to achieve rapid alarm	MQTT requires a separate theme
send short messages	Send customized alarm information to mobile phone through SMS to realize fast alarm	SMS content is within 70 bytes

5、After completing all parameter configuration, confirm that there is no error, click the "OK" button, and restart the equipment according to the prompt;

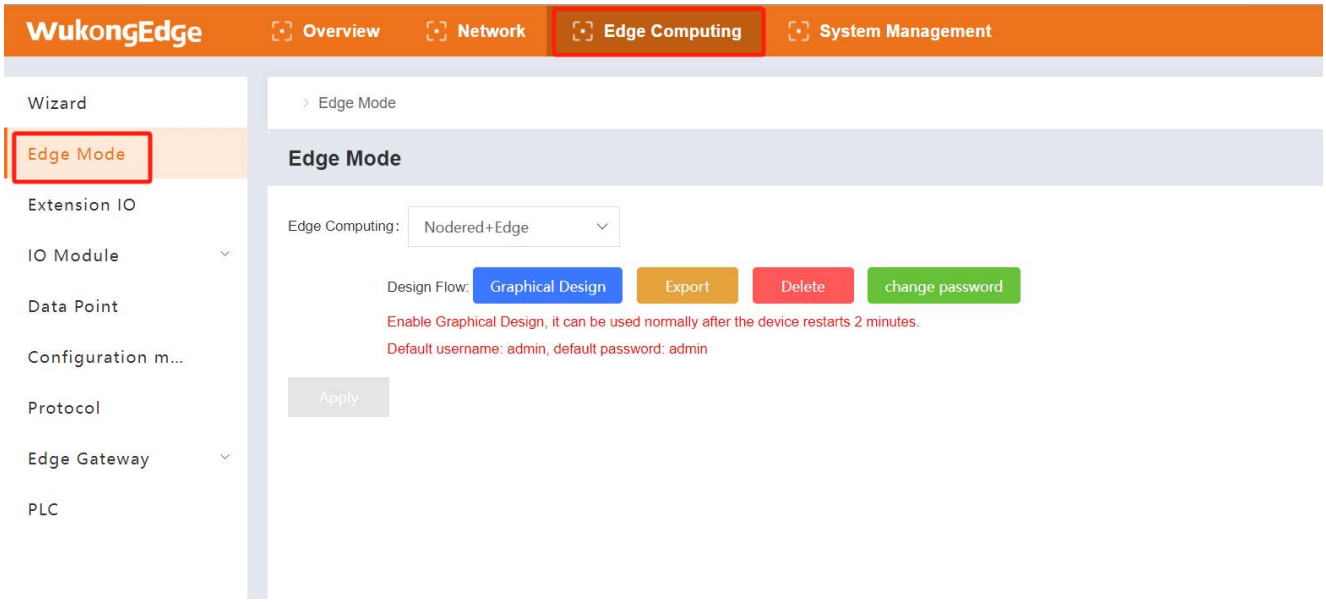
6、After the equipment restarts, after collecting data at the edge, the linkage control will judge and execute corresponding actions.

4.5.Node-Red

WukongEdge app has the latest version of Node-Red built in and uses low-code graphical programming mode. Developers can quickly build application logic by simply dragging and connecting, and can complete complex data processing and process control tasks without writing a lot of code. This greatly reduces the development threshold, improves development efficiency, and helps developers quickly turn ideas into practical applications.

Graphical development and edge computing make the localization of complex logic data more efficient and fast.

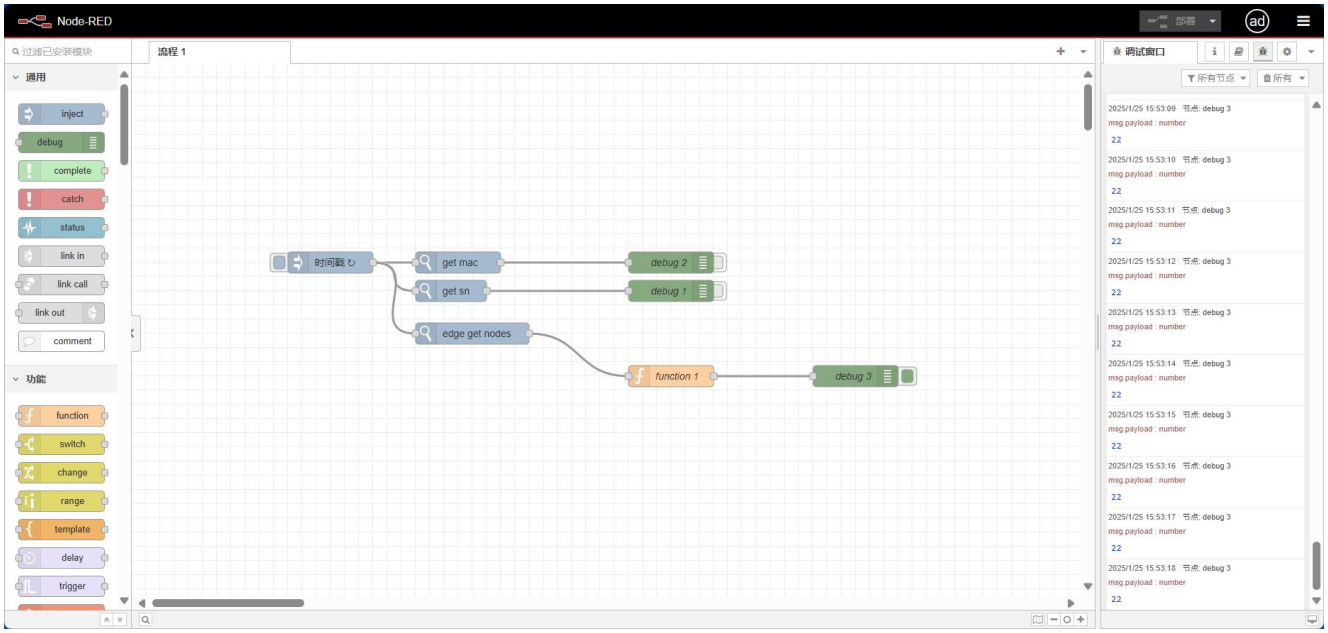
The use method is also very simple, just need to find "edge calculation-> mode management" in the built-in web page, set the edge calculation mode to "edge + graphical", and then restart the device, after the restart, also in the interface, click the "graphical design" button, you can enter the graphical editing interface.



