



Industrial Managed Layer-3 Switch

User Manual

V2.1

October 19th, 2020

Series covered by this manual:
EHG76XX, EHG96XX, RHG76XX*, EMG86XX,

* The user interface on these products may be slightly different
from the one shown on this user manual

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Preface

This manual contains some advanced network management knowledge, instructions, examples, guidelines, and general theories. The contents are designed to help users manage the switch and use its software, a background in general theory is a must, when reading it. Please refer to the Glossary for technical terms and abbreviations.

Who Should Use This User Manual

This manual is to be used by qualified network personnel or support technicians who are familiar with network operations, and might be useful for system programmers or network planners as well. This manual also provides helpful and handy information for first time users. For any related problems, please contact your local distributor. If they are unable to assist you, please redirect your inquiries to www.atoponline.com.

Warranty Period

Atop technology provides a limited 5-year warranty for managed Ethernet switches.

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1 Introduction

1.1 Introduction to Industrial Managed Switch

Atop's EHG (Ethernet Switching Hub Full Gigabit) 76XX series are product lines of powerful industrial managed switch which are referred to as Open Systems Interconnection (OSI) Layer 3 bridging/routing devices. Unlike an "unmanaged" switch, which is normally found in homes or in Small Office/Home Office (SOHO) environments and runs in "auto-negotiation" mode, each port on a "managed switch" can be configured for its link bandwidth, priority, security, and duplex settings. The managed switches can be managed by Simple Network Management Protocol (SNMP) software, web browsers, Telnet, or serial console. Since every single port can be configured to specific settings, network administrators can better control the network and maximize network functionality.

Atop's managed switch is also an industrial switch and not a commercial switch. A commercial switch simply works in a comfortable office environment. However, an industrial switch is designed to perform in harsh industrial environments, i.e., extreme temperature, high humidity, dusty air, potential high impact, or the presence of potentially high static charges. Atop's managed switch works fine even in these environments.

Atop's managed switch is designed to provide faster, secure, and more stable network. One advantage that makes it a powerful switch is that it supports network redundancy protocols/technologies such as Ethernet Ring Protection Switching (ERPS), iA-Ring, Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), and Media Redundancy Protocol (MRP). These protocols provide better network reliability and decrease recovery time down to less than 20 ms.

Atop's managed Layer-3 switches add to all these features above mentioned, typically present into a Layer-2 managed switch, also Routing capability through IPv4 static routing, RIPv1/v2 and OSPFv2 dynamic routing. Unlike Switching (where packet addressing is made based on the MAC address), Layer-3 switches route the packet based on the IP address.

Atop's managed switch supports a wide range of IEEE standard protocols. This switch is excellent for keeping systems running smoothly, reliable for preventing system damage or losses, and friendly to all levels of users. The goal of this innovative product is to bring users an enhanced network management experience.

Note:

Throughout the manual, the symbol * indicates that more detailed information of the subject will be provided at the end of this book or as a footnote.

1.2 Software Features

Atop's industrial Layer-2 Managed switches come with a wide range of network protocols and software features. These protocols and software features allow the network administrator to implement security and reliability into their network. These features enable Atop's switches to be used in safety applications, and factory and process automation. The followings are the list of protocols and software features.

