PROFITAP

X3-SERIES

X3-440G

X3-880G

ADVANCED NETWORK PACKET BROKERS

USER MANUAL

If you have any questions, you can contact us through our website:

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TABLE OF CONTENTS

1. Overview

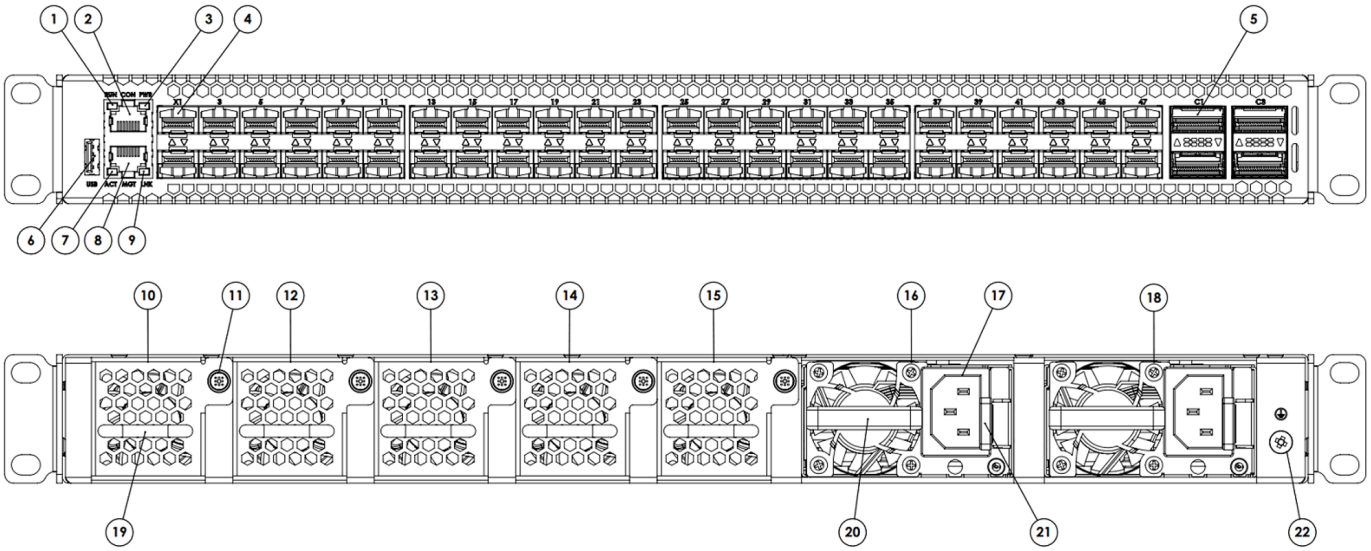
This document provides information about the configuration and operation of X3-Series Network Packet Brokers.

2. Hardware Guide

2.1. Included Accessories

- DB9 to RJ45 serial cable
- (2) Front-mounting ears with (8) screws
- (2) Rear-mounting ears
- (2) AC power cords

2.2. Physical Description



Front View		Rear View	
1	Status LED	10/12/13/14/15	(5) FAN modules
2	Console port	11	FAN module locking screw
3	Power LED	16/18	(2) modular Power Supply Units
4	(48) 1G/10G SFP+	17	PSU input connector
5	(4) 40G/100G QSFP28	19	FAN module handle
6	USB port	20	PSU handle
7	Management port Activity LED	21	PSU lock
8	Management port	22	Grounding lug
9	Management port Link LED		

2.3. Ports Description

2.3.1. Console Port

This serial port is intended to be used for local configuration and administration of the X3 device with Command Line Interface (CLI).

Port parameters: RJ45, RS232, 115200, N, 8, 1

Default username and password for serial connection:

- Username: **admin**
- Password: **Passok@123**

2.3.2. Management Port

This port is intended to be used for local and remote configuration, administration and monitoring of the X3 device with HTTPS / SNMP / SSH.

Port parameters: RJ45, 10BASE-T/100BASE-TX, Auto negotiation, Auto MDI/MDIX

Default username and password for SSH connection:

- Username: **admin**
- Password: **Passok@123**

2.3.3. USB Port

Port parameters: USB 2.0

2.4. Unpacking and Installing the Device

1. Unbox the X3 unit;
2. Refer to the list of included accessories and check the contents of the box;
3. Attach the (2) mounting ears to the main unit using the (8) screws;
4. Install the X3 unit in the rack;
5. Connect the ground wire to the grounding lug (#22);
6. Power up the X3 unit.

2.5. Troubleshooting and Maintenance

2.5.1. Replacing FAN Module

X3 fan tray contains five fan modules. If a fan module fails, you should replace it, however X3 will function with one failed fan module. You can remove individual fan modules using the following procedure:

1. Unscrew the FAN module locking screw (#11);
2. Remove the FAN module using the Fan module handle (#19);
3. Place the new FAN module in the empty slot;
4. Tighten the locking screw (#11).

2.5.2. Replacing PSU

X3 power tray contains two PSU modules. If a PSU module fails, you should replace it, however X3 will function with one failed PSU module. You can remove individual PSU module using the following procedure:

1. Disconnect the power cord from the PSU (#17) to be replaced;
2. Push the PSU lock (#21) on the left;
3. Pull the PSU using the handle (#20);
4. Insert the new PSU until the lock (#21) is in its locked position;
5. Connect the power cord to the new PSU (#17).

3. Initial Setup

3.1. Initial IP Settings

- IP: 192.168.2.100
- Subnet mask: 255.255.255.0
- Default gateway: 192.168.2.1

3.2. Initial Setup

Initial setup can be done via the management port or the serial console port.

Using any terminal software, connect to the device through SSH or serial connection.

Login, using the following credentials:

- Username: **admin**
- Password: **Passok@123**

After logging in, the user can access the system shell and administrate the device using the canonical GNU/Linux OS facilities.

The IP and subnet mask of the device can be changed using the following command, with **`ip_addr`** being the IP address and **`mask`** being the CIDR prefix:

```
sudo ip addr add [ip_addr/mask] dev eth1
```

For example:

```
sudo ip addr add 10.10.10.180/16 dev eth1
```

Note that this IP assignment is not persistent. To assign a permanent IP, see 4.3.1.

The user password can be changed using the following command:

```
sudo passwd
```

4. Web UI

This chapter describes method to connect to the Web UI.

Use a supported browser and go to **https://192.168.2.100**

Depending on the browser you might need to accept the self-signed certificate.

Default username and password for Web UI connection:

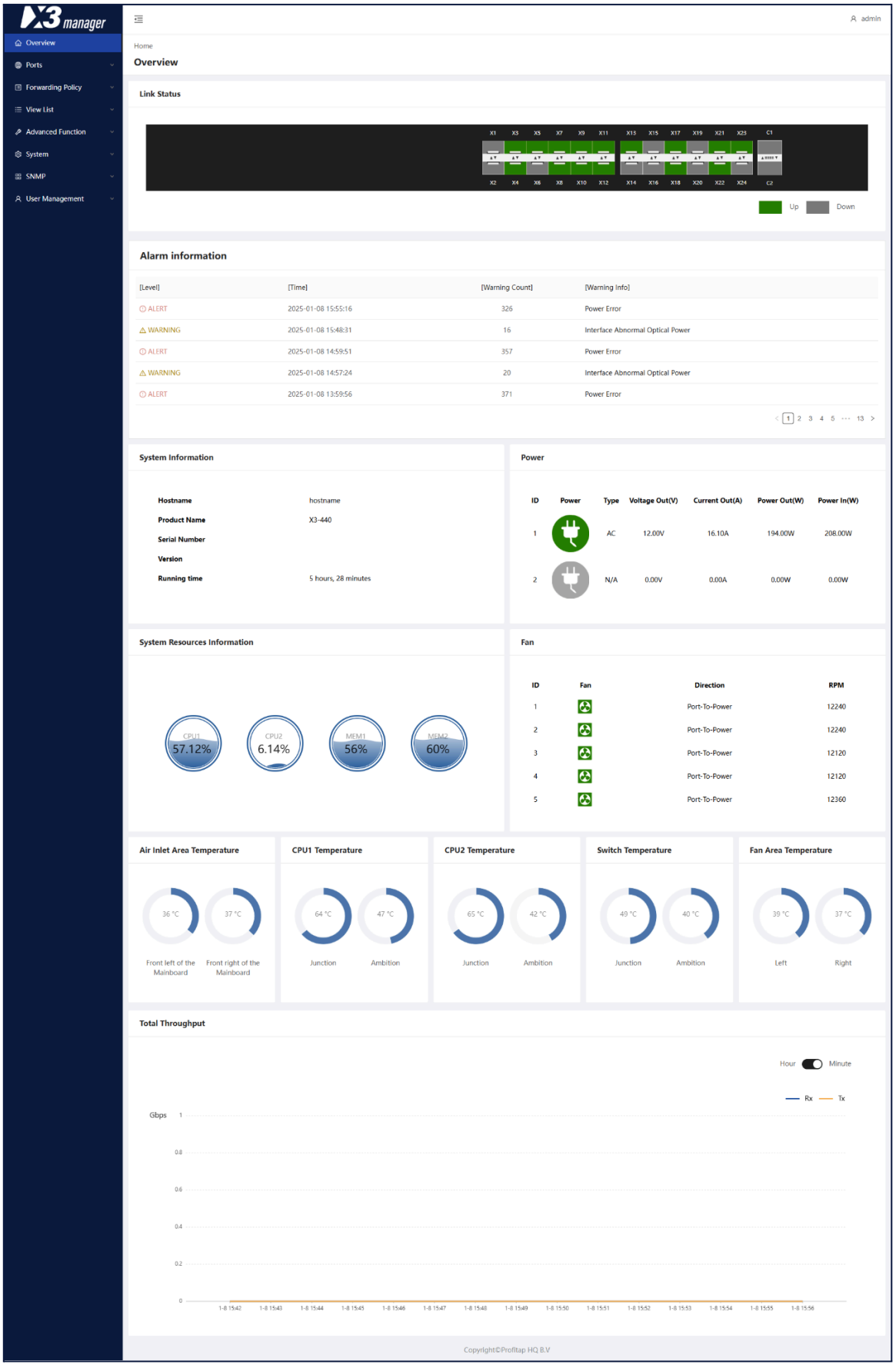
- Username: **admin**
- Password: **Passok@123**

Supported browsers:

- Firefox
- Chrome

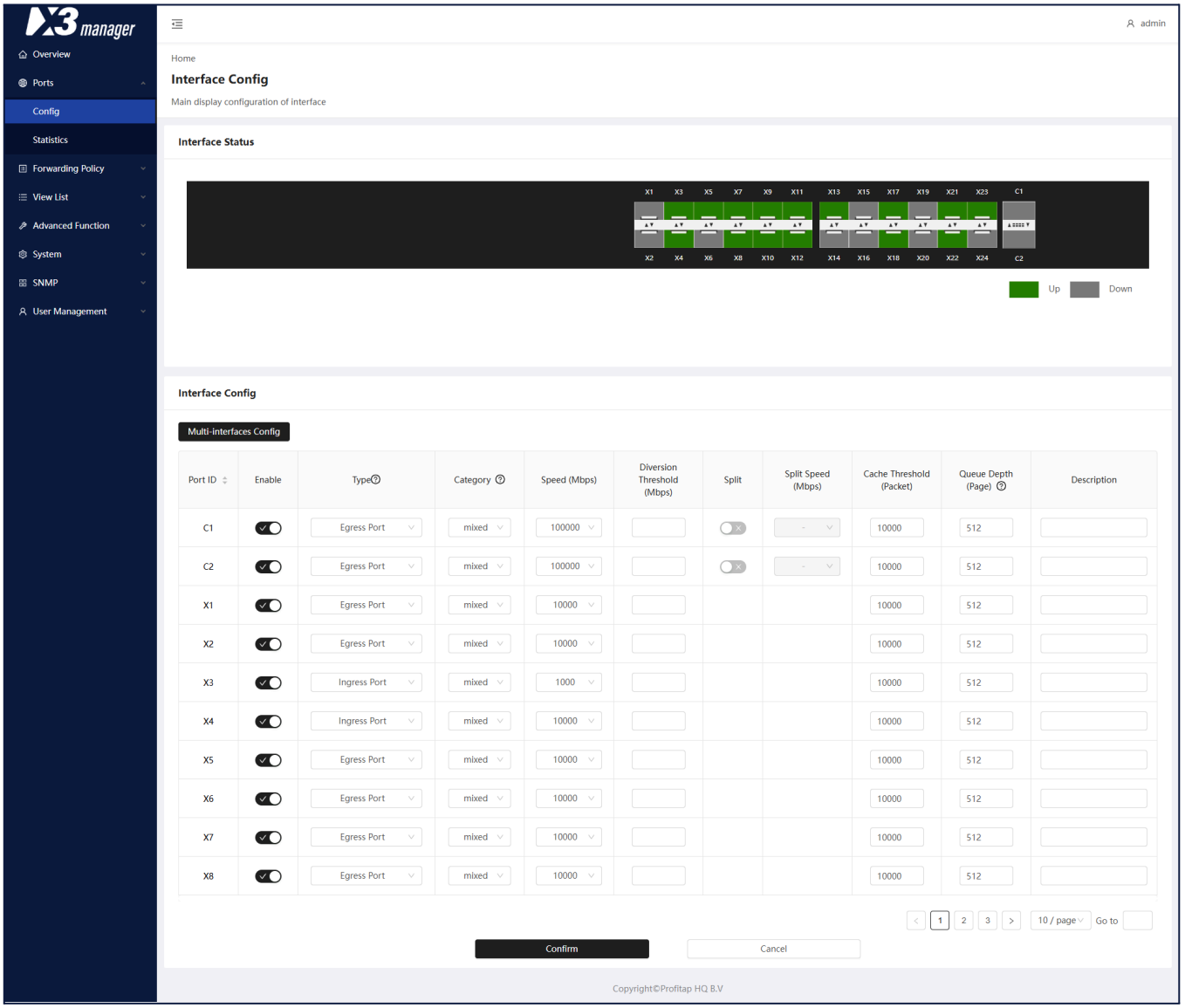
4.1. System Overview

The **Overview** page provides system information such as system alerts, PSU and FAN state, system temperature, system resource utilization, total throughput, and firmware version.



4.2. Port Configuration and Statistics

4.2.1. Port Configuration



Ports can be configured on the **Ports > Config** page.

Enable

Individual ports can be enabled or disabled via the *Enable* button. All ports are enabled by default.

Port Type

By default, all ports are set to Egress. To accept traffic, a port must be set to Ingress.

Port type configuration details:

- Egress Port: packets are allowed to be sent;
- Ingress Port: packets are allowed to be received and sent;
- Egress Port (Force Tx): packets are allowed to be sent, packets can output without valid link;
- Loopback: packets egressing a loopback interface will be available on its ingress interface, without the need for external physical loopback.

Port Category

The *Category* option is purely informative, and can be used to describe the function of the port (e.g. *mixed* for mixed traffic source, *mirror* for SPAN port, *monitor* for TAP).

Port Speed

The port speed can be set depending on the type of port:

- SFP+: 1G/10G
- QSFP28: 40G/100G/100G FEC

Port Split

QSFP28 ports can be split into 4 x 1G, 4 x 10G, 4 x 25G, or 4 x 25G FEC logical ports by enabling the *Split* option and selecting a *Split Speed*.

Cache Threshold (Packet)

Number of packets that can be cached on a single port, with a maximum of 90,000 packets.

Queue Depth (Page)

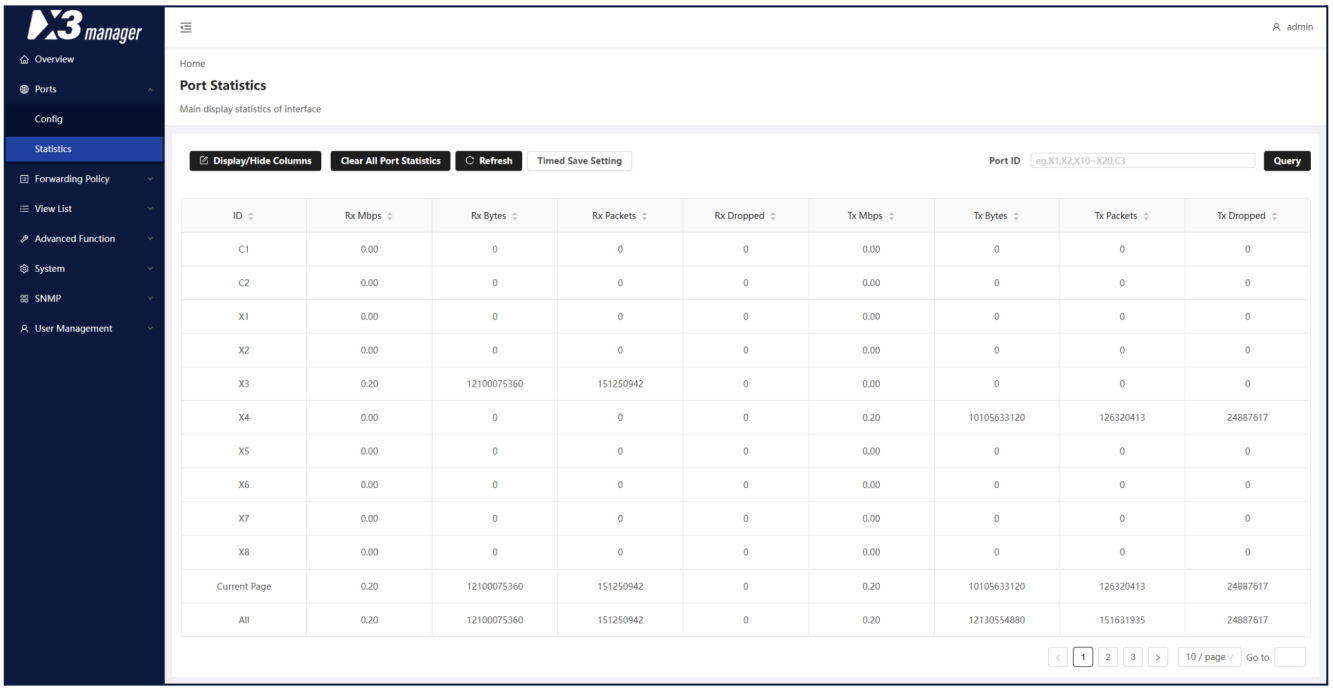
Cache size per port. 8MB is the maximum cache size per port. In total, there is a 24MB of shared buffer. Cache size is allocated in pages. One page is 256 bytes. A maximum of 32640 pages can be allocated to a single port.

