NEXCOM International Co., Ltd.

IoT Automation Solutions Business Group

Industrial Mesh Wi-Fi Serial/Ethernet Device Gateway

NIO 51

User Manual

NEXCOM International Co., Ltd.
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PREFACE

This manual is for WLAN service providers or network administrators to set up a network environment using the NIO 51 product line.

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Acknowledgements

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Regulatory Compliance Statements

This section provides the FCC compliance statement for Class B devices and describes how to keep the system CE compliant.

Declaration of Conformity

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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IMPORTANT NOTE:

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/CANADA.

Operation of this device is restricted to indoor use only.

This device is intended only for OEM integrators under the following conditions:

The antenna must be installed such that 20 cm is maintained between the antenna and users.

The transmitter module may not be co-located with any other transmitter or antenna.

For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

As long as 3 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

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End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.

CE

The product(s) described in this manual complies with all applicable European Union (CE) directives if it has a CE marking. For computer systems to remain CE compliant, only CE-compliant parts may be used. Maintaining CE compliance also requires proper cable and cabling techniques.

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RoHS Compliance

NEXCOM RoHS Environmental Policy and Status Update

NEXCOM is a global citizen for building the digital infrastructure. We are committed to providing green products and services, which are compliant with European Union RoHS (Restriction on Use of Hazardous Substance in Electronic Equipment) directive 2011/65/EU, to be your trusted green partner and to protect our environment. RoHS restricts the use of Lead (Pb) < 0.1% or 1,000ppm, Mercury (Hg) < 0.1% or 1,000ppm, Cadmium (Cd) < 0.01% or 100ppm, Hexavalent Chromium (Cr6+) < 0.1% or 1,000ppm, Polybrominated biphenyls (PBB) < 0.1% or 1,000ppm, and Polybrominateddiphenyl Ethers (PBDE) < 0.1% or 1,000ppm. In order to meet the RoHS compliant directives, NEXCOM has established an engineering and manufacturing task force to implement the introduction of green products. The task force will ensure that we follow the standard NEXCOM development procedure and that all the new RoHS components and new manufacturing processes maintain the highest industry quality levels for which NEXCOM are renowned.

The model selection criteria will be based on market demand. Vendors and suppliers will ensure that all designed components will be RoHS compliant.

How to recognize NEXCOM RoHS Products?

For existing products where there are non-RoHS and RoHS versions, the suffix "(LF)" will be added to the compliant product name. All new product models launched after January 2013 will be RoHS compliant. They will use the usual NEXCOM naming convention.

Safety Information

Before installing and using the device, note the following precautions:

- Read all instructions carefully.
- Do not place the unit on an unstable surface, cart, or stand.
- Follow all warnings and cautions in this manual.
- When replacing parts, ensure that your service technician uses parts specified by the manufacturer.
- Avoid using the system near water, in direct sunlight, or near a heating device.

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Installation Recommendations

Ensure you have a stable, clean working environment. Dust and dirt can get into components and cause a malfunction. Use containers to keep small components separated.

Adequate lighting and proper tools can prevent you from accidentally damaging the internal components. Most of the procedures that follow require only a few simple tools, including the following:

- A Philips screwdriver
- A flat-tipped screwdriver
- A grounding strap
- An anti-static pad

Using your fingers can disconnect most of the connections. It is recommended that you do not use needle-nose pliers to disconnect connections as these can damage the soft metal or plastic parts of the connectors.

Safety Precautions

1. Read these safety instructions carefully.
2. Keep this User Manual for later reference.
3. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
5. Keep this equipment away from humidity.
6. Put this equipment on a stable surface during installation. Dropping it or letting it fall may cause damage.
7. The openings on the enclosure are for air convection to protect the equipment from overheating. DO NOT COVER THE OPENINGS.
8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
9. Place the power cord in a way so that people will not step on it. Do not place anything on top of the power cord. Use a power cord that has been approved for use with the product and that it matches the voltage and current marked on the product's electrical range label. The voltage and current rating of the cord must be greater than the voltage and current rating marked on the product.

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10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
12. Never pour any liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If one of the following situations arises, get the equipment checked by service personnel:
    a. The power cord or plug is damaged.
    b. Liquid has penetrated into the equipment.
    c. The equipment has been exposed to moisture.
    d. The equipment does not work well, or you cannot get it to work according to the user's manual.
    e. The equipment has been dropped and damaged.
    f. The equipment has obvious signs of breakage.
15. Do not place heavy objects on the equipment.
16. CAUTION: DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER. DISCARD USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.

Technical Support and Assistance

1. For the most updated information of NEXCOM products, visit NEXCOM's website at www.nexcom.com.
2. For technical issues that require contacting our technical support team or sales representative, please have the following information ready before calling:
   – Product name and serial number
   – Detailed information of the peripheral devices
   – Detailed information of the installed software (operating system, version, application software, etc.)
   – A complete description of the problem
   – The exact wordings of the error messages

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Warnings

Read and adhere to all warnings, cautions, and notices in this guide and the documentation supplied with the chassis, power supply, and accessory modules. If the instructions for the chassis and power supply are inconsistent with these instructions or the instructions for accessory modules, contact the supplier to find out how you can ensure that your computer meets safety and regulatory requirements.

1. Handling the unit: carry the unit with both hands and handle it with care.
2. Opening the enclosure: disconnect power before working on the unit to prevent electrical shocks.
3. Maintenance: to keep the unit clean, use only approved cleaning products or clean with a dry cloth.

Cautions

Electrostatic discharge (ESD) can damage system components. Do the described procedures only at an ESD workstation.

If no such station is available, you can provide some ESD protection by wearing an antistatic wrist strap and attaching it to a metal part of the computer chassis.

Conventions Used in this Manual

Warning:
Information about certain situations, which if not observed, can cause personal injury. This will prevent injury to yourself when performing a task.

Caution:
Information to avoid damaging components or losing data.

Note:
Provides additional information to complete a task easily.

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Chapter 1: Product Overview

1.1 Introduction

NIO 51 brings the wireless connectivity from serial devices or Ethernet devices perfectly to Wi-Fi Mesh in smart factories. Wi-Fi Mesh can be used for device to AP or mesh backbone between APs.

NIO 51 supports a variety of operation modes and high immunity to EMC high level protection, wide temperature and wide power range for harsh environment.

NIO 51 can also be managed and discovered by nCare I4.0 network manager. It's a very competitive solution against other device gateways in the market.

Key Features:

- ✓ IEEE 802.11a/b/g/n, 2X2 MIMO
- ✓ Dual band 2.4GHz/5GHz
- ✓ Support a variety of operation modes:
  - Serial to Wireless (Mesh or Client)
  - Serial to Ethernet
  - Ethernet to Wireless
- ✓ Support Modbus/TCP, Modbus/RTU
- ✓ Offline serial port buffer with 20 MB of storage
- ✓ High immunity to surge, ESD & EFT protection (Surge: Level-3 / ESD, EFT : Level-4)
- ✓ Wide DC power range with 12 - 48V
- ✓ Wide operating temperature from -40°C to 70°C
- ✓ Remote Management by nCare

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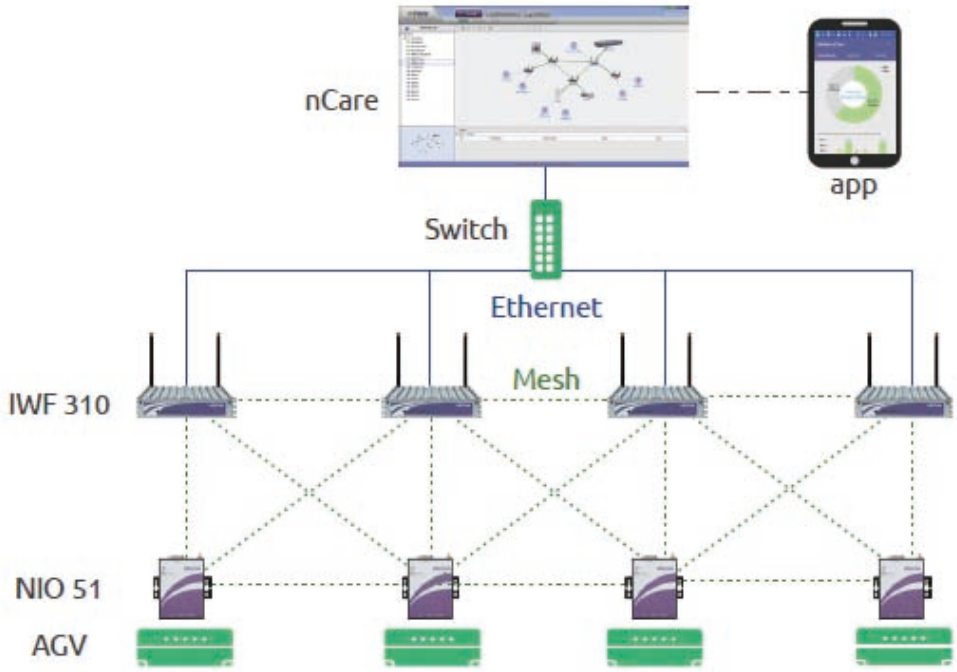
NIO 51 Mesh Application Scenarios



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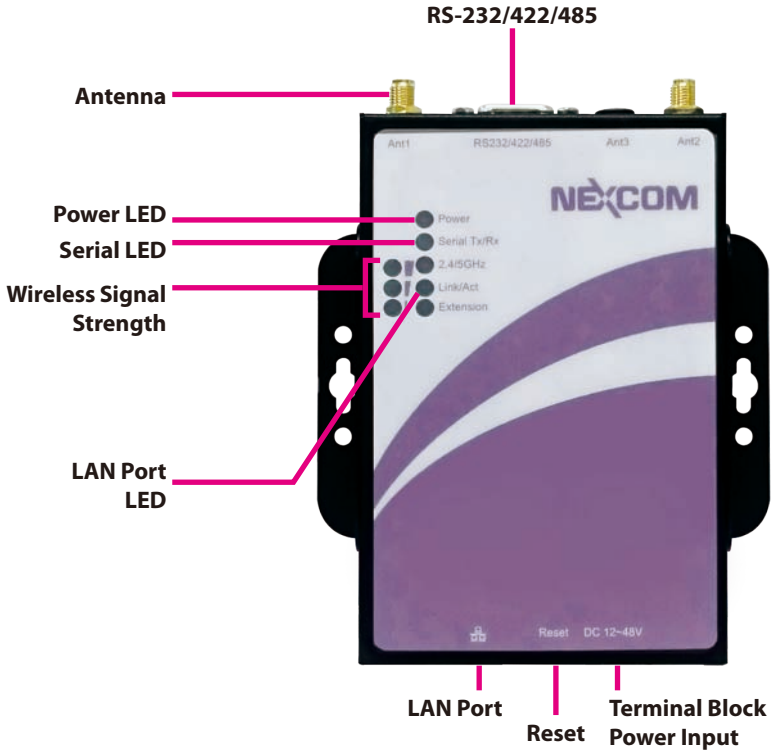
1.2 Panel Layout

1.2.1 NIO 51 Top Panel View



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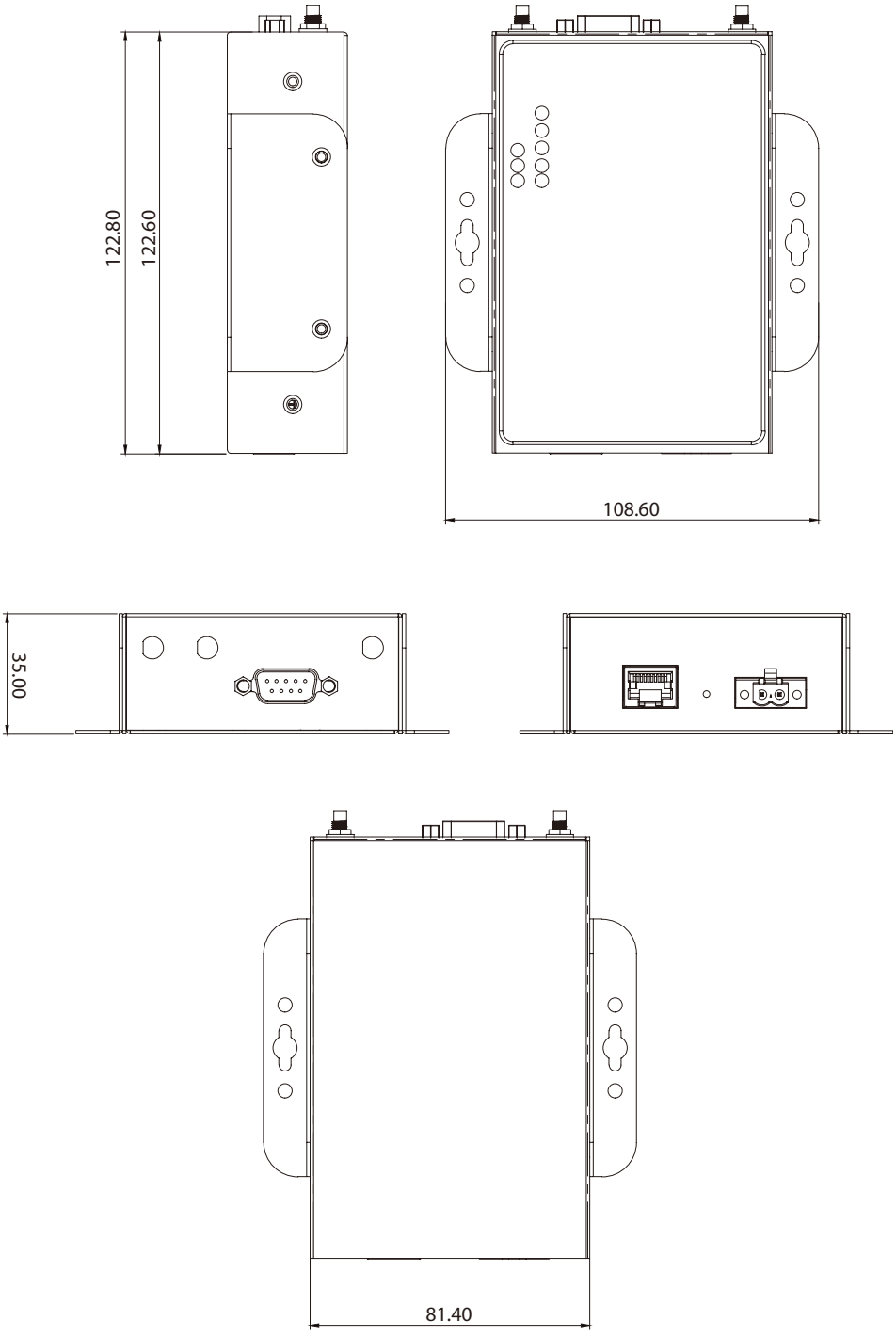
1.2.2 NIO 51 Dimension



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1.3 LED Indicators

Name	Color	Function
Power	Green Orange	Boot time is around 40 ~ 45s. LED color changes when booting up: Green (Steady on, 10s) ↓ Orange (Steady on, 30s) ↓ Green (Steady on, Ready)
Serial Tx/Rx	Green Red	Green: Tx, serial port to serial device. Red: Rx, serial device to serial port.
2.4/5 GHz	Green Blue	Green: 2.4 GHz Blue: 5 GHz
Link / Act	Green	Blinking: LAN port sending and receiving data.
Signal Strength (3 LEDs)	Green	1 Green LED: The signal strength is between 10% ~ 40%. 2 Green LEDs: The signal strength is between 40% ~ 70%. 3 Green LEDs: The signal strength is between 70% ~ 100%.

1.4 Reset Button

Name	Color	Function
Reboot	3 ~ 10s	LED Color Change: Green -> Orange -> Boot up
Reset to default	X > 10s	Green -> Orange (flash once) -> Green -> Orange -> Boot up

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1.5 Package Contents

NIO 51 unit x 1	
Dual band antenna x 2	
Wall-mount kit x 1 DIN-Rail kit x 1	
Terminal Block Connector x 1	

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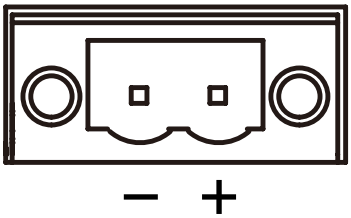
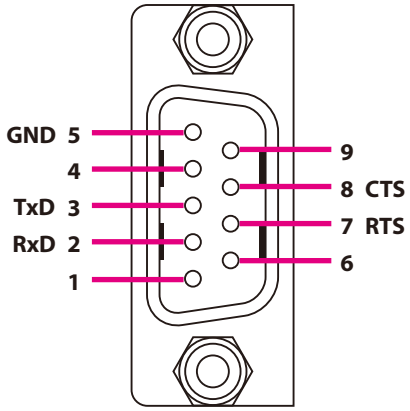
1.6 Power and Serial Port Pin Assignment

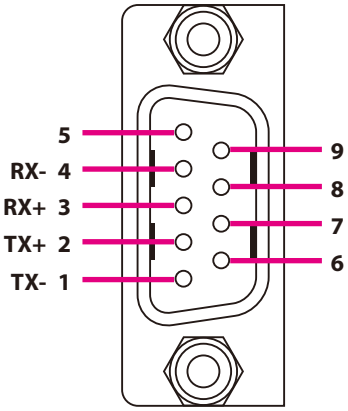
Terminal Block Power Input



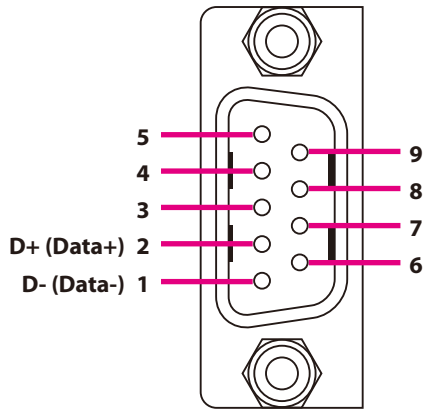
RS-232 Pin Assignment



RS-422 Pin Assignment



RS-485 Pin Assignment



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Chapter 2: System Configuration

2.1 Quickly Access NIO 51 with Web Browser

Login

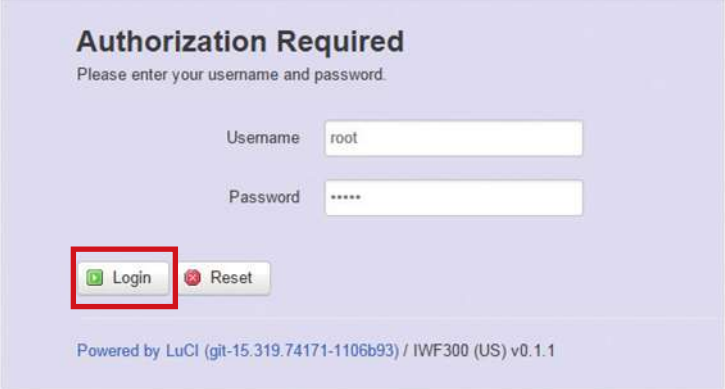
To access the NIO 51 device, you can open a web browser to access the Web GUI via the default IP address **192.168.1.1**

The default administrator login settings are:

Login: **root**

Password: **admin**

The first page you would is see the login page like the below screenshot:



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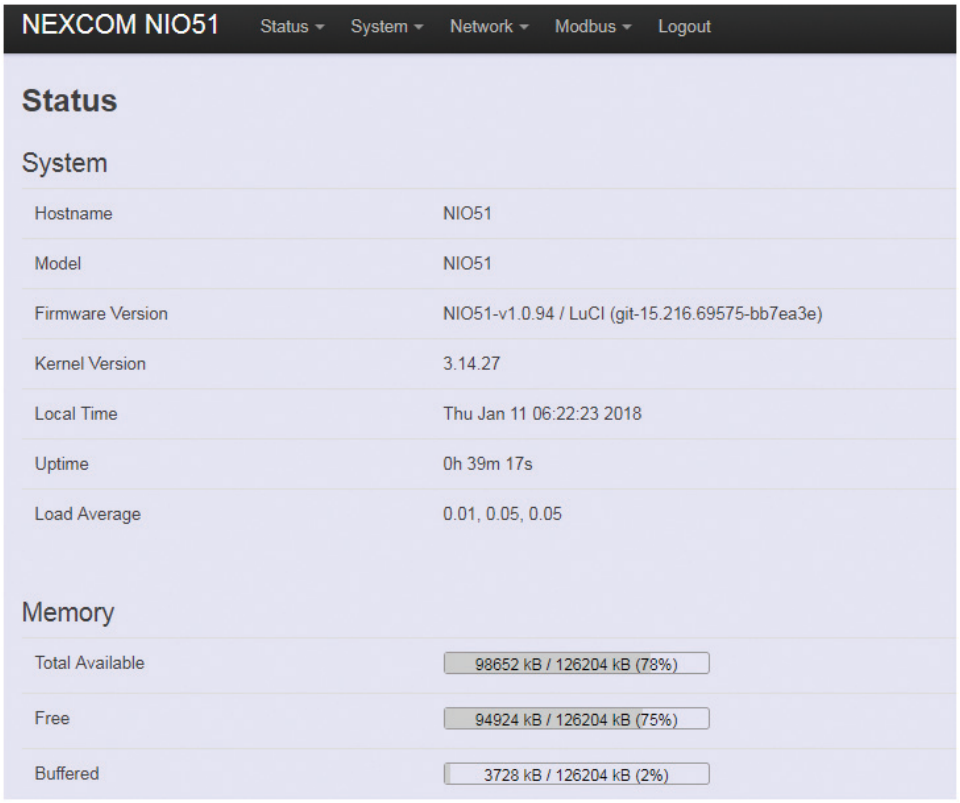
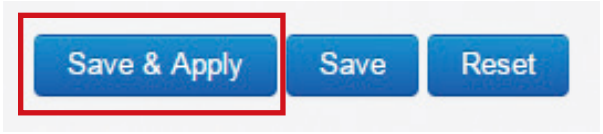
After successful login you will see the "Status" page of the web management interface with current information of System, Memory, Network, DHCP, Wireless, and Associated Stations. The device now is ready for configuration.



Saving Changes

"Save & Apply" the configuration at the bottom of the Web GUI after you change the settings.



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Unsaved Changes

"UNSAVED CHANGES" provides the information to see the parameters which were not saved and applied.

Click the "Save & Apply" button to save the parameters.

Auto Refresh

Click the "AUTO REFRESH" button to turn on/off the automatic Web GUI refresh function.