- User Interfaces
 - Web browser
 - Telnet Console
 - Serial Console
- Dynamic Host Configuration Protocol (DHCP) Server/Relay/Client with Option 66/67
- Time Synchronization
 - Network Time Protocol (NTP) Server/Client
 - Simplified Network Time Protocol (SNTP)
 - IEEE 1588 Precision Clock Synchronization Protocol (PTP)v2 hw- E2E TC and sw-Boundary Clock
- Port Mirroring
- Quality of Service (QoS) Traffic Regulation
- Link Aggregation Control Protocol (LACP)
- Link Layer Discovery Protocol (LLDP)
- Medium Access Control (MAC) Filtering
- Generic Attribute Registration Protocol (GARP) / GARP Multicast Registration Protocol (GMRP)/GARP VLAN Registration Protocol (GVRP)
- Internet Group Management Protocol (IGMP),
- Protocol Independent Multicast (PIM), PIM Sparse Mode (SM), PIM Dense Mode (DM), PIM Source Specific Mode (SSM)
- Distance Vector Multicasting Routing Protocol (DVMRP)
- Simple Network Management Protocol (SNMP) v1/v2/v3 (with MD5 Authentication and DES encryption)
- SNMP Inform
- Spanning Tree Protocol (STP)/Rapid Spanning Tree Protocol (RSTP)/Multiple Spanning Tree Protocol (MSTP)/Media Redundancy Protocol (MRP)
- Virtual Local Area Network (VLAN)
- IEEE 802.1x / Extensible Authentication Protocol (EAP) / Remote Authentication Dial-In User Service (RADIUS) / Terminal Access Controller Access-Control System (TACACS+)
- Security (selected models only)
 - MACsec
 - 802.1AE authentication and key exchange
- Ring
 - Ethernet Ring Protection Switching (ERPS)
 - iA-Ring
 - Compatible-Ring
 - Compatible-Chain
 - U-Ring
- Alarm System (with E-mail Notification or Relay Output)
- Industrial Protocols
 - Modbus/TCP
 - Profinet (including MRP Ring)
- Layer-3 Switching:
 - IP Routing
 - IPv4 Routing
 - Routing Information Protocol (RIP)v1/v2
 - OSPFv2 (Open Shortest Path First Protocol for IPv4)
- Virtual Router Routing Protocol (VRRP)

2 Configuring with a Web Browser

Chapter 2 explains how to access the industrial managed switch for the first time. There are three ways to configure this Ethernet Switch:

1. Web browser
2. Telnet console
3. Serial console

The web browser and the telnet console methods allow users to access the switch over the Internet or the Ethernet LAN, while the serial console method requires a serial cable connection between the console and the switch. There are only a few differences among these three methods. Users are recommended to use the web browser method to configure the system because of its user-friendly interface.

2.1 Web-based Management Basics

Users can access the managed switch easily using their web browsers (Internet Explorer 8 or 11, Firefox 44, Chrome 48 or later versions are recommended). We will proceed to use a web browser to introduce the managed switch's functions.

2.1.1 Default Factory Settings

Below is a list of default factory settings. This information will be used during the login process. Make sure that the computer accessing the switch has an IP address in the same subnet and the subnet mask is the same.

IP Address: 10.0.50.1
Subnet Mask: 255.255.0.0
Default Gateway: 0.0.0.0
User Name: admin
Password: default

2.1.2 Login Process and Main Window Interface

Before users can access the configuration, they have to log in. This can simply be done in two steps.

1. Launch a web browser.
2. Type in the switch IP address (e.g. http://10.0.50.1), as shown in Figure 2.1).

Note: When the user name and password is left empty, the login prompt will not show.



Figure 2.1 IP Address for Web-based Setting

After the login process, the main interface will show up, as shown in Figure 2.2. The main menu (left side of the screen) provides the links at the top-level links of the menu hierarchy and by clicking each item allows lower-level links to be displayed. Note that in this case the Port 5 is highlighted in green, indicating that the port is being connected. Detailed explanations of each subsection will be addressed later as necessary.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- + VLAN
- + VRRP
- + DHCP Server
- + Security
- + ERPS/Ring
- + LLDP
- + PROFINET
- + EtherNet/IP
- + IP Routing
- + Client IP Setting
- + System

Basic System Information	
Model name	EHG7608-4PoE-4SFP
Device Description	Managed Switch, EHG7608-4PoE-4SFP
MAC address	00:60:E9:1E:93:B9
Application Version	4.27-svn42
Kernel Version	4.27-svn42
Image Build Info.	root@buildSvr #1 SMP Mon Apr 30 13:52:00 IST 2018
Memory	113788K used, 141828K free, 0K buff, 44560K cached
Board Temperature	38.68 Centigrade

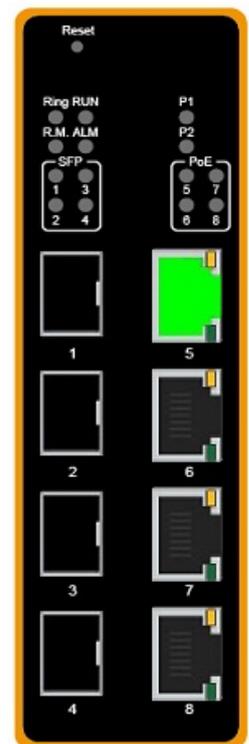


Figure 2.2 Default Web Interface

2.2 Basic Information

To help users become familiar with the device, the **Basic** section provides important details of the switch. This is also the main welcome screen once the user has logged in. The details make it easier to identify different switches connected to the network. The Basic section is categorized into six subsections as shown in the left panel of Figure 2.3.