Port Description

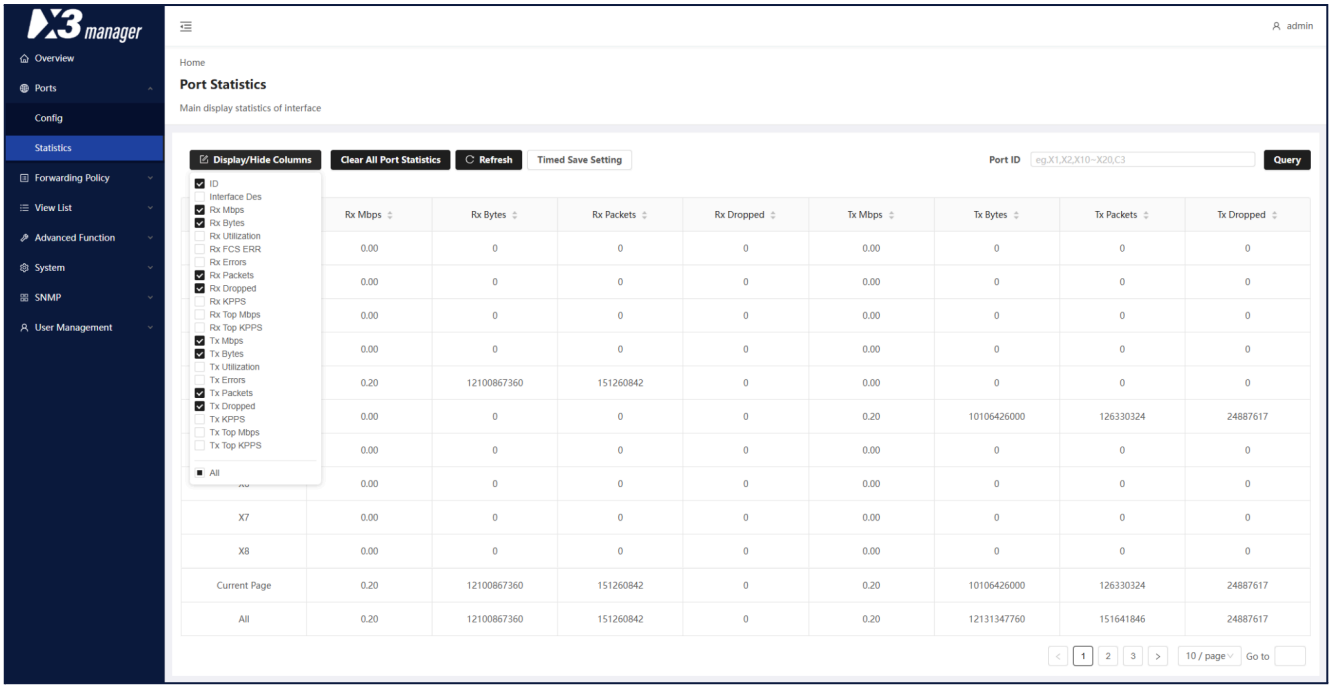
A description can be input for each port.

4.2.2. Statistics

The **Ports > Statistics** page displays statistics for each port. Statistics columns can be displayed or hidden via the *Display/Hide Columns* button.



Port Statistics page

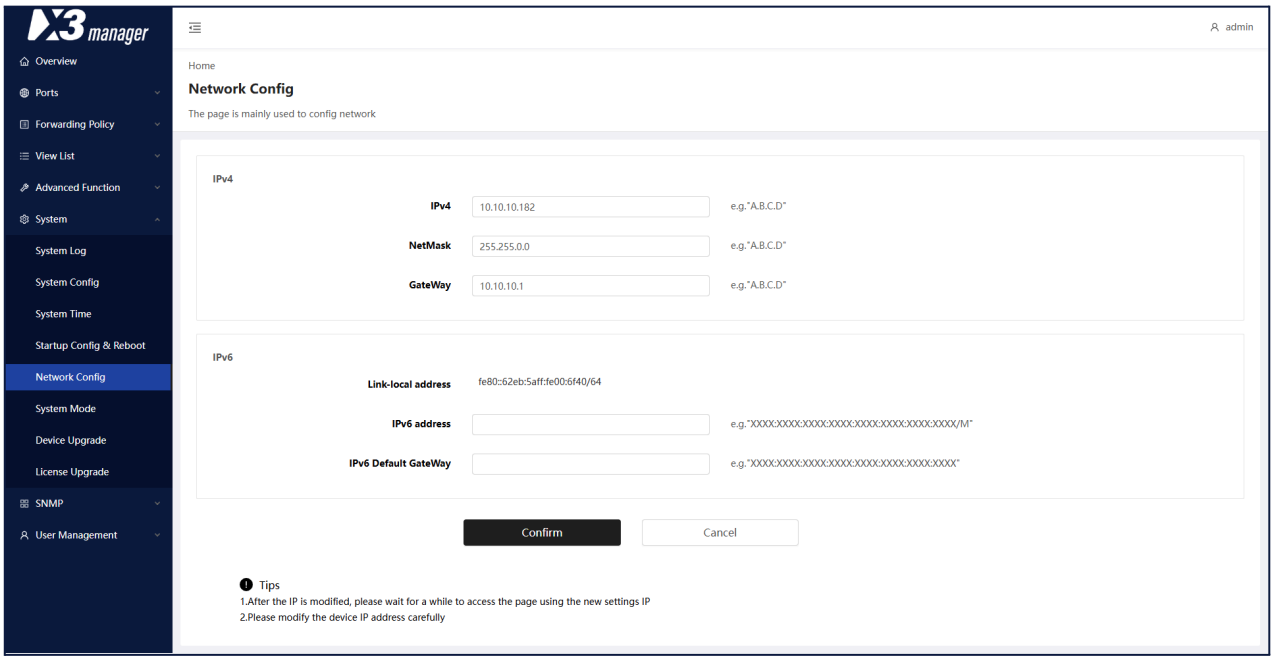


Port Statistics page with Display/Hide Columns menu open for customization of displayed statistics columns

4.3. Device Administration

4.3.1. Network Configuration

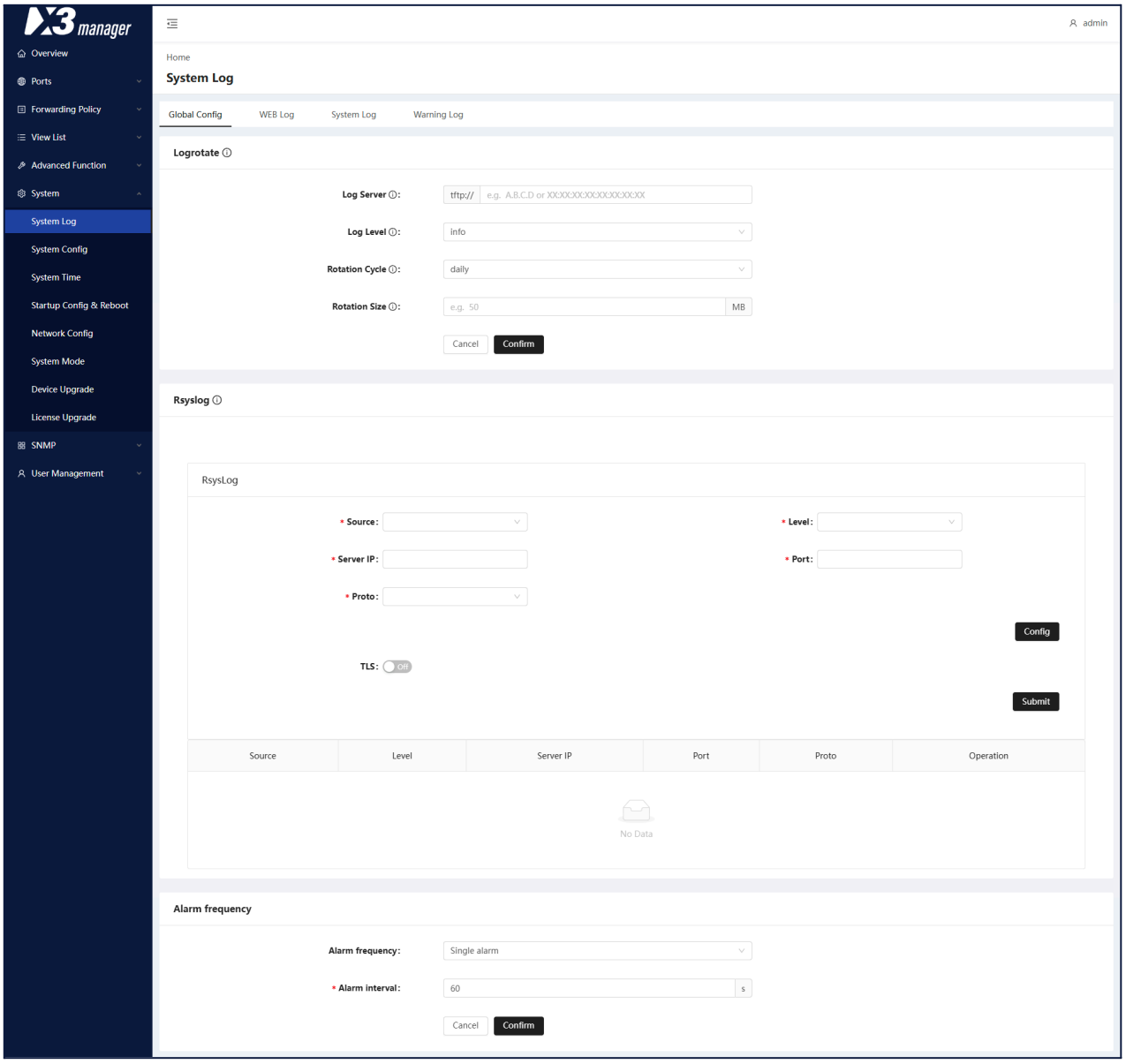
Navigate to **System > Network Config** to modify the network settings of the management interface. The device supports IPv4 and IPv6.



4.3.2. System Log

Navigate to the **System > System Log** page. The **Global Config** tab allows you to configure the log collection system. TFTP and rsyslog are supported:

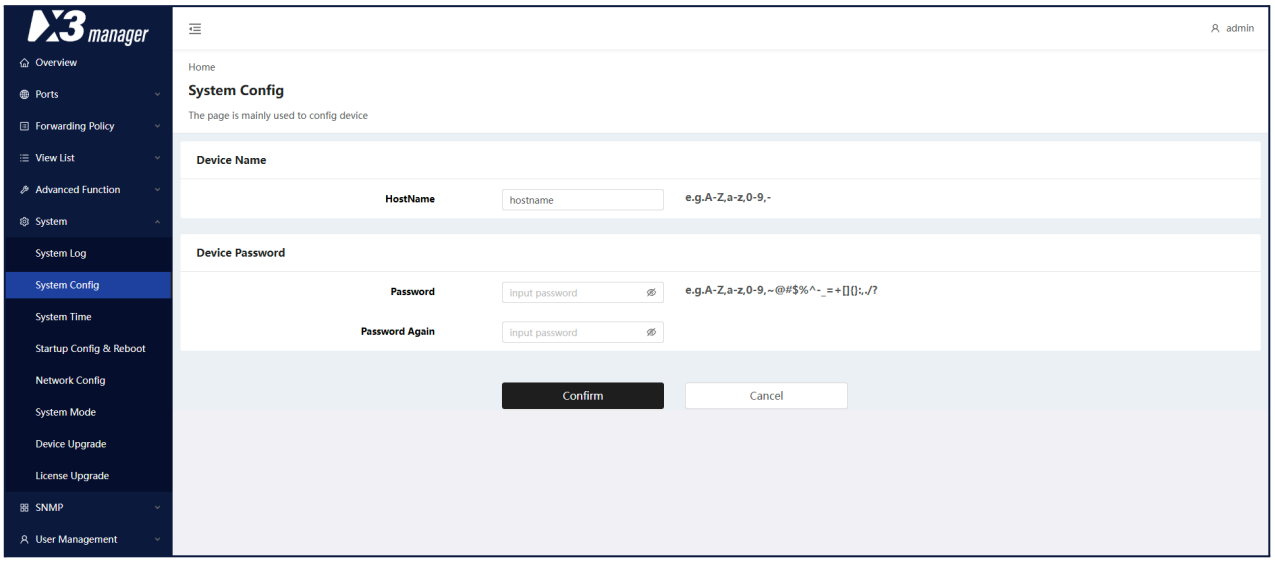
- **Logrotate:** Logs from `/var/log` and `/usr/elog/` will be uploaded to the configured server via the TFTP protocol.
- **Rsyslog:** For real-time log upload.



Navigate to the **Web Log** tab to see the logs of actions carried out through the Web GUI. These logs can be exported as an Excel file.

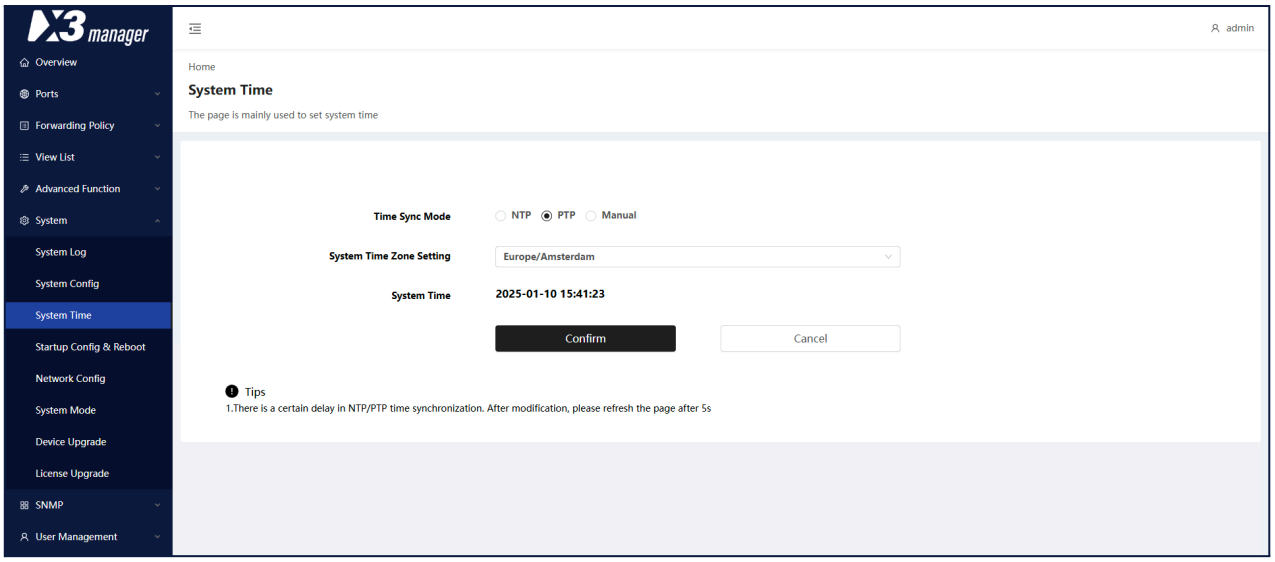
4.3.3. System Config

Navigate to the **System > System Config** page to set the device name and CLI password.