In Node-Red's graphical editing interface, the layout of each area is clear and the division of labor is clear, which greatly improves the user experience. Rich and diverse nodes are neatly arranged on the left side of the interface, covering various functions such as data input, processing and output. In the middle of the interface is the design area.Users can freely select the required nodes from the left side, drag them to this area, and intuitively establish the logical relationship between nodes through connections, so as to easily construct complex and efficient data processing processes.

There is a deploy button at the top of the right side of the interface. With a single click, you can quickly deploy the designed process to the system. Below the button is the debugging area, which displays various information and data of process operation in real time to help users find and solve possible problems in time to ensure stable and accurate operation of the whole process.

Basic operation steps: pull node-> design logic-> deployment logic-> debugging optimization-> final deployment.

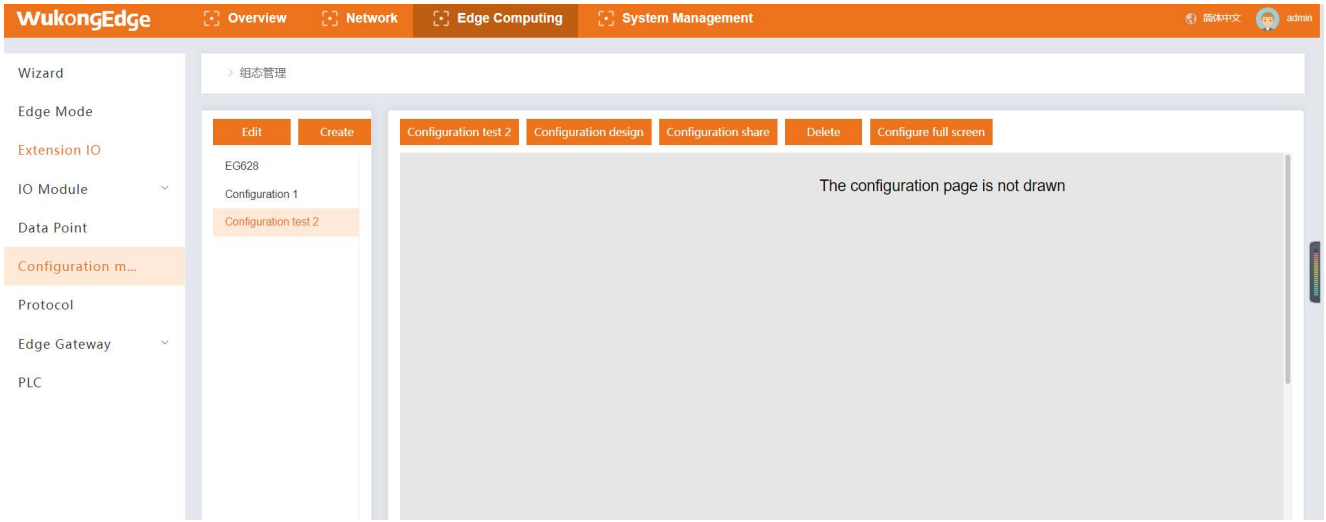


4.6.Configuration management

WukongEdge deeply integrates powerful configuration management functions, comprehensively covering core links such as configuration editing, configuration publishing and display. In the configuration editing stage, users can easily customize various personalized configuration screens with the intuitive and flexible operation interface to accurately meet the diverse needs of different scenarios. After editing, the configuration content can be published quickly.

With deep integration with edge computing, WukongEdge breaks the limitations of traditional data presentation and enables local presentation of data configurations. This means that without

relying on remote servers, the system can quickly process and present data locally, significantly reducing data transmission delays, improving the real-time and stability of the display, and bringing efficient and smooth user experience. Local configurations can be created and displayed on the built-in web page.

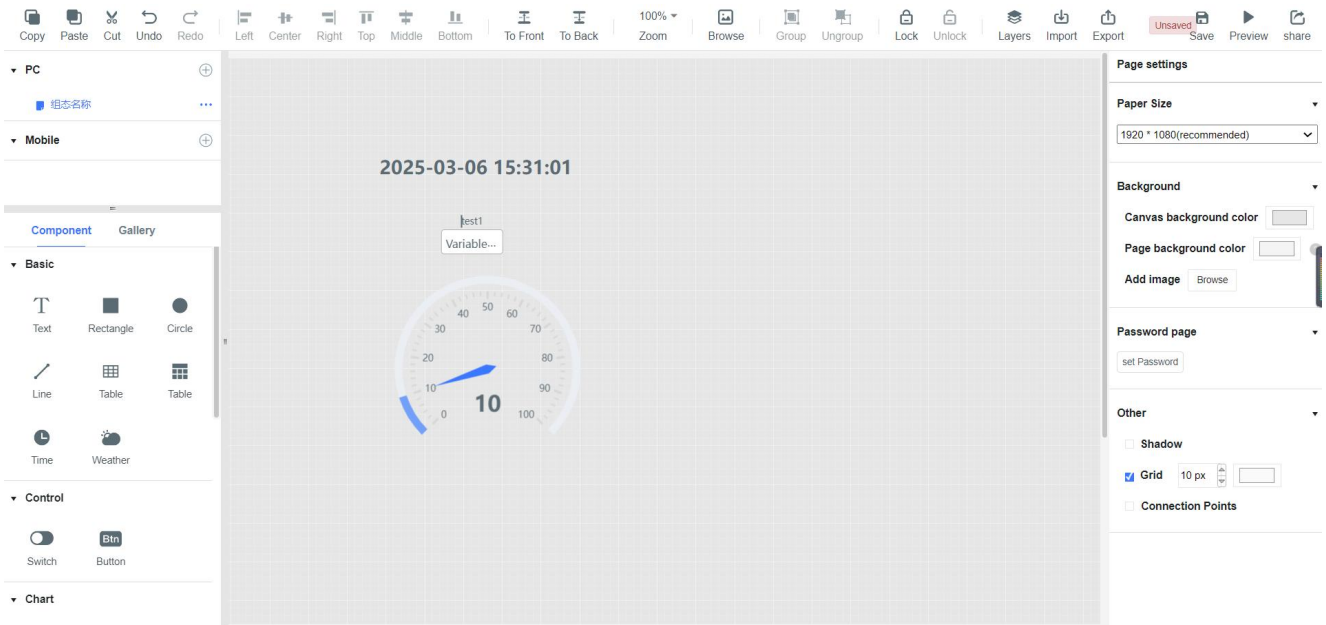


Specific usage is as follows:

1、In the built-in web page, find the "Edge Calculation-> Data Points" interface to complete the configuration of slave and point information;

2、In the built-in web page, find the "Edge Computing-> Configuration Management" interface, click the "Create" button to create a new configuration;

3、Select the newly created configuration and click the "Configuration Design" button to jump to the configuration editing interface and perform configuration design;



4、Edit the configuration and associate the relevant points to realize the display of data;

5、After completing all configuration editing and point association, click the "Preview" button to view the effect;

6、After confirming that there is no problem, click the "Save" button, and close the editing interface after saving;

7、Will go to the built-in web interface, select the new configuration, you can preview the interface, you can also click "configuration full screen" to view;

8、After the configuration is created and the data acquisition is normal, the local configuration can be displayed digitally.

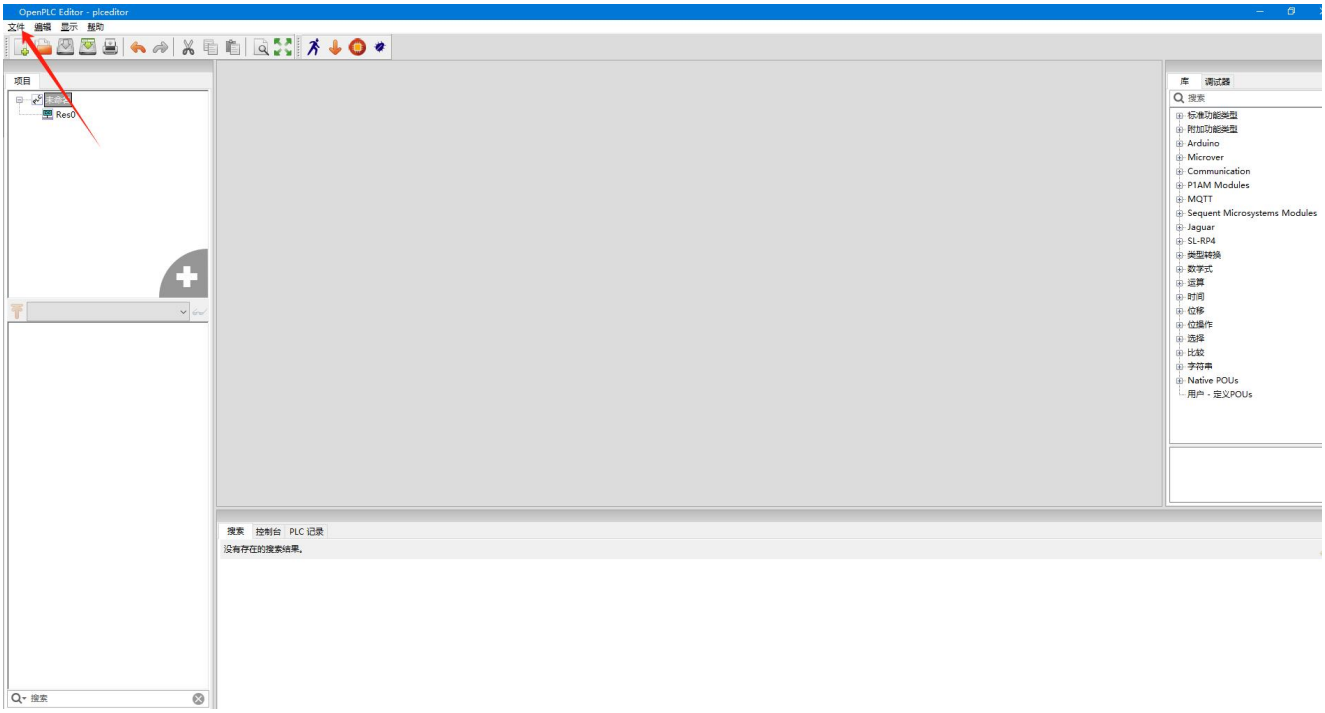
9、Local configuration can also be shared. As long as the device and mobile phone or computer login terminal are kept in the same network, you can use the shared connection to view the configuration. Remote configuration can also be accessed through personal cloud.

4.7.PLC programming

WukongEdge application framework built-in OpenPLC runtime, can be used with OpenPLC programming software to achieve PLC standard functions in accordance with IEC61131 - 3 standard. The framework supports ladder diagram, ST and other five programming languages, you can quickly learn to achieve the old and new PLC switch. WukongEdge has built-in runtime status monitoring and program upload, runtime monitoring, and settings functions. The application steps are as follows:

1、Download OpenPLC Editor and install it;