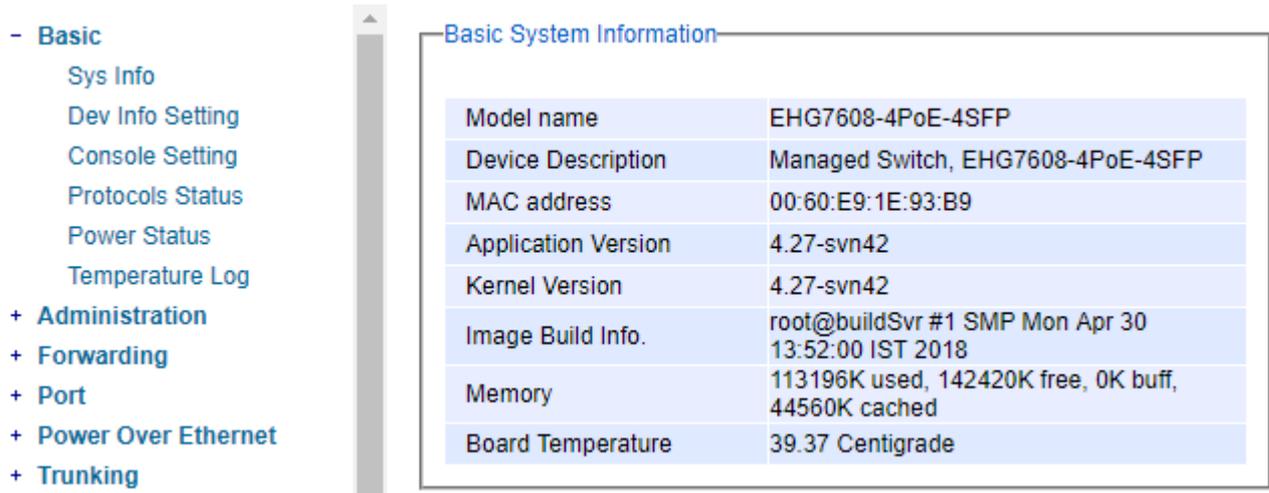


Figure 2.3 Basic Information Dropdown Menu

2.2.1 Sys Info

This subsection provides basic system information of Atop's industrial managed switch. The user can check the model name, device description, MAC address, firmware version, image build information, memory usage of the switch, and current board's temperature. Note that Atop's firmware generally consists of application version and kernel version. Figure 2.4 depicts an example of Basic System Information of EHG7608-4PoE-4SFP. Table 2.1 summarizes the description of each basic information.

Basic System Information	
Model name	EHG7608-4PoE-4SFP
Device Description	Managed Switch, EHG7608-4PoE-4SFP
MAC address	00:60:E9:1E:93:B9
Application Version	4.27-svn42
Kernel Version	4.27-svn42
Image Build Info.	root@buildSvr #1 SMP Mon Apr 30 13:52:00 IST 2018
Memory	113196K used, 142420K free, 0K buff, 44560K cached
Board Temperature	39.37 Centigrade

Figure 2.4 Details of Sys Info Webpage

Table 2.1 Descriptions of the Basic information

Label	Description
Model name	The device's complete model name
Device Description	The model type of the device
MAC address	The MAC address of the device
Application Version	The current application version of the device
Kernel Version	The current kernel version of the device
Image Build Info.	Information about the firmware image such as date of creation
Memory	The current RAM's availability and the size of cached and shared memory
Board Temperature	The current temperature of the board inside the chassis in degree Celsius(a.k.a. Centigrade)

2.2.2 Device Information Setting

Users can assign device's details to Atop's switch in this subsection. By entering unique and relevant system information such as device name, device description, location, and contact, this information can help identify one specific switch among all other devices in the network that supports SNMP. Please click on the "Update" button to update the information on the switch. Figure 2.5 shows Device Information Setting page of an EHG7608 managed switch model. Table 2.2 summarizes the device information setting descriptions and corresponding default factory settings.