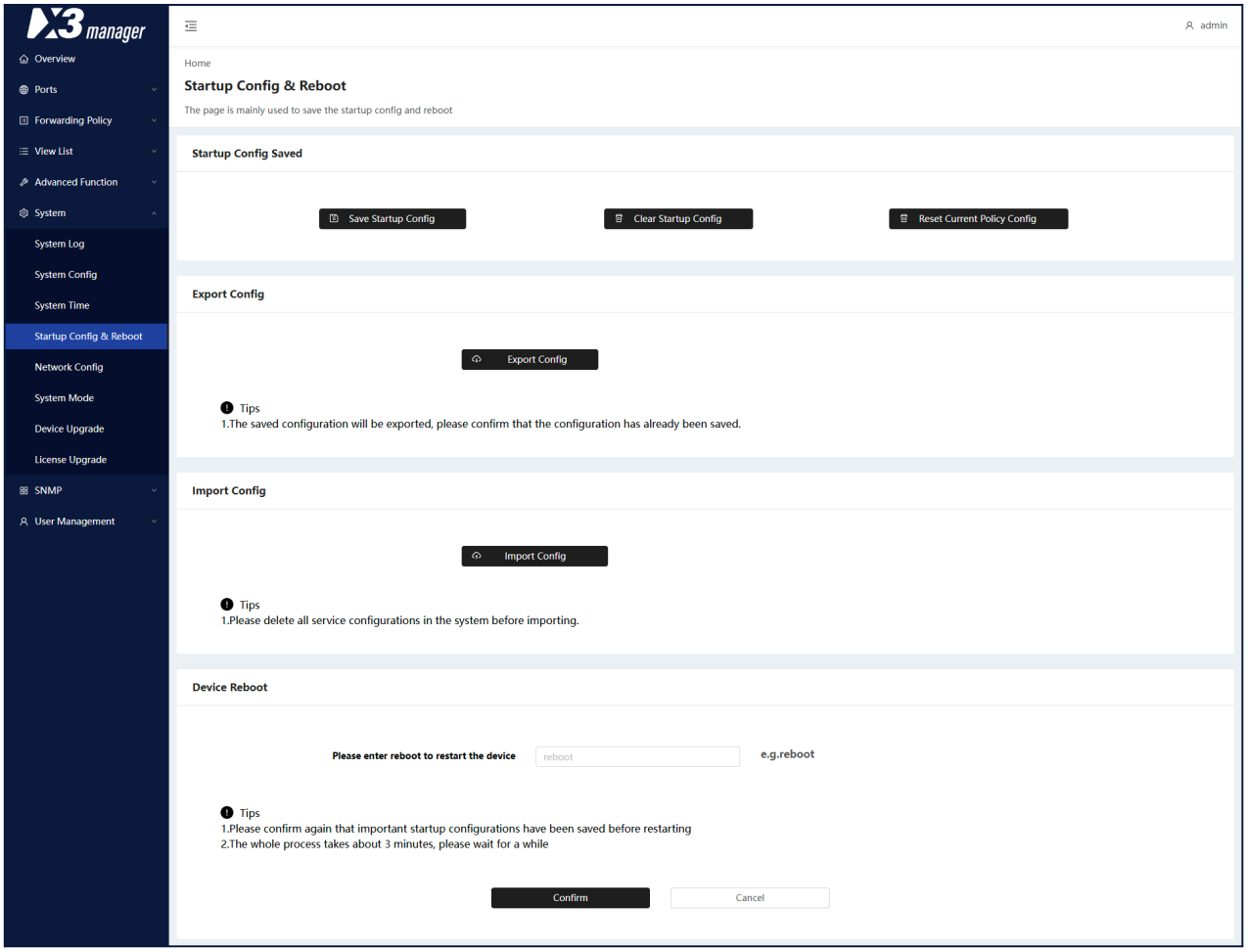
4.3.4. System Time

Navigate to the **System > System Time** page to set the time on the device. NTP, PTPv2, and manual are supported.



4.3.5. Startup Config & Reboot

The **System > Startup Config & Reboot** page allows you to save or clear the startup configuration, reset the policy configuration, import or export the device configuration, and reboot the device.



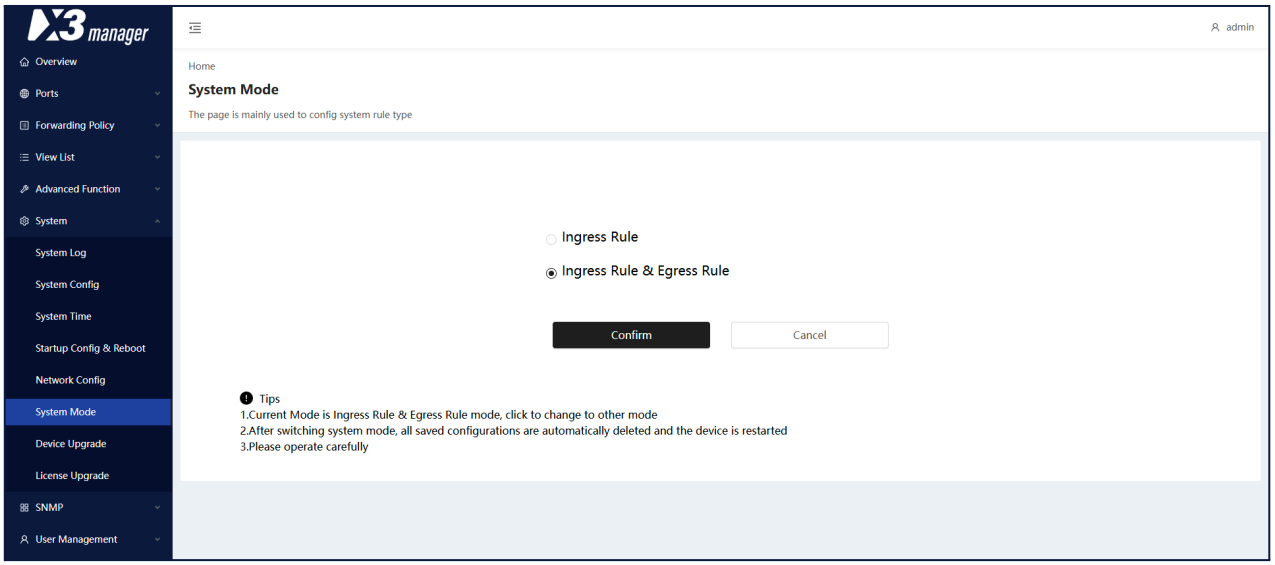
- **Save Startup Config:** Saves the current configuration as the startup configuration. The device always boots with the saved startup configuration, hence the current configuration needs to be saved before rebooting the device.
- **Clear Startup Config:** Clears the startup configuration. The device will boot with the default configuration. Use with caution.
- **Reset Current Policy Config:** Resets the current policy configuration. In rare cases, this can be resorted to. Device will be running on the default configuration.
- **Export Config:** Exports the startup configuration. Use the *Save Startup Config* option beforehand to save the current configuration as the startup configuration, then use *Export Config* to save it as a file.
- **Import Config:** Imports a configuration file. Use the *Clear Startup Config* option beforehand to clear the current configuration, then use *Import Config* to upload a previously-saved configuration file.
- **Device Reboot:** Reboots the device. The word "reboot" must be entered before confirming.

4.3.6. System Mode

Navigate to the **System > System Mode** page to modify the forwarding policy mode of the device. The device supports two modes:

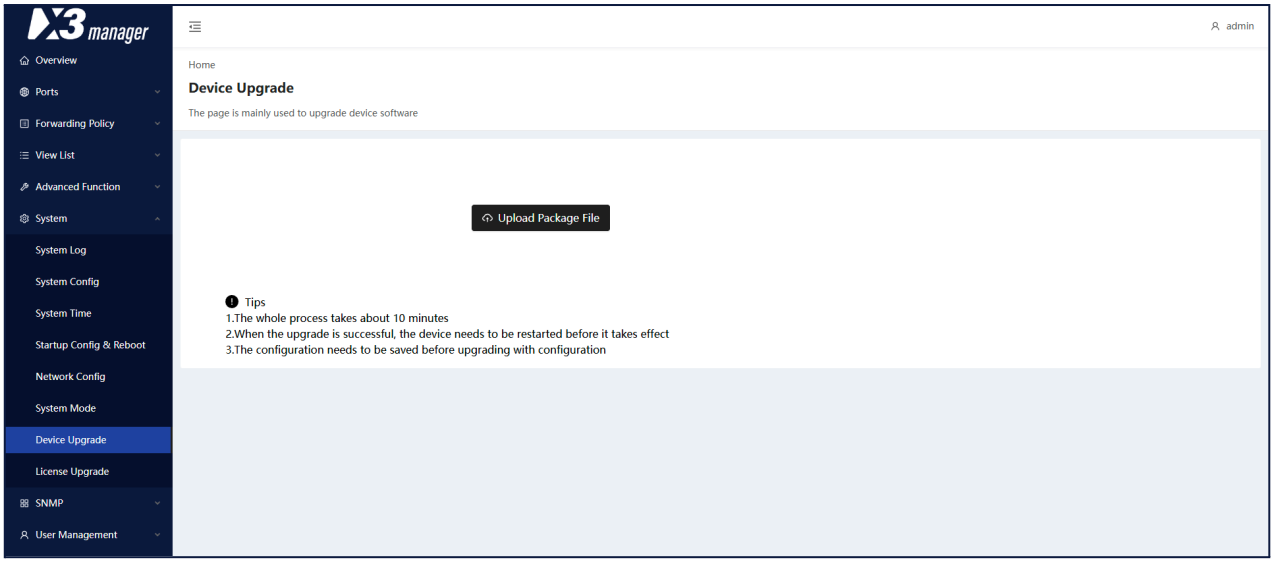
- **Ingress Rule:** Supports ingress group filtering rules only.
- **Ingress Rule & Egress Rule:** Supports filtering rules on both ingress groups and egress groups.

Ingress Rule & Egress Rule mode is the default.



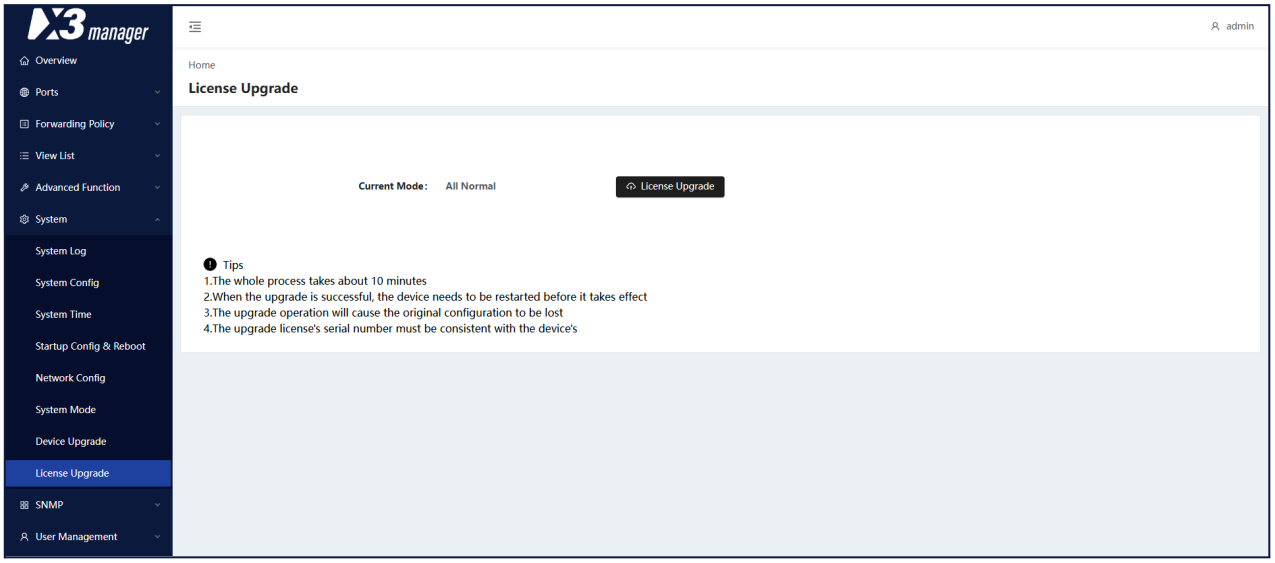
4.3.7. Device Upgrade

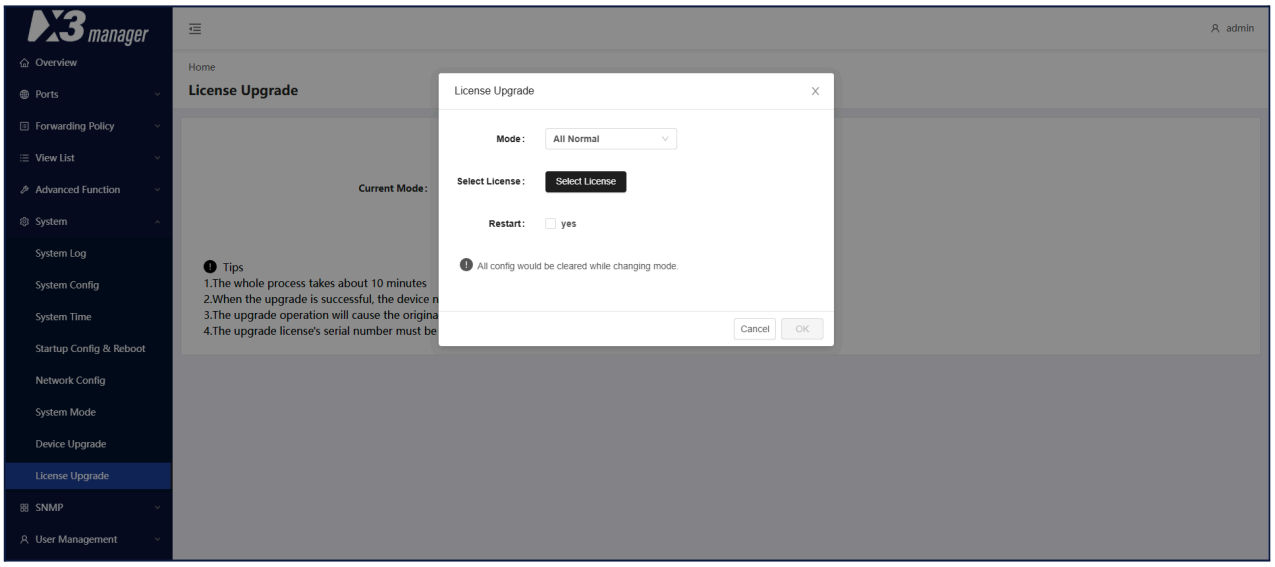
Navigate to **System > Device Upgrade** to update the device software by uploading a software update file.

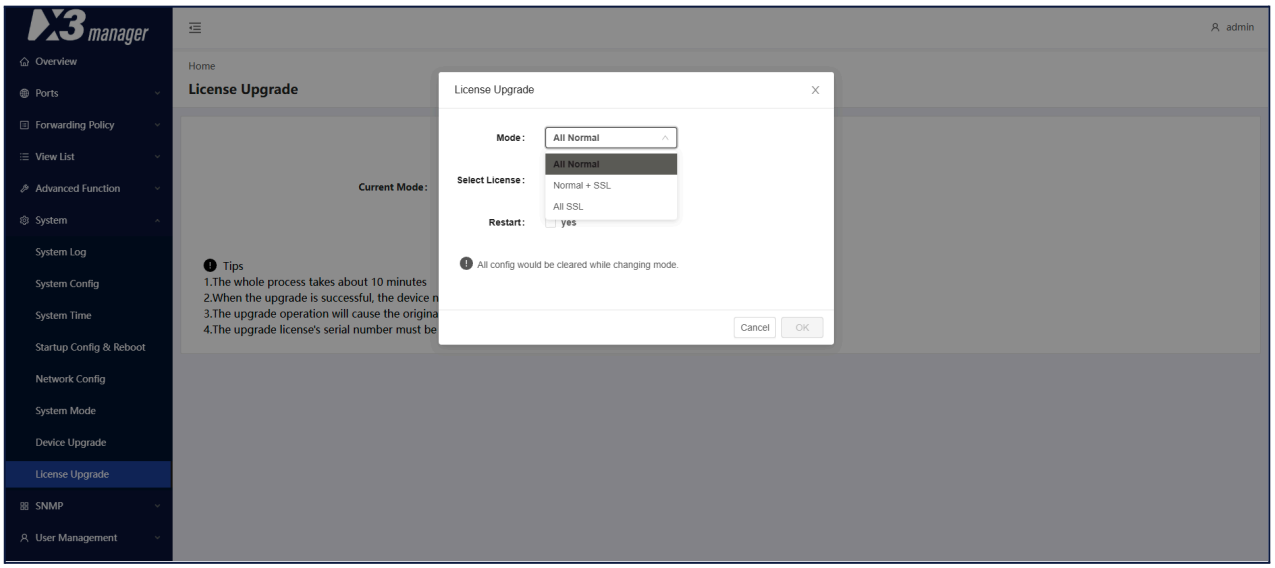


4.3.8. License Upgrade

Navigate to **System > License Upgrade** to update the device license by uploading a license file.

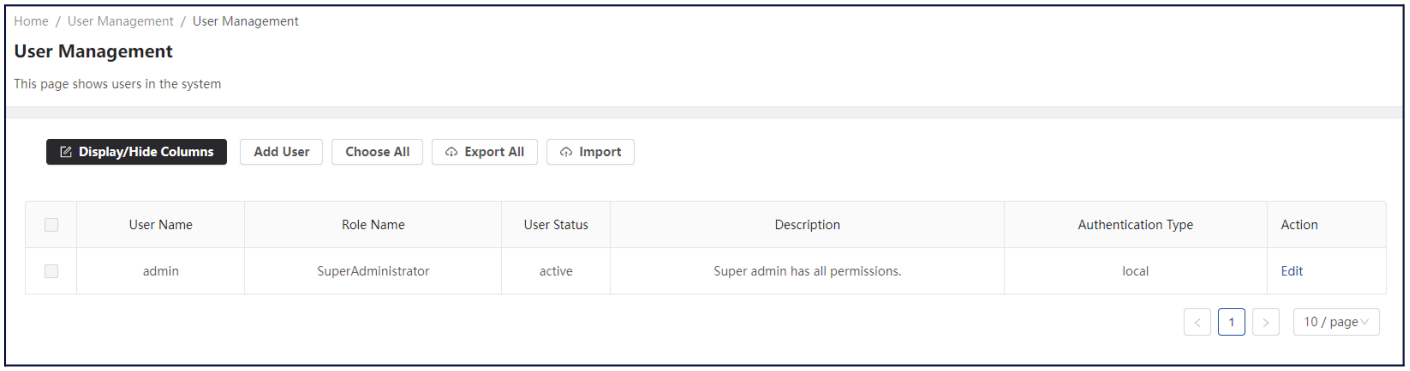






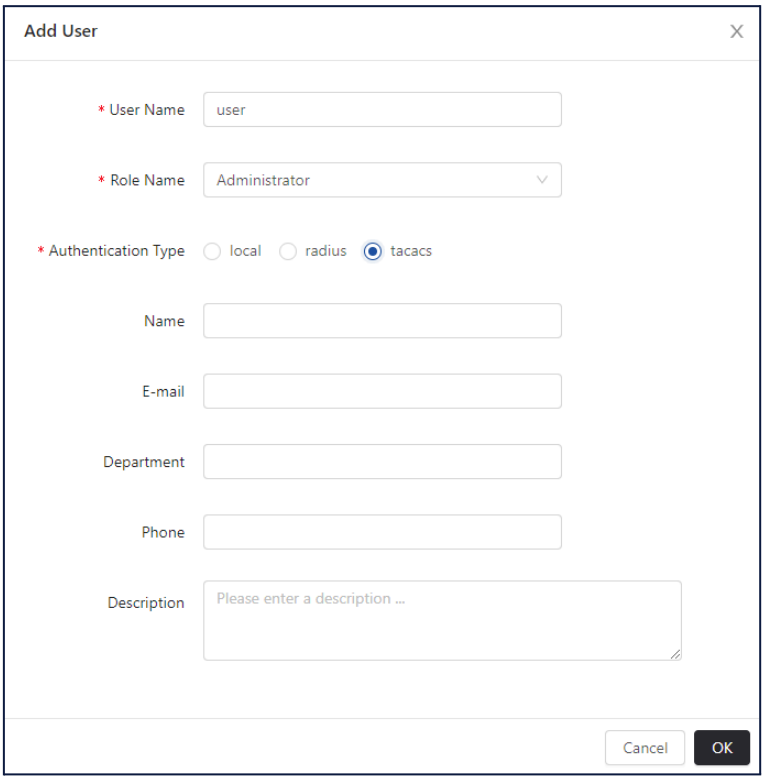
4.3.9. Local Users

Navigate to **User Management > User Management** to add or edit users. Local and remote user accounts and type of account must be specified in this configuration panel. At least one local super administrator account is required on the unit. A super administrator may change passwords of any account in this panel. The current account password can also be changed from the user menu in the top right-hand corner of the interface.