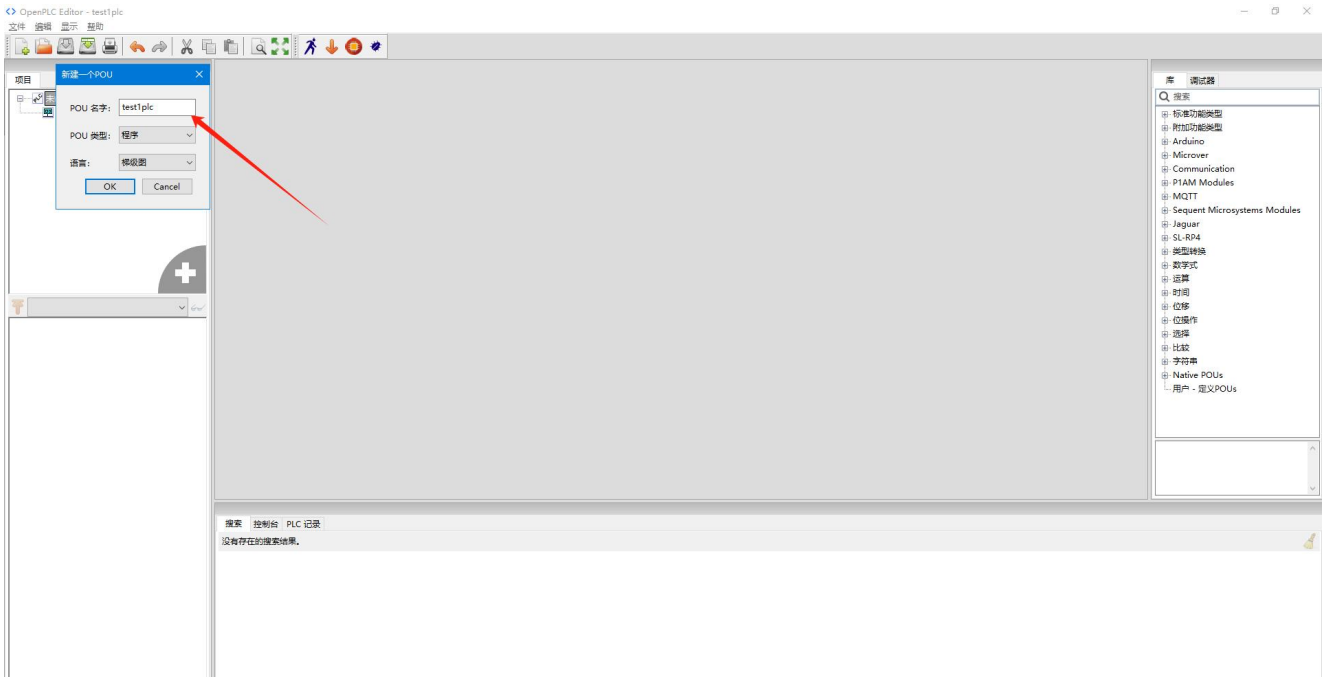
2、Open OpenPLC Editor, create a new project, click File-> New, and a Save dialog box will appear, allowing you to choose where to store the project. OpenPLC Editor projects are actually folders, not individual files. You cannot store items in a folder if there are already files in it. Create a new folder for the project, open it, and select it as the project location.



3、Once you select the location, OpenPLC Editor creates the project for you using default settings and configurations and opens a new dialog box asking you to create a new POU. POU is short for Program Organization Unit and is used to store all the code you write in your project. You can create three types of POU:

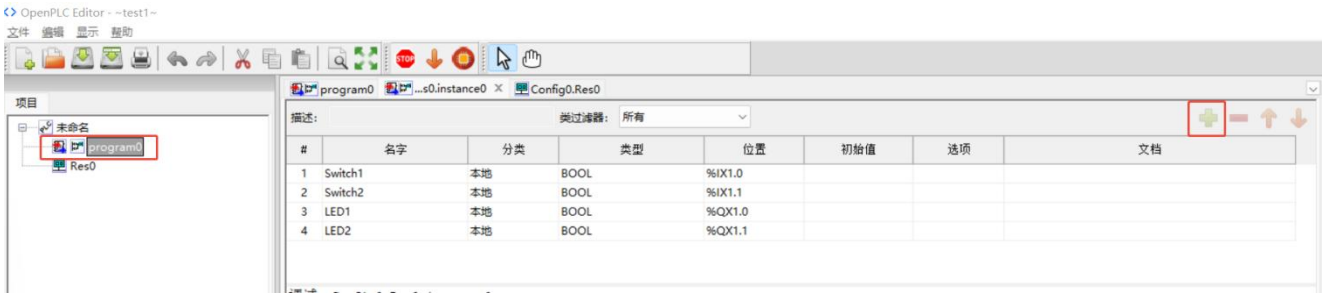
- Program-Application code that combines inputs, outputs, functions, and function blocks.
- Function-Reusable user code with a return value.
- Function Block-Reusable user code that retains state (instances).

4、In this tutorial, we create only one Program POU. Therefore, simply fill in the program name and make sure the POU type is "Program" and the language is "LD." Also, note that program names cannot contain spaces or special characters.