Figure 2.5 Details of Device Information Settings Webpage

Table 2.2 Descriptions of the System Settings

Label	Description	Factory Default
Device Name	Specifies a particular role or application of different switches. The name entered here will also be shown in Atop's Device Management Utility. Max. 63 Char.	(Model name)
Device Description	Detailed description of the unit. Max. 63 Characters.	Managed Switch + (Model name)
Location	Location of the switch. Max. 63 Characters.	Switch Location
Contact	Provides contact information for maintenance. Enter the name of whom to contact in case a problem occurs. Max. 63 Characters.	www.atop.com.tw

2.2.3 Console Setting

In this chapter, we use a web browser for configuring the switch. For the serial console method, please go to Chapter 3 Configuring with Serial Console for more detail on how to connect console to the switch. The **Console**

Setting here only shows the setting parameters of a serial console's connection, which can be used by a console software such as Tera Term. Figure 2.6 below shows an example of the serial console's connection parameters.

Console Setting

Baud Rate	115200 bps
Data	8 bits
Parity	None
Stop	1 bit
Flow Control	None

Figure 2.6 Setting Parameters for the Console Method

2.2.4 Protocols Status

Protocols Status subsection reports status of all protocols in the switch. While users can view status of all protocols at once in this webpage, the detailed explanation of each protocol and method will be provided in the following sections. Figure 2.7 shows the web interface for the Protocol Status page.

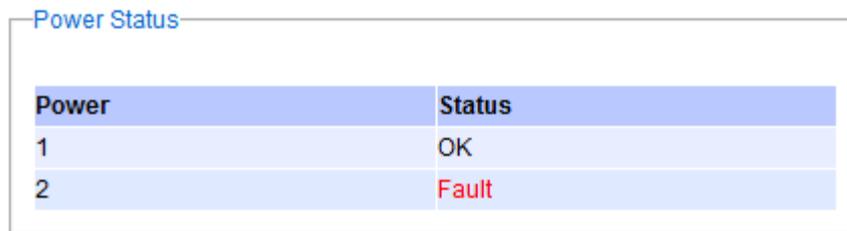
Protocol Status

Protocol	Status
SNTP	Disabled
PTP	Disabled
LACP	Disabled
GVRP	Disabled
GMRP	Disabled
IGMP	Disabled
SNMP	Disabled
STP	Disabled
RSTP	Disabled
MSTP	Disabled
802.1x	Disabled
ERPS	Disabled
iA-Ring	Disabled
Compatible-Ring	Disabled
U-Ring	Disabled
LLDP Tx	Enabled
LLDP Rx	Enabled
Compatible-Chain	Disabled
Profinet	Disabled
MRP	Disabled
NTP Server	Disabled
Telnet	Enabled
SSH	Enabled
EtherNet/IP	Disabled
DHCP Server	Disabled
VRRP	Disabled
PIM Sparse Mode	Disabled
PIM SSM	Disabled
PIM Dense Mode	Disabled
DVMRP	Disabled

Figure 2.7 Protocol Status Webpage

2.2.5 Power Status

Atop's managed switch features dual VDC power supply inputs. For Non-PoE models, 9-57VDC can be supplied to Power Input 1 (V1+ and V1- pins) and/or Power Input 2 (V2+ and V2- pins). For PoE models, 45-57VDC should be supplied under 802.3af mode and 51-57VDC should be supplied under 802.3at mode. For instance, the EHG7608-4PoE-4SFP has the following three power ratings: 9-57VDC with a maximum current of 2.8 Amperes (No PoE mode), 45-57VDC with a maximum current of 1.7 Amperes (802.3af mode), and 51-57VDC with a maximum current of 2.3 Amperes (802.3at mode). Figure 2.8 shows the status of each power input. A "Fault" status means that the power on that supply input is either not connected or the power is not supplied properly.