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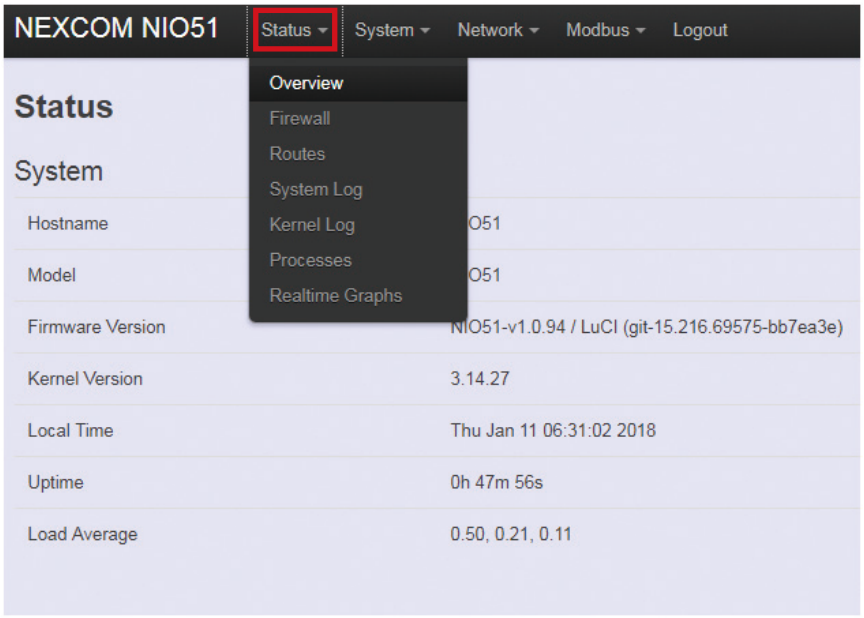
2.2 Status

2.2.1 Status

To display more detailed status, you can click the "Status" menu under the menu bar, then select the item of Overview, Firewall, Routes, System Log, Kernel Log, Process, and Real-time Graphs from the pull-down list like the below screen:



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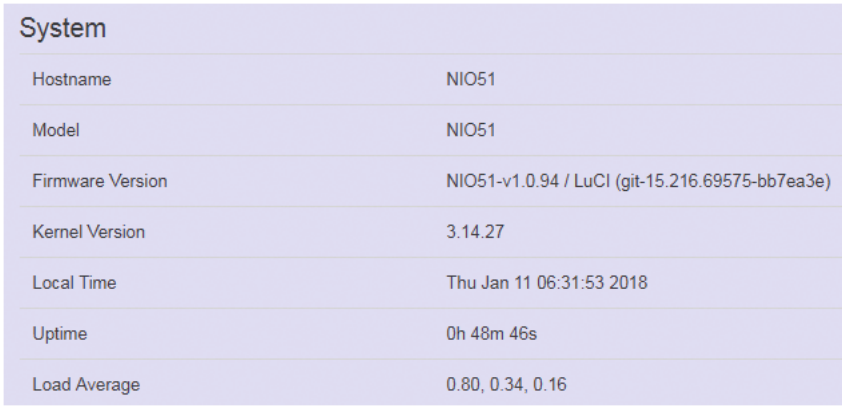
2.2.2 Overview

To see the overall status of NIO 51, click "Overview" to display system information and the current settings of the NIO 51's ports.

2.2.2.1 System



Hostname: Displays NIO 51 name.
Model: Displays NIO 51 HW basic information.
Firmware Version: Displays NIO 51 firmware version.
Kernel Version: Displays NIO 51 current kernel version.
Local Time: Displays NIO 51 current date and time.
Uptime: Displays how long NIO 51 has been operating since last boot-up uptime.
Load Average: CPU average loading.
For example:

CPU average loading: 94% in the past 1 minute.
43% in the past 5 minutes.
24% in the past 15 minutes.

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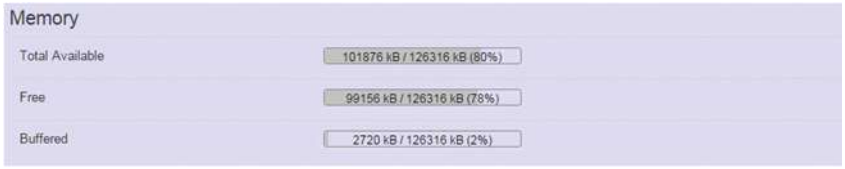
2.2.2.2 Memory



Total Available: Displays NIO 51 current available memory.

Free: Displays NIO 51 current free memory.

Buffered: Displays NIO 51 memory used for buffering.

2.2.2.3 Network

IPv4 WAN Status: Displays current IPv4 connection information.

IPv6 WAN Status: Displays current IPv6 connection information.

Active Connections: Displays current active connections.

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2.2.2.4 DHCP Leases

DHCP Leases

Hostname	IPv4-Address	MAC-Address	Leasetime remaining
IM03-AndrewWang1	192.168.1.219	08:3e:8e:67:64:03	10h 25m 0s
IM03-JonesChen	192.168.1.215	9c:2a:70:1b:4c:9d	6h 1m 34s
?	192.168.1.142	94:a1:a2:87:6f:08	9h 22m 13s
NEXCOM-SQA	192.168.1.105	00:0d:f0:ac:c8:63	10h 34m 24s
River-Ubuntu	192.168.1.118	80:19:34:c9:04:00	6h 51m 48s

This displays information about hosts (personal computers or electronic devices) that are connected to NIO 51 including IPv4, MAC address and leasing time

2.2.2.5 DHCPv6 Leases

DHCPv6 Leases

Hostname	IPv6-Address	DUID	Leasetime remaining
River-Ubuntu	fdfc:68c3:19eb::10b/128	0004767fcd07324b68cbab02958b2991f645	6h 51m 39s
NEXCOM-SQA	fdfc:68c3:19eb::3b0/128	000100011e1b93b70010f32db9b8	10h 34m 17s
IM03-JonesChen	fdfc:68c3:19eb::d25/128	000100011b2c6cb9206a8a9612c0	4h 14m 5s
NIFE-3600-SQA	fdfc:68c3:19eb::ed2/128	000100011e1c6e5e0010f32db9b8	5h 13m 27s

This displays information about hosts (personal computers or electronic devices) that are connected to NIO 51 including IPv6, DUID and leasing time.

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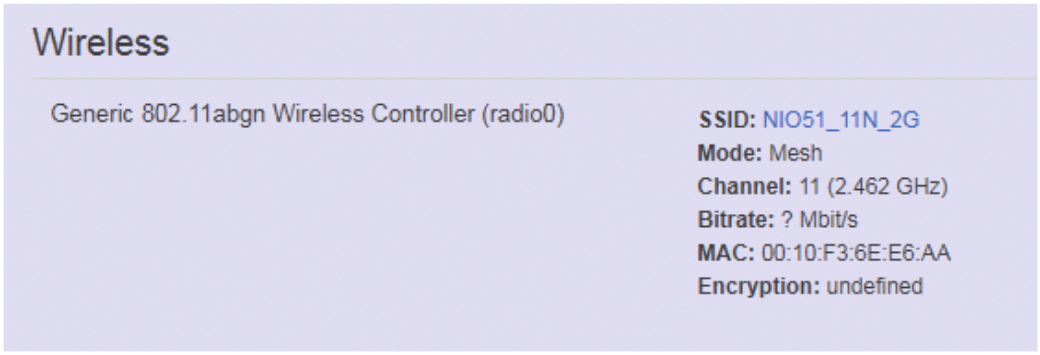
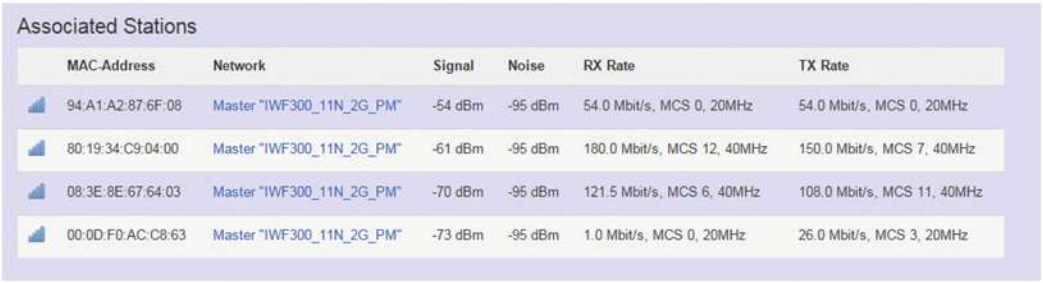
2.2.2.6 Wireless



This displays wireless information about NIO 51.

SSID: Displays the name of the wireless network.
Mode: Displays the mode in this radio.
Channel: Displays current channel used.
Bitrate: Displays current wireless data rate.
MAC: Displays MAC address of this radio.
Encryption: Displays current encryption setting.

2.2.2.7 Associated Stations



Displays current associated device information (personal computers or electronic devices) with NIO 51, including device's MAC address, signal level, noise and connecting data rate.

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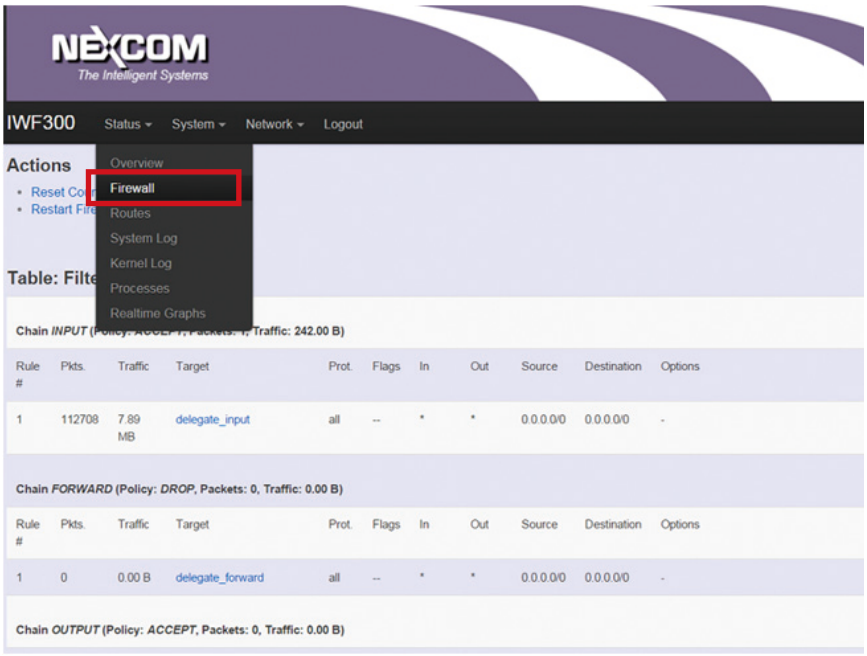
2.2.3 Firewall

Firewall setting is a particular function which allows user to connect or block two or more interfaces in device with sophisticated and specifically defined parameters in this Web page.

The settings in Firewall are suggested to keep it as factory default.



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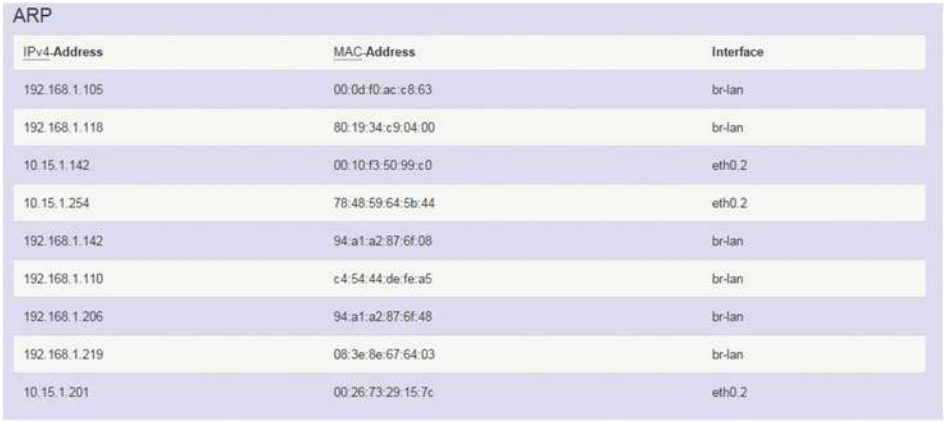
2.2.4 Routes

This section displays information about routing list for current connected device.

2.2.4.1 ARP

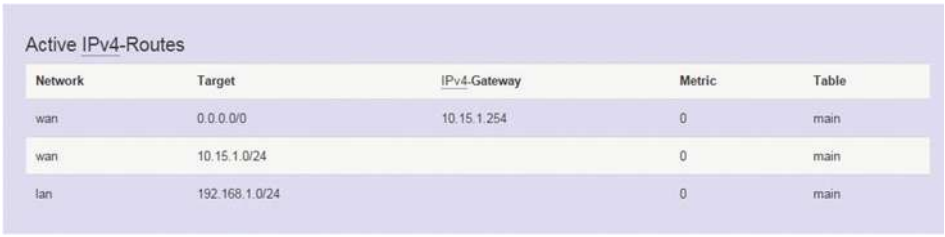


ARP

IPv4-Address	MAC-Address	Interface
192.168.1.105	00:0d:f0:ac:c8:63	br-lan
192.168.1.118	80:19:34:c9:04:00	br-lan
10.15.1.142	00:10:f3:50:99:c0	eth0.2
10.15.1.254	78:48:59:64:5b:44	eth0.2
192.168.1.142	94:a1:a2:87:6f:08	br-lan
192.168.1.110	c4:54:44:de:fe:a5	br-lan
192.168.1.206	94:a1:a2:87:6f:48	br-lan
192.168.1.219	08:3e:8e:67:64:03	br-lan
10.15.1.201	00:26:73:29:15:7c	eth0.2

Displays ARP information in NIO 51 including IPv4 address, MAC address and connecting interface.

2.2.4.2 Active IPv4-Routes



Active IPv4-Routes

Network	Target	IPv4-Gateway	Metric	Table
wan	0.0.0.0/0	10.15.1.254	0	main
wan	10.15.1.0/24		0	main
lan	192.168.1.0/24		0	main

Displays active WAN and LAN port's IPv4 routing table.

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2.2.4.3 Active IPv6-Routes

Active IPv6-Routes

Network	Target	Source	Metric	Table
lan	fdfc:68c3:19eb:0:e5df:2aba:f91:5221		0	main
lan	fdfc:68c3:19eb::/64		1024	main
wan	ff02::1		0	local
wan	ff02::2		0	local
wan	ff02::c		0	local
wan	ff02::1:2		0	local
wan	ff02::1:3		0	local
wan	ff02::1:ff50:9e09		0	local
lan	ff00::/8		256	local
(eth0)	ff00::/8		256	local
wan	ff00::/8		256	local
lan	ff00::/8		256	local
lan	ff00::/8		256	local

Displays active IPv6 routing table of WAN and LAN port.

2.2.4.4 IPv6 Neighbors

IPv6 Neighbours

IPv6-Address	MAC-Address	Interface
fdfc:68c3:19eb:0:1f4:f243:8e92:e881	80:19:34:c9:04:00	lan
fdfc:68c3:19eb:0:e5df:2aba:f91:5221	80:19:34:c9:04:00	lan
fdfc:68c3:19eb::3b0	00:0d:f0:ac:c8:63	lan
fdfc:68c3:19eb:0:21cf:78b5:a2c9:e438	00:0d:f0:ac:c8:63	lan
fdfc:68c3:19eb:0:b815:35d6:d6b7:df68	00:0d:f0:ac:c8:63	lan
fdfc:68c3:19eb:0:691a:9a70:b879:924d	80:19:34:c9:04:00	lan
fdfc:68c3:19eb:0:468:1e7:d4fe:8c9a	9c:2a:70:1b:4c:9d	lan
fdfc:68c3:19eb:0:f118:d10c:ab71:1676	80:19:34:c9:04:00	lan
fdfc:68c3:19eb:0:7c3e:bc4c:52e3:de5a	00:0d:f0:ac:c8:63	lan
fdfc:68c3:19eb:0:6046:1236:d6c8:82c1	00:0d:f0:ac:c8:63	lan
fdfc:68c3:19eb:0:c654:44ff:fede:fea5	c4:54:44:de:fe:a5	lan
fdfc:68c3:19eb:0:e151:5f16:e22f:fc7c	c4:54:44:de:fe:a5	lan
fdfc:68c3:19eb:0:61ad:92b6:99e2:bf9b	80:19:34:c9:04:00	lan

Displays connected device with IPv6 information.

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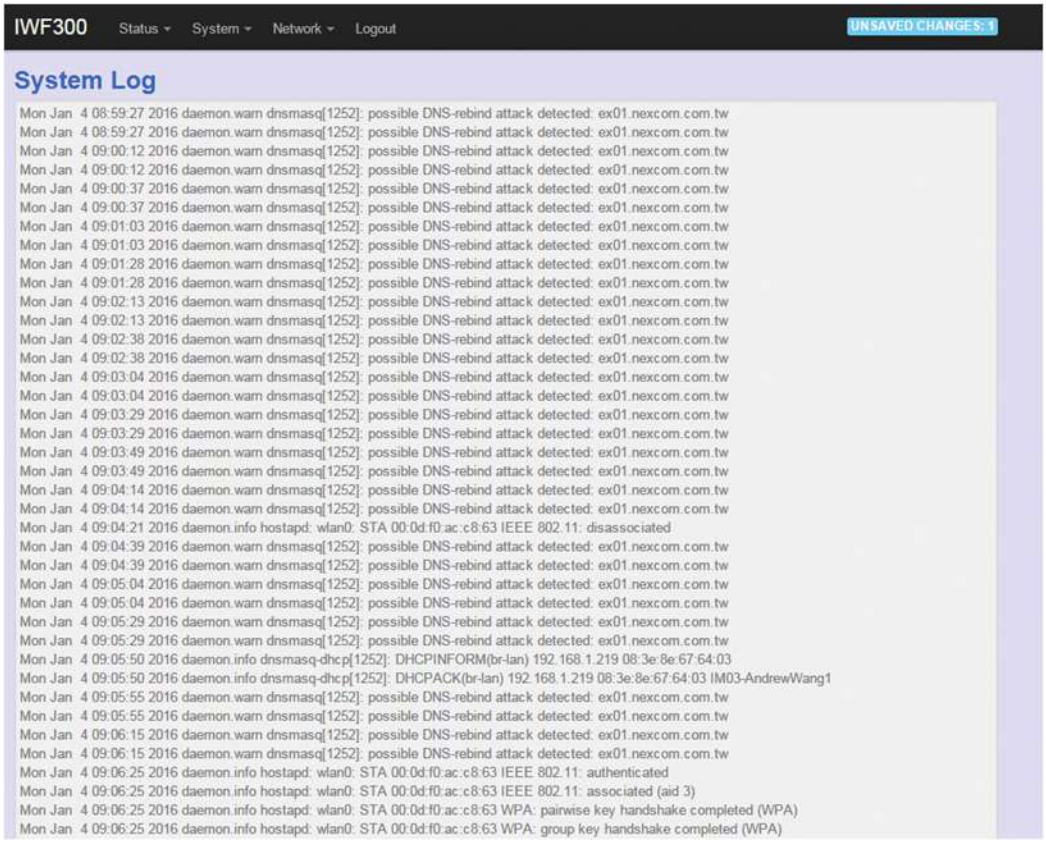
2.2.5 System Log



Displays the record of system activities. The administrator can monitor the system status by checking this log.

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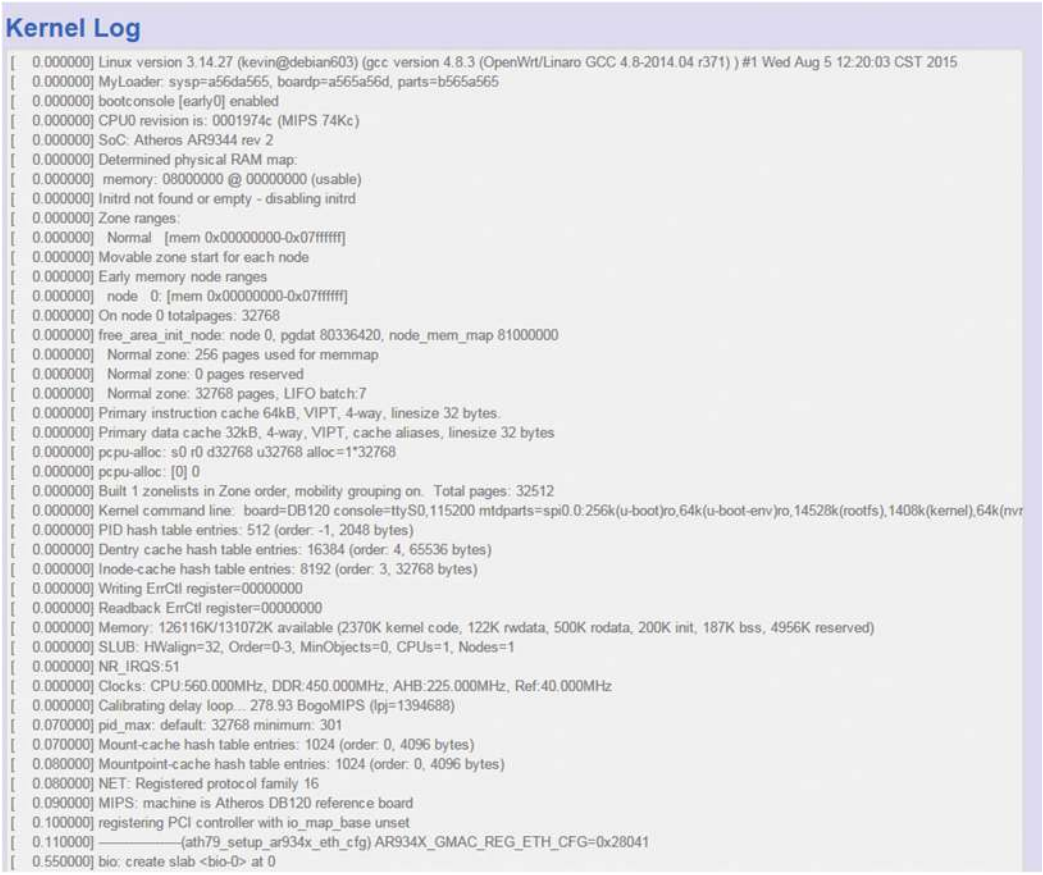
2.2.6 Kernel Log



Displays the record of kernel activities. The administrator can monitor the system status by checking this log.