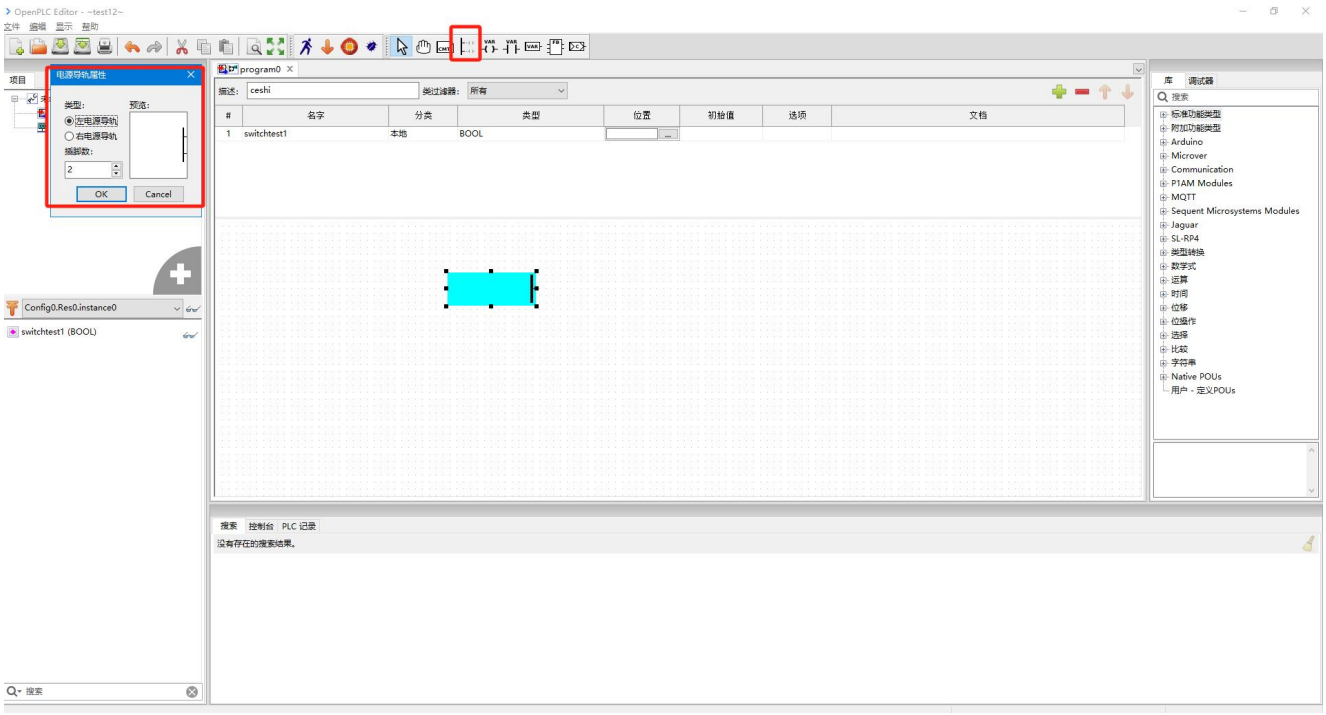


5、After the project is created, click on the program name on the right to open the ladder diagram editor. The upper part of the screen is used to place variables, and the middle part is used to draw diagrams. All variables need to be added first;

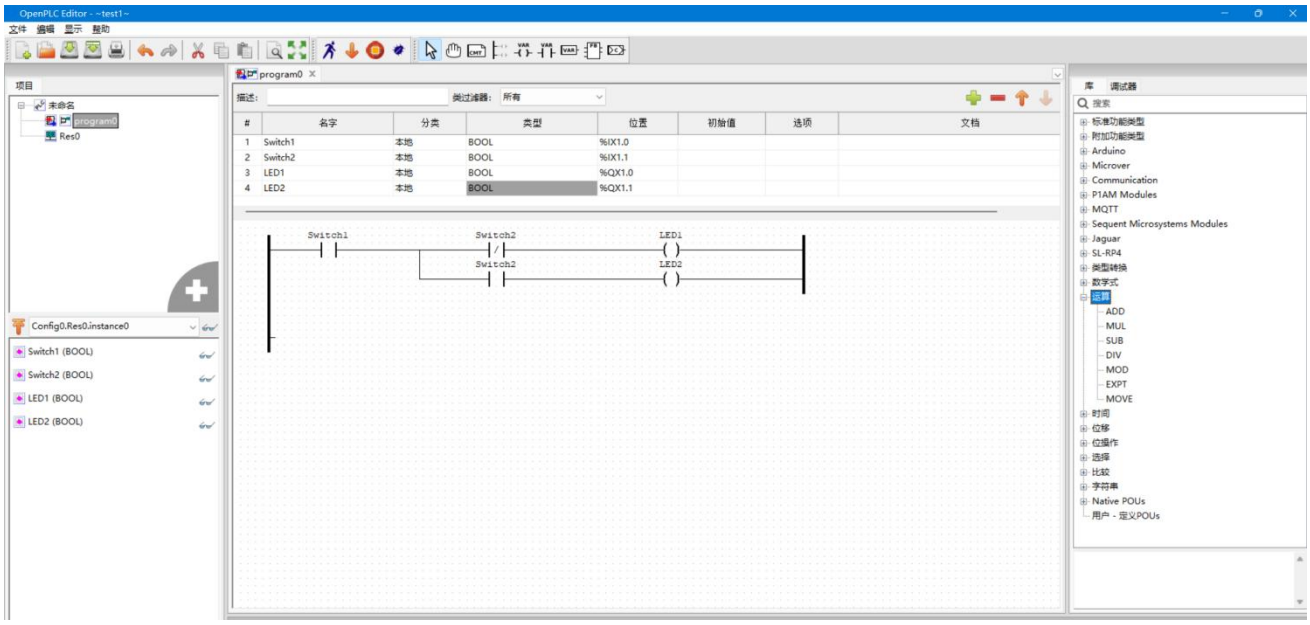
6、Click the program name on the right, in the variable window, click the green plus sign to add variables, as shown in the following example:



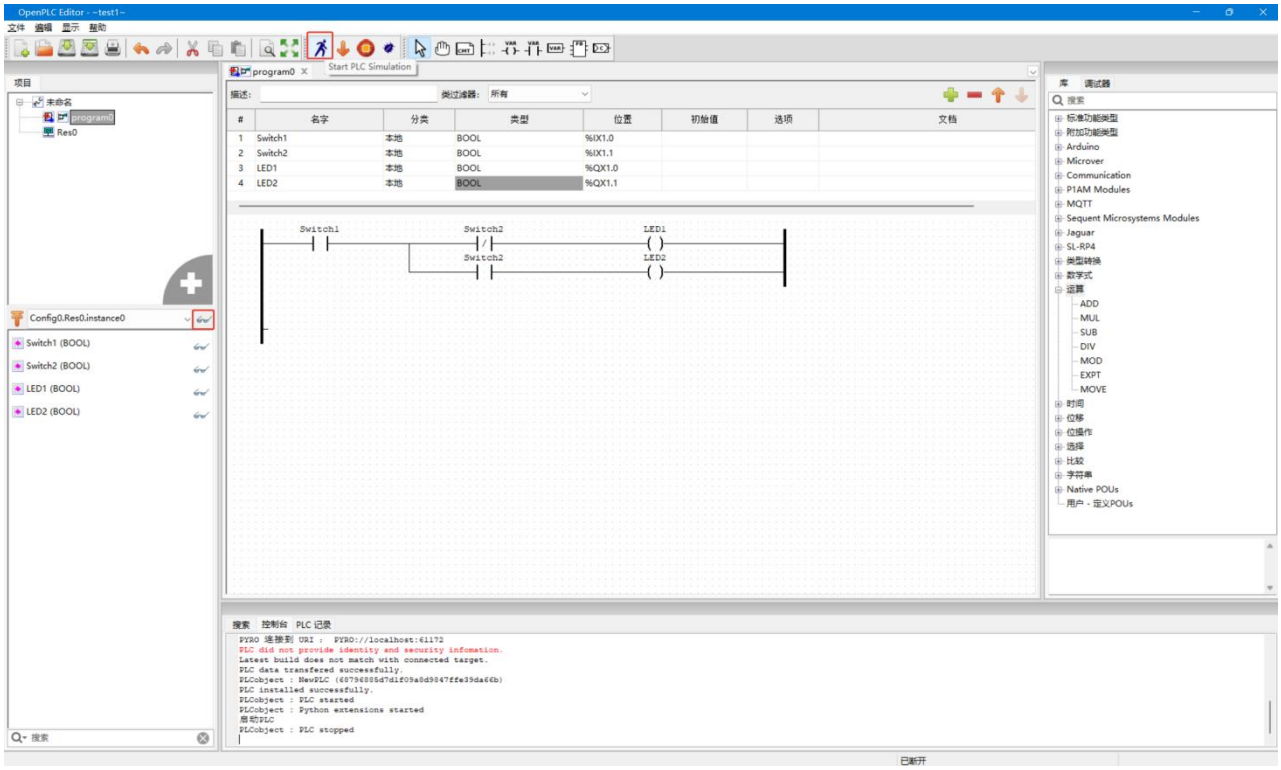
7、After variables are added, ladder diagram design is carried out, click the power rail icon in the toolbar, and then click on the program design interface to jump out of the power rail setting interface and add the left and right power rails.