Power	Status
1	OK
2	Fault

Figure 2.8 Power Status Webpage

2.2.6 Temperature Log

This subsection provides user and system temperature logs. There are summary statistics and distribution of temperature information for each log. The highest temperature, the lowest temperature and the average temperature are reported in degree Celsius. Additionally, there is a recorded time which shows the time since the temperature log were recorded. Under the summary statistics, there is a table showing the ranges of temperature, percentages of time in each range, and amount of time in each range. The user can reset the user statistics by clicking on the **Reset** button at the bottom of User Temperature Log. However, the system temperature log cannot be reset by the users. Note that the information is not automatically update. Information provided in this webpage will help the users to monitor the status of the industrial managed switch in harsh environment. The users have to click reload on the web browser to update for the latest statistics. Figure 2.9 shows the **User Temperature Log** box and Figure 2.10 shows the System Temperature Log box.

Note that there is a sensor component in the industrial managed switch which can detect the inside temperature. The software inside the switch can read the sensor's data and transform it into temperature in a unit of degree Celsius. Because the device is airtight, the inside temperature will be higher than the outside temperature around 20 degrees. For the industry level switches, the lowest operating temperature (outside) will be around -20 to -40 degrees Celsius and the highest operating temperature (outside) will be around 70 to 85 degrees Celsius.

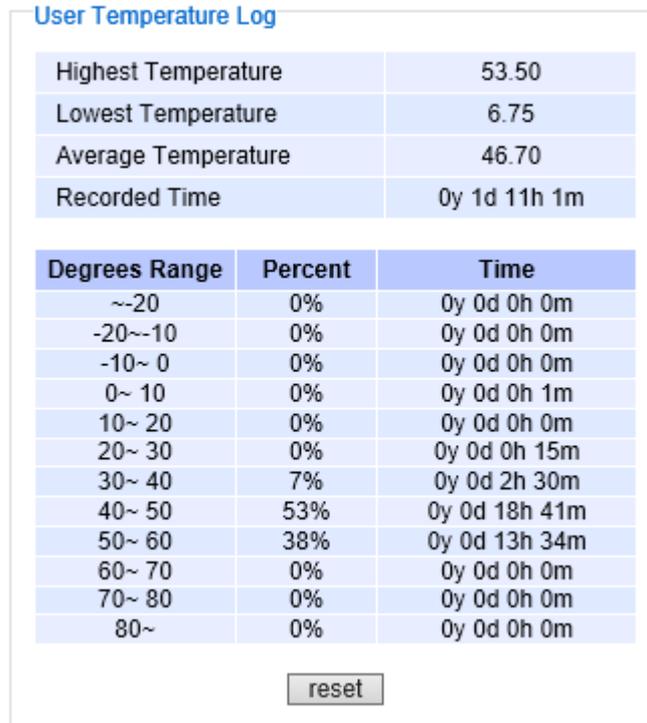


Figure 2.9 User Temperature Log

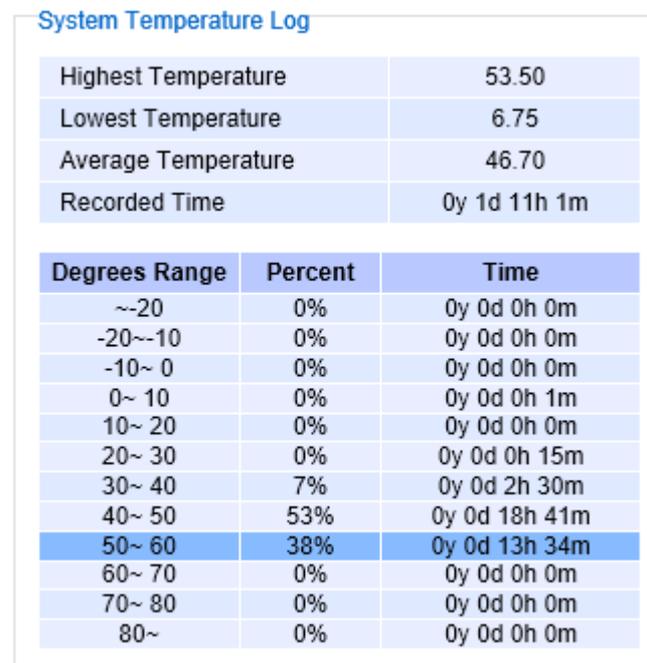


Figure 2.10 System Temperature Log

2.3 Administration

In this section, users will be able to configure **Password**, **IP Settings**, **IPv6 Setting**, **Ping**, **Ping6**, **Mirror Port**, **System Time**, **Modbus Setting**, **PTP**, **SSH**, **Telnet**, and **DIP Switch**. Figure 2.11 shows the Administration section with the list of its subsections on the left of the screen.