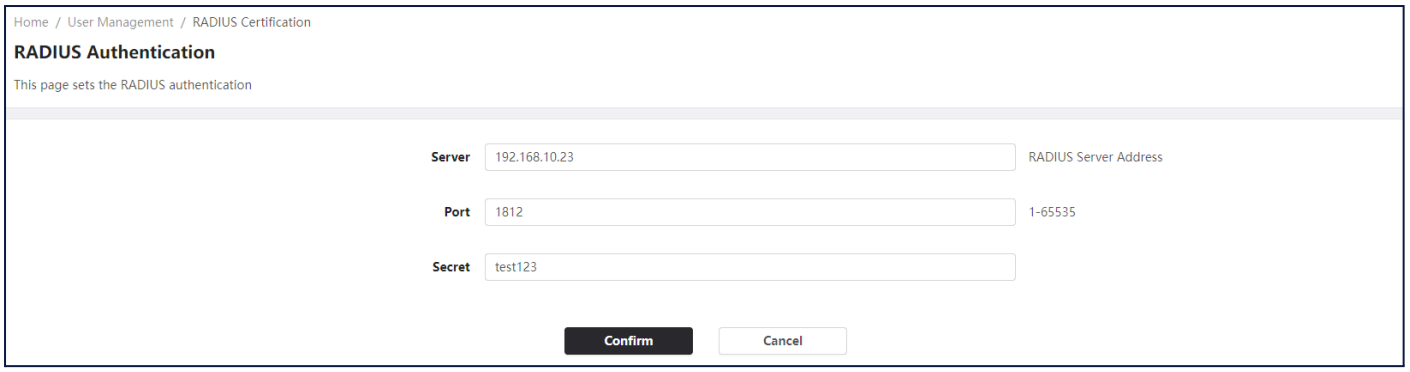


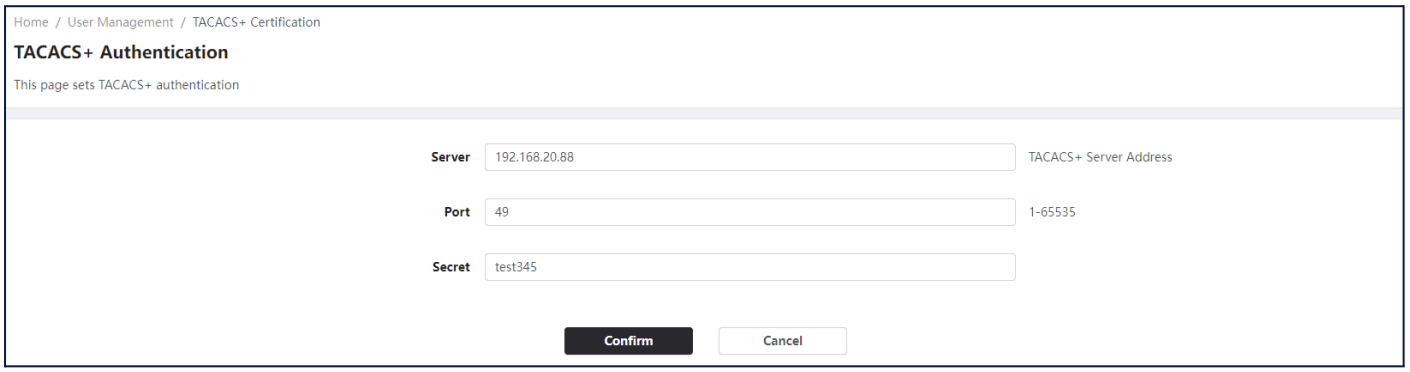
4.3.10. TACACS+ and RADIUS authentication

Authentication can be managed remotely by a TACACS+ or RADIUS server. The user account and its role (authorization) must be defined on the unit, the authentication will be provided by the server.



The TACACS+ and RADIUS server information can be provided on the **User Management > TACACS+ Certification** and **User Management > RADIUS Certification** pages respectively. You must provide the server IP address/port and server secret.

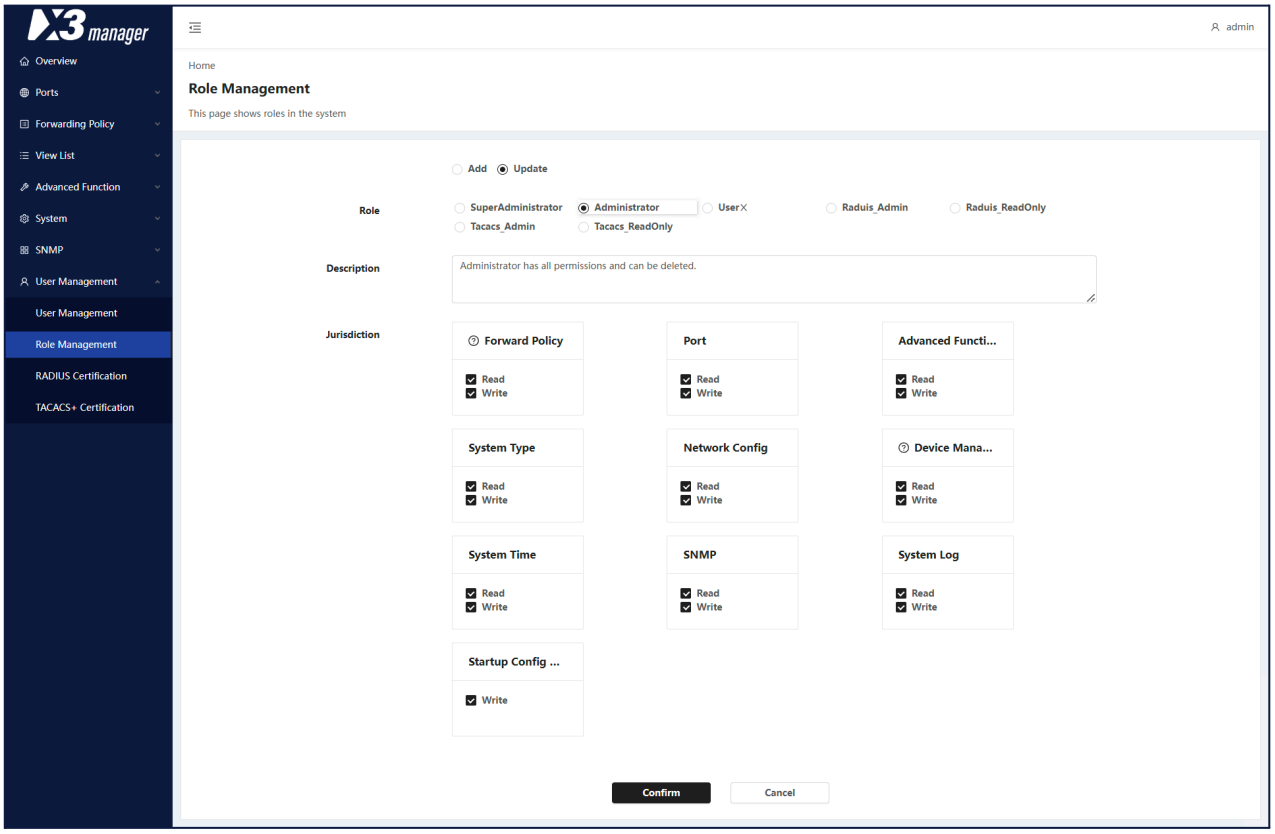




4.3.11. Role Management

The **User Management > Role Management** page allows you to add roles and modify role permissions.

- **Add:** Adds a new role.
- **Update**: Modifies a role's permissions.



4.3.12. SNMP

SNMP Config

The **SNMP > SNMP Config** page can be used to control the device's SNMP(v2c/v3) service. The **SNMP Server Config** tab allows the configuration of SNMP server settings, the **SNMP V3 Users** tab allows the configuration of SNMPv3 user settings, and the **SNMP Trap Config** allows the configuration of SNMP *Traps* and *InformRequests*.

Port Trap Config

The **SNMP > Port Trap Config** page can be used to modify, reset, and query port traps.

Explanation of the fields:

FCS	Error packet with check code error.
Error	Error packet with abnormality in structure or MAC.
Speed Max	Maximum allowable port usage rate.
Speed Min	Minimum allowable port usage rate.
Mutation	Maximum allowable port speed rate (Mbps) of mutation.
Link Status	Interface link status.

System Trap Config

The **SNMP > System Trap Config** page allows the user to turn specific traps on or off, and modify trap thresholds.

MIB File Management

The **SNMP > MIB File Management** page allows the import and export of MIB files.

4.4. Features Overview

Features depend on the type of firmware running on the X3 device. You can change the running firmware in *System > License Upgrade*. License must be provided to enable the desired firmware. Available firmware options are:

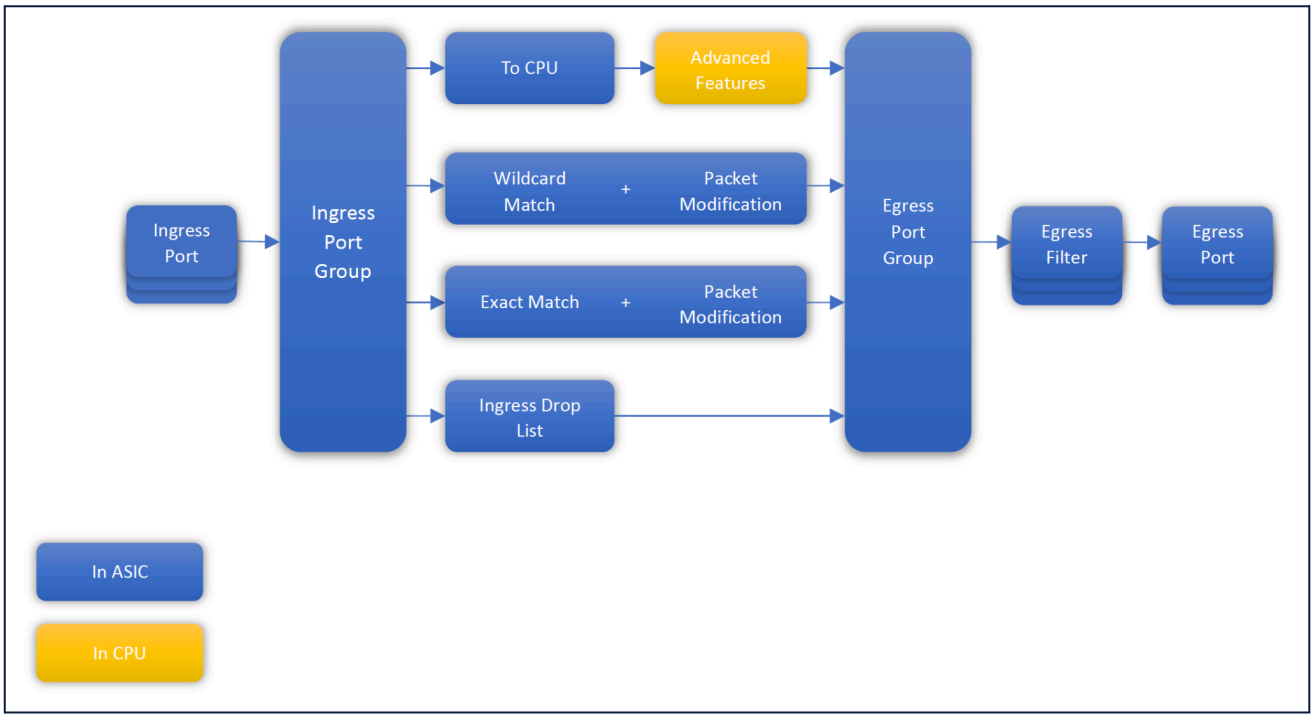
- Normal
- All SSL
- Normal + SSL

Please note that even if a feature is available for multiple firmware, performance will vary depending on the type of firmware used.

FEATURE	NORMAL FIRMWARE	SSL FIRMWARE	NORMAL + SSL FIRMWARE	PROCESSED BY
NetFlow	✔	✘	✔	CPU
SSL	✘	✔	✔	CPU
Deduplication	✔	✔	✔	CPU
IP Reassembly	✔	✘	✔	CPU
TCP Reordering	✔	✔	✔	CPU
Wildcard Match	✔	✔	✔	ASIC
Exact Match	✔	✔	✔	ASIC
Tunnel Stripping	✔	✔	✔	ASIC
Slicing	✔	✔	✔	ASIC
Timestamping	✔	✔	✔	ASIC
*Advanced Rules**	✔	✘	✔	CPU
Load Balancing	✔	✔	✔	ASIC
*Advanced Load Balancing***	✔	✘	✔	CPU
*Encapsulation/Tunnel****	✔	✔	✔	ASIC
Traffic Management	✔	✘	✔	CPU

** Filter by: Tuple-4, Tuple-6, L2, Regex, Packet Type, URL, IMSI filtering, TCP Flag*
*** Round-Robin, Weighted Round-Robin, Inner Layer, Outer Layer*
**** Stripping/Termination VLAN, GRE, GTP, VXLAN, MPLS, ERSPAN, Cisco FabricPath*

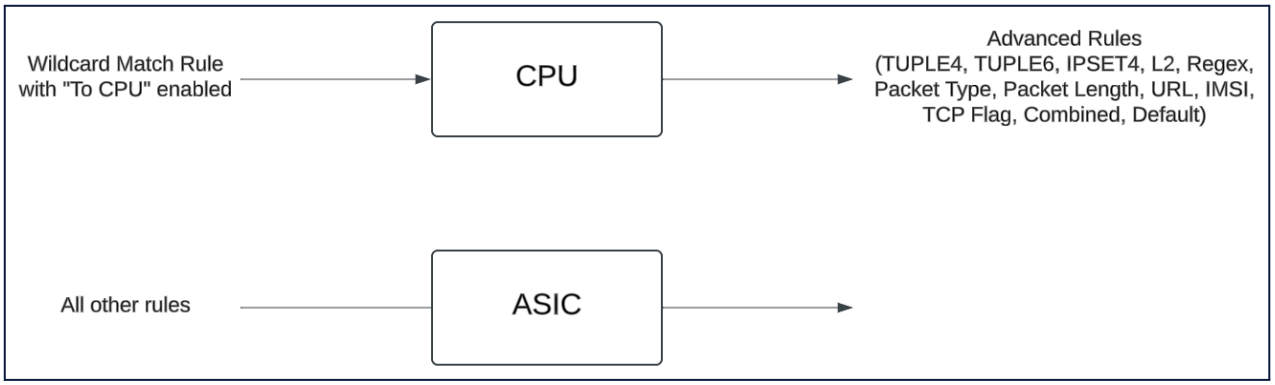
4.5. Traffic Flow Overview



To forward traffic to the CPU for processing of advanced features, a *Wildcard Match* rule with the *To CPU* option enabled must be created. *Advanced Rules* tell the CPU how to process the traffic.

For traffic processed by the ASIC, one rule is enough. For traffic processed by the CPU, two rules are needed: one *Wildcard Match* rule with the *To CPU* option enabled, and one *Advanced Rule* (e.g. IPSET4, Regex).

All advanced features are processed in the CPU.