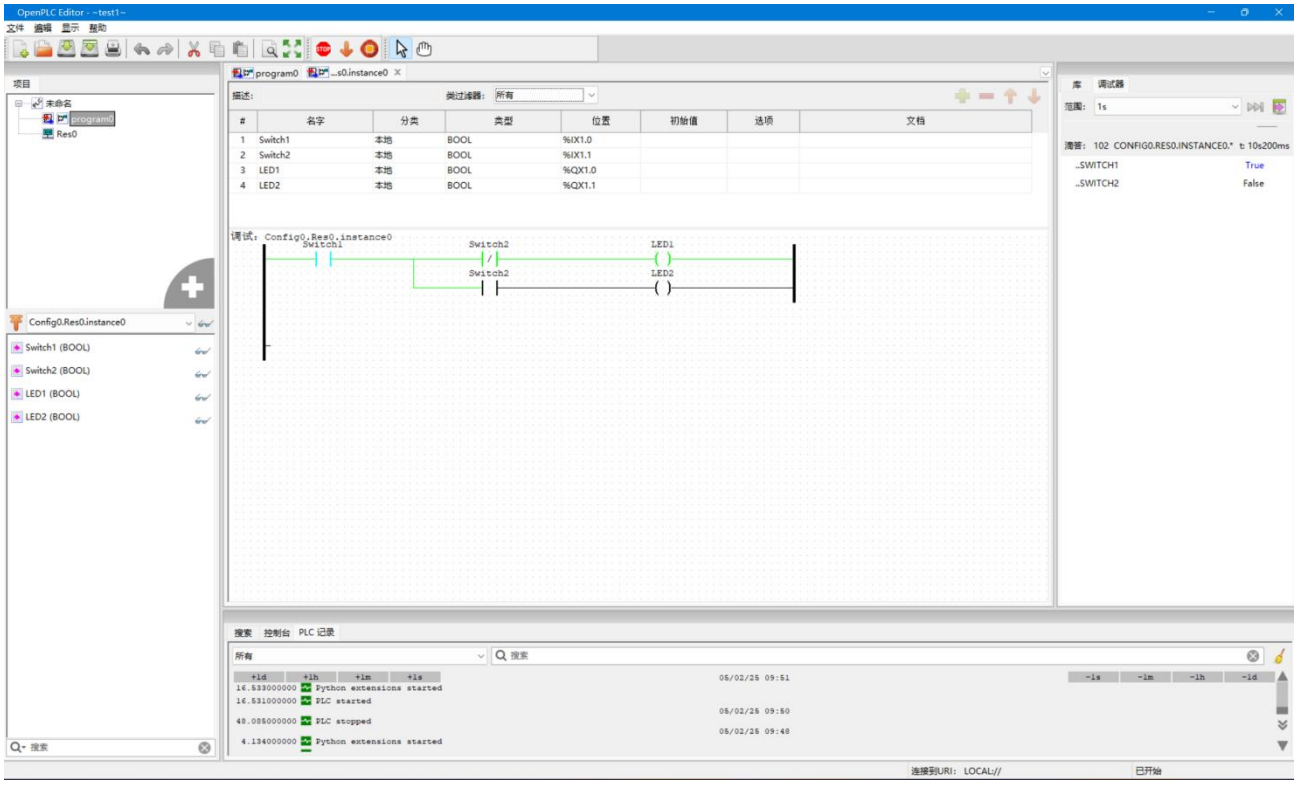
8、Add contacts and coils and other functions to complete the ladder diagram design.



9、After the ladder diagram design is completed, the simulation debugging is carried out first before downloading. Click "Start PLC Simulation" on the toolbar to carry out simulation. After clicking, a new window will open, and you can see the electronic flow of the program. The green line indicates that it has been activated, and the black line indicates that it has not been activated. Right-click the contact to "force true" or "force false", and then debug through forced action to observe the on-off situation of the line.