The screenshot displays the Administration configuration interface. On the left is a vertical dropdown menu with the following items: + Basic, - Administration (expanded), Password, IP Setting, IPv6 Setting, Ping, Ping6, Mirror Port, System Time, Modbus Setting, + PTP, SSH, Telnet, DIP Switch, + Forwarding, + Port, + Power Over Ethernet, + Trunking, + Unicast/Multicast MAC, + GARP/GVRP/GMRP, + IP Multicast, + SNMP, and + Spanning Tree. The main content area is divided into two sections:

- Local Login Setting:** Contains three input fields: User Name (with 'admin' entered), Password (with masked characters), and Confirmed Password. An 'Update' button is located below these fields.
- Auth Server Setting:** Contains several configuration options: Authentication Server (checkbox, currently unchecked), Server Type (dropdown menu set to 'RADIUS'), Server IP/Name (input field), Server Port (input field with '1812' entered), Shared Key (input field with masked characters), Confirmed Shared Key (input field), Authentication Type (dropdown menu set to 'MD5'), and Server Timeout (1~255 sec) (input field with '5' entered). An 'Update' button is located below these fields.

A red **NOTE :** is present at the bottom of the Auth Server Setting section, stating: "RADIUSD usually runs on port 1812, TACACSD usually runs on port 49."

Figure 2.11 Administration Dropdown Menu

2.3.1 Password

Password "default" is set for the device when it is manufactured. Users can modify it password to ensure overall system security. The user name and password can be updated in this page as shown in Figure 2.12. Setting for a local authentication is introduced in this subsection, while setting for a remote authentication is described in later sections. The user name and password set here are applied to all types of access to Atop's switch: web management user interface (UI), secure shell (SSH), and command line interface (CLI). Please click on the "Update" button to update the user name and password information on the switch. Table 2.3 summarizes the description of each field.

The screenshot shows a web form titled "Local Login Setting". It contains three text input fields stacked vertically, labeled "User Name", "Password", and "Confirmed Password". Below the "Confirmed Password" field is a rectangular button labeled "Update".

Figure 2.12 Password Setting Webpage

Table 2.3 Descriptions of Password Setting

Label	Description	Factory Default
User name	User's Name. Max. 15 characters	admin
Password	Password to log-in. Max. 15 characters	default
Confirmed Password	Re-type the password. This has to be exactly the same as the password entered in the above field. Max. 15 characters	NULL

In addition to the local authentication, the switch can be configured to request for authentication through a centralized RADIUS or TACACS+ server when the local authentication fails. Figure 2.13 shows the setting parameters for authentication server while Table 2.4 summarizes the authentication server settings. For the RADIUS and TACACS+ comparison, please refer to Table 2.5 so that you can choose the solution that best suits your needs.

The screenshot shows a web form titled "Auth Server Setting". It contains a table of settings:

Authentication Server	<input type="checkbox"/> Enabled
Server Type	RADIUS ▼
Server IP/Name	<input type="text"/>
Server Port	<input type="text" value="0"/>
Shared Key	<input type="text"/>
Confirmed Shared Key	<input type="text"/>
Authentication Type	MD5 ▼
Server Timeout (1~255 sec)	<input type="text" value="0"/>

Below the table is an "Update" button. At the bottom, there is a red "NOTE" stating: "RADIUSD usually runs on port 1812, TACACSD usually runs on port 49."

Figure 2.13 Authentication Server Setting

Table 2.4 Authentication Server Settings

Label	Description	Factory Default
Authentication Server	Enable / disable authentication through a remote authentication server	Disabled
Server Type	Choose Authentication Server type: RADIUS or TACACS+. See notes below for a detailed explanation.	RADIUS
Server IP/Name	IP address of the authentication server	NULL
Server Port	Communication port of the authentication server	1812
Shared Key	The key used to authenticate with the server. Max. 15 characters.	12345678
Confirmed Shared Key	Re-type the shared key. Max. 15 characters.	NULL
Authentication Type	Authentication mechanism. For RADIUS: MD5. For TACACS+: ASCII, PAP, CHAP, MSCHAP.	RADIUS is MD5 TACACS+ is ASCII
Server Timeout (1~255 sec)	The time out period of waiting for a response from the authentication server. This will affect the time that the next login prompt shows up in case that the server is not available.	5

***NOTE:**

RADIUS (Remote Authentication Dial in User Service):

RADIUS is an access server that uses authentication, authorization, and accounting (AAA) protocol for authentication and authorization. It is a distributed security system that secures remote access to networks and network services against unauthorized access. The RADIUS specification is described in [RFC 2865](#), which obsoletes [RFC 2138](#).