4.5.1. Functional Blocks Description

FUNCTIONAL BLOCK	FUNCTION
Ingress Port	Strip Tunnels: GRE, GTP, VXLAN, MPLS, ERSPAN, Cisco FabricPath Per port inner/outer filtering option
Ingress Port Group	Form a logical group of port(s)
Wildcard Match	Forward traffic based on: IPv4/6 addresses, L4 Ports, VNI, MPLS (3 labels), outer VLAN, inner VLAN, Protocol, EtherType, DSCP, VNI, IP Fragment, Packet Type, Packet Size, TCP Flag, HTTP method Additional action: Add/remove/modify VLAN, modify MAC addresses, slice packets
Exact Match	Forward traffic based on: IPv4/6 addresses, Protocol, L4 Ports Additional action: Add VLAN, delete double VLAN
(To CPU)	Forward traffic to CPU based on: IPv4/6 addresses, Protocol, L4 Ports
Ingress Drop List	Discard traffic based on: IPv4/6 addresses, L4 Ports, VNI, MPLS (3 labels), outer VLAN, inner VLAN, Protocol, EtherType, DSCP, VNI, IP Fragment, Packet Type, Packet Size, TCP Flag, HTTP method
Egress Port Group	Form a logical group of port(s)
Egress Filter	Drop or permit traffic based on: MAC addresses, IPv4/6 addresses, L4 Ports, outer VLAN, inner VLAN, Protocol, EtherType, DSCP, Packet Type, TCP Flag Additional action: Add/remove/modify VLAN
Egress Port	Enable Timestamp output
Advanced Features	Filter: IPv4/6 Tuple, IPv4/6 IP list, L2, Regex, packet type, packet length, URL, IMSI, TCP Flag, Combined filters

4.5.2. Theory of Operation

Ingress rules priority is managed by the rule number ID. User can define the rule ID at rule creation, but rule ID can’t be modified when the rule is applied. For this reason, it is highly recommended to partition the rule table IDs by filter type, that way it is easy to insert rules before or after the applied rules.

Example 1:

This first example describes the rule priority. It is possible to form complex rules by allowing and/or dropping part of the traffic.

ID	INGRESS	EGRESS	TYPE OF RULE	PARAMETER	EFFECT
99	X1		Ingress Drop List / Wildcard	Source IP = 10.0.0.0/8	Drop all traffic coming from X1 matching the masked IP
100	X1	X2	Policy / Wildcard	Protocol = tcp	All TCP traffic coming from X1, not dropped by rule 99, will output on X2
101	X1	X2	Policy / To CPU	-	All traffic coming from X1, not dropped by rule 99, not matched by rule 100, will be sent to CPU and output on X2

Example 2:

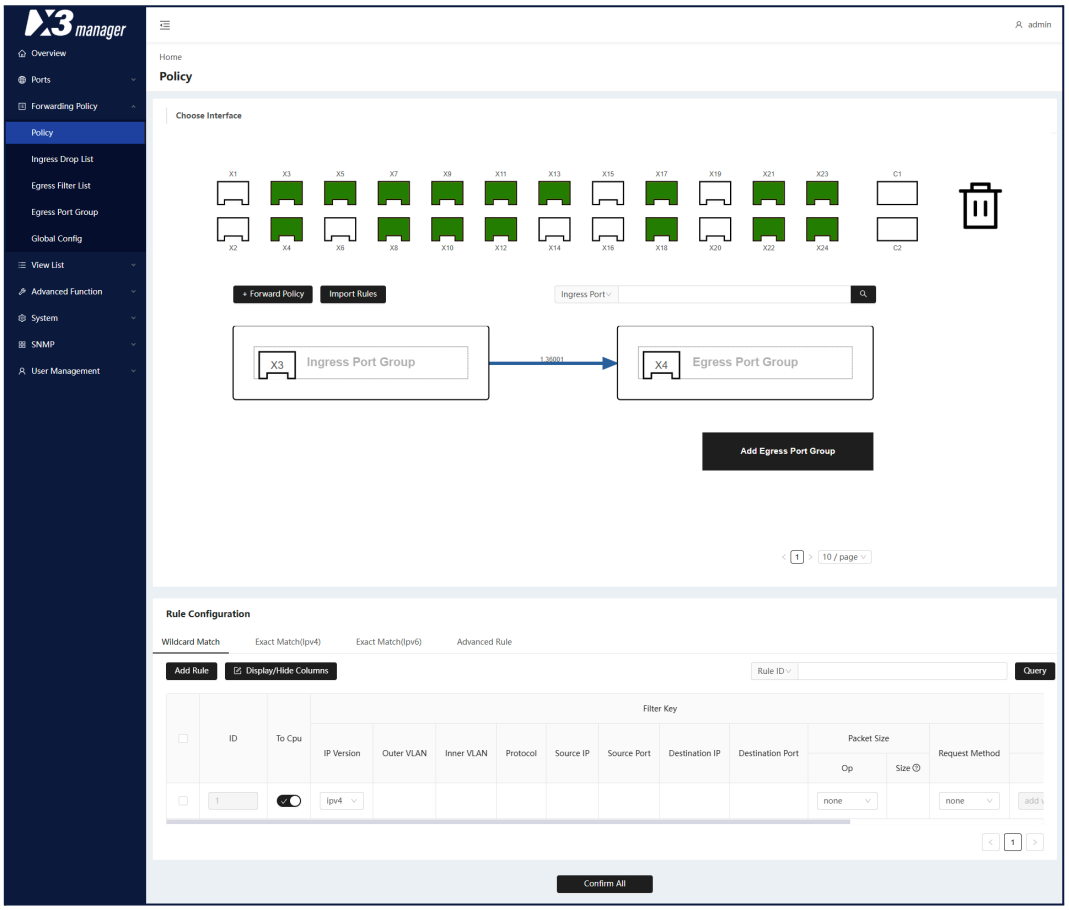
In this example, only HTTPS traffic is sent to the CPU for decryption, decrypted traffic egresses on port X2, all other traffic egresses on port X2 directly.

ID	INGRESS	EGRESS	TYPE OF RULE	PARAMETER	EFFECT
98	X1	X2	Policy / To CPU	Source Port = 443	All traffic coming from X1 and matching the rule is sent to CPU and output on X2
99	X1	X2	Policy / To CPU	Dest. Port = 443	All traffic coming from X1 and matching the rule, not matching rule 98 is sent to CPU and output on X2
100	X1	X2	Policy / Wildcard	-	All traffic coming from X1 and not matching rules 98 or 99 will output on X2

4.5.3. Benchmarks

Performance of features are evaluated with the latest released firmware. Performance of features processed in CPU depend on the type of traffic, packet rate and concurrent features enabled. Concurrent use of multiple features may affect the overall performance of all features processed in CPU. ASIC features are processed at wire speed and are not subject to any performance degradation.

4.6. Traffic Policy



Traffic Policy can be configured on the **Forwarding Policy > Policy** page. It defines the routing between Ingress and Egress ports, the filters, and the traffic manipulation.

A typical workflow is as follows:

1. Add a new Forward Policy by pressing the **+ Forward Policy** button.
2. Drag and drop one or more ports into the **Ingress Port Group** block.
   Note: ingress port and port group options can be defined by clicking on the Ingress Port Group block (see 4.6.1 and 4.6.2).
3. Drag and drop one or more ports into the **Egress Port Group** block.
   Note: egress port and port group options can be defined by clicking on the Egress Port Group block (see 4.6.3 and 4.6.4).
4. Click the **arrow** connecting the Ingress Port Group and Egress Port Group.
   The page will scroll at the bottom of the page, where you can then define the traffic rules for these port groups.
5. Define the traffic rules.
   Note: depending on the ingress and egress port and port group options defined previously, you may need to enable the "To CPU" option to direct traffic to the CPU (see Features Overview for the list of features processed by the CPU).
6. Press the *Confirm All* button at the bottom of the page.

> **Note:** An Ingress port can only be part of one Ingress Port Group at a time. An Egress Port can be part of multiple Egress Port Groups.

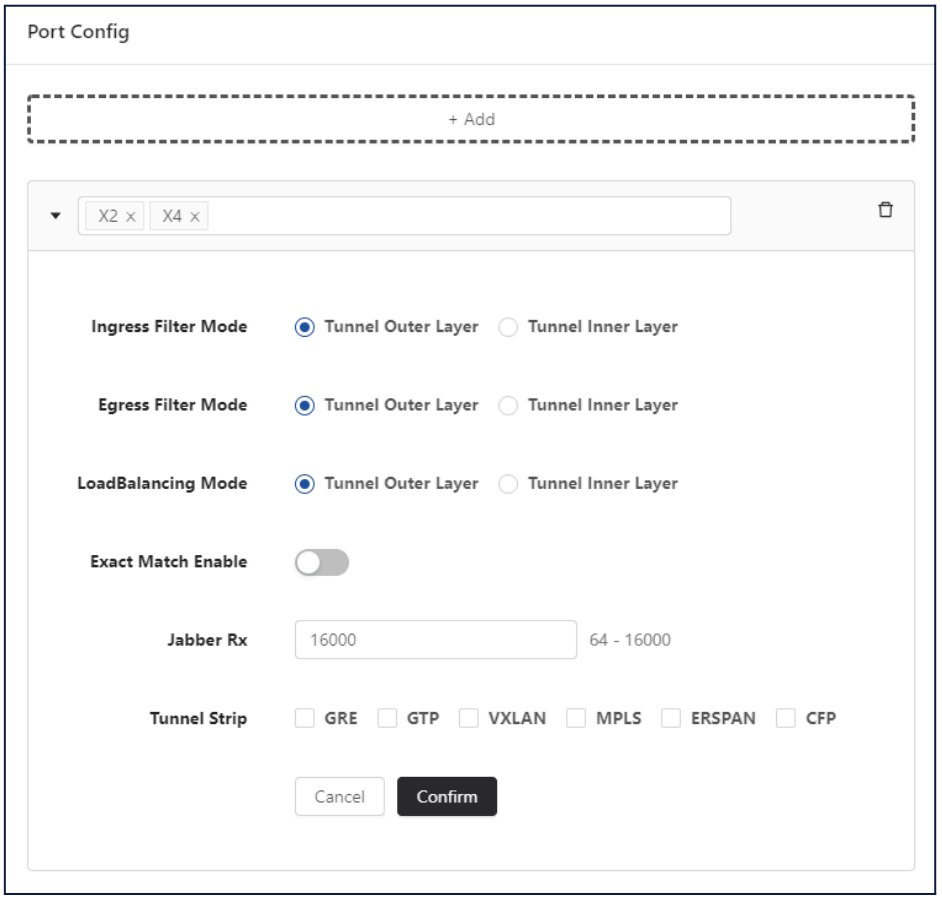
4.6.1. Ingress Port Group Options

On the **Forwarding Policy > Policy** page, click an *Ingress Port Group* to open its configuration. Some *Ingress Port Group* features may not be available with the running firmware. The list of available features for each firmware is described in the following table. To change the Firmware, see the Update section.

SETTING	NORMAL FIRMWARE	SSL FIRMWARE	NORMAL + SSL FIRMWARE	DESCRIPTION
NetFlow	✔	✘	✔	Enable NetFlow generation
SSL Enable	✘	✔	✔	Enable SSL decryption on the traffic
Deduplication	✔	✔	✔	Enable packet deduplication
IP Reassembly	✔	✘	✔	Enable IP fragment reassembly
TCP Reordering	✔	✔	✔	Enable TCP packet reordering
Tuple Mode	✔	✘	✔	Define the tuple mode (Outer, Sub-Outer, Inner)
Match Mode	✔	✘	✔	Define the filtering mode (First match: only the first match is executed, Full match: all filters are ANDed)
Priority	✔	✘	✔	When filtering mode = First match, define the filter priority
Regex Rule Priority	✔	✘	✔	When filtering mode = First match, define the regex priority

Note that *Advanced Features* are handled in the CPU, and thus require the *To CPU* option to be enabled (see 4.8).

4.6.2. Ingress Port Options



On the **Forwarding Policy > Policy** page, click an *Ingress Port Group* to open its configuration, then click *Port Config* to open the additional port configuration options. In this section, ports can be organized into subgroups, and the following settings can be configured for each subgroup:

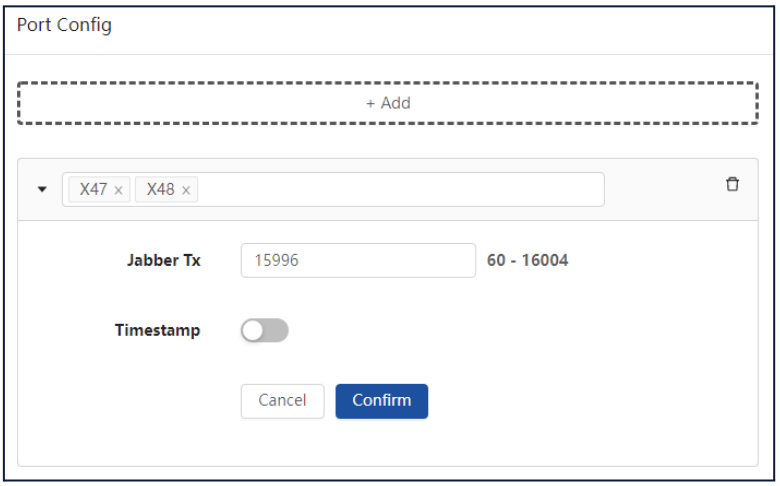
SETTING	OPTION	DESCRIPTION
Ingress Filter Mode	Tunnel Outer Layer	Enable Ingress Filters on the outer layer
	Tunnel Inner Layer	Enable Ingress Filters on the inner layer
Egress Filter Mode	Tunnel Outer Layer	Enable Egress Filters on the outer layer
	Tunnel Inner Layer	Enable Egress Filters on the inner layer
Load Balancing Mode	Tunnel Outer Layer	Calculate Load Balancing hash on the outer layer
	Tunnel Inner Layer	Calculate Load Balancing hash on the inner layer
Exact Match Enable	Enable/Disable	Enable accurate matching rules on this port
Jabber Rx	64 - 16000	Define the max ingress packet length in Byte
Tunnel Strip	GRE|GTP|VXLAN|MPLS|ERSPAN|CFP	Enable tunnel stripping on this port or port group

4.6.3. Egress Port Group Options

On the **Forwarding Policy > Policy** page, click an *Egress Port Group* to open its configuration. The *Egress Port Group* type can be defined. This option defines the way traffic will egress the ports that are part of the port group. The egress type can be defined to output traffic to a single interface, multiple interfaces in replication or load balancing, replication to multiple load balancing groups, and the encapsulation method.

EGRESS TYPE	DESCRIPTION	ADDITIONAL OPTIONS
Copy	Replicate traffic to multiple interfaces.	Encapsulation (ERSPAN / VXLAN) Desensitization Header out Add VLAN Remove Header (VLAN | VXLAN) Sample Output Stripping by Offset
Load Balance	Load Balance the traffic to multiple interfaces.	
Single Interface	Send traffic to a single interface.	
Super Group	Send traffic to multiple Load Balance groups.	
IPGRE	Create an IPGRE tunnel to encapsulate the traffic.	Source IP, Destination IP, Source MAC, Destination MAC
NVGRE	Create an NVGRE tunnel to encapsulate the traffic.	

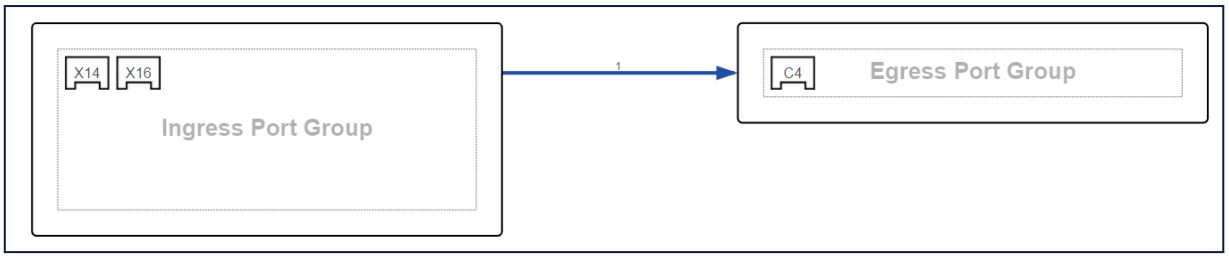
4.6.4. Egress Port Options



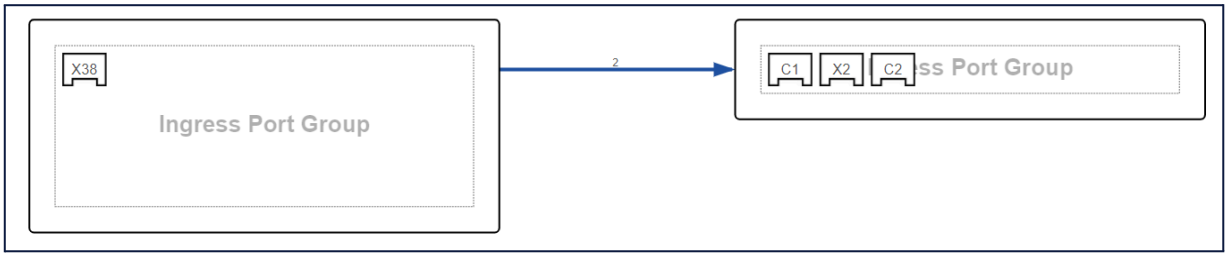
On the **Forwarding Policy > Policy** page, click an *Egress Port Group* to open its configuration, then click *Port Config* to open the additional port configuration options. In this section, ports can be organized into subgroups, and the following settings can be configured for each subgroup:

SETTING	OPTION	DESCRIPTION
Jabber Tx	60 – 16004	Define the max egress packet length in Byte.
Timestamp	-	Add timestamp trailer to packets.
Bandwidth Max	25 – 100000	Limit the bandwidth of the port.

4.6.5. Aggregation



4.6.6. Replication



4.7. Filtering

4.7.1. Ingress Rule

Wildcard Match

A *Wildcard Match* rule is a flexible type of rule that can be used to match packets by several fields. One rule can contain key values for any of the listed fields.