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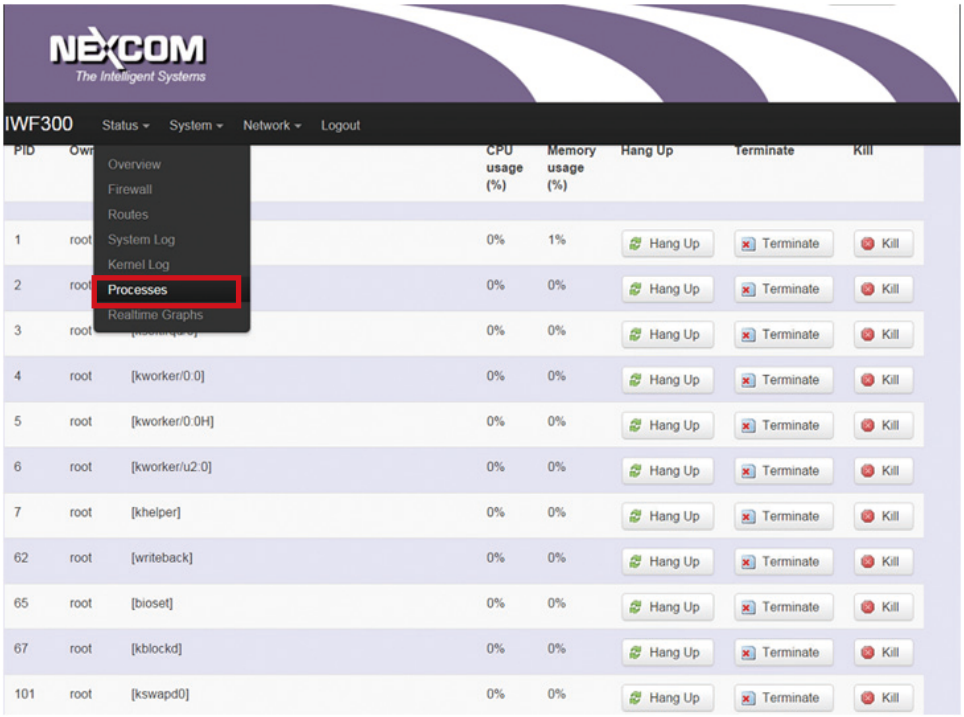
2.2.7 Processes

This Webpage is designed for detailed troubleshooting/ status monitoring by professional personnel in the field. Any improper termination or killing of individual process tasks may cause device malfunction. **It is suggested that the settings are kept as factory default.**



2.2.8 Real-time Graphic

This section provides utilities to monitor NIO 51 system information including real-time load, real-time Ethernet traffic, real-time wireless signal and real-time associated device traffic.

To monitor status in this section, please make sure the Web GUI "auto refresh" function must be "**turn on**".

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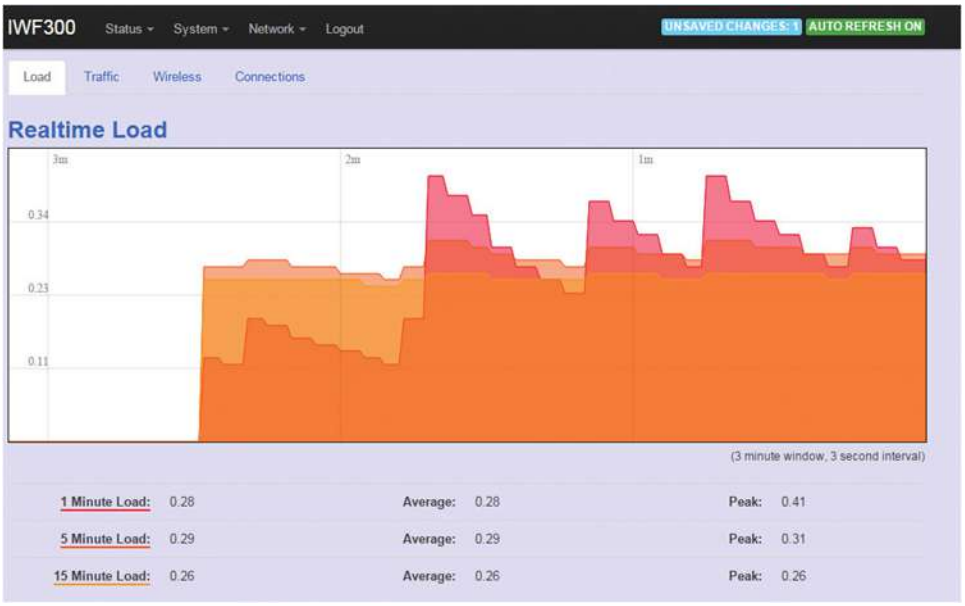
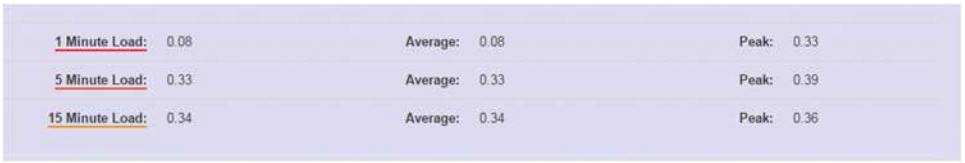
2.2.8.1 Load



Displays real-time CPU average loading percentage.
For example:



1 minute	Minimum	8%	Average	8%	Peak	33%
5 minutes		33%		33%		39%
15 minutes		34%		34%		36%

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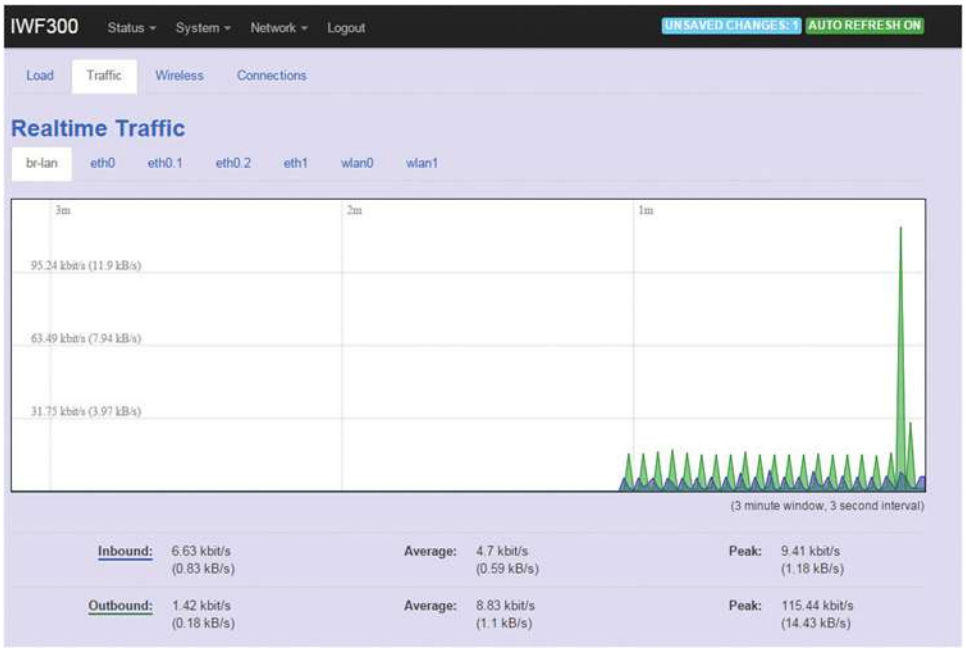
2.2.8.2 Traffic



Displays NIO 51 Ethernet real-time traffic loading.

Inbound: Incoming data packet size.
Outbound: Outgoing data packet size.

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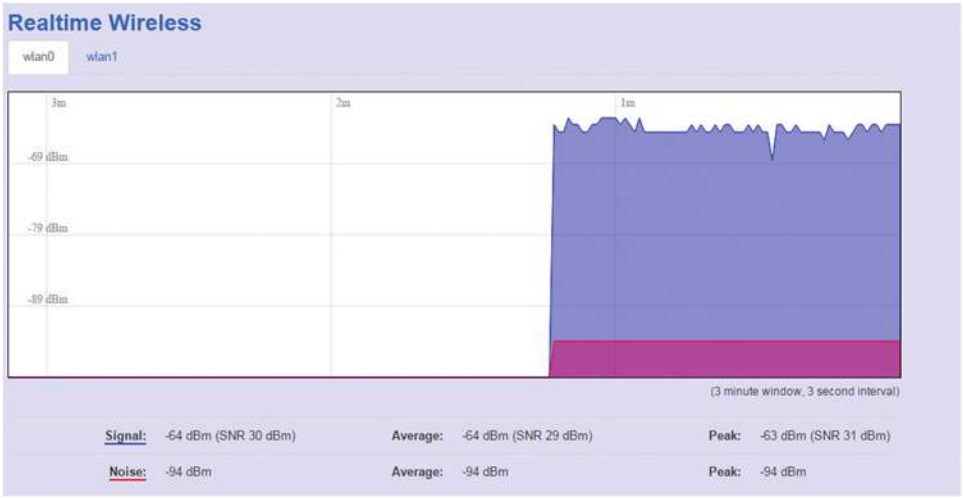
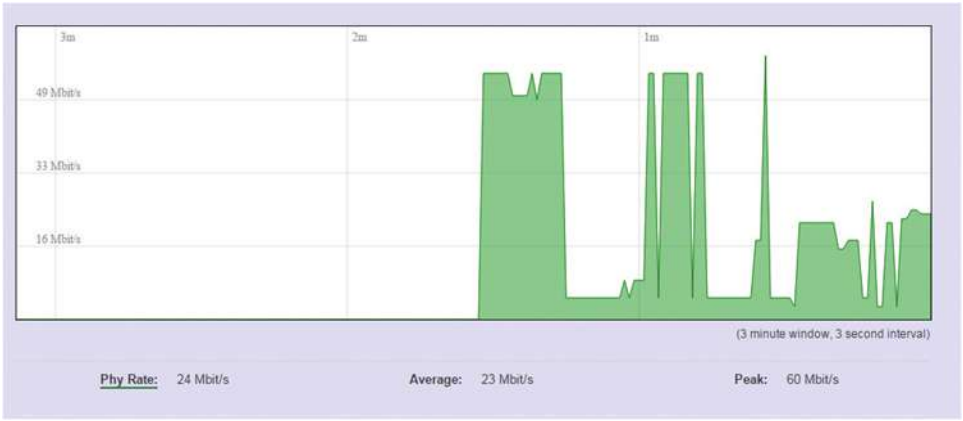
2.2.8.3 Wireless





Displays wireless real-time signal quality including signal level, noise and data rate.

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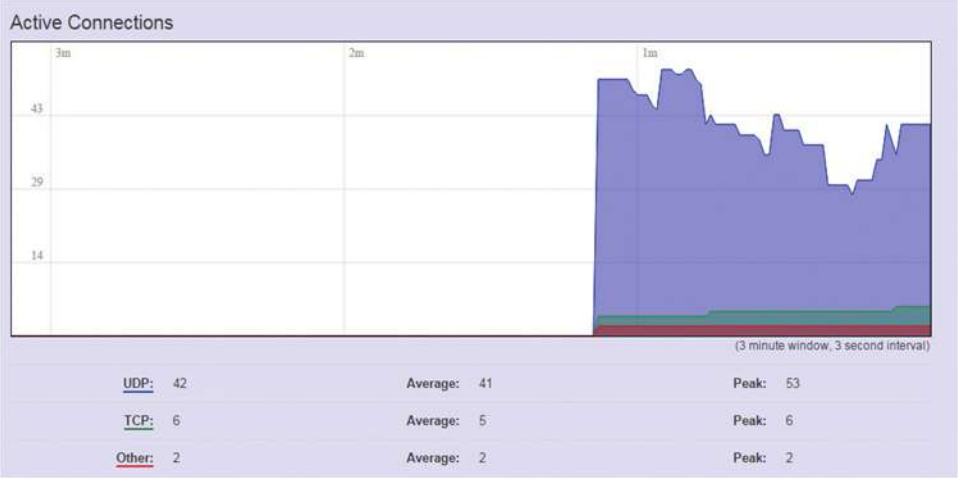
2.2.8.4 Connections



Network	Protocol	Source	Destination	Transfer
IPV4	ICMP	IM03-AndrewWang1.lan:0	IWF300.lan:0	602.29 KB (10279 Pkts.)
IPV4	UNKNOWN	0.0.0.0:0	all-systems.mcast.net:0	92.06 KB (2946 Pkts.)
IPV4	UDP	IM03-AndrewWang1.lan:17500	192.168.1.255:17500	57.95 KB (345 Pkts.)
IPV4	TCP	IM03-AndrewWang1.lan:57367	40.113.115.191:443	53.97 KB (573 Pkts.)
IPV4	TCP	IM03-AndrewWang1.lan:62255	IWF300.lan:80	19.43 KB (217 Pkts.)
IPV4	UDP	10.15.1.254:67	255.255.255.255:68	6.91 KB (21 Pkts.)
IPV4	TCP	IM03-AndrewWang1.lan:57369	tl-in-f125.1e100.net:5222	4.25 KB (55 Pkts.)
IPV4	TCP	IM03-AndrewWang1.lan:57366	91.190.218.53:12350	2.68 KB (48 Pkts.)
IPV4	UDP	IM03-AndrewWang1.lan:68	255.255.255.255:67	328.00 B (1 Pkts.)
IPV4	UDP	IWF300.lan:67	IM03-AndrewWang1.lan:68	328.00 B (1 Pkts.)
IPV4	UDP	IM03-AndrewWang1.lan:137	192.168.1.255:137	234.00 B (3 Pkts.)
IPV4	UDP	10.15.1.138:61033	10.1.1.2:53	118.00 B (1 Pkts.)
IPV4	UDP	10.15.1.138:43389	10.1.1.2:53	118.00 B (1 Pkts.)
IPV4	UDP	10.15.1.138:52009	10.1.1.2:53	118.00 B (1 Pkts.)

Displays NIO 51 real-time active connection information, including TCP and UDP connections.

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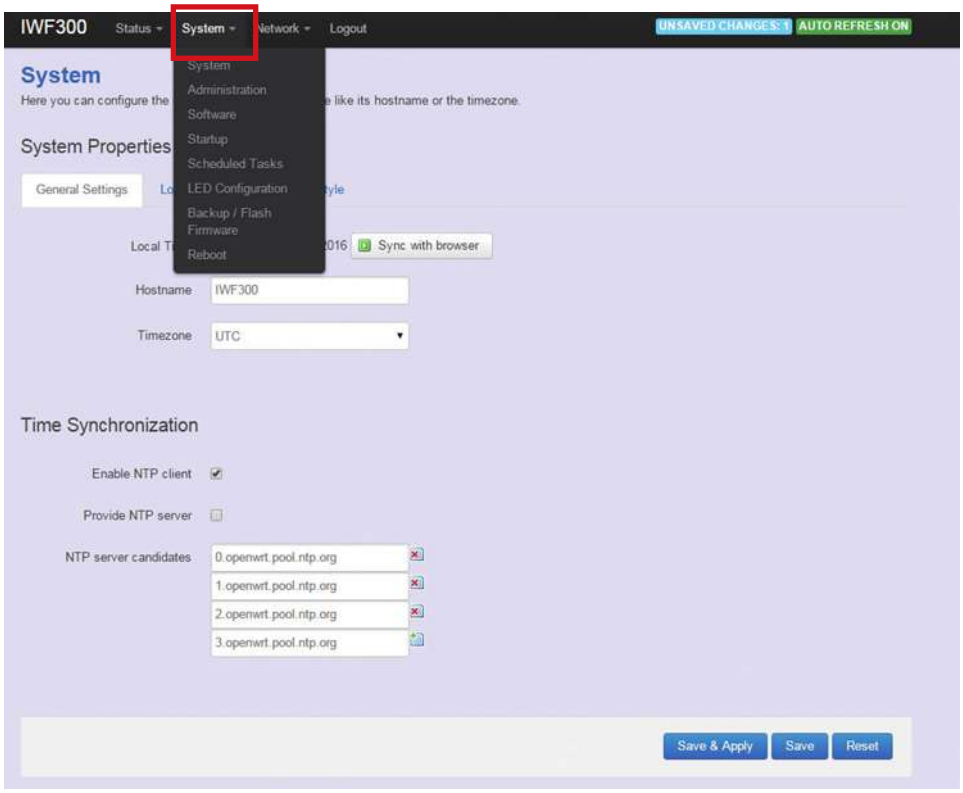
2.3 System

To set up detailed configuration about the NIO 51 system, click the "System" under the menu bar, then select the items such as System, Administration, Software, Start up, Scheduled Tasks, LED configuration, Backup/Flash Firmware and Reboot from the pull-down list like the below screen:



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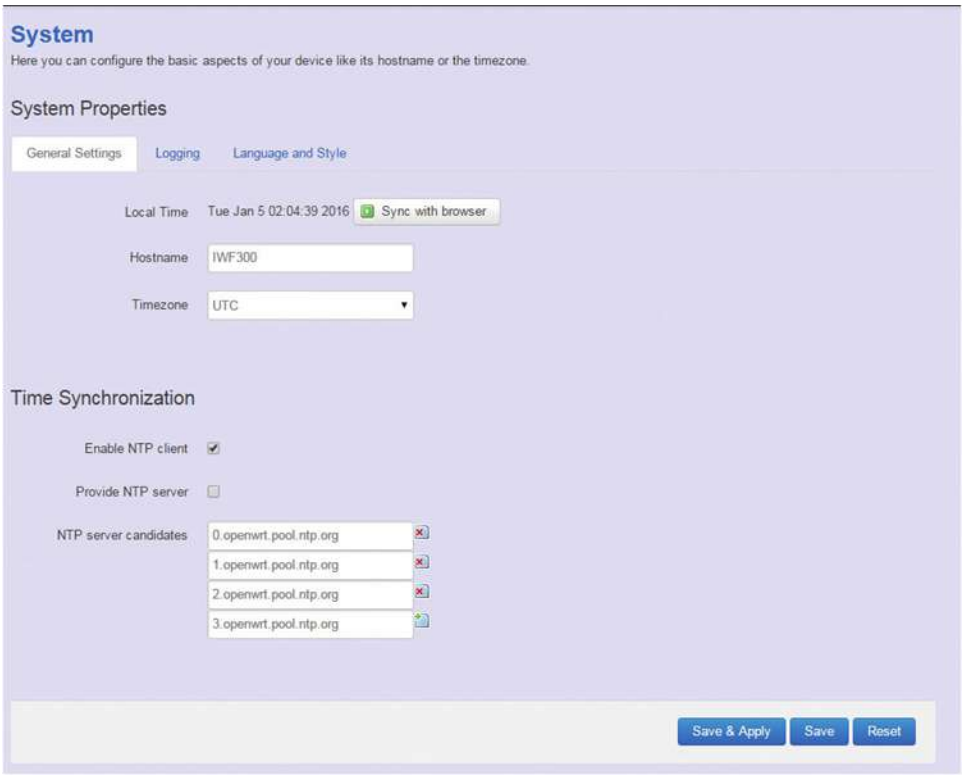
2.3.1 System

2.3.1.1 General Settings

This section provides general settings of NIO 51 including Time, Host name, Time zone and NTP.



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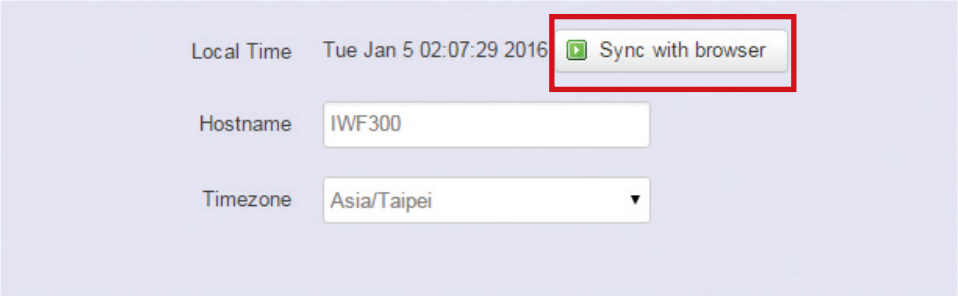
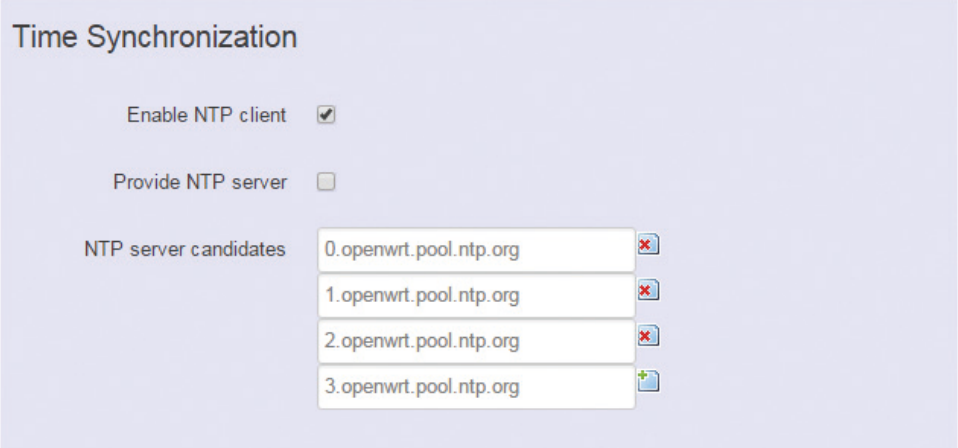
Click "Sync with browser" and let NIO 51 sync time with your current computer, then select your country from the Timezone pull-down list.



Enter the address of an SNTP server to receive time updates.