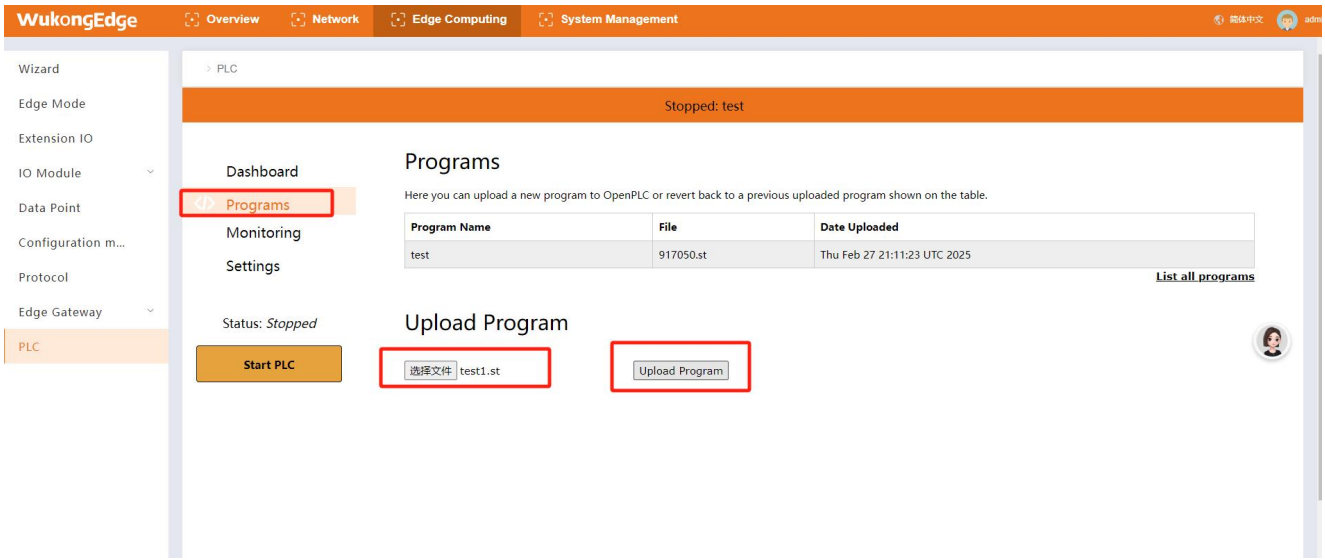


10、In addition to viewing electron flow graphically on a chart, you can trace data for each variable in your program on the debugger panel on the right side of the screen. To add variables to the debugger panel, click the glasses icon in front of each variable in the left panel. In addition, double-clicking on a variable on the debugger panel also allows you to see a real-time chart showing the current value of the variable. This is useful when programming steps or manipulating data.

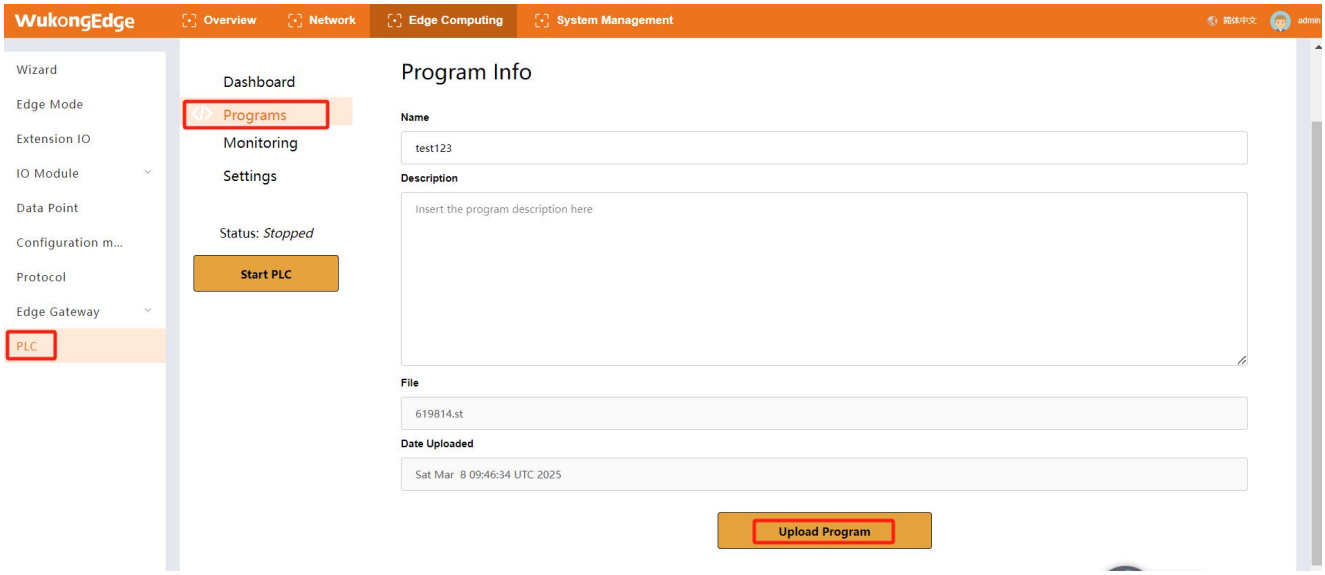


11、After debugging, confirm that there is no problem, click the "" button in the toolbar, compile and generate a file that can be recognized by runtime, and save it.

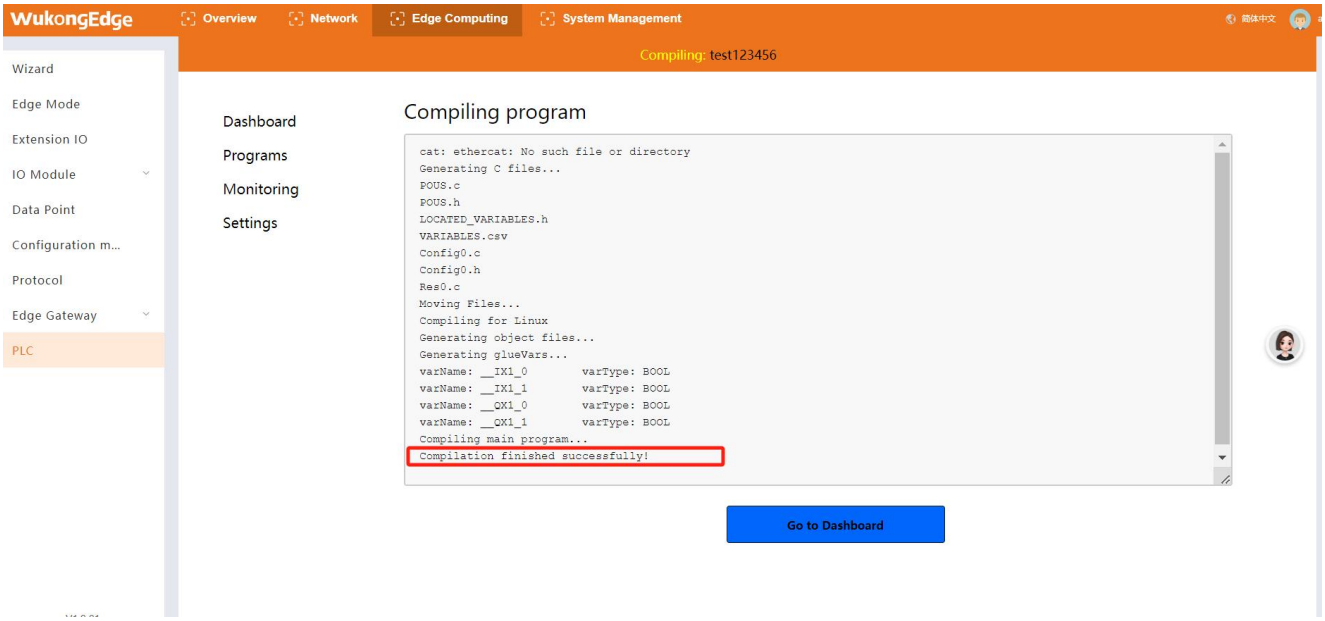
12、Go to WukongEdge built-in web page, find "Edge Computing->PLC" interface, in the program interface, select the saved.st program file, and then click "Upload Program".