FIELD	EXPECTED VALUE	EXAMPLE
Source IPv4/6	IP / Mask	10.10.10.0/255.255.255.0
Destination IPv4/6	IP / Mask	10.10.10.0/255.255.255.0
Source Port	Decimal	55397
Destination Port	Decimal	80
Outer VLAN	Decimal	10
Inner VLAN	Decimal	12
EtherType	0x0800, 0x86dd, VLAN (single, double, QinQ), VNTag, None	QinQ
Protocol	Protocol number or literal	tcp
DSCP	Decimal	46
VNI	Decimal	36
IP Fragment	Yes, No, None	No
TCP Flag	Decimal bitmap	3
MPLS #1	Decimal	1
MPLS #2	Decimal	2
MPLS #3	Decimal	3
Packet Size	=/< Decimal	< 127
Request Method	GET, POST, None	GET

One or more actions can be associated with each rule. Possible actions are:

- VLAN (add, delete outer/inner/both, modify outer/inner);
- Hit counter.

Wildcard match rules feature a *To CPU* option. Enabling this option will forward the traffic to the CPU for the processing of advanced features.

Exact Match

Exact Match is another type of ingress rule. Packets are filtered according to exact match tuple rules.

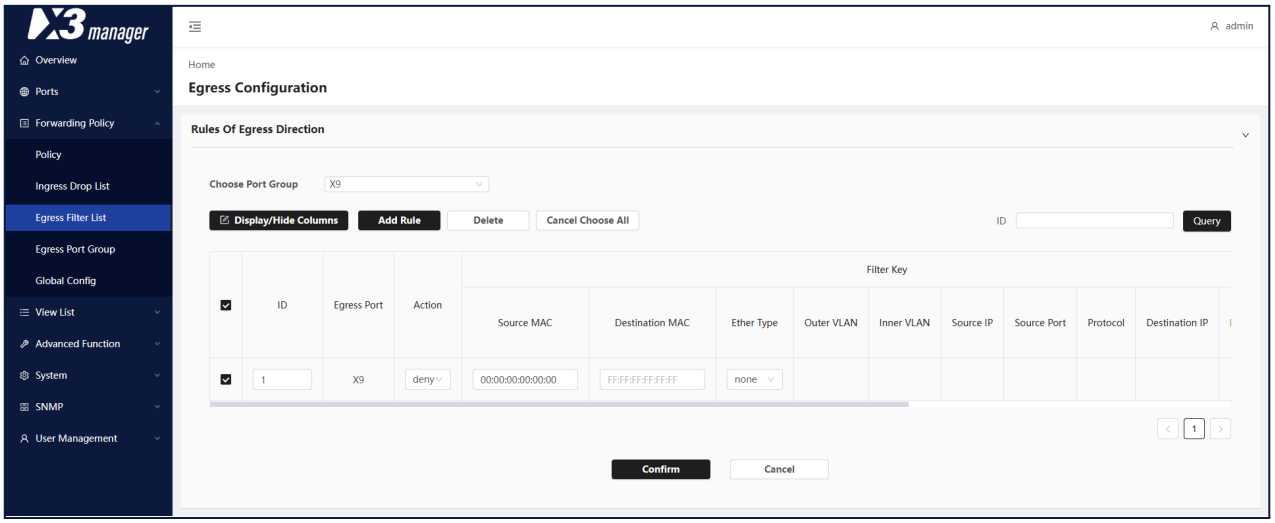
FIELD	EXPECTED VALUE	EXAMPLE
Source IPv4/6	IP	10.10.10.1
Destination IPv4/6	IP	10.10.10.2
Protocol	Protocol number or literal	udp
Source Port	Decimal	55397
Destination Port	Decimal	80

One or more actions can be associated with each rule. Possible actions are:

- VLAN (add, delete double)
- Hit Counter

4.7.2. Egress Rule

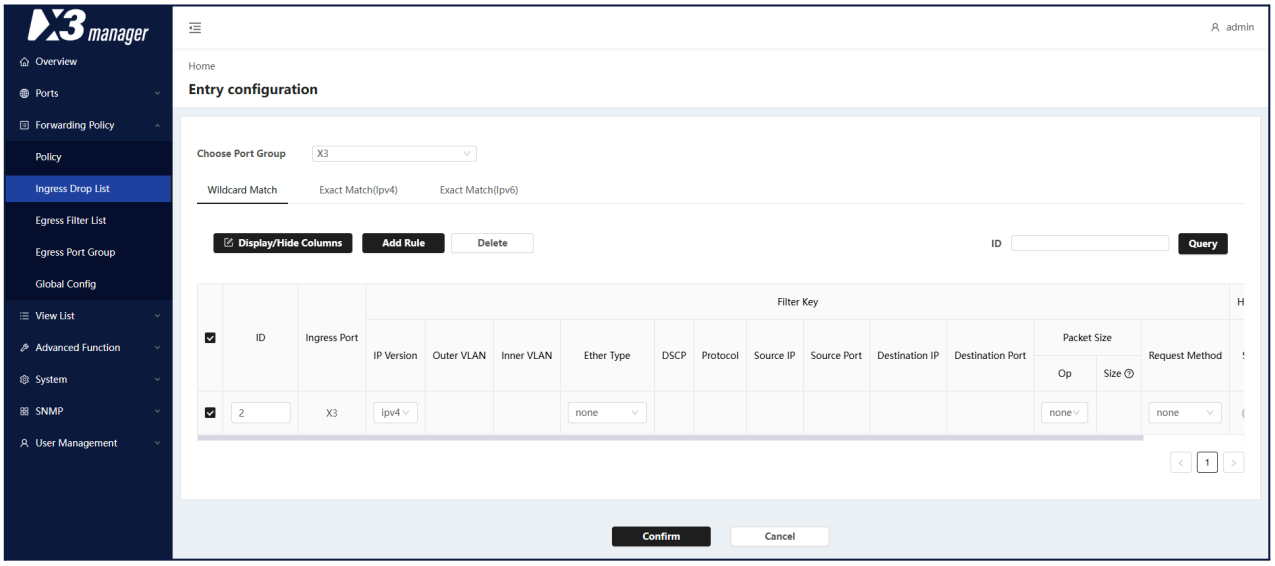
Navigate to the **Forwarding Policy > Egress Filter List** page to set up egress rules.



Select a port group, then add one or more egress rules to target specific traffic. Targeted traffic can be either allowed to egress (*permit*), or dropped (*deny*).

4.7.3. Ingress Drop

Navigate to the **Forwarding Policy > Ingress Drop List** page to set up ingress drop rules.



4.7.4. Advanced Rules

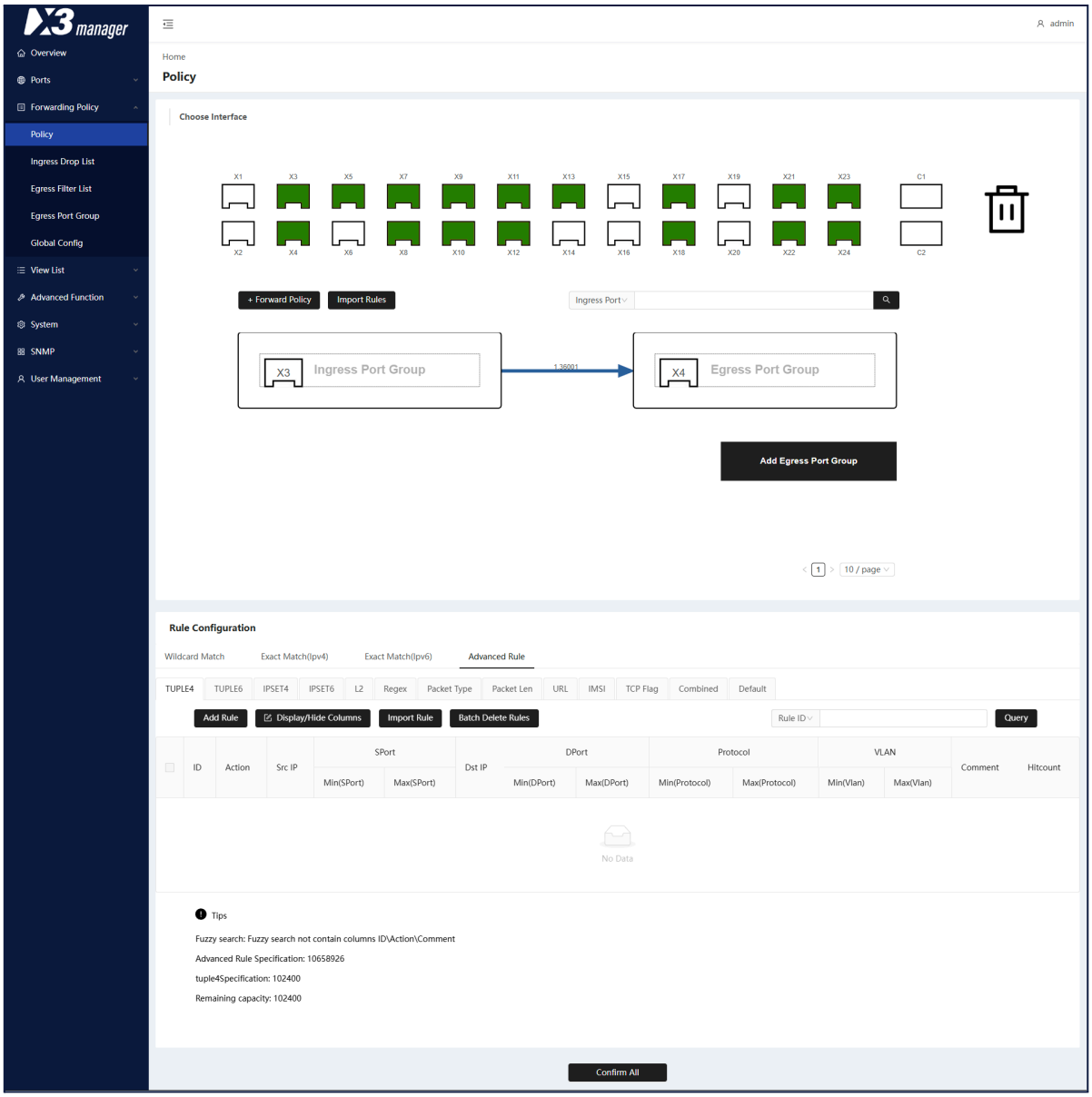
Advanced Rules are processed by the CPU.

Navigate to the **Forwarding Policy > Policy** page, select a flow (click the arrow between an *Ingress Port Group* and an *Egress Port Group*), and open the **Advanced Rule** tab.

The available Advanced Rule types are as follows:

- **TUPLE4 (IPv4 mask rule):** Allows IPv4 IP mask, port range, protocol and VLAN.
- **TUPLE6 (IPv6 mask rule):** Allows IPv6 IP mask, port range, protocol and VLAN**.**
- **IPSET4 (extract rules IPv4):** Allows IPV4 IP, port and protocol.
- **IPSET6 (extract rules IPv6):** Allows IPV4 IP, port and protocol.
- **L2 (Layer 2 filtering):** Allows source/destination MAC address, Ether Type and 1-4 layers of VLAN.
- **Regex (keyword rules):** Filtering packets by keywords, including modes of full_packet, fixed_window, and float_window.
    - Full_Packet: Matching starts from the header of the packet with whole packet.
    - Fixed_Window: Matching starts from the packet header ranged in 0-256 bytes.
    - Floating_Window: Can match from L2_load (outer IP header), L3_load (inner TCP/UDP/SCTP head, check outer layer when no inner layer), and L4_load (inner TCP/UDP/SCTP payload, check outer layer when no inner layer). Rules support the regular matching, hexadecimal (using '\x') and file content such as GET/POST. Searching area interval is left-close and right-open and 0 represents the first character to match.
- **Packet Type:** Filtering by packet types.
- **URL:** Filtering by HOST+URI in the HTTP.
- **IMSI:** Filtering by IMSI field in GTPv2.
- **Combined:** Combined with multiple types of rules. It can only be hit when all of its sub rules can be hit.
- **Default:** Default filtering, always has the lowest priority.

Note: Tips at the bottom of the page show the maximum size of different kinds of advanced rules that can be configured.

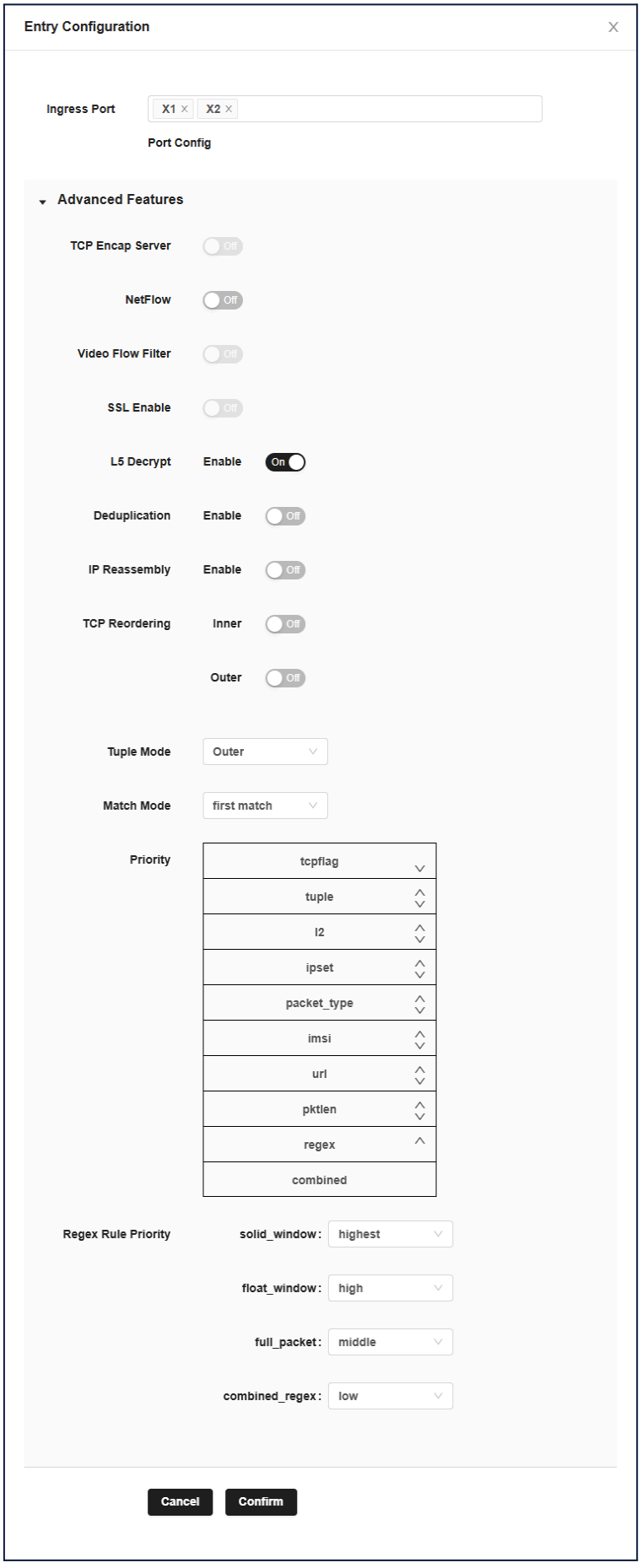


4.8. Advanced Features

Advanced Features are handled in the CPU. If Advanced Features are set in a rule but the traffic is not sent to the CPU, they will not be processed.

To send the traffic to the CPU, navigate to the **Forwarding Policy > Policy** page, select a flow by clicking the **arrow** between an *Ingress Port Group* and an *Egress Port Group*, click the *Add Rule* button on the *Rule Configuration* section's *Wildcard Match* tab, click the *To CPU* toggle to enable it, then click the *Confirm All* button.