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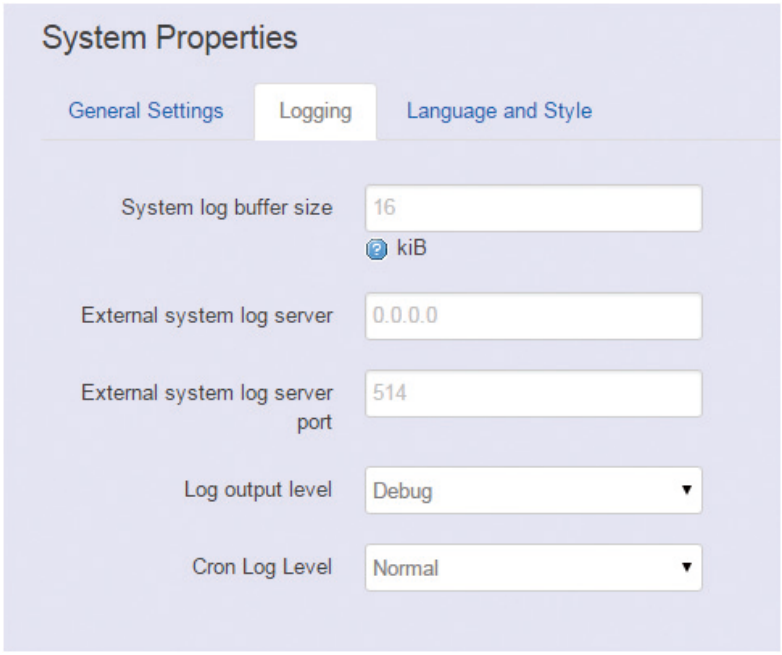
2.3.1.2 Logging

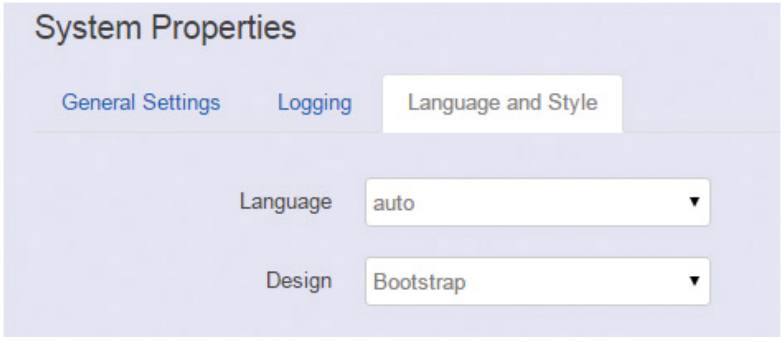
This section provides settings for log configuration.



System log buffer size: The size of log information. Unit: Kbytes.
External system log server: The server address of external log server.
External system log server port: The port number of external log server.
Log output level: The output information of log, including Debug, Info, Notice, Warring, Error, Critical, Alert, and Emergency.
Cron Log Level: The minimal level for cron messages to be logged to syslog.

2.3.1.3 Language and Style

This section provides settings for language and Web GUI style. NIO 51 only provides English as default and NEXCOM style of Web GUI.



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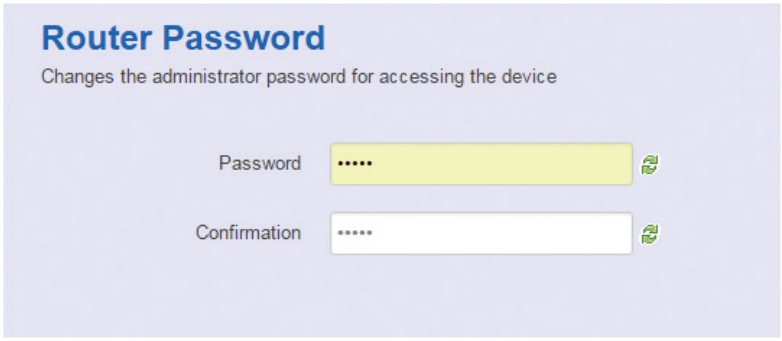
2.3.2 Administration

2.3.2.1 Router Password

To change the default password, enter the new password and confirm it.



2.3.2.2 SSH Access

Secure Shell (SSH). Enable your NIO 51 to be accessed via SSH-based application.

Interface: Select the interface.
Port: Enter the port number.
Password authentication: Enable/Disable SSH password authentication.
Allow root logins with password: Enable/Disable the root user to login with password.
Gateway ports: Enable/Disable remote hosts to connect to local SSH forwarded ports.

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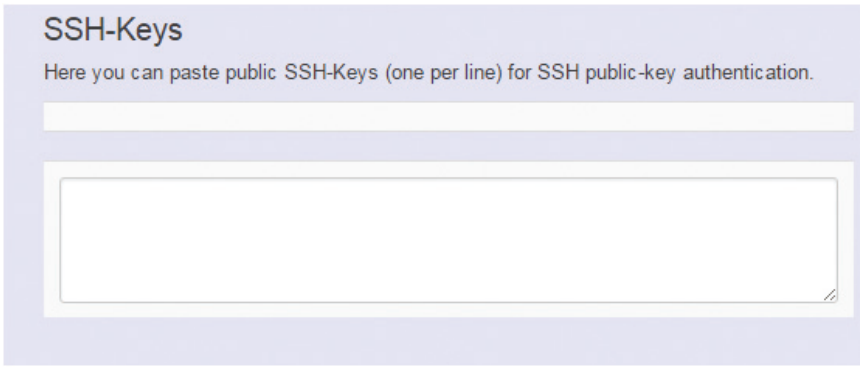
Paste public SSH-Keys (one per line) for SSH public-key authentication.



2.3.3 SNMP

R/W Community: SNMP Read-Write Community String - Used in requests for information from a device and to modify settings on that device.

R/O Community: SNMP Read-Only Community String - Enables a remote device to retrieve “read-only” information from a device.

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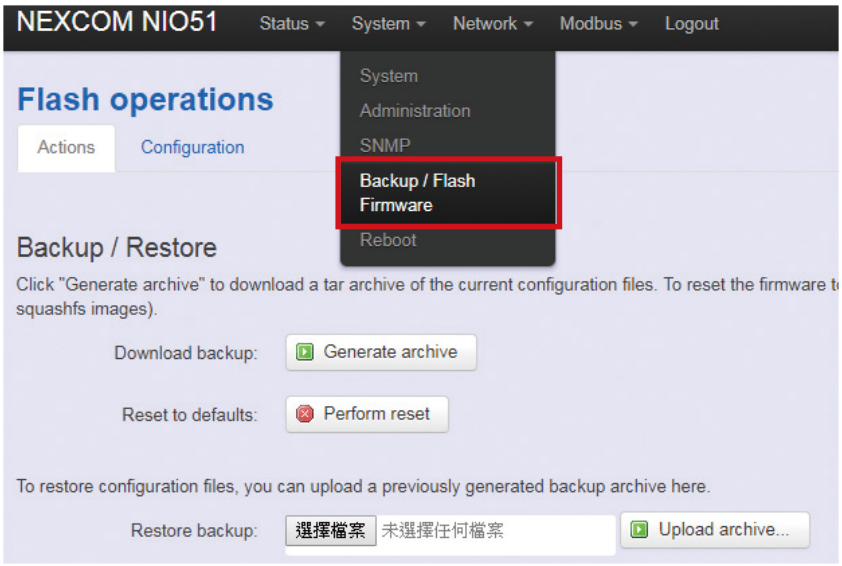
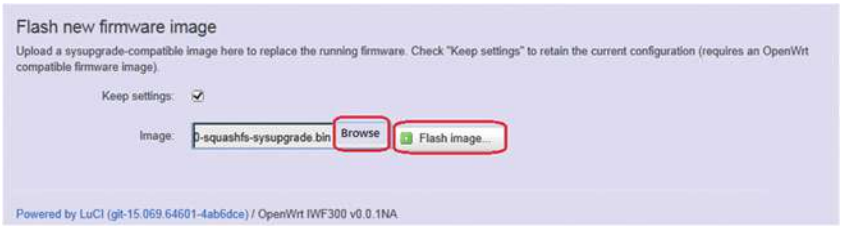
2.3.4 Backup/Flash Firmware

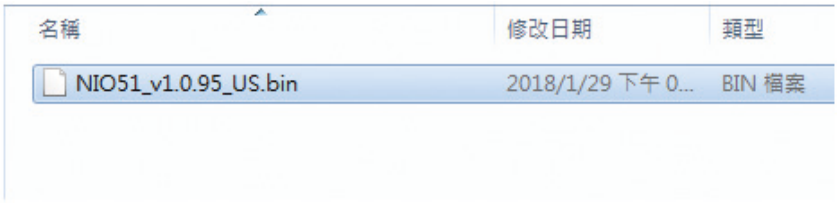
2.3.4.1 Upgrade Firmware

To upgrade a new firmware onto the device, please select "System" from the menu bar, and then select "Backup/Flash Firmware".



Please click "Browse" to select the new firmware.





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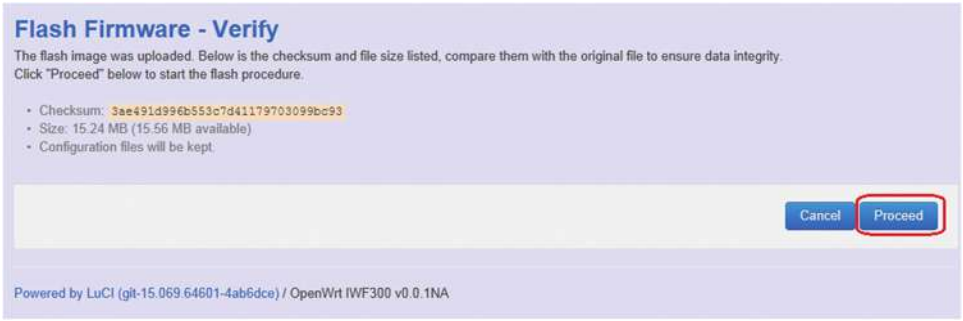
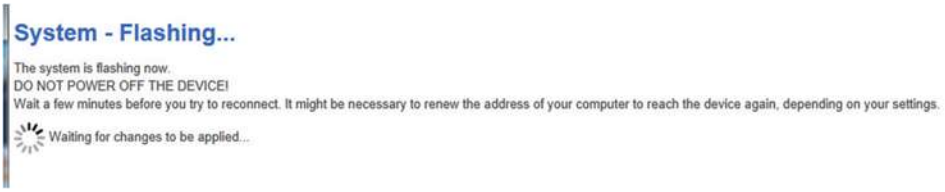
Then the GUI will display the file checksum.



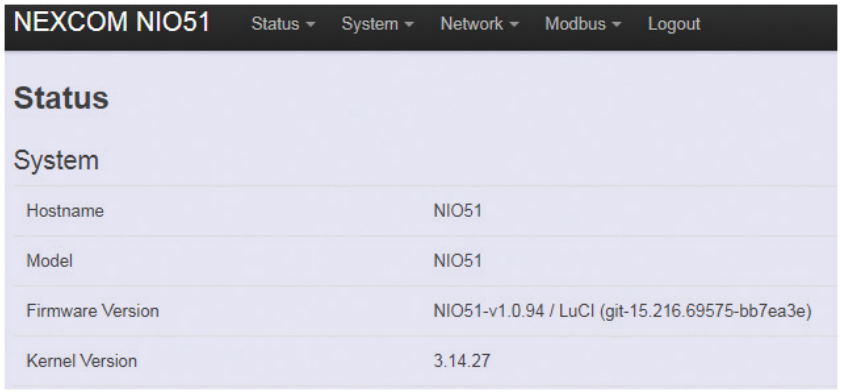
Click "Proceed" to start the upgrade process.

Note: After you click "Proceed", the DUT firmware will be upgraded with the file you selected, and the upgrade progress will be displayed like below:



Note: The whole programming might take several minutes to complete the flash writing. PLEASE DO NOT REBOOT OR POWER OFF THE DEVICE before the whole progress completes.

If the firmware upgrade is successful, the GUI should switch to the Login page.
You can also check the version via the "Firmware Version" field under the Status page.



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2.3.4.2 Backup Configuration

To backup your current configuration, please choose "System" from the menu bar, then select "Backup/Flash Firmware" and click the "Generate archive" button under the Backup / Restore section, like:

Then save it as a file in your PC.

To restore the device to your previous configuration, please choose "System" from the menu bar, then select "Backup/Flash Firmware" and click "Browse" under the section to select your previous configuration file, then click the button "Upload archive…", like:

Note: After restoring the file, the system will apply the changes and reboot automatically. Due to the settings from configuration backup, the IP address may change and you have to enter the new IP address accordingly. Otherwise, the new web page may not be accessible.

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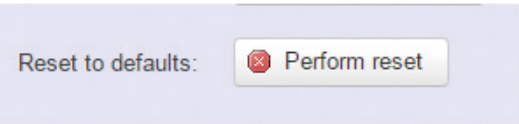
2.3.4.3 Reset to default

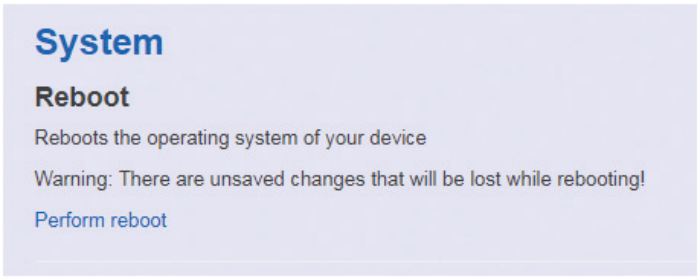
To reset NIO 51 to default settings, please click "Perform reset".



Note: The whole programming might take several minutes to complete the process. PLEASE DO NOT REBOOT OR POWER OFF THE DEVICE before the whole progress completes.

2.3.7 Reboot

Click the "Perform Reboot" button to warm start the system. After the system finishes the reboot process, it will direct back to the Login page.



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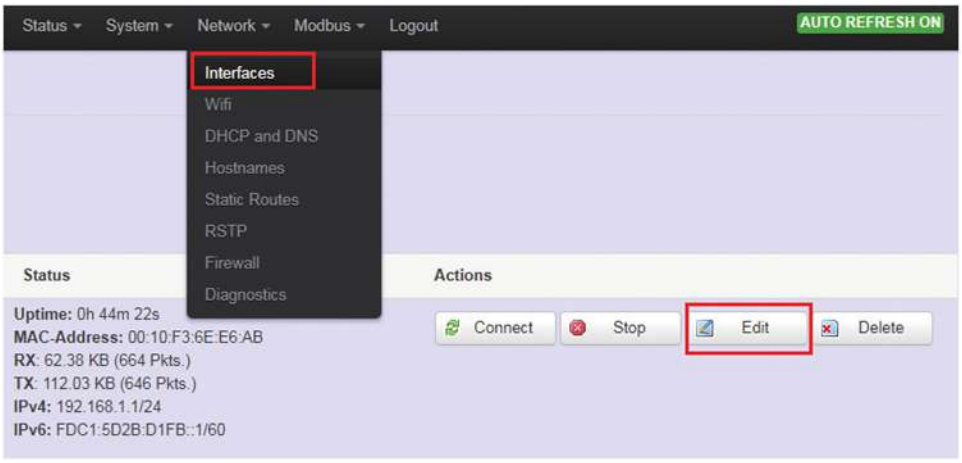
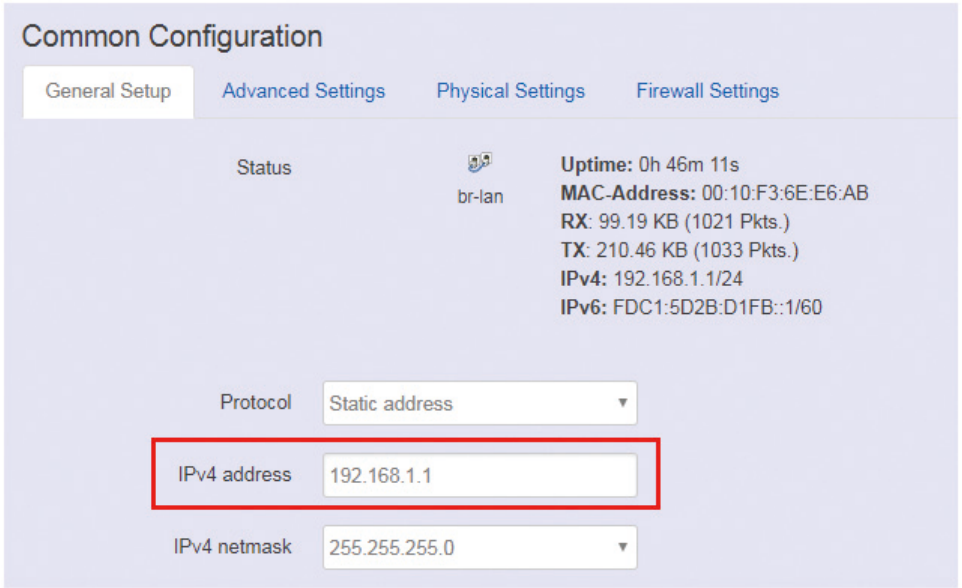
2.4 Network

2.4.1 Interfaces

2.4.1.1 Change Default IP Address

To set up a new IP address, please click "Network" from the menu bar, then select "Interfaces" and click "Edit".





Under the "IPv4 address" field, you can input the new IP address of this device, and then pull down the scroll bar to the bottom of the Web GUI page and click "Save & Apply" to save this new IP address into flash and apply it immediately.

Note: After applying new IP, it would take several minutes to switch to the Status page via the new IP address. Please enter the new IP address on the browser again if the GUI does not switch to new GUI page after 5 minutes.

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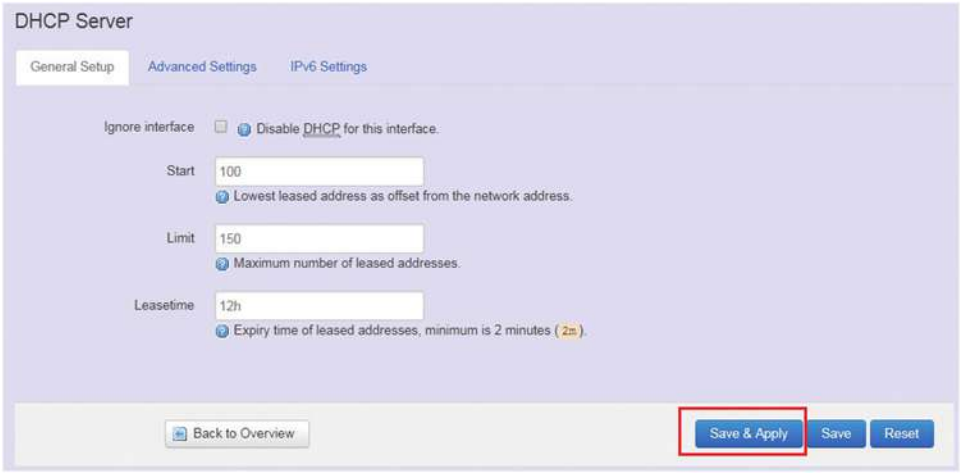

2.4.1.2 Interfaces Overview

Connect: Link this interface to the network, functions like "Save & Apply".
Stop: Disable the interface to link to the network.
Edit: Modify LAN port group settings.
Delete: Delete this interface group.

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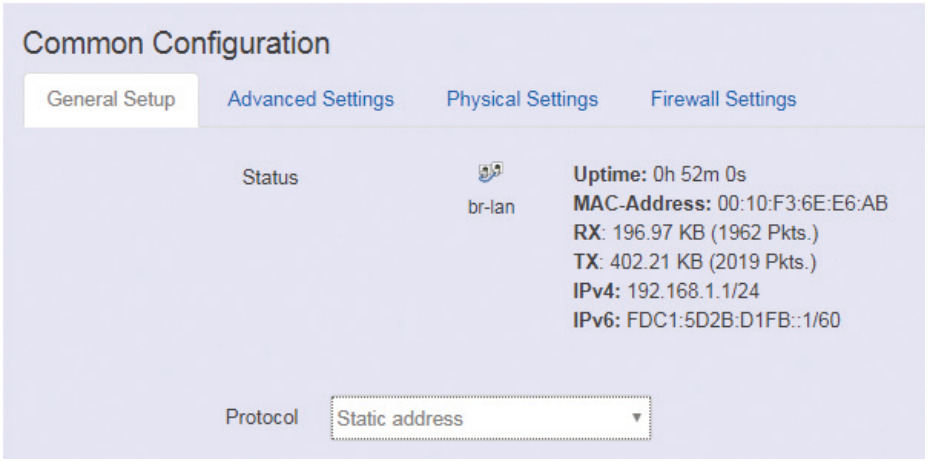
2.4.1.3 LAN Interface Overview

On this page you can configure the network interfaces. You can bridge several interfaces by ticking the "bridge interfaces" field and enter the names of several network interfaces separated by spaces.



<General Setup>

The default protocol is static address setting. It is suggested that a static IP is used for the LAN port.

Static address

Static IP (Manual): Choose this option if you do not have a DHCP server in your network, or if you wish to assign a static IP address to NIO 51.

DHCP client

When Dynamic IP (DHCP) is selected, the DHCP client will be functional once this selection is made.

Unmanaged

This interface has no configuration interface or options.

PPP

Used to provide point to point link for connecting NIO 51 to old serial modem.

PPPoE

Used for cable modem or ADSL users to link NIO 51 to your internet provider.

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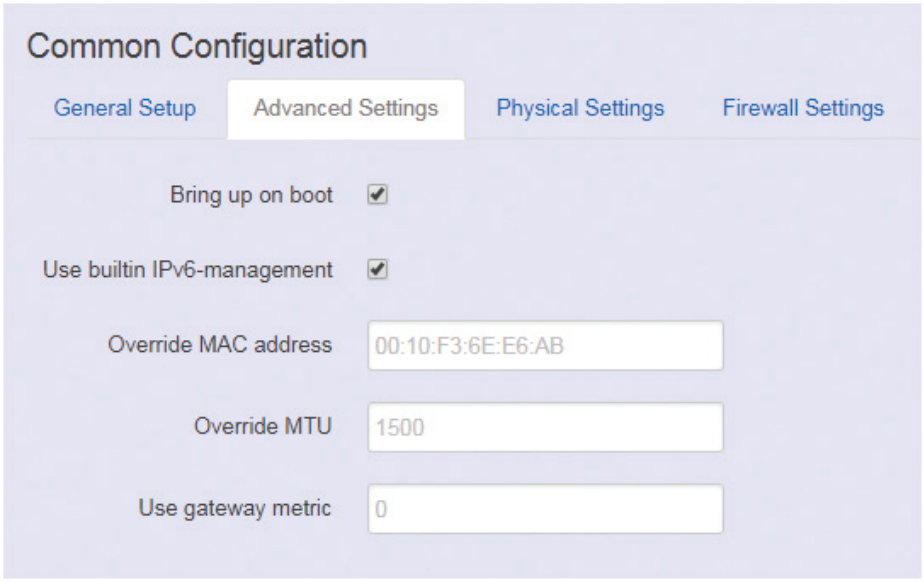
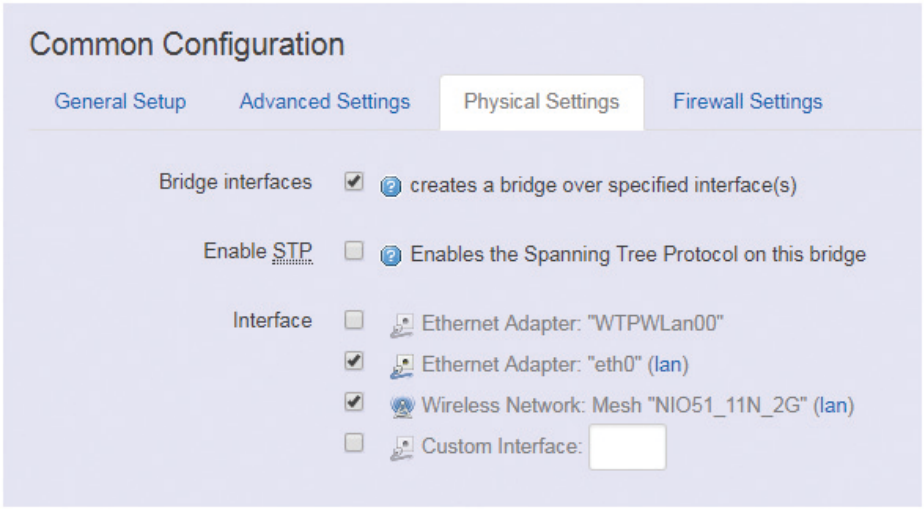
<Advanced Settings>

Advanced settings and configuration, it is advised that generic users leave the settings unchanged.