TACACS+ (Terminal Access Controller Access-Control System Plus):

TACACS+ is a security application that provides centralized validation of users attempting to gain access to a router or network access server. The TACACS+ specification is described in [Cisco's TACACS+ RFC draft](#).

Table 2.5 Comparison of Authentication Server Settings between RADIUS and TACACS+

	RADIUS	TACACS+
Transport Protocol	UDP	TCP
Authentication and Authorization	Separates AAA	Combines authentication and authorization
Multiprotocol Support	No	Yes, support AppleTalk Remote Access (ARA) and NetBIOS protocol
Confidentiality	Only password is encrypted	Entire packet is encrypted

2.3.2 IP Setting

In this subsection, users may modify network settings of Internet Protocol version 4 (IPv4) for the managed switch. Additionally, on industrial managed switch, any virtual local area network (VLAN) group can be assigned an IP interface address. There are two types of IP setting that can be done in this subsection: 1) setting managed (or management) interface IP address and 2) setting IP interface address for VLAN. Note that a VLAN group must be created first as described in Section 2.14.2.1 before assigning an IP interface address in this section. Each IP interface address is a separated subnet. The user can configure multiple IP interface addresses on the switch. The IP interface of VLAN 1 is the default managed (or management) interface of the switch as configured in Section 2.14.1.

This subsection is divided into two parts: **IP Setting** and **IP Interface**. The IP Setting part is depicted in Figure 2.14. The **Managed Interface VID** has a default value of 1. However, the **Gateway**, the **Primary DNS** and **Secondary DNS** can be entered. If the user set gateway or DNS on this page, the managed switch will not set the gateway or the DNS from DHCP server. After entering the desired information, please click **Update** button to change the IP Setting.

The screenshot shows a web page titled "IP Setting". At the top, there is a red warning message: "Warning: Change static IP address will cause the Web disconnect." Below the warning, there are three input fields: "Gateway" with the value "10.0.0.254", "Primary DNS", and "Secondary DNS". At the bottom of the form is an "Update" button.

Figure 2.14 IP Setting under IP Setting Webpage

The second part of IP Setting section is the **IP Interface** part as shown in Figure 2.15. In this part, there is a table at the bottom that lists the IP interface information of each VLAN Identification number (VID). The user can configure IP interface address for VLAN 1 to 4094 in this IP interface part. Note that the maximum number of IP interface is 32. The user can remove each entry in the table by clicking on the **Remove** button. The user can configure the IP Interface address for each VLAN ID (VID) in this part. To change the IPv4 address of the managed switch (default is 10.0.50.1), the user can enter a new **Static IP Address** and a new **Subnet Mask**, and select **VID = 1** from the drop-down list then clicking **Update** button. Note that the user will need to manually update the new IP address in the URL field of the web browser if the IP address of the managed switch is changed.

DHCP	IP Address	Subnet Mask	VID
Disabled	11.0.50.10	255.255.0.0	10
Disabled	10.0.50.1	255.255.0.0	1
Disabled	12.0.50.20	255.255.0.0	20

Figure 2.15 IP Interface Part under IP Setting Webpage

To configure IP interface address for other VLAN Identification number (VID), enter the desired **Static IP Address** and **Subnet Mask**, and select a **VID** from the drop-down list, and then click on the **Update** button. Additionally, each IP interface of the switch can enable the Dynamic Host Configuration Protocol (DHCP) by checking the **DHCP** box option to obtain an IP address and related information automatically from a DHCP server thus reducing the work for an administrator. Note that when checking the **DHCP** option, the **Static IP Address** and the **Subnet Mask** will be inactive. The only field that can be selected is the **VID** which means that the VID will obtain the IPv4 address automatically for its interface. Note that before deleting any VLAN group as described in Section 2.14.2.1, please make sure that the VID does not establish an IP interface. The description of each field and its default value in IP Setting webpage are summarized in Table 2.6.