4.8.1. Ingress Port Group Advanced Features

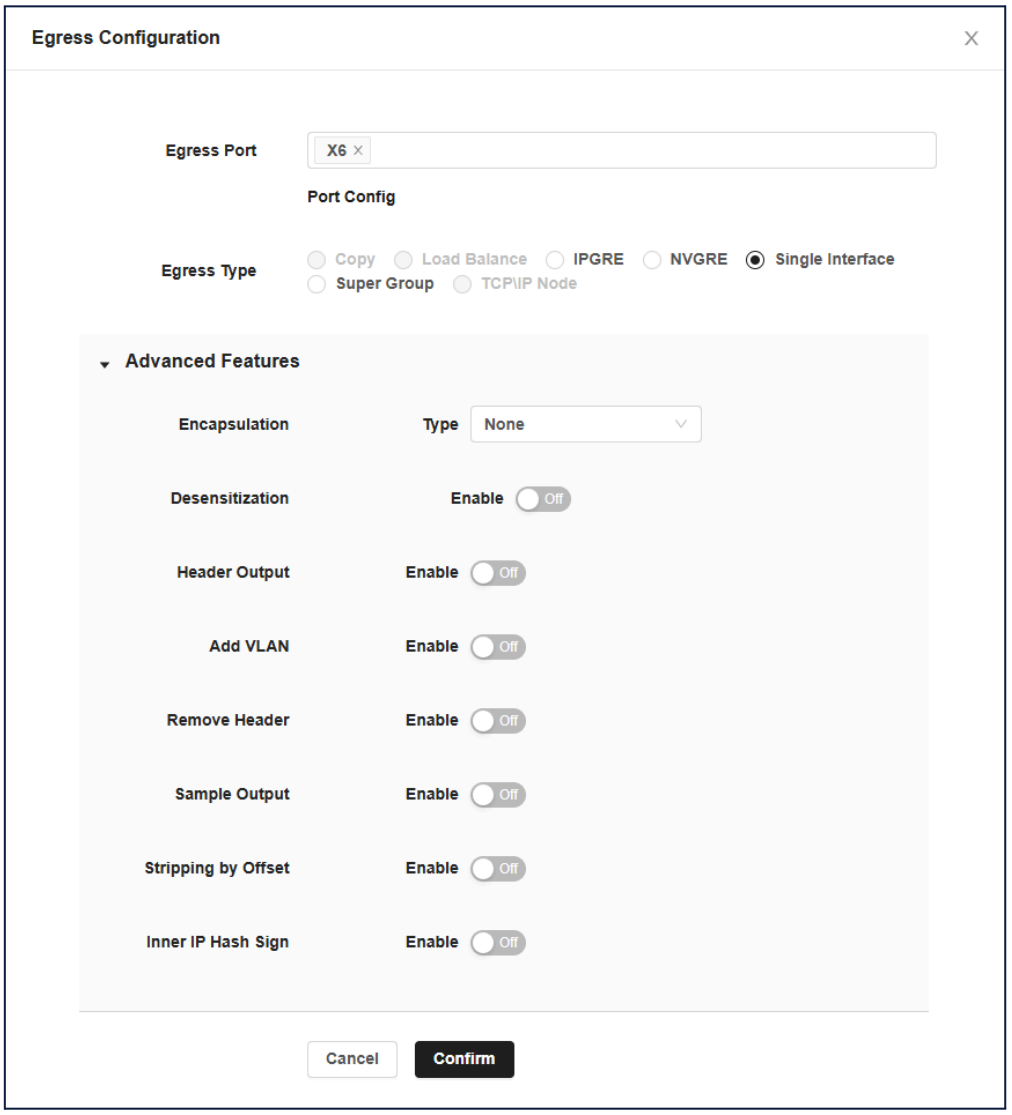


- **TCP Encap Server:** This feature is not supported in X3 anymore.
- **NetFlow:** To perform NetFlow statistics in this ingress group or not.
- **SSL Enable:** To apply SSL bypass in this ingress group or not.
- **L5 Decrypt:** To configure whether to decode L5 content. When enabled, the device can filter matching URL, SIP, RTP/RTCP, but when HTTP/SIP packets are fragmented, the traffic will be out of order.
- **Deduplication:** To discard repeated packets. Deduplication time interval can be set in per hundred
- millisecond (max. 1000 ms) and can choose fields (TCP, TTL, MAC, L2, etc.) to ignore.
- **IP Reassembly:** To reassemble fragmentation internally, and configure the depth to outer layer or
- to inner and outer layer. Also to choose whether to output the synthesized packets or discard original
- fragmentation. Enabling IP Reassembly will reorganize the packets internally, and to output all the
- fragmentation hit the rules to the designated port.
- **TCP Reordering:** To rearrange TCP packets unordered and output in order. Can choose to sort by outer or inner layer.
- **Tuple mode:** To choose filtering layer based on outer/sub-outer/inner layer of IP to hit rules in this ingress
- group.
- **Match Mode:**
    - Full Match mode: All advanced rules' hitting priority depends on rule ID,
    - First Match mode: Rules' hitting priority depends on 'different rule > within rule > rule ID'. In first match mode, the priority between rules can be adjusted. Priority between regex rules can be adjusted.
- **Priority:** To edit the priority between different kinds of rules. Appears if match mode is "first match".
- **Regex Rule Priority:** To edit the priority into regex rule. Appears if match mode is "first match".

In first match mode:

- The default hitting priority of advanced rules is tcpflag > tuple > L2 > ipset > packet_type > imsi > url > pktlen > regex > combined.
- Internal priority of Regex: solid_window > float_window > full_packet > combined.
- Internal priority of IPSET: 5-tuple > 3-tuple (sip + sport + proto > dip + dport + proto) > 2-tuple (sip + dport > dip + sport > sip + proto > dip + proto > sport + proto > dport + proto) > 1-tuple (sip > dip).
- Internal priority of URL: precise URL > fuzzy URL.
- Internal priority of the TCP flag: specified load > default load.
- Internal priority of Combined rules is based on its sub-rules' priority: combination of (A+*) > (B+C+D+*). If sub-rule types are same, the one which has greater number of sub-rule types has a higher priority: the combination of (A+B+C) > (A+B). If sub-rule types and numbers are both same, the comparison between internal priority among the same type of sub-rules takes precedence over the comparison between different type of sub-rules: the combination of (B+C-max) > (A+C).

4.8.2. Egress Port Group Advanced Features



- **Encapsulation:** To encapsulate VXLAN/ERSPAN header and to edit relevant information.
- **Desensitization (Data Masking):** Modify or encrypt data bytes in the packet. Supports customize and keyword modes.
    - Customize: Desensitize data within a range.
        - Set_Num: Replace all data bytes within a range to be a specified value.
        - Rc4_Key: Encrypt all data bytes within a range by RC4 algorithm.
    - Keyword: Desensitize specified keywords within a range. Mode default to be Set_Num.
- **Header Output:** Output the packet without payload.
- **Add VLAN:** Add designated VLAN, range 1-4095.
- **Remove Header:** Strip tunnel header: remove layers of VLAN (range 1-15 layers), VXLAN (range 1-2 layers), MPLS (range 1-15 layers), GRE, DCE (the tunnel header defined by Cisco).
- **Sample Output:** Can sample output packets based on optional 5-tuple, inner/outer layer, and interval base (sample size), start, end can be edited.
- **Stripping by Offset (Slicing):** Stripping flow data from several optional different layer and header update is supported.
- **Inner IP Hash Sign:** Hashing the value of inner IP and sign it in DMAC; including hash modulus, hash IP length and whether to overwrite DMAC can be set.

4.8.3. Packet Deduplication

The Packet Deduplication feature discards duplicated packets from a physical port, a port group, or across any port. As duplication may have various causes, X3 provides several options to configure the feature.

Packet fields used for deduplication:

- Layer 1: Ingress Port Group;
- Layer 2: MAC addresses, EtherType, VLAN;
- Layer 3: IP header;
- Layer 4: TCP sequence number, TCP ACK.

To set up deduplication, navigate to the **Forwarding Policy > Policy** page, click an *Ingress Port Group* to open its configuration, enable *Deduplication*, configure the options, then confirm.

The Deduplication feature is achieved in the CPU. Traffic must be routed to the CPU (see 4.8).

Configurable Deduplication options:

Option	Layer	Fields
Ignore Port	1 (Port Group)	Ingress Port Group
Ignore MAC	2 (ETHERNET)	Source MAC Address Destination MAC Address
Ignore L2	2 (ETHERNET)	EtherType VLAN MPLS
Ignore DSCP	3 (IP)	DSCP
Ignore TTL	3 (IP)	TTL
Ignore IP-ID	3 (IP)	IPv4 Identification field
Ignore IP	3 (IP)	IP Header (except DSCP, IP-ID and TTL)
Ignore TCP	4 (TCP)	TCP sequence number TCP ACK Flag

Time interval
The deduplication time interval can be set per 100 ms (max. 1000 ms).

4.8.4. Data Masking

Data Masking allows you to obfuscate specific data in egress.

To configure data masking, navigate to the **Forwarding Policy > Policy** page, click an *Egress Port Group* to open its configuration, and enable *Desensitization*. With *Desensitization* enabled, select the mode. Depending on the selected mode, the configuration options are defined below.

Data Masking is achieved in the CPU and requires traffic to be routed to the CPU (see 4.8), as well as a Default Advanced Rule (*Advanced Rule* > *Default*).

Mode: Keyword

Range
The range in bytes of the data that will be obfuscated, starting from the targeted data (regex).

Match Times
The number of times the regex can match data within each packet.

Regex
The regular expression for targeting data.

Mode
Set_Num: replaces all data bytes within the specified range with the specified value.

Value
The value that will replace the targeted data, specified as decimal ASCII value.

Mode: Customize

Offset Type
MAC_Hdr_Start: data obfuscation will start from the MAC header.
MAC_Data_Start: data obfuscation will start from the MAC payload.
IP_Hdr_Start: data obfuscation will start from the IP header.
IP_Data_Start: data obfuscation will start from the IP payload.
L4_Hdr_Start: data obfuscation will start from the L4 header.
L4_Data_Start: data obfuscation will start from the L4 payload.

Range
The range in bytes of the data that will be obfuscated, starting from the selected offset type.

Mode
Set_Num: replaces all data bytes within the specified range(s) with the specified value.
Rc4_Key: encrypts all data bytes within the specified range(s) with RC4 algorithm.

Value (*Set_Num* mode selected)
The value that will replace the specified data.

RC4 Key (*Rc4_Key* mode selected)
The RC4 key with which to encrypt the specified data.

4.9. Tunneling

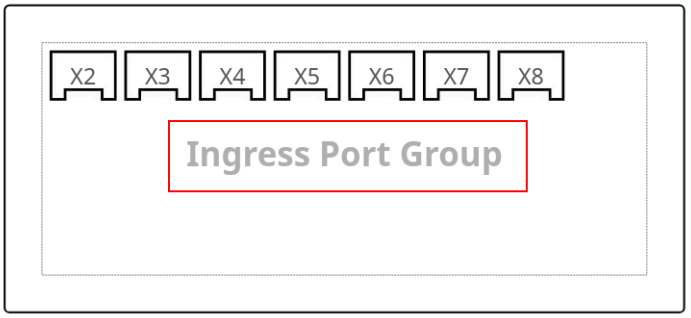
4.9.1. Tunnel Stripping

Strips tunnel headers at ingress. This functionality is performed at line rate in the data plane. The following tunneling protocols are supported: GRE, GTP, VXLAN, MPLS, ERSPAN, CFP. To enable tunnel stripping, see Ingress Port Options.

4.9.2. Tunnel Termination

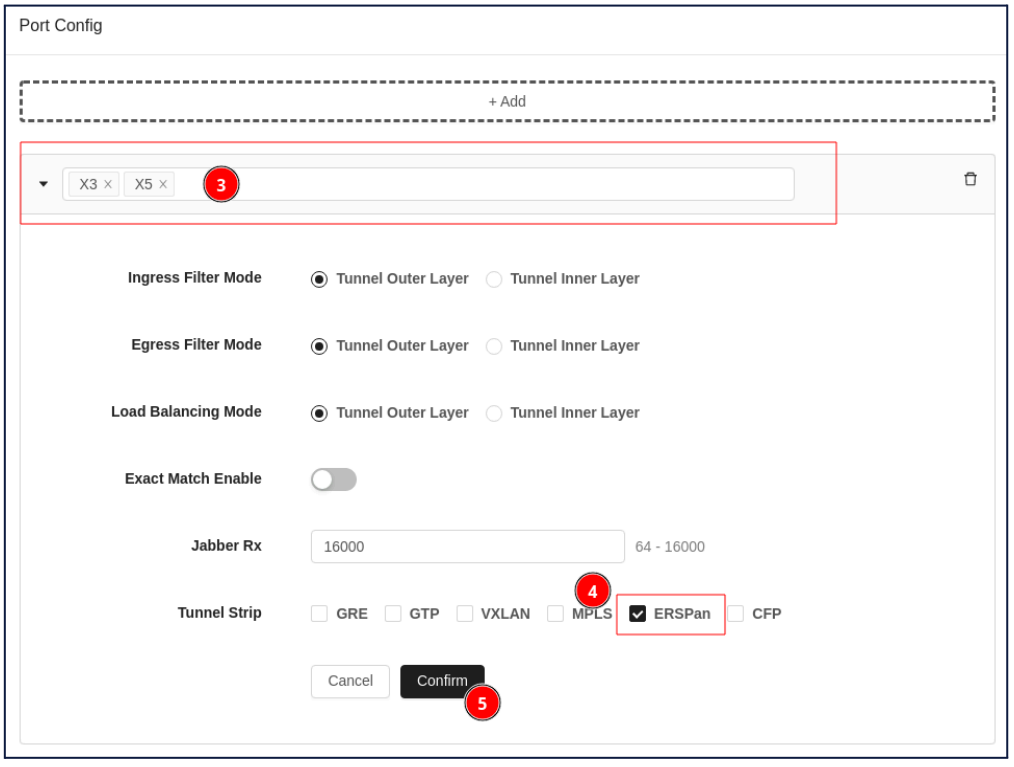
In order to configure one or more input interfaces to perform tunnel termination, it is necessary to activate the tunnel stripping option on these interfaces (see 4.9.1), and to configure an IP address for ICMP response. This is possible using the following procedure:

1. In **Forwarding Policy > Policy**, click *Ingress Port Group* to open the ingress port group configuration menu.



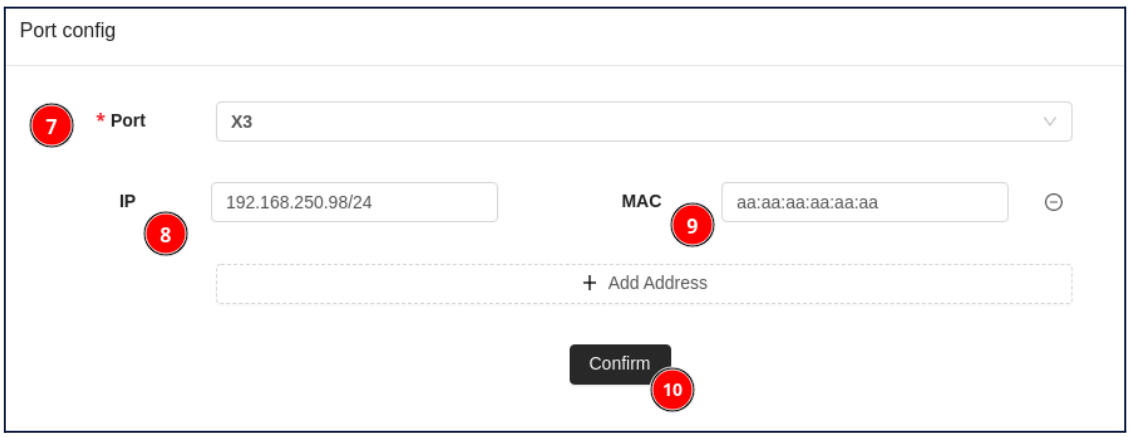
2. Click *Port Config* to open the port configuration menu.

3. Remove all ports from the port list except for those for which you wish to activate tunnel stripping.
4. Select the type(s) of tunnel(s) to strip, for instance ERSPAN.
5. Click *Confirm*.



6. Navigate to **Advanced Function > ICMP Response** and click *New config* to add a new configuration.
7. Select the port you wish to configure.
8. Set the IP address and CIDR mask.
9. Set the interface MAC address (this must be unique in your network).

10. Click *Confirm*.



4.9.3. Tunnel Creation

To encapsulate the traffic in an IPGRE or NVGRE tunnel, navigate to the **Forwarding Policy > Policy** page, click an *Egress Port Group* to open its configuration, set *Egress Type* to *IPGRE* or *NVGRE*, and fill in the fields.

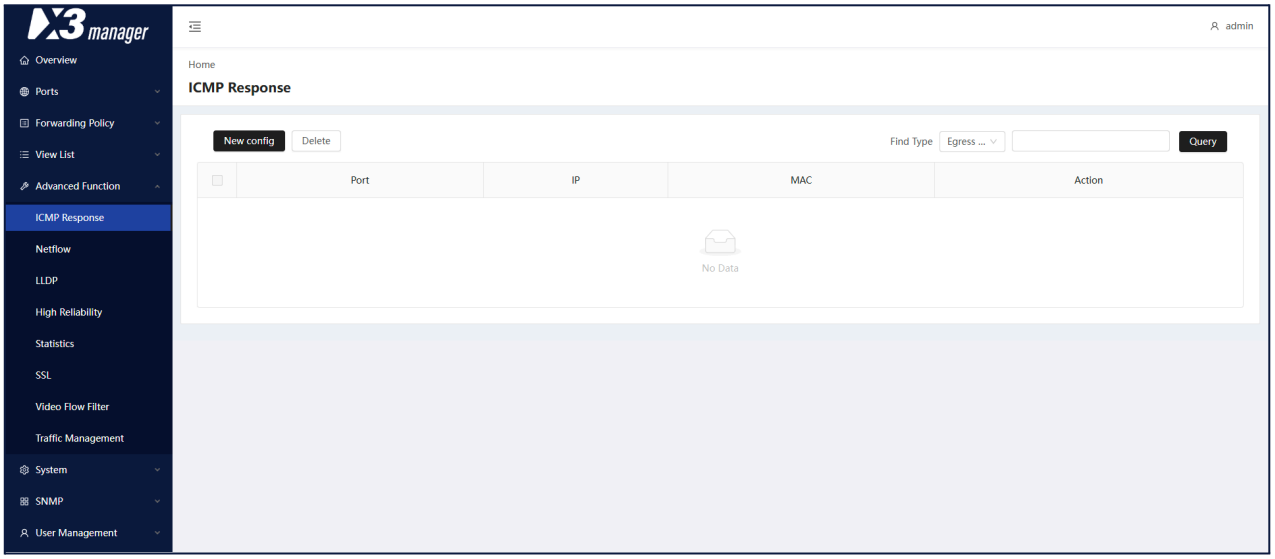
To encapsulate the traffic in a VXLAN or ERSPAN tunnel, navigate to the **Forwarding Policy > Policy** page, click an *Egress Port Group* to open its configuration, set *Egress Type* to *Single Interface*, set *Encapsulation Type* to *VXLAN* or *ERSPAN*, and fill in the fields.