<Physical Settings>



Bridge interfaces

You can bridge an interface group for your LAN interface. After enabling bridge interfaces, select the interfaces to bridge.

Interface

Select the interfaces for your bridge group. Select both the Ethernet adapter (most likely eth0.1 or eth1) and the wireless network.

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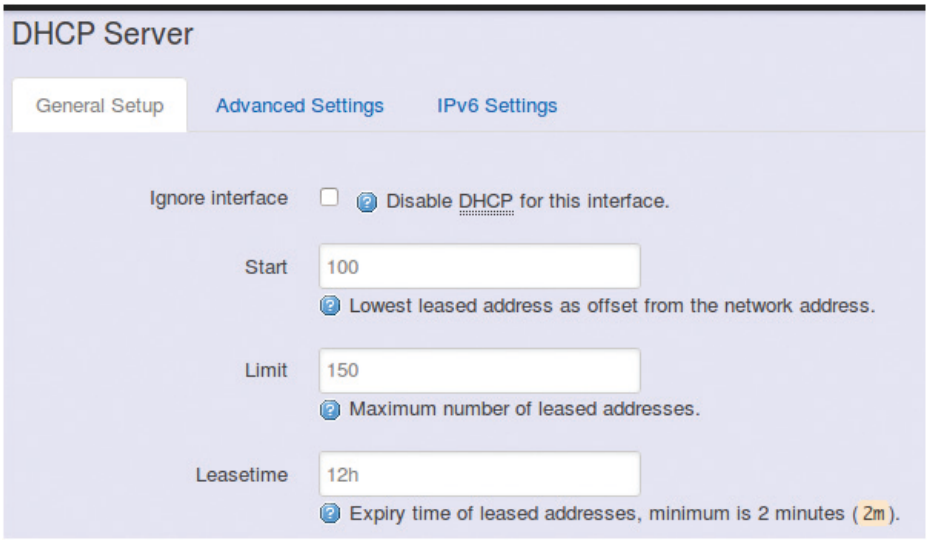
2.4.1.4 DHCP Server

<General Setup>



Ignore Interface: Select this option to disable your DHCP server, you will need a static IP or another DHCP server for your network interfaces. Default is "enable DHCP".

<Advanced Settings>

Dynamic DHCP: Dynamically allocate DHCP addresses for clients. If disabled, only clients with static leases will be served.

Force: Force DHCP on this network even if another server is detected.

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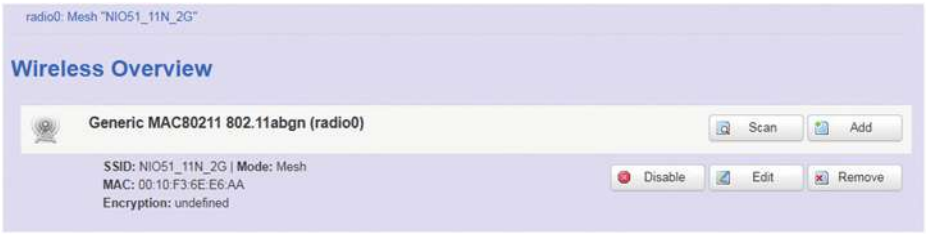
2.4.2 WiFi

2.4.2.1 Wireless Overview

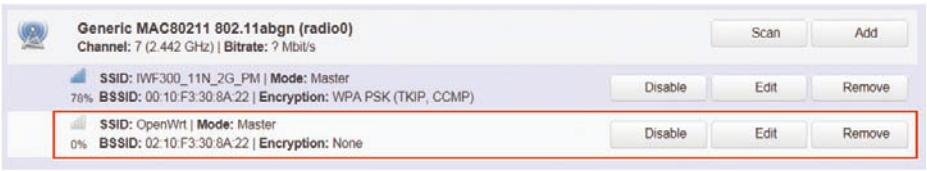


To set up the Wireless configuration, please select "Network" in the tab, then select "WiFi", which would show you the current status of radio interfaces.

Wireless Overview includes channel, SSID, MAC address and security setting information.

Scan: Scan any AP nearby the Radio, we can check how many APs are nearby this AP and avoid using the same channel.

Add: Add a new virtual AP in the same radio interface. You will see the new interface after clicking "Add".



Disable: Disable the radio interface.
Edit: Configure the radio interface.
Remove: Remove radio interface. Please note that the radio must be disabled first when you don't want to use the radio interface.

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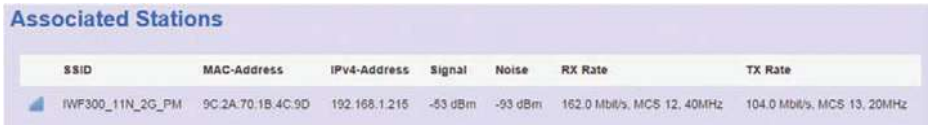
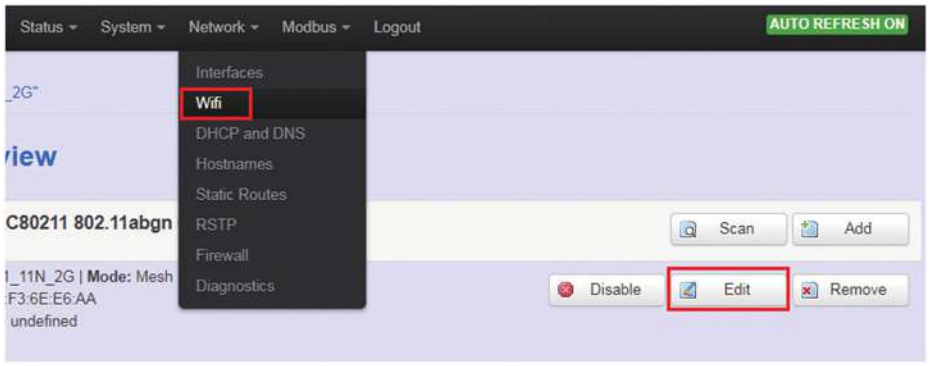
2.4.2.2 Associated Stations

Associated stations show wireless client connection information. It includes the SSID, MAC/IP address, RSSI signal strength and Tx/Rx rate of the wireless client connected.

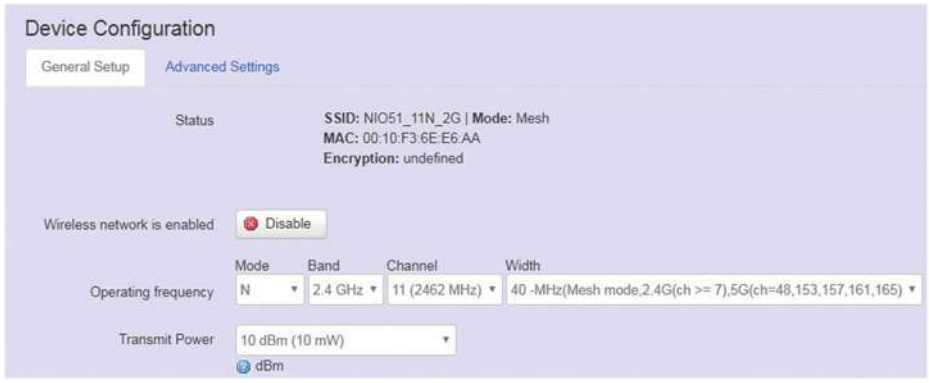


2.4.2.3 Wireless Configuration

Please select "Network" -> "Wifi" and click Edit to configure wireless settings.



The **Device Configuration** section covers physical settings of the radio hardware such as channel, transmit power and so forth.



<General Setup>

Wireless network is enabled: Enable or disable the radio interface.

Operating frequency: Select radio frequency and channel bandwidth for signal transmission.

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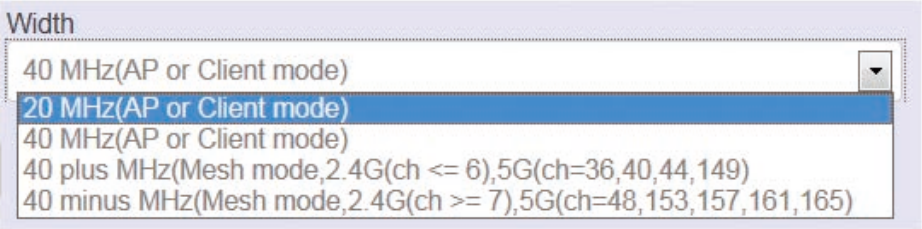
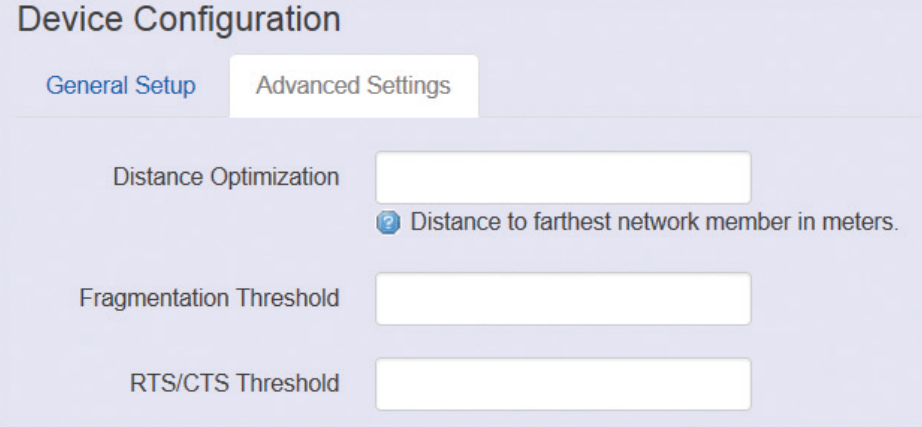
For channel bandwidth, please note you need to confirm AP/client mode or mesh mode and the channel you will use.



Transmit Power: Select the transmit power of a radio.

<Advanced Settings>



Distance Optimization: Specify the ACK timeout by entering the value manually. ACK timeout can be entered by defining the link distance. A value too short for the ACK timeout may cause transmission time out and no packets can be received. A value too long may cause low throughput rate.

Fragmentation Threshold: Default=off. Specify the Fragmentation threshold by entering the value manually [300-2346 bytes]. This is the maximum size for a packet before data is fragmented into multiple packets. Setting the Fragmentation threshold too low may result in poor network performance. Only minor modifications of this value are recommended.

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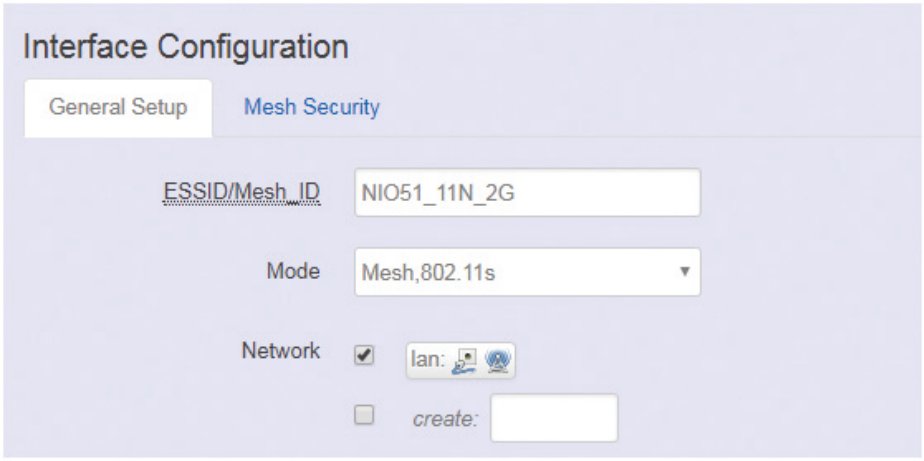
RTS/CTS Threshold: Default=off. RTS/CTS (Request to Send / Clear to Send) is the optional mechanism used by the 802.11 wireless networking protocol to reduce frame collisions introduced by the hidden node problem. RTS/CTS is an additional method to implement virtual carrier sensing in Carrier sense multiple access with collision avoidance (CSMA/CA). Specify the RTS threshold by entering the value manually [0-2346 bytes]. Typically, sending RTS/CTS frames does not occur unless the packet size exceeds this threshold.

The **Interface Configuration** section covers SSID operation mode and encryption.



<General Setup>
ESSID: Edit the SSID. The default SSID for radio0 is NIO51_11N and default SSID for radio1 is NIO51_11N_2G.
Mode: Select the operation mode:

- Client Router
- 802.11s (Mesh mode)

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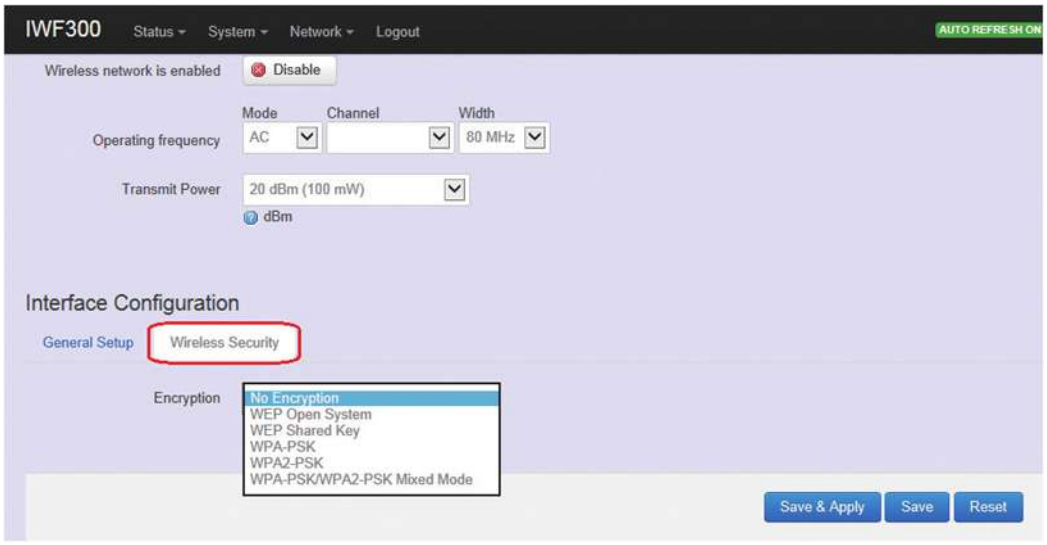
<Wireless Security>



Encryption: To setup the Security on Radio, please select one of the Encryption method:

- No Encryption
- WEP Open System: WEP provides a basic level of security, preventing unauthorized access to the network. WEP uses static shared keys that are manually distributed to all clients that want to use the network.
- WEP Shared Key: WEP provides a basic level of security, preventing unauthorized access to the network, and encrypting data transmitted between wireless clients and an access point. WEP uses static shared keys that are manually distributed to all clients that want to use the network.
- WPA-PSK: Clients using WPA for authentication.
- WPA2-PSK: Clients using WPA2 for authentication.
- WPA-PSK/WPA2-PSK Mixed Mode: Clients using WPA or WPA2 for authentication.

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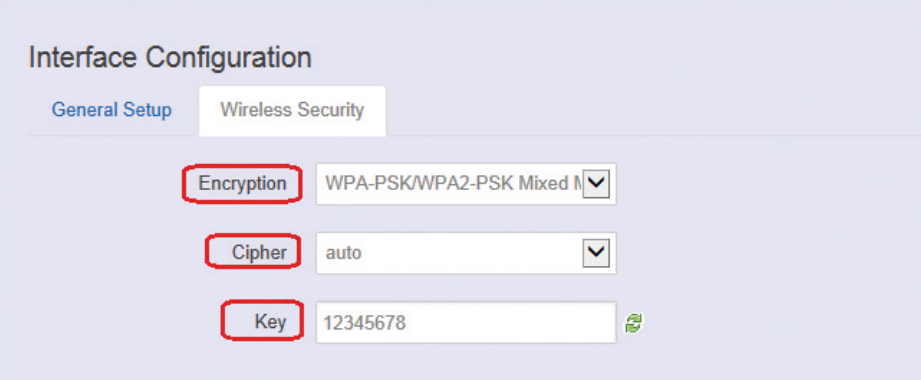
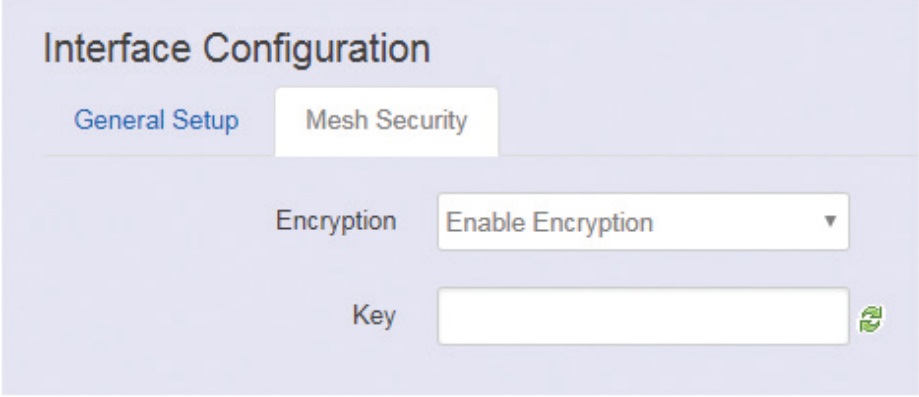


Cipher: It is recommended to select TKIP and CCMP (AES).

- Force CCMP (AES)
- Force TKIP
- Force TKIP and CCMP (AES)

The cycle icon will display the characters you just input.

For mesh security, please input the same shared key for each mesh device.



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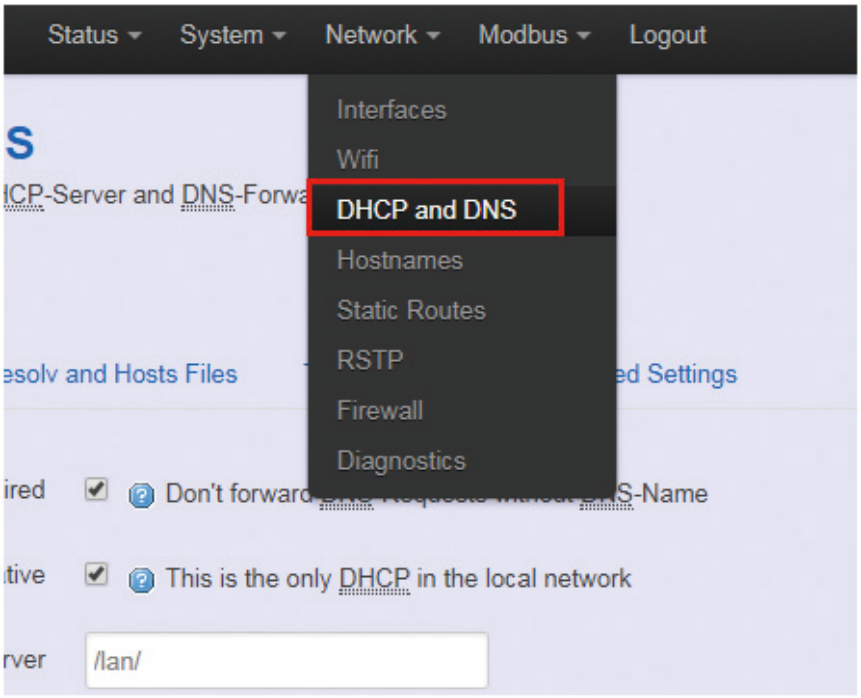
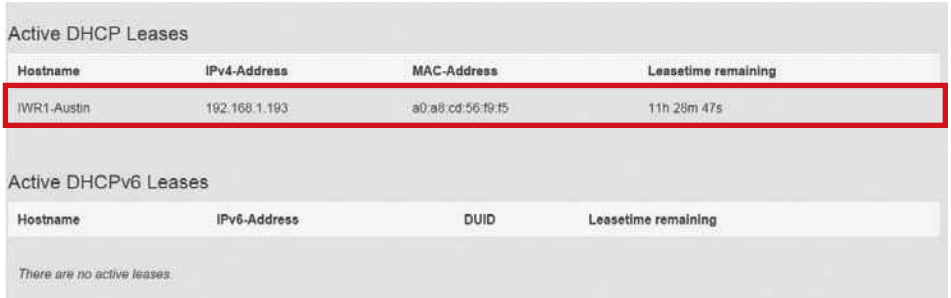
2.4.3 DHCP and DNS

A combined DHCP-Server and DNS-Forwarder for NAT firewall is provided in NIO 51.

Click "Network" -> "DHCP and DNS" in the GUI menu. The "DHCP and DNS" page will appear. There are four categories of settings or lease status: "Active DHCP Leases", "Active DHCPv6 Leases", "Static Leases", and "Server Settings".



Scroll to the following screen in the "DHCP and DNS" window.



This screen displays the lease information to which DHCP server assigns automatically, including **Hostname**, **IP address**, **MAC address** (or **DUID**), and Remaining Lease-time (DUID stands for the DHCP Unique Identifier). Please look at the frame in red above.

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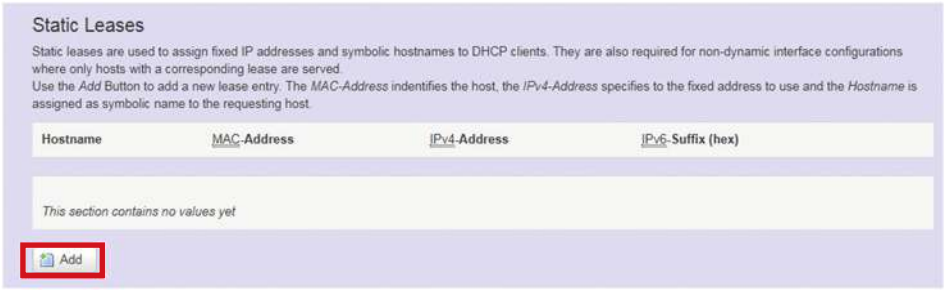
The next category that users can scroll to is "Static Leases" as follows.