Table 2.6 Descriptions of IP Settings

Label	Description	Factory Default
DHCP	By checking this box, an IP address and related fields will be automatically assigned. Otherwise, users can set up the static IP address and related fields manually.	Uncheck
Static IP Address	Display current IP address. Users can also set a new static IP address for the device.	10.0.50.1
Subnet Mask	Display current Subnet Mask or set a new subnet mask	255.255.0.0
Gateway	Show current Gateway or set a new one	0.0.0.0
Primary DNS	Set the primary DNS IP address to be used by your network	NULL
Secondary DNS	Set the secondary DNS IP address. The Ethernet switch will locate the secondary DNS server if it fails to connect to the Primary DNS Server.	NULL
VID	Virtual local area network identification number is the ID value for VLAN that need to be configured with IPv4 address.	NULL

2.3.3 IPv6 Setting

This subsection enables Atop’s industrial managed switch to operate in Internet Protocol version 6 (IPv6) network. The webpage is subdivided into two parts: **IPv6 Setting** and **IP interface for IPv6**. The first part called **IPv6 Setting** is shown in Figure 2.16. This part also provides the current IPv6 address information (**Link-Local Address**) and allows the users to configure the **Gateway** and the **Domain Name Service (DNS)** for IPv6 network. The users have a choice to enable or disable the **Manual DNS** by checking the box behind it. When the **Manual DNS** option is checked, the users will be able to enter the IPv6 addresses of the Primary DNS and the Secondary DNS. If the users change any DNS setting, please clicking on the **Update** button to allow the new configuration to take effect.

The screenshot shows a web interface titled "IPv6 Setting". At the top, there is a red warning message: "Warning: Change static IPv6 address will cause the Web disconnect." Below the warning is a table with the following fields:

Link-Local Address	fe80::260:e9ff:fe19:52aa/64
Gateway	<input type="text"/>
Manual DNS	<input type="checkbox"/>
Primary DNS	<input type="text"/>
Secondary DNS	<input type="text"/>

At the bottom of the form is an "Update" button.

Figure 2.16 IPv6 Setting Part of IPv6 Setting Webpage

The second part called **IP Interface for IPv6** is shown in Figure 2.17. Similar to IPv4 Setting in previous subsection, the IPv6 Setting also allows the user to set IPv6 interface address for a virtual local area network (VLAN) group based on the **VLAN identification number (VID)**. For managed switch, the users have options to enable Autoconfig, DHCPv6, or Manual setting. Note that in IPv6 network, there are three types of auto configuration: stateless, stateful, and a combination of both. The **"Autoconfig"** option here is the stateless configuration, while the **"DHCPv6"** option is the stateful configuration. If the users check both the **Autoconfig** and the **DHCPv6** options, the switch will use the combination of stateless and stateful configuration. When selecting the **"Manual"** option, the users will have to enter the **Global Unicast Address, Prefix Length, and Gateway**. After finishing the setting, please click on the **Update** button to allow the new configuration to take effect.

The screenshot shows the 'IP Interface for IPv6' configuration page. It features a form with three radio buttons: 'Autoconfig', 'DHCPv6', and 'Manual'. Below these are three input fields: 'Global Unicast Address', 'Prefix Length', and 'VID'. An 'Update' button is located below the input fields. At the bottom of the page, there is a table with the following columns: VID, AutoConfig, DHCP, Manual, Manual Global Unicast Address, Dynamic Global Unicast Address, and Global Unicast Address.

Figure 2.17 IP Interface for IPv6 Part of IPv6 Setting Webpage

At the bottom of this part as shown in Figure 2.17, there is also a list of IPv6 interface setting for each **VLAN identification number (VID)**. The users can click on the **Remove** button at the end of the line to remove any entry (or remove IPv6 interface address setting) from this list which is similar to the IPv4 Setting in previous subsection. Table 2.7 explains each field in the **IPv6 Setting** webpage.

Table 2.7 Description of IPv6 Setting

Label	Description	Factory Default
Autoconfig	By checking this box, all IPv6 setting will be