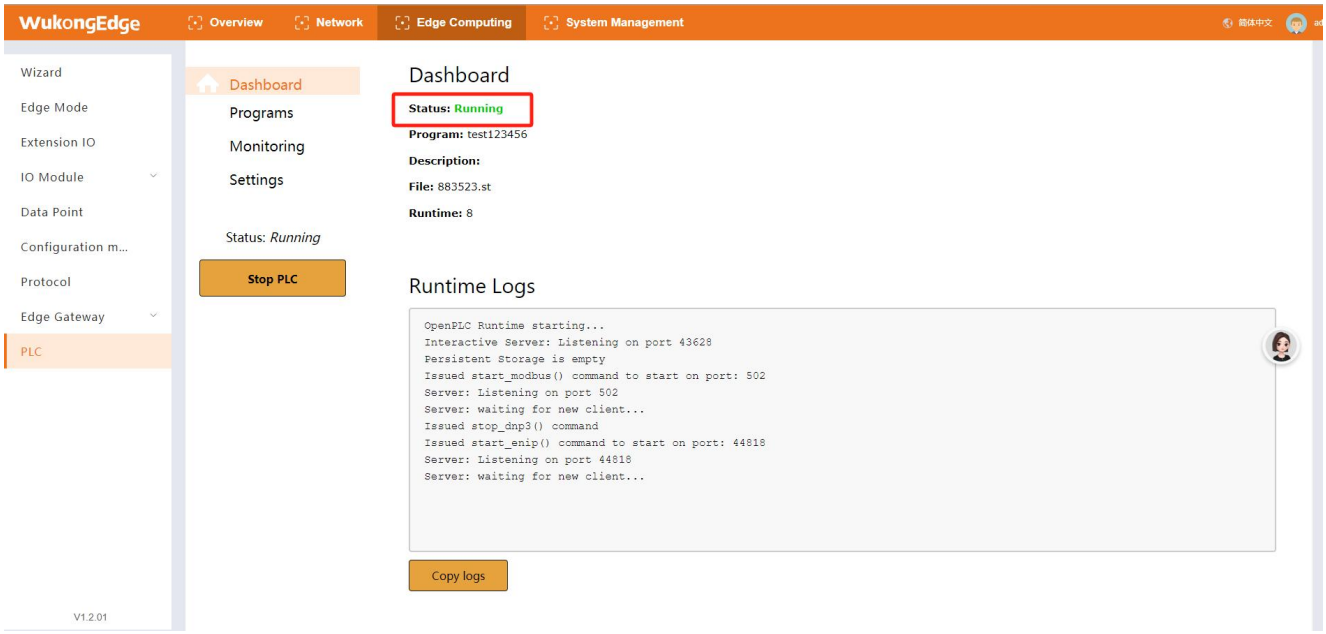
13、In the new interface that pops up, set the name and description of the program, then click "Upload Program" and wait for the upload to complete.



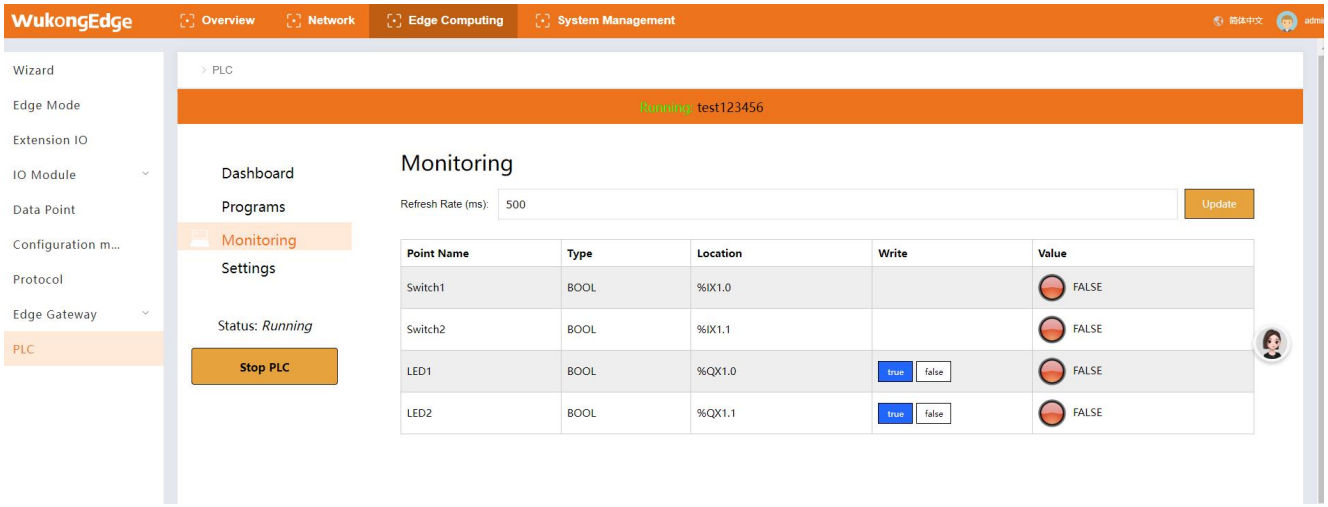
14、After uploading the program, click "Back to Overview" to go to PLC Overview interface.



15、Click "Run PLC" on the overview interface, and the status will change to "Running".



16、You can view the status information of points in the "Monitoring" interface.



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