Static leases are used to assign fixed IP addresses and symbolic hostnames to DHCP clients by calculating MAC-Address. They are also required for non-dynamic interface configurations where only hosts with a corresponding lease are served.



Add: Add a new lease entry.
After clicking the "Add" button, a new entry with 4 blank input boxes will appear. Allow users to fill in the information such as the MAC-**Address** (identifies the host), the IPv4-**Address** (specifies the fixed address to use) and the **Hostname** (is assigned as symbolic name to the requesting host).

Delete: Delete the followed entry.

Scroll to the screen identified as "Server Settings" category.
There are 4 tabs to select more options for DHCP and DNS services in NIO 51.

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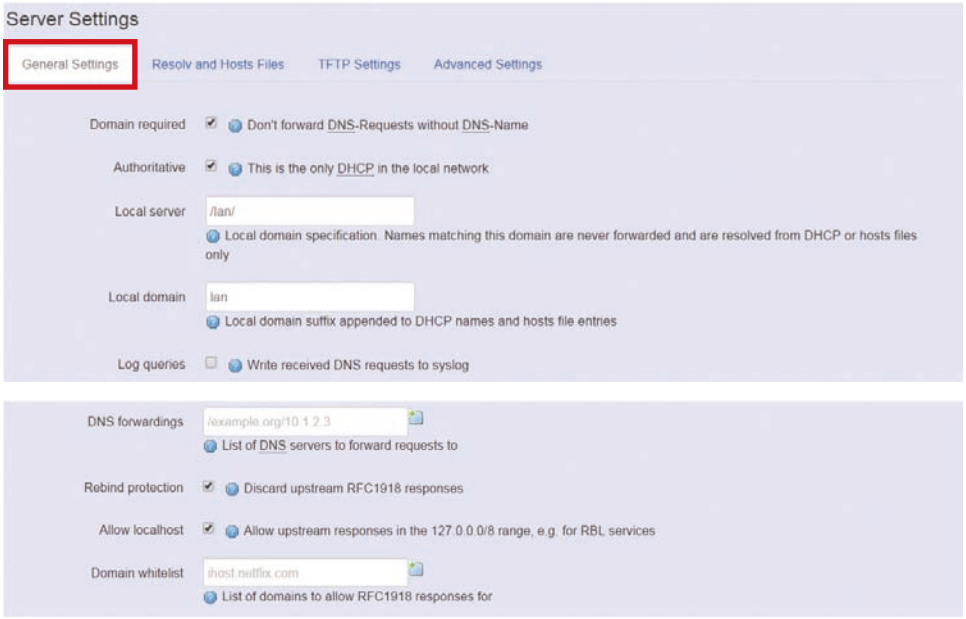
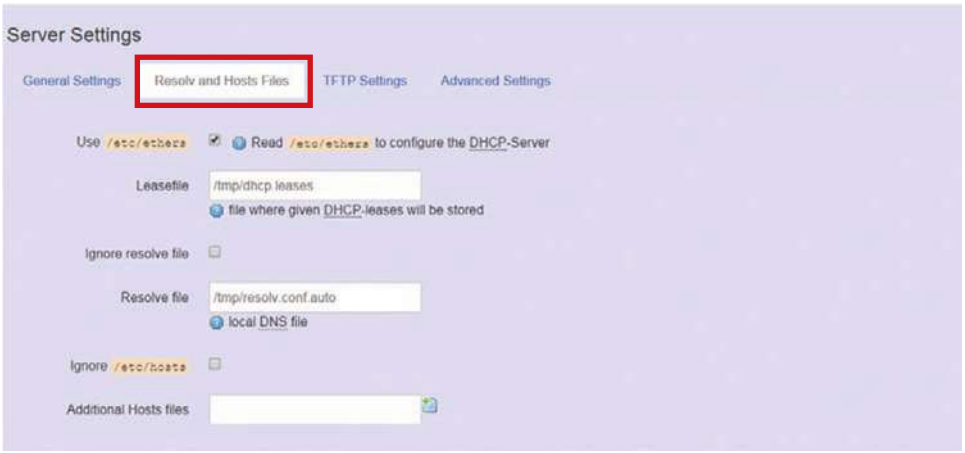
<General Settings>

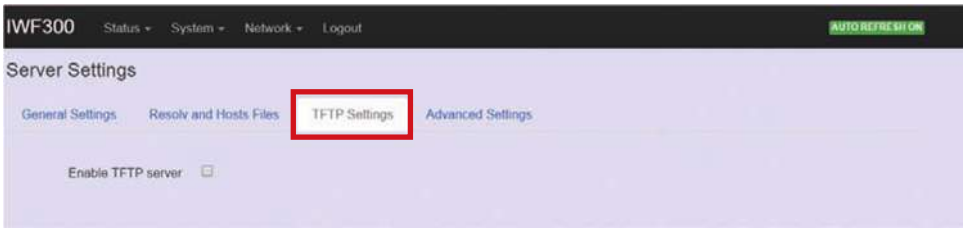


Domain required: Default value is checked.
Authoritative: Default value is checked.

<Resolve and Hosts Files>



<TFTP Settings>



By default, TFTP server is not enabled.

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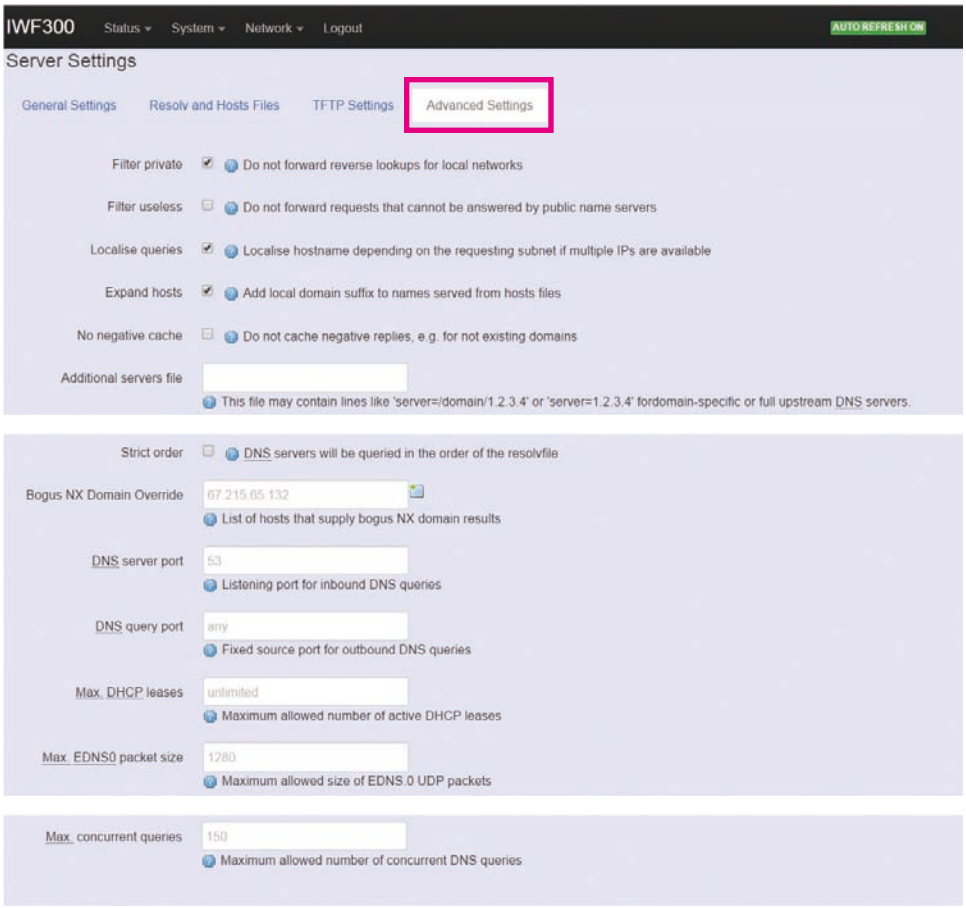
<Advanced Settings>



Max. DHCP Leases: Default value is unlimited.
Max. concurrent queries: Default value is 150.

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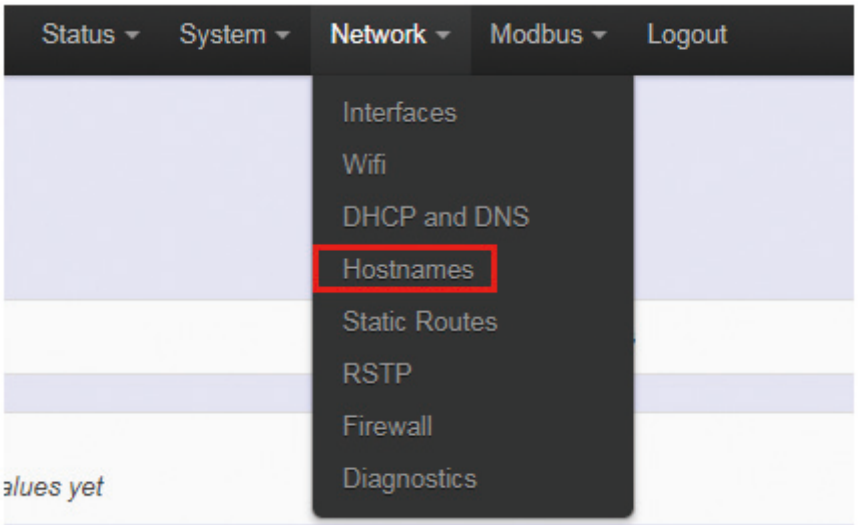
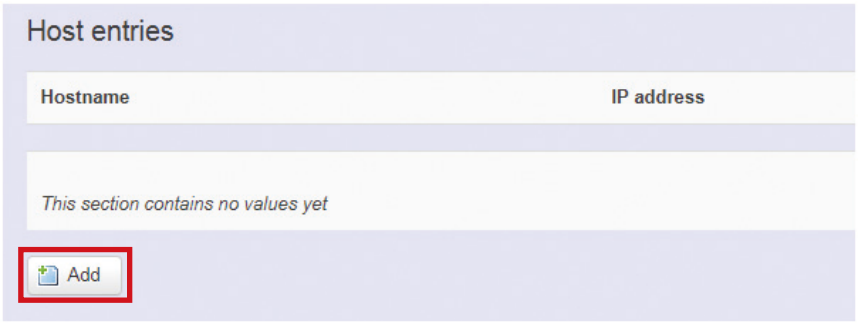
2.4.4 Hostnames

Clicking the "Network" -> "Hostnames" in the GUI menu will bring up the "Hostnames" page.



For devices that do not have hostname or do not resolve automatically, a hostname-IP paired to a specific device must be assigned.



Add: Create a host entry (hostname-IP pair) for a specific device.

(For example, **Hostname** => "Test-Device"; **IP address** =>"192.168.1.251")

Delete: Delete the followed host entry.

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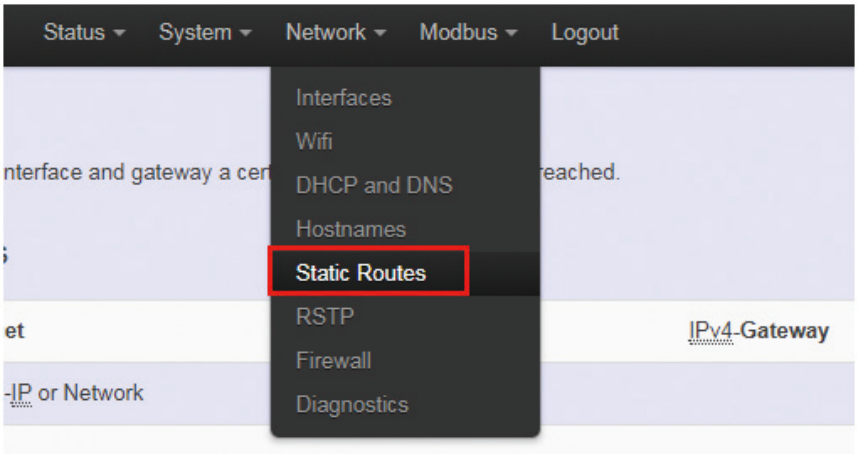
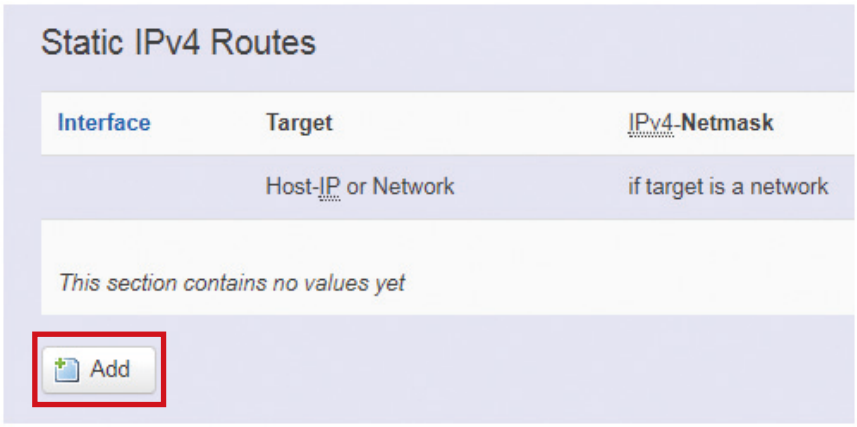
2.4.5 Static Routes

Clicking "Network" -> "Static Routes" in the GUI menu will bring up the "Routes" page for two categories: "Static IPv4 Routes" and "Static IPv6 Routes".

Static routes specify the interface and gateway which certain host or network can be reached over. Such pair (interface and gateway) is called a route.



For IPv4 network, scroll down to the "Static IPv4 Routes" screen as follows.



Add: Add an entry for a route to an IPv4 network or host.

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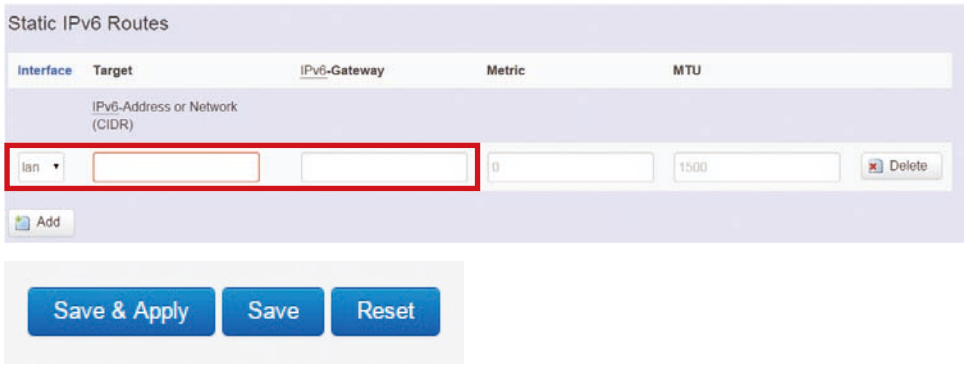
For example: Target network = 192.168.10.0;
Netmask = 255.255.255.0; NIO 51 WAN IP = 192.168.0.1;
The route to be assigned will be "wan" for interface and "192.168.0.253" for gateway.
Leave "Metric" and "MTU" field to default values as 0 and 1500 respectively.

Delete: Delete a followed route entry.

For IPv6 network, scroll down to the "Static IPv6 Routes" screen as follows.

Add: Add an entry for a route to an IPv6 network or host.

Clicking the "Add" button will show the following entry.



Clicking the "Save & Apply" button will activate the entries.

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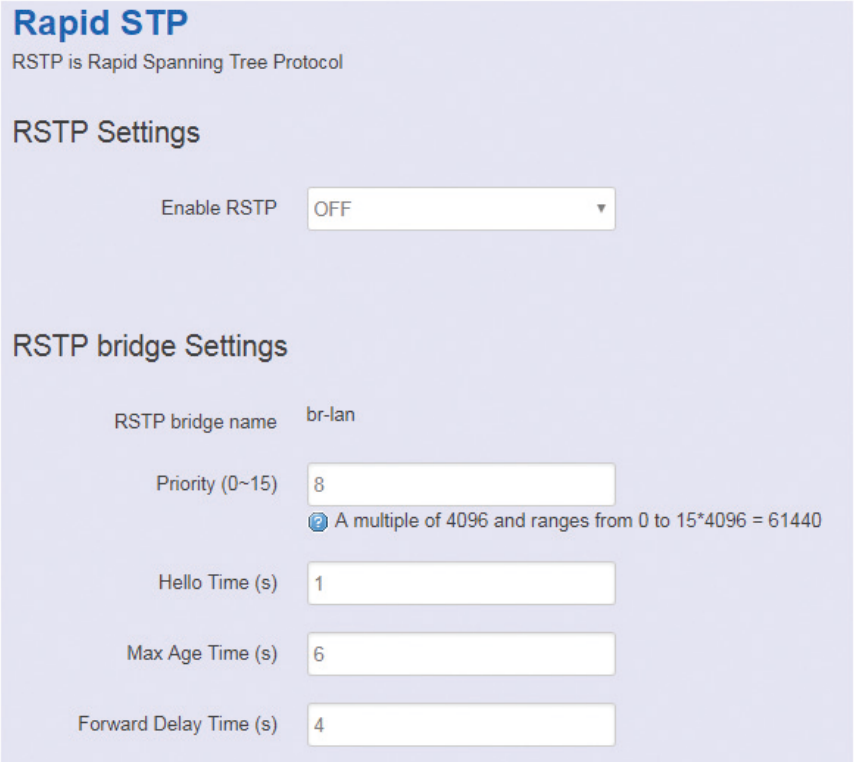
2.4.6 RSTP

Normally, when an AP LAN port connects to a LAN switch, enabling RSTP is required. For NIO 51, RSTP is not required.

Click "Network" -> "RSTP" in the GUI menu, and navigate to the RSTP page for configuring RSTP attributes in NIO 51.



Priority: Used to decide which switch is the root bridge. The smaller the value; the higher the Priority. If switch has same Priority, compare MAC address. Root bridge can decide Hello Time, Max Age, Forwarding Delay of the entire network.

Hello Time: The hello time is the time between each bridge protocol data unit (BPDU) that is sent on a port. This time is equal to 1 second by default.

Max Age Time: Cannot receive BPDU in specified max age time, system will re-establish RSTP topology. This time is 6 seconds by default.

Forward Delay Time: The forward delay is the time that is spent in the listening and learning state. This time is equal to 4 seconds by default.

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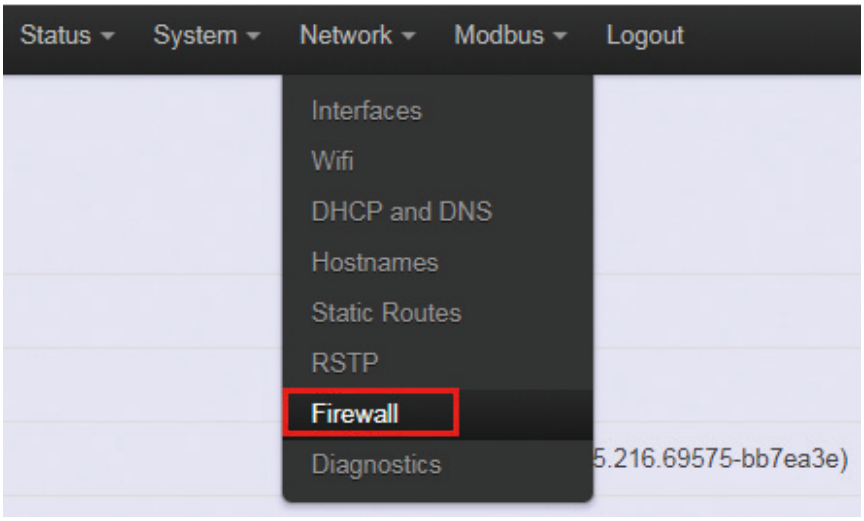
2.4.7 Firewall

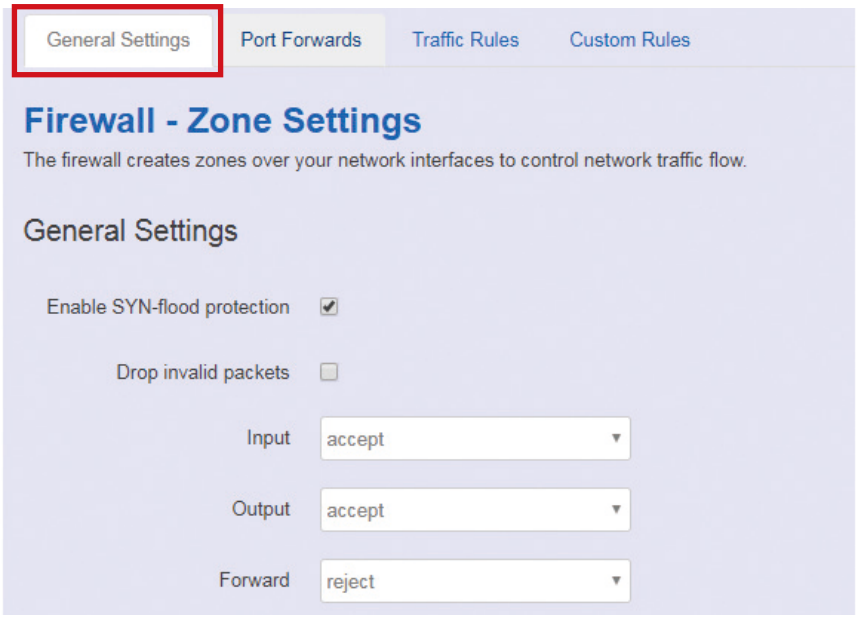
Click "Network" -> "Firewall" in the GUI menu, and navigate to the firewall attributes configuration page.



<General Settings>

Clicking the "General Settings" tab on the top of the screen will show the "Zone Settings" configuration including "General Settings" and "Zones" categories.

In the "General Settings" category, there are 5 basic options for traffic control over interfaces:
"Enable SYN-flood protection" (default: enabled), "Drop invalid packets" (default: disabled), "Input" (default: accept), "Output" (default: accept), and "Forward" (default: reject).