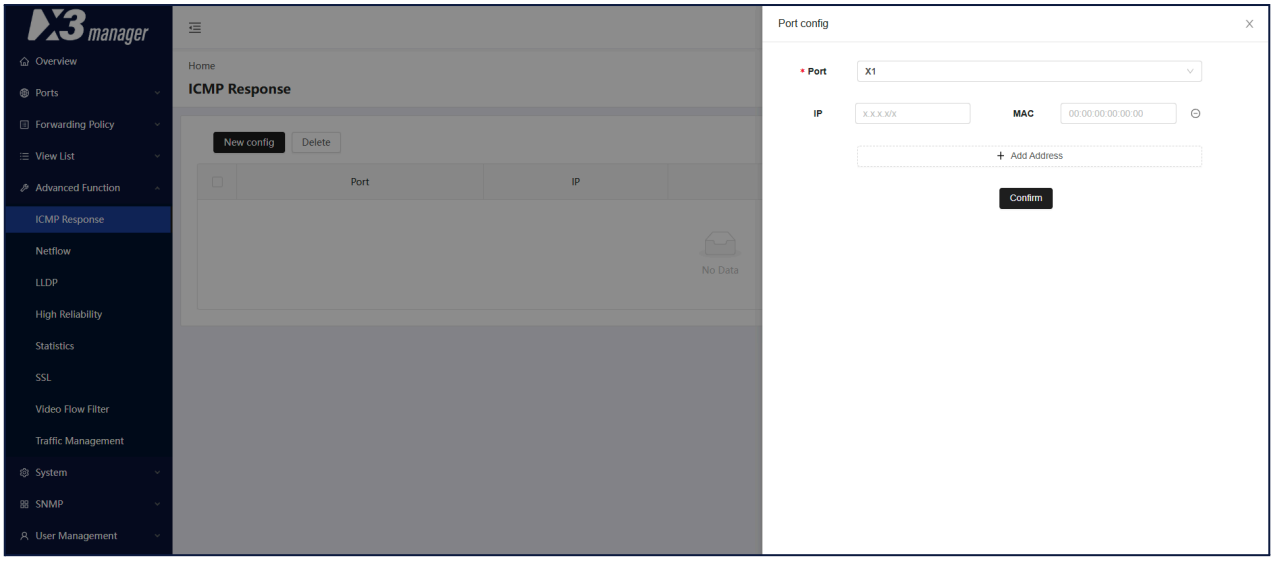
VXLAN and ERSPAN tunnel creation is done in the CPU and requires the *To CPU* option (see 4.8).

4.10. Advanced Function

4.10.1. ICMP Response

Viewing, adding and deleting ICMP response configuration on ports. IP address and MAC address can be configured to port. Each interface can have a maximum number of 16 different IPv4 IP. For tunnel termination, assigning an IP address to the port is mandatory.





4.10.2. NetFlow

The X3 NetFlow feature enables generation and export of NetFlow statistics.

NetFlow can be enabled and configured on the **Advanced Function > NetFlow** page.

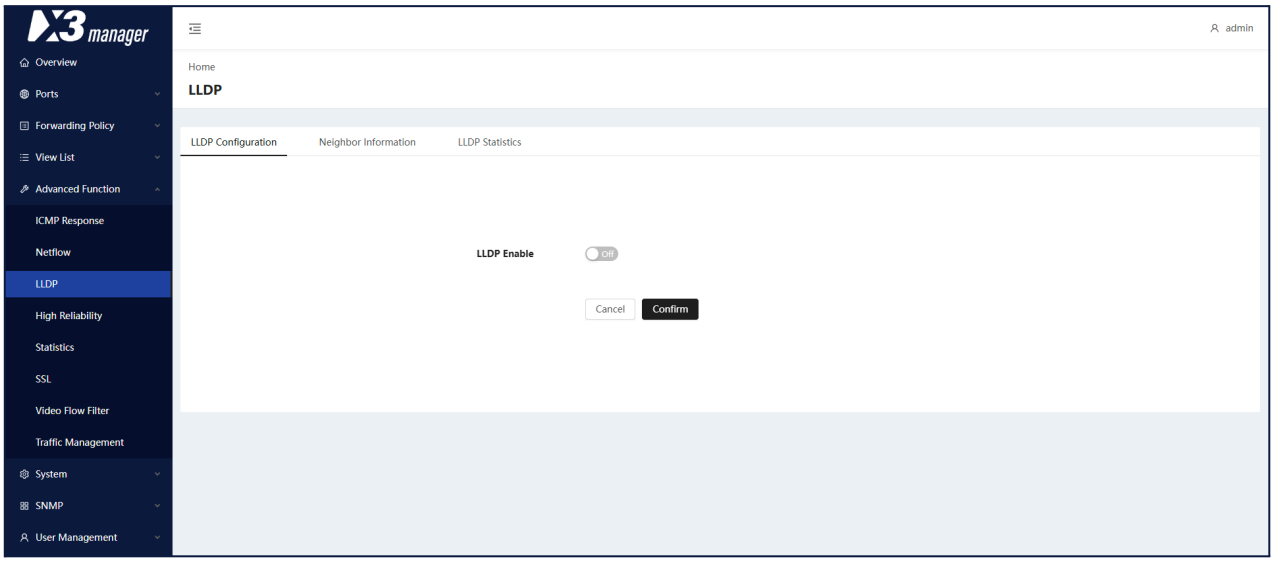
NetFlow Version: v5 / v9

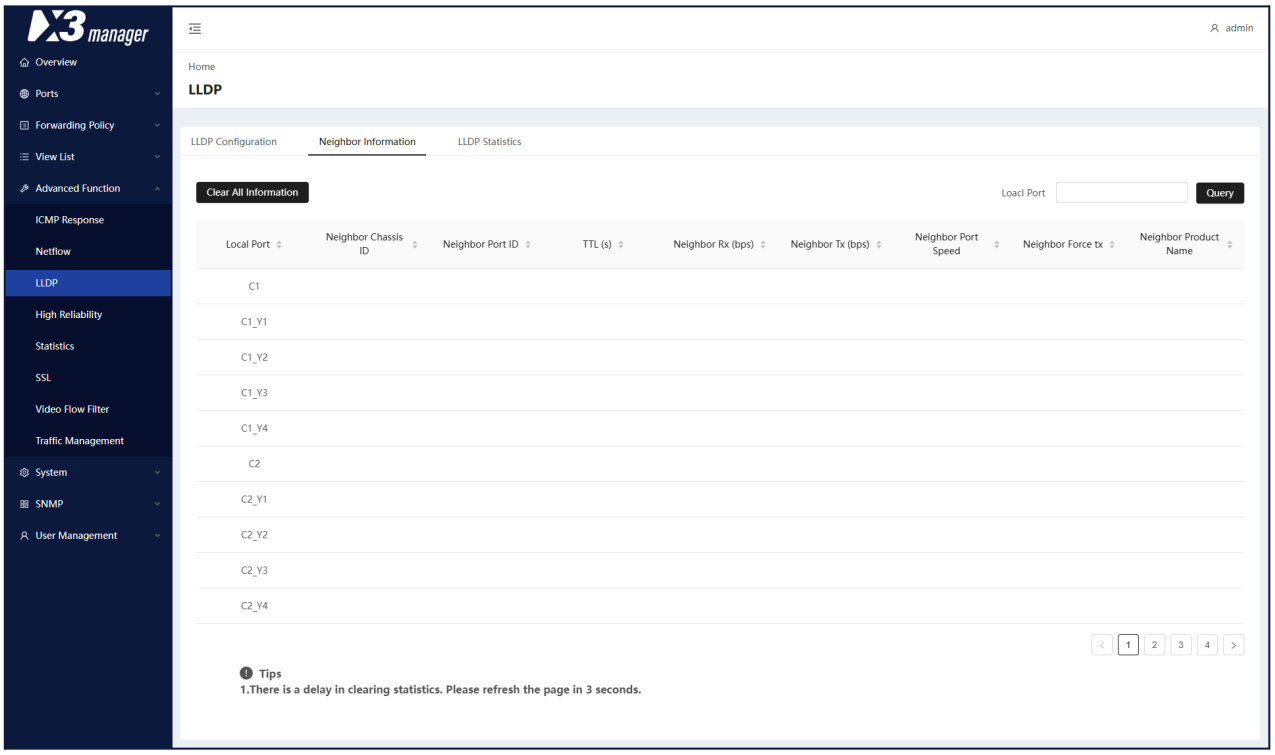
SETTING	OPTION	DESCRIPTION
NetFlow Version	v5 / v9	Select the NetFlow version to use
IP Version	IPv4 / IPv6	Select the IP version for the NetFlow packets
Dst MAC1	MAC Address	Input the MAC address of the NetFlow collector
Dst IP1	IP Address	Input the IP address of the NetFlow collector
Dst Port	UDP Port	Input the destination port
Sample Mode	None / Fixed / Random / Stream	Select the sampling mode. The sampling mode is based on packets, except for stream option
Sample Rate Interval	0 - 16000	In fixed sampling, sample one of configured number of packets In random sampling: randomly take one of configured number of packets as a sample In stream sampling: take a stream of packets from configured number of packets as a sample
NetFlow Output	Enable / Disable	Enable the NetFlow statistic output
Output ports	Port	Assign the output port of NetFlow statistic messages

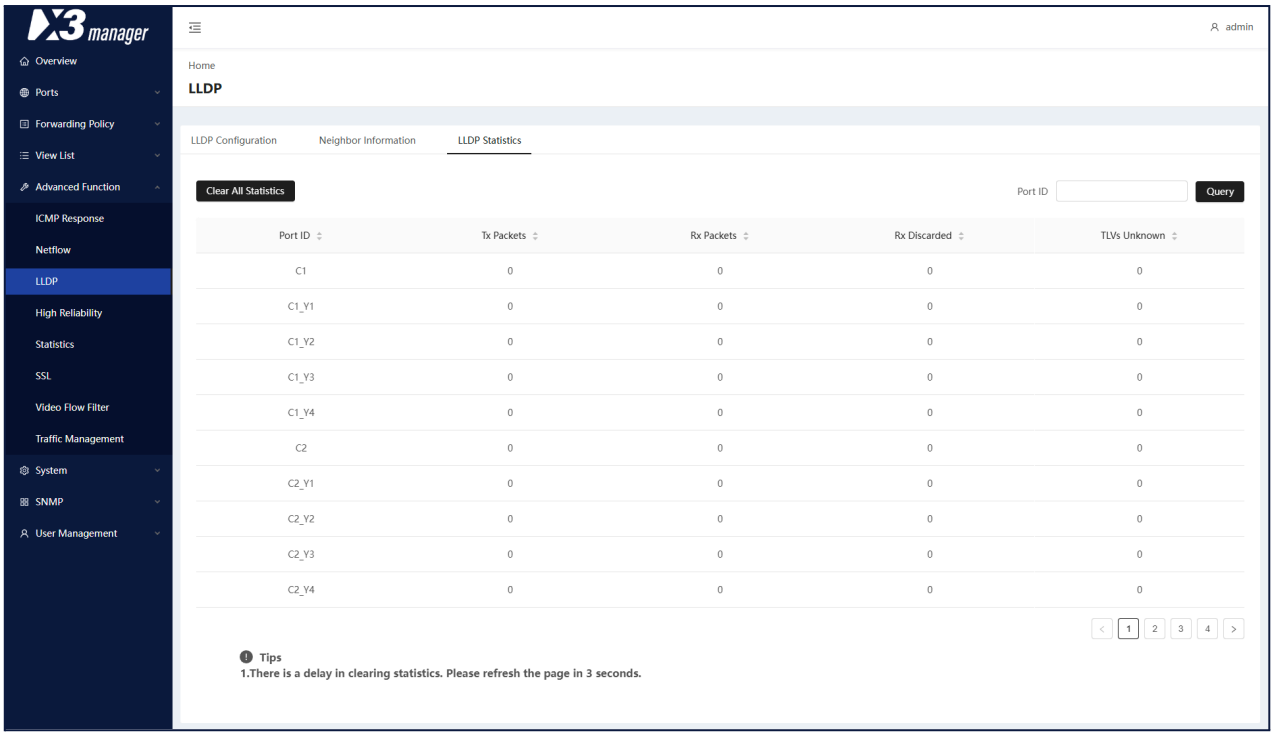
Once enabled and configured, NetFlow generation can be enabled for specific ingress port groups (see Ingress Port Group Options).

4.10.3. LLDP

To view and configure LLDP. Neighbor information and statistics are available.







4.10.4. High Reliability

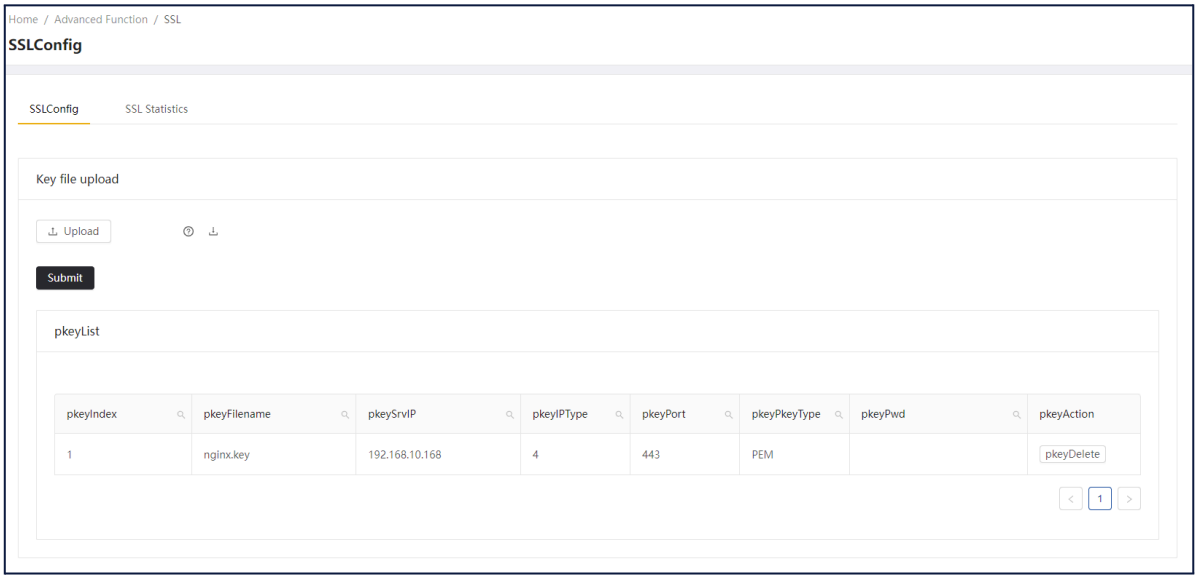
This page provides configurations to high reliability, including port, load balance and cascade group.

- **Port:** To configure the main port and its spare port and linkages.
  - **Spare:** Spare port of the main port. When the main port is down (offline), flow packets will be sent to spare port to output.
  - **Linkages:** Linked port of the main port. When the main port is down (offline), linked port will also be down.
- **Load Balance:** To configure the main load balance group and its spare group, linkages and inter connection.
  - **Spare:** Spare group of the main load balance group. When one of the port in main load balance group is down (offline), flow packets will be sent to spare group to output by load balance.
  - **Linkages:** Linked port of the main load balance group. When one of the port in main load balance group is down (offline), linked port will also be down.
  - **Inter Connection:** Cascade group of the main load balance group. When one or several ports in main load balance group is down (offline), all of flow packets outputting from them will be sent to cascade group to output by load balance.
- **Cascade Group:** To configure cascade group and ports in it.

4.10.5. Statistics

The **Advanced Function > Statistics** page displays flow statistics of TCP reassembly, IP reassembly, deduplication, packet type, and TCP encapsulation.

4.10.6. SSL Decryption



To enable SSL Decryption, first upload a private key file (.key) and its associated configuration file (.json) on the **Advanced Function > SSL** page. Example files can be downloaded from this page. The files should be formatted as follows:

example.json	{"pkey_index":1,"srv_ip":"192.168.10.168","file_password":"","srv_port":443,"filename":"example.key","ip_type":4,"pkey_type":"PEM"}
example.key	-----BEGIN PRIVATE KEY----- MIIJQgIBADANBgkqhkiG9w0BAQEFAASCCSwwggkoAgEAAoICAQDv7pBDJgQJASPv VndDJnVhLQy3LjAnwK4/nqCx0WMhz+f2Sb/T3FQMdabf31jrEg2OFM31TBi5w+sd WIbGO4VwWPSCTGhKWWJiLOWN052cLXK8jV+9HP29JkrxJgasbN2Hhs6hue/j3pWZ ... L/4ggvQSWvefMhpslNwubzVDZpzapMnuRw5kxQClbyLTG3nWKPMe1FdjMaCuXF/V pn2FJVhtctnlhrxJHRlNLB1cd18NxPUepWDRuJhFpu2dHW4zqp/egsEzZglV47bY 1x68m081vyYjYTNhCm2w5t3aqWifaMEbHt5MwBXiN7THfs07WEva61goDP8XaZoW YKgrRnuj/WFwzciAPjBCmQYFv9V7vw== -----END PRIVATE KEY-----

Once this is done, navigate to the **Forwarding Policy > Policy** page, click an *Ingress Port Group* to open its configuration, activate *SSL Enable*, then confirm.

The SSL Decryption feature is achieved in the CPU. Traffic must be routed to the CPU (see 4.8).

4.10.7. Video Flow Filter

Navigate to **Advanced Function > Video Flow Filter** to filter IP packets belonging to a domain. Once domain(s) are configured, when DNS flow packets of relevant domain name are input into the device, the device will learn and store the IPs of those DNS packets into its database, and will issue relevant accurate match rules to the device. If there is no DNS packets exchange, the filter won't work.

4.10.8. Traffic Management (Traffic Shaping)

The **Advanced Function > Traffic Management** page allows the user to enable traffic shaping, which limits the amount of traffic sent out from the interfaces. Click *Add Group* to select the ports on which to enable shaping, and set the maximum speed in *Mbps*.

The *Statistics* tab will display the amount of packets which are sent from the interfaces.

Traffic Shaping is done on egress ports by the CPU and requires the traffic to be routed to the CPU (see 4.8), and will use part of the bandwidth available for other advanced features.

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