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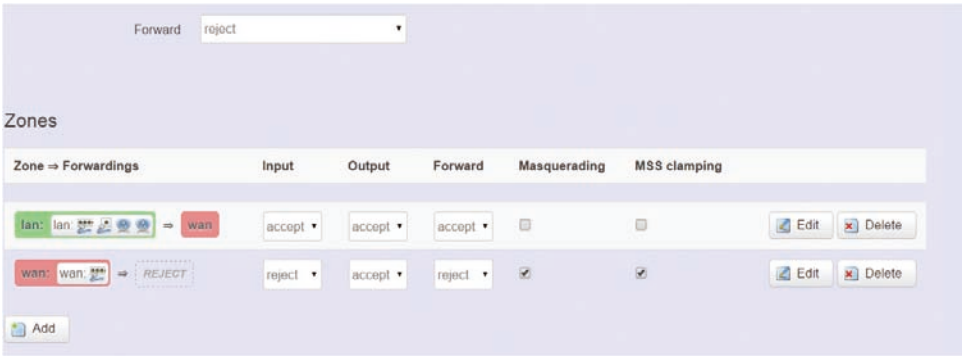
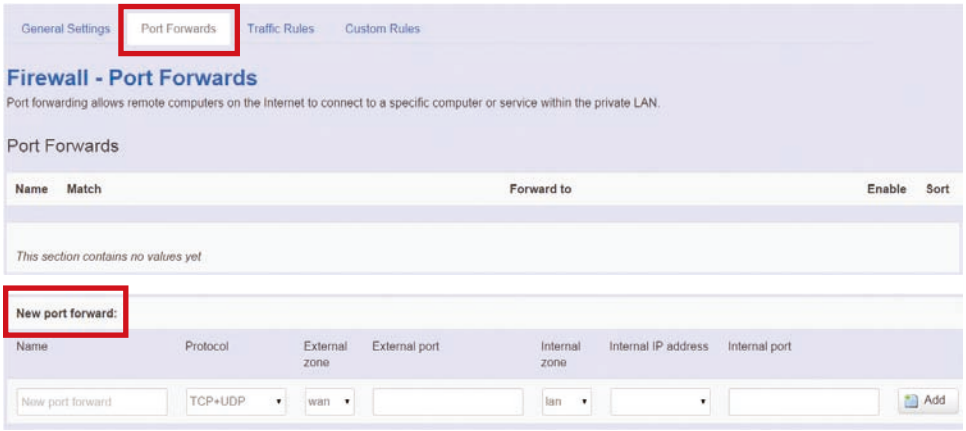
In the "Zones" category, create or edit zones over your network interfaces to control network traffic flow.



There are 3 control buttons for "Zones" settings:
Edit: Edit the followed flow entry.
Delete: Delete the followed flow entry.
Add: Create a new entry for traffic flow among zones over interfaces.

<Port Forwards>
Clicking the "Port Forwards" tab on the top of the screen will show the tables for port forwarding. Adding or editing a specific forwarding table allows remote computers on the internet to connect to a specific computer or service within the private LAN.



In the "New port forward" category, there is only one button for flow editing:
Add: Create a new flow entry for port forwarding among zones.

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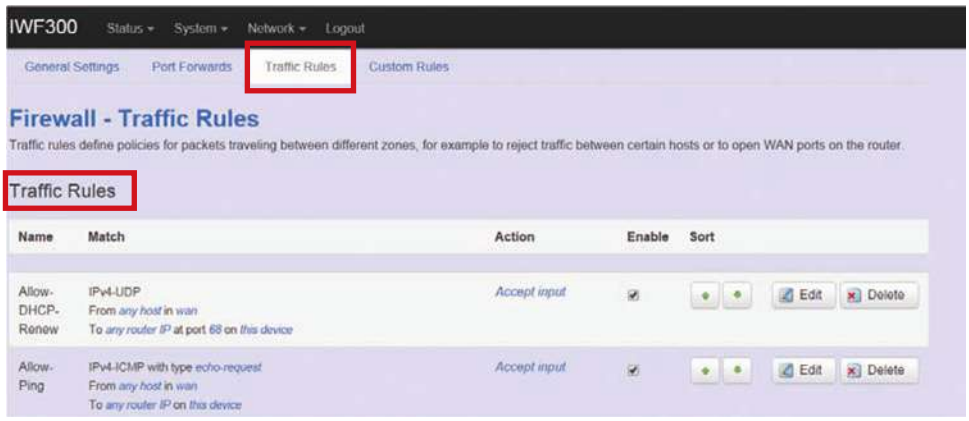
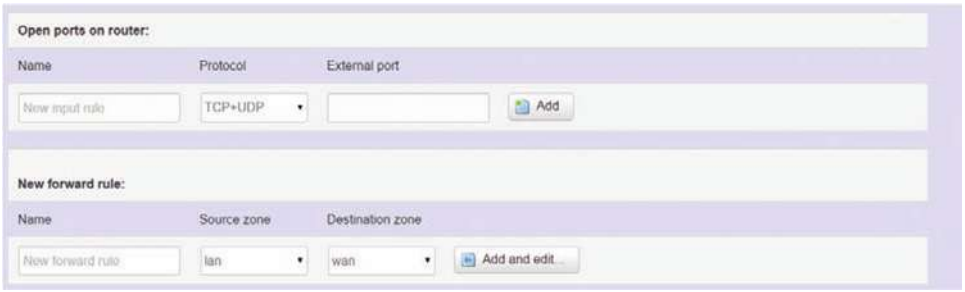
<Traffic Rules>

Clicking the "Traffic Rules" tab on the top of the screen will bring up the policy tables of 2 categories: "Traffic Rules" and "Source NAT".



In the "Traffic Rules" category, the flow entries of traffic rule define policies for packets traveling between different zones (for example, to reject traffic between certain hosts or to open WAN ports on the router).



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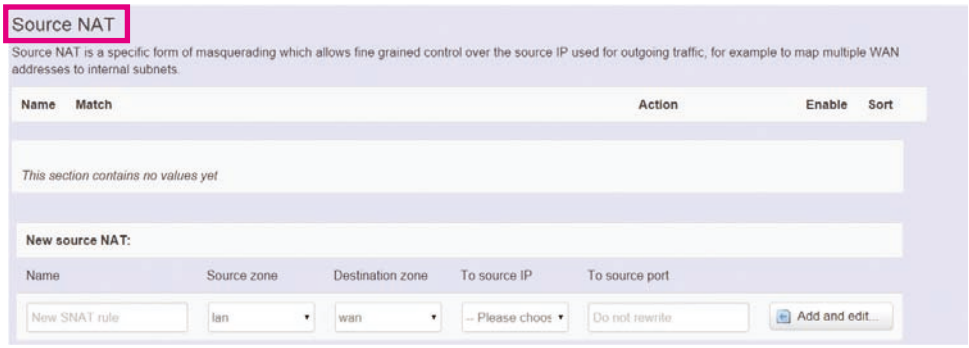
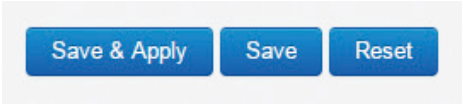
In "Source NAT" category, specific flow entries of masquerading that allow fine grained control over the source IP used for outgoing traffic (for example, to map multiple WAN addresses to internal subnets) can be added or edited.



Add and edit: Create a new entry with default values, and edit at once if required.

Please remember to click the "Save & Apply" button to activate the new settings.



<Custom Rules>

Custom rules allow you to execute arbitrary iptables commands which are not otherwise covered by the firewall framework. The commands are executed after each firewall re-start, right after the default rule-set has been loaded.

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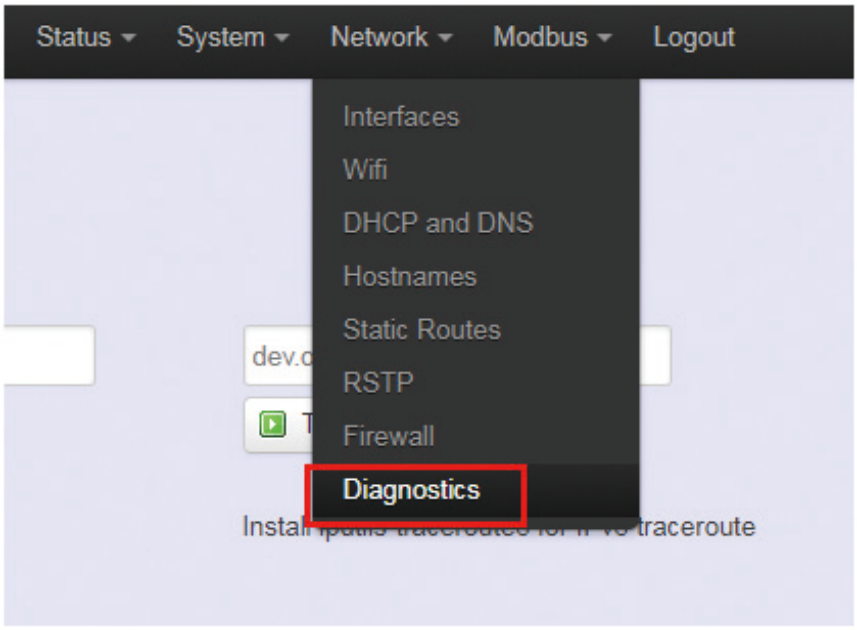
2.4.8 Diagnostics

Click "Network" -> "Diagnostics" in the GUI menu, and navigate to the "Diagnostics" web page.



In this page, there are 3 utilities for users to diagnose interface settings and network paths: Ping, Traceroute, and Nslookup.

Ping: Test the reachability of a host on an Internet Protocol (IP) network and measure the round-trip time for messages sent from the originating host to a destination host and back. The only required parameter is the name or IP address of the destination host.

Traceroute: Track the route packets taken from an IP network on their way to a given destination host. The only required parameter is the name or IP address of the destination host.

Nslookup: Query the Domain Name System (DNS) to obtain domain name or IP address mapping.

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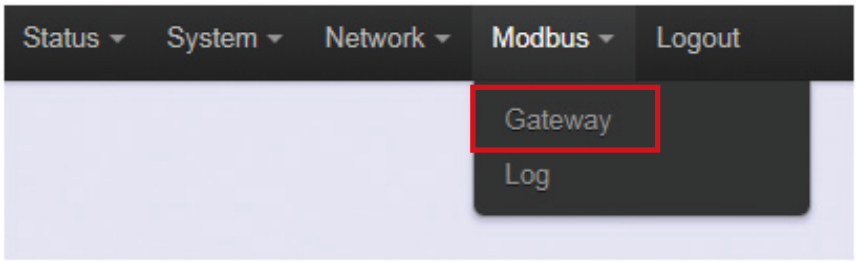
2.5 Modbus

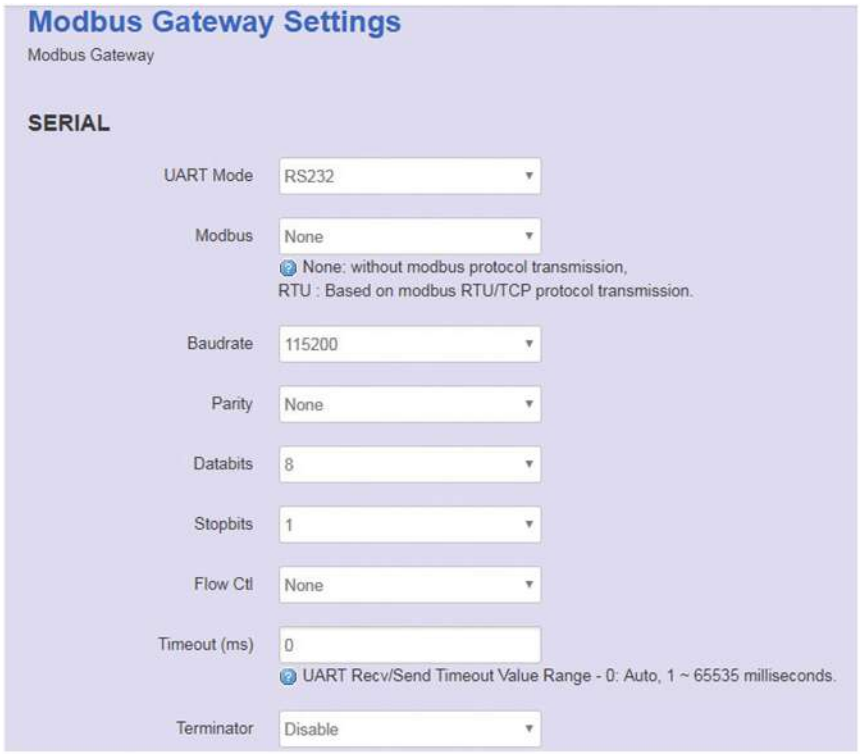
Configuration for serial and Modbus/RTU settings. For serial to Ethernet or wireless data transmission, NIO 51 supports TCP server or TCP client mode to connect control server.

2.5.1 Gateway

Please select "Modbus" -> "Gateway" to configure serial and Modbus/RTU.



<Serial and Modbus/RTU Setting>



UART mode: Select RS-232 or RS-422 or RS-485.
Model: Select "None" for RS-232/RS-422/RS-485 and select "RTU" for Modbus/RTU.
Baudrate: 300 bps to 961200 bps.

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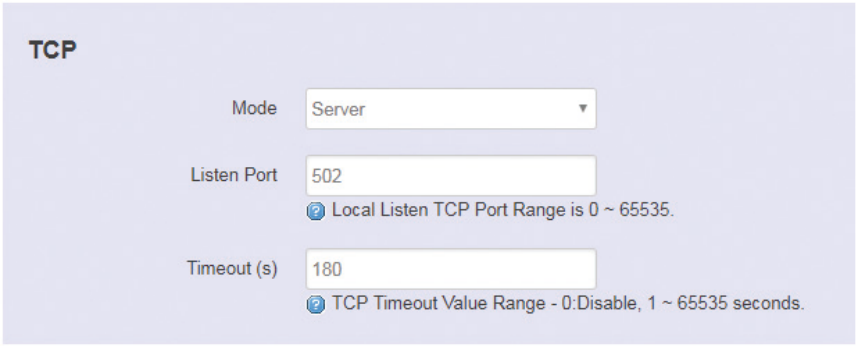
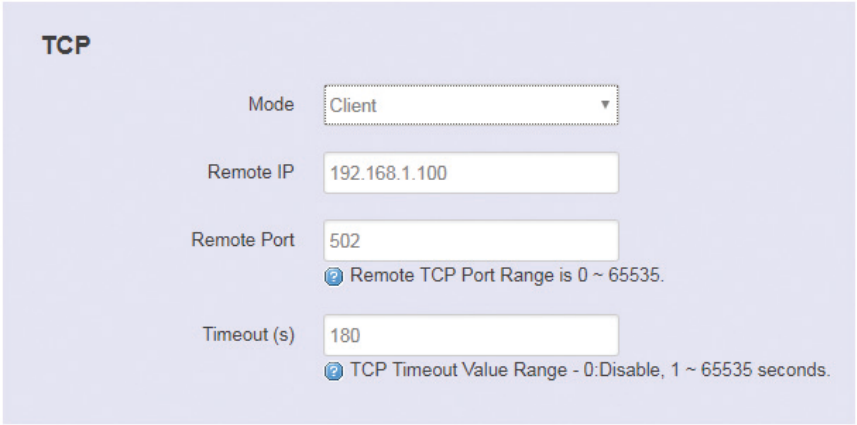
Parity: None, Odd, Even.
Databit: Data bits 8.
Stopbit: Stop bits 1
Flow Ctl: None, RTS/CTS, XON/XOFF
Timeout: This field specifies how long NIO 51 will wait for a response before ignoring the Modbus/RTU request.

- 0: Auto
- 1 ~ 65535 milliseconds: If the serial device does not respond within the specified time, NIO 51 will ignore the Modbus/RTU request.

Terminator: You may need to add termination resistors in some critical RS-485 environments to prevent the reflection of serial signals. NIO 51 built-in 120 Ω and termination resistor can be enabled.

<TCP and Modbus/TCP Setting>





Mode: Select TCP client or TCP server mode.
Listen Port: Configure listen port for TCP server mode.
Remote IP: This field specifies the remote host that will access the device.

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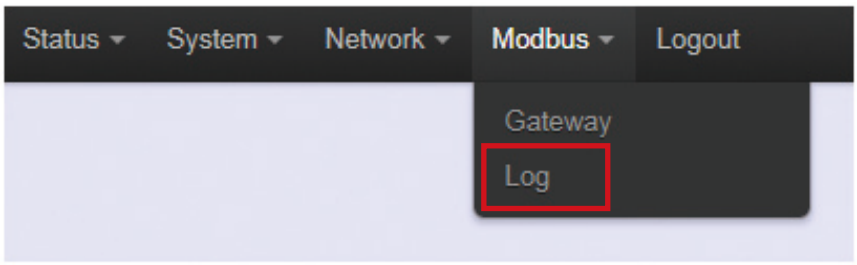
Remote Port: This field specifies the remote host TCP port that will access the device.
Timeout: This field specifies how long NIO 51 will wait for a response before closing the TCP connection.

- 0: Disable. The TCP connection will remain open even if there is no response packet.
- 1 ~ 65535: If the remote host does not respond to the packet within the specified time, NIO 51 will close the existing TCP connection.

2.5.2 Log

Please select "Modbus" -> "Log" to check the log.



The logs include Serial/Modbus configuration changes, sending and receiving of serial data and TCP connection.

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Chapter 3: Product Specification

Wi-Fi Radio
- IEEE 802.11a/b/g/n, 2x2 MIMO

Serial Interface
- RS232/422/485 with isolation
  - Data bits: 8
  - Stop bits: 1
  - Parity: none, even, odd
  - Baud rate: 300bps ~ 921.6Kbps

Ethernet Interface
- 10/100Mbps

Power Requirements
- Input voltage: 12~48VDC, 2-pin removable terminal block
- Input current: 1.5A@12VDC

LED Indicator
- 1 x Power/status
- 1 x Serial status
- 3 x RSSI indicator
- 1 x Wi-Fi 2.4/5GHz indicator
- 1 x Link/Act indicator
- 1 x Extension module

Factory Default/Reset Button
- Press reset button 10 seconds for factory default

Connector Type
- DC input: Phoenix contact terminal block
- Ethernet: RJ-45 connector
- Serial signal: DB9

Wi-Fi Operating Mode
- EZ Mesh
- Client router

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Wi-Fi Security (Client Mode)

- WEP (64/128)
- WPA/WPA2 mixed
- WPA2-personal (PSK+CCMP/AES), WPA2-enterprise

Protocol

- Modbus TCP
- Modbus RTU
- Transparent mode for serial to Wi-Fi/Ethernet

Serial Port Characteristics

- Flow control: XON/XOFF, RTS/CTS
- Serial data log: 64KB
- Offline port buffering: 20MB
- Min. concurrent TCP client number: 10

Software Watchdog

Dimension

- 81.4 x 122.6 x 35 (W x D x H) (mm)

Weight: 450g

Mounting

- Wall mounting
- DIN mounting

Construction

- SGCC chassis with fanless design

Certification

- EMI: FCC, CE Class A
- RF
  - FCC: Part 15C
  - CE: EN300328, EN301893
- EN 62368-1 (pending)
- EMC
  - EN301 489-1/17, FCC Part 15 subpart B, EN55032/55024
  - IEC61000-4-2: level 4
  - IEC61000-4-4: level 4
  - IEC61000-4-5 Surge: level 3

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Environment

- Operating temp: -40°C ~ 70°C
- Storage temp: -40°C ~ 85°C
- Relative humidity: operating 5% ~ 95%, non-condensing
- RoHS compliant
- Vibration
  - Random: 2Grms @ 5~500Hz, IEC60068-2-64
  - Sinusoidal: 2Grms @ 5~500Hz, IEC60068-2-6
- Shock: 50G, half sine, 11ms, IEC60068-27

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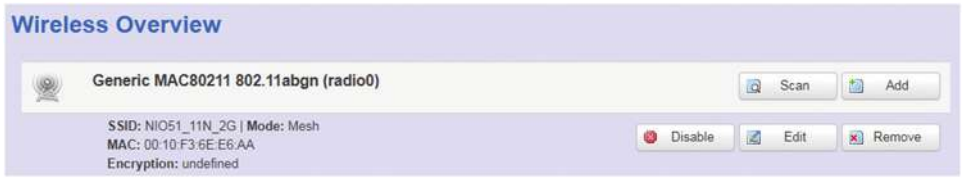
Chapter 4: Configuration Example

4.1 How to Configure 5G Mesh

Step 1. In the "Network" -> "Wifi" page, press the "Edit" button.

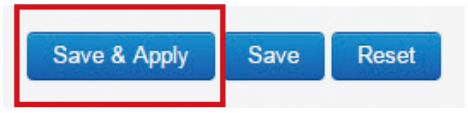


Step 2. Select the 5G channel. Mode = **Mesh 802.11s**

Step 3. If your 5G channel is 36, 40, 44, 149, select the 40MHz (Only for mesh mode… ch=36, 40, 44, 149) option.

If your 5G channel is 48, 153, 157, 161, 165, select the 40MHz (Only for mesh mode… ch=48, 153, 157, 161, 169) option.

Step 4. Press the "Save & Apply" button.



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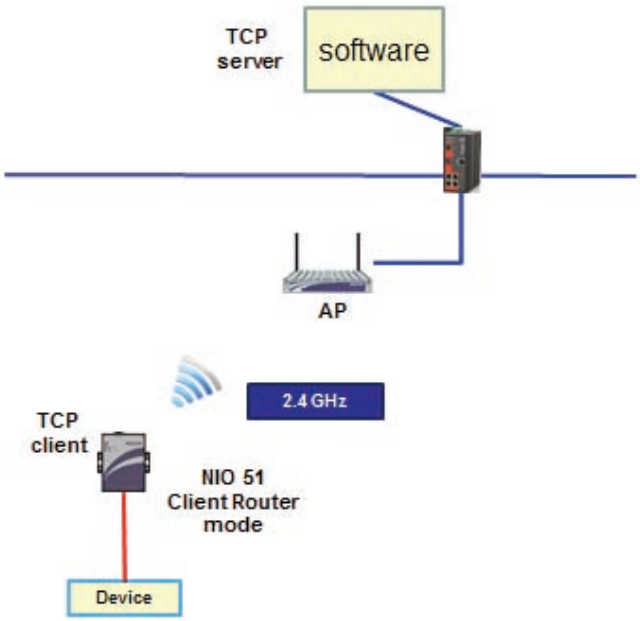
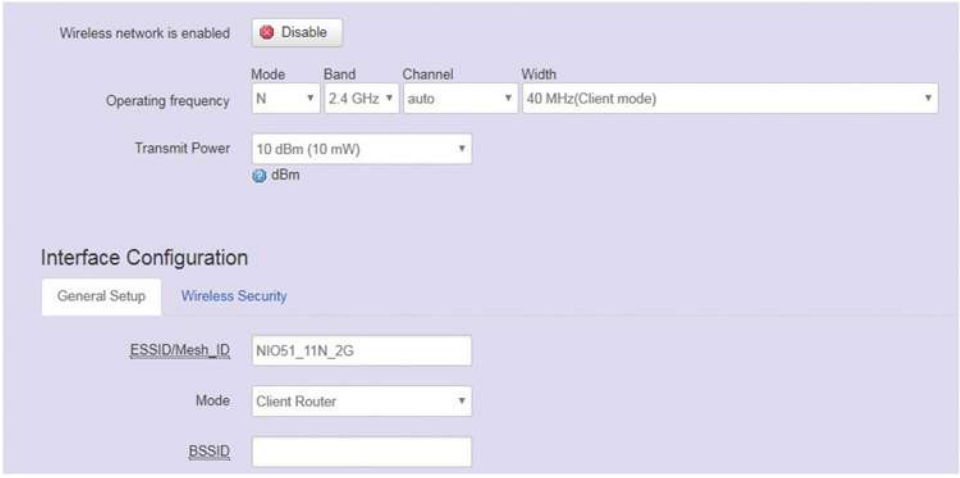
4.2 How to Configure 2.4G Client Router

Network Infrastructure Example



Step 1. Please select "Network" -> "Wifi" and click Edit.

Step 2. Configure Channel SSID and "Client router" mode.
For channel setting, you can select "auto" to scan the channel automatically or you can select the channel if you already know the AP channel that you want to connect.



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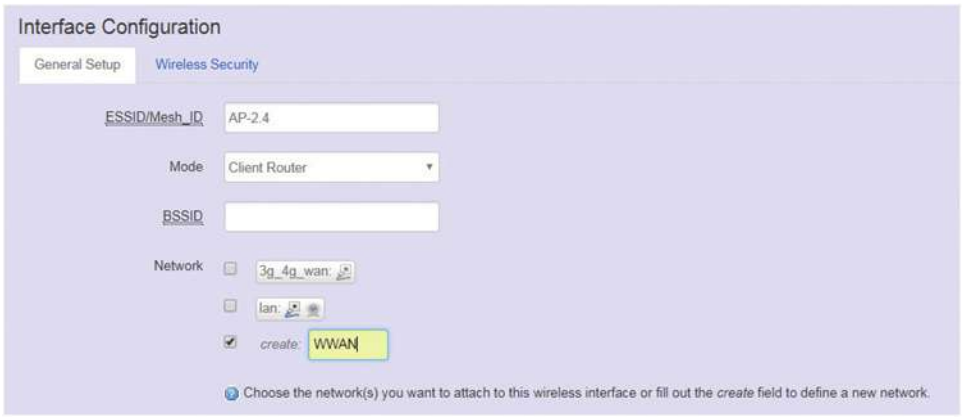
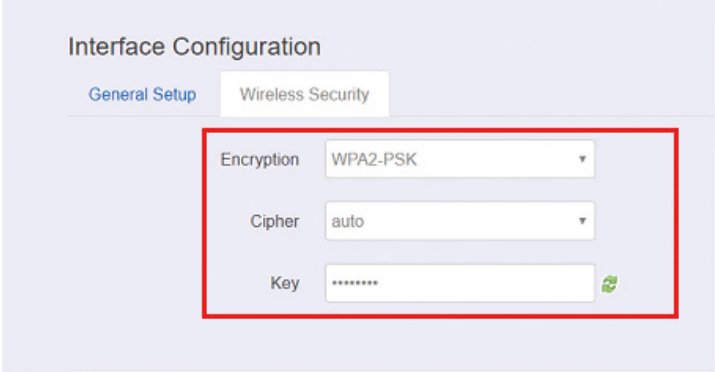
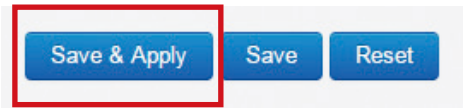
Step 3. For Network, click "create" and enter WWAN (Wireless WAN) in the text field, then add new network interface.



Step 4. Configure the WPA2 password.



Step 5. Press the "Save & Apply" button.



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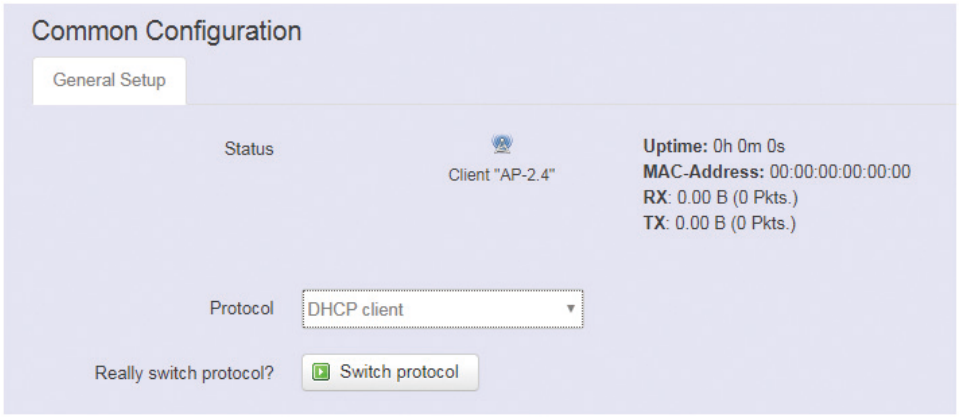
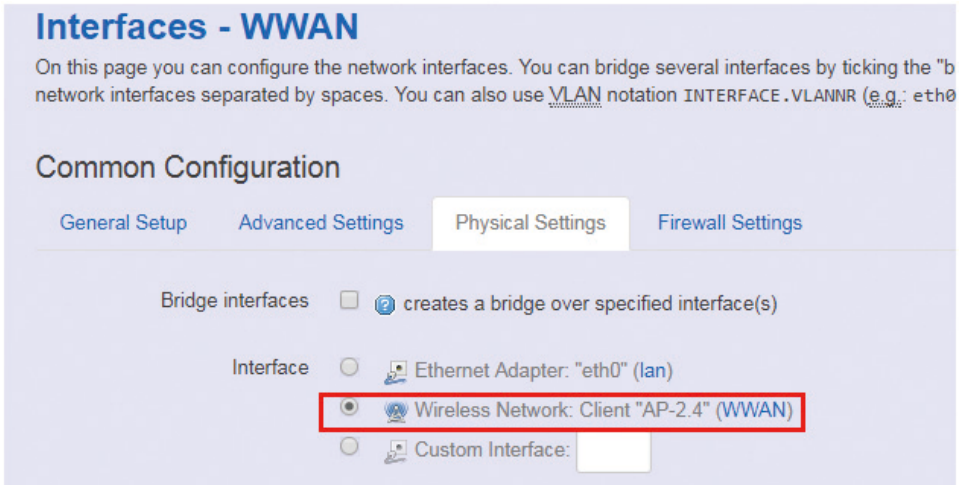
4.3 Configure WWAN Interface Setting

Step 1. Please select “Network” -> “Interface” and click WWAN Edit.

Step 2. It is suggested that DHCP client is selected if your AP has DHCP server function. Click “Switch protocol” to switch the DHCP client mode for WWAN interface.



Step 3. Because WWAN interface is used for AP connection, please make sure that Wireless Network is selected in the “Physical Settings” tab.



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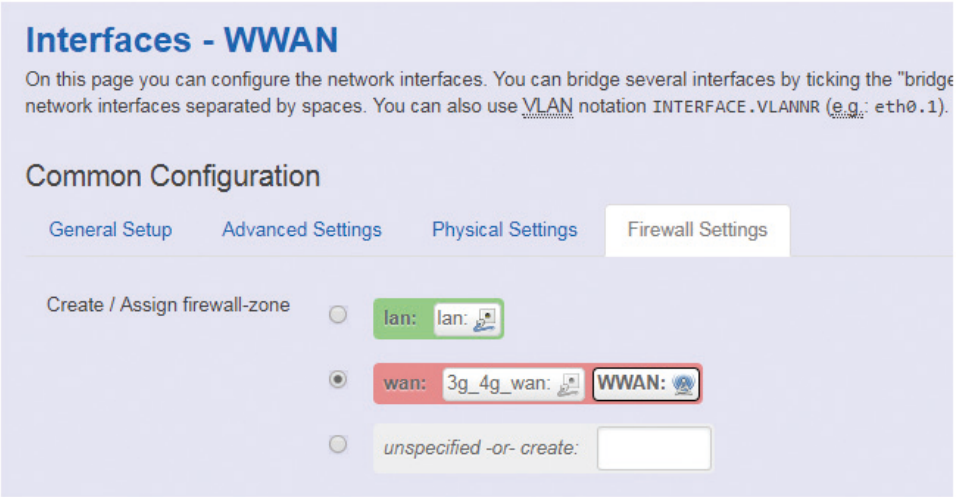
Step 4. You can enable firewall for the WWAN interface or select "unspecified" to disable firewall.



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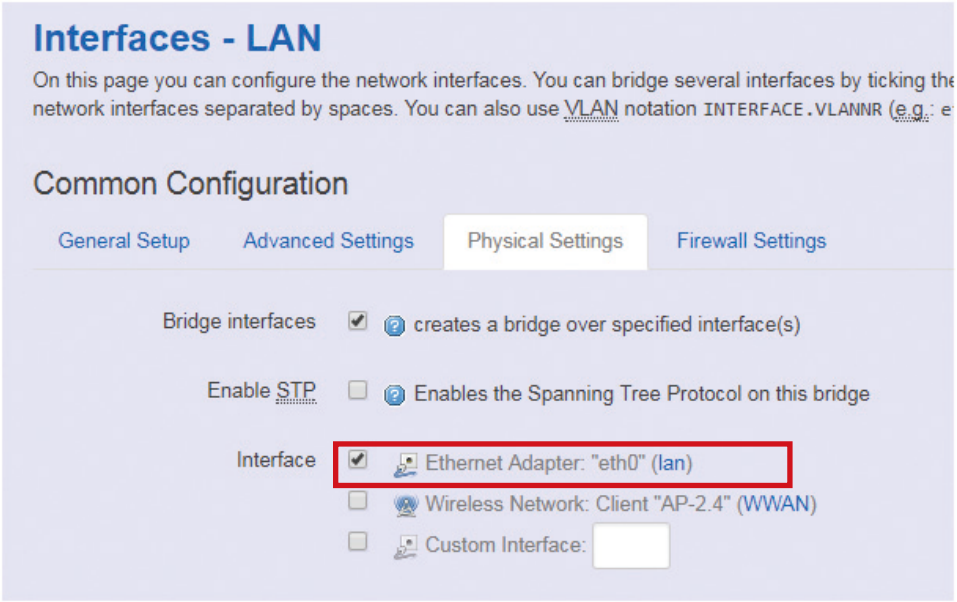
4.4 Configure LAN Interface Setting

Step 1. Please select "Network" -> "Interface" and click LAN Edit.

Step 2. Because LAN interface is used for device LAN connection, please make sure that Ethernet Adapter is selected in the "Physical Settings" tab.



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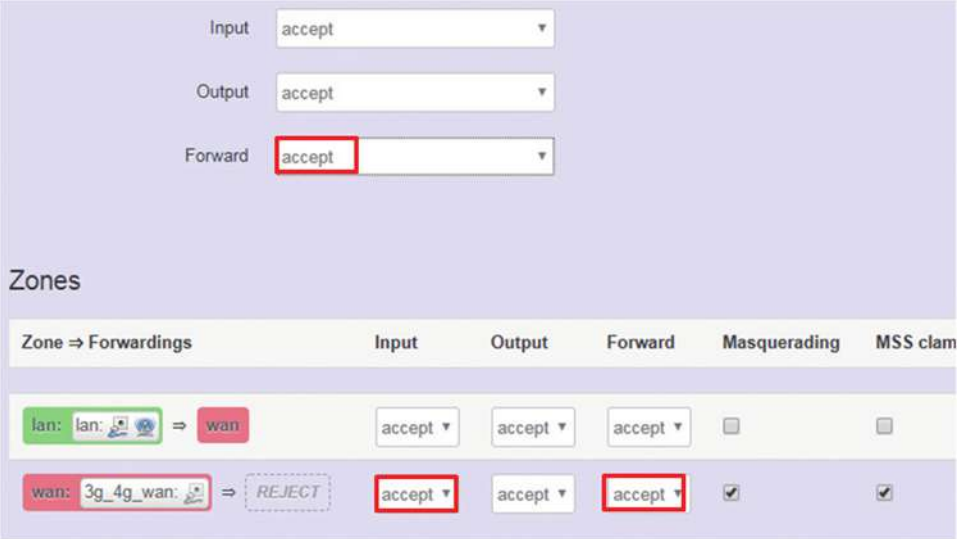
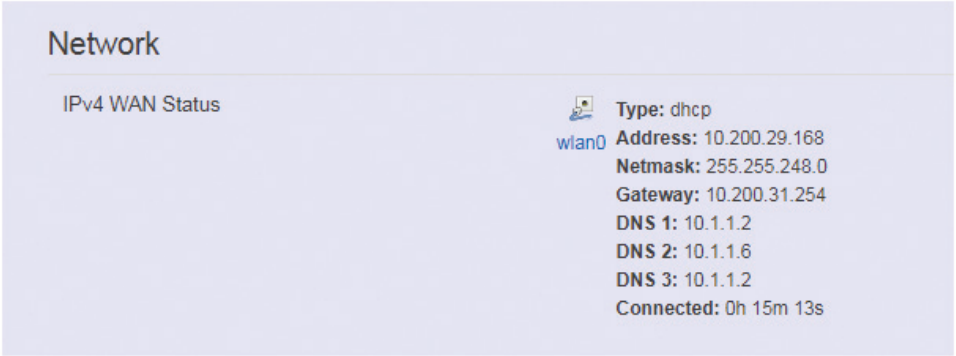
4.5 Configure Firewall Setting

Step 1. Please select “Network” -> “Firewall” and select “accept” to accept input and forward packets.



4.6 Verify Network Status

Step 1. Please select “Network” -> “Overview” to check the WAN status.



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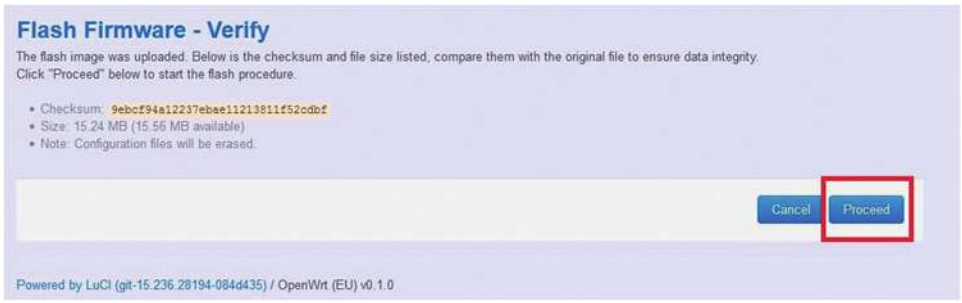
4.7 How to Run Firmware Upgrade

Step 1. In the “System” -> “Flash firmware” page, select your image and press the “Flash image” button.

Step 2. Press the “Proceed” button, then the image will be flashed to the device, please wait for 2 minutes.



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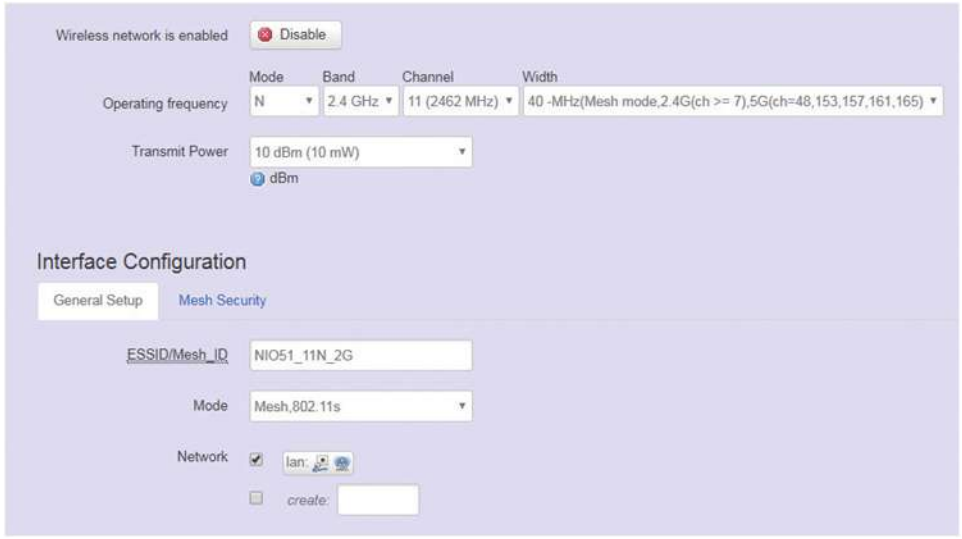
4.8 How to Restore to Default Settings

Step 1. In the "System" -> "Flash firmware" page, press the "Platform reset" button.

NIO 51 Default Parameters:

LAN port default IP = 192.168.1.1
WAN port default IP = DHCP Client
Login user name: root
Login password: admin



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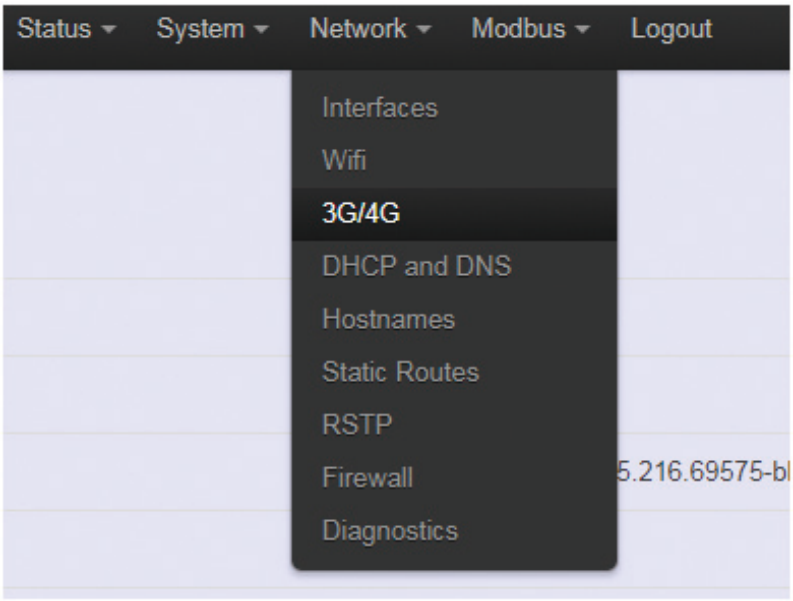
Chapter 5: Appendix

5.1 Wi-Fi and 3G/4G Redundant Function

NIO 51 supports Wi-Fi and 4G redundant function. The main application area for this function is in industrial vehicles. Industrial vehicles use Wi-F or 4G when arriving to or leaving from stations. The 3G/4G function is a project based function.

The standard NIO 51 does not include a 3G/4G module, please install the 3G/4G module in the mini PCI slot of NIO 51 and then install an antenna and SIM card. After finishing the installation, the 3G/4G setting will show up in the Web GUI. Please select "Network" -> "3G/4G" to configure.



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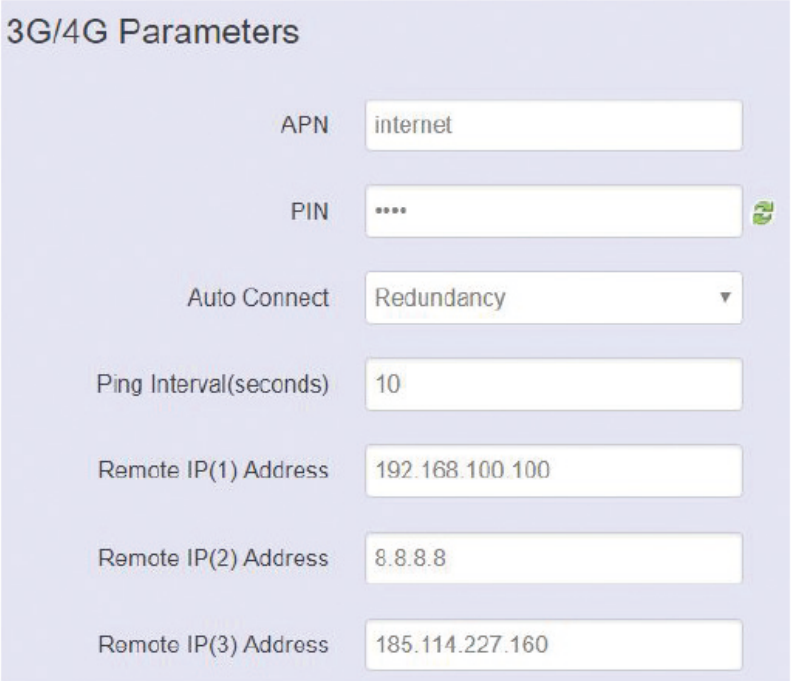
3G/4G Parameters



Please select "Redundancy" to enable Wi-Fi and 4G redundant function. You will then need to enter Remote IP address.

When NIO 51 cannot ping Remote IP(1), NIO 51 will ping Remote IP(2) and then Remote IP(3). If you only configured remote IP(1), NIO 51 will activate 3G/4G connection directly.

When NIO 51 can ping Remote IP(1) to Remote IP(3), NIO 51 will stop 3G/4G connection .

Remote IP(2) and Remote IP(3) settings are not required.

APN: The service provider may use access point network (APN) information to connect 3G/4G service. Please enter the access point network (APN) information here.
PIN: SIM card PIN code.
Auto Connect:

- **None:** Never connect 3G/4G.
- **Yes:** Always connect 3G/4G, it is suggested that Wi-Fi is disabled.
- **Redundancy:** Enable Wi-Fi and 4G redundant function.

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Ping interval: Ping interval between two Remote IPs.
Remote IP(1) address: When Redundancy function is enabled, you can configure wireless remote IP(1).
Remote IP(2) address: When Redundancy function is enabled, you can configure wireless remote IP (2).
Remote IP(3) address: When Redundancy function is enabled, you can configure wireless remote IP (3).

Check 3G/4G Connection Status

Please select "Status" -> "Overview", and then check the 3G/4G status. You can check the telecom operator's IP and gateway, 3G/4G information, etc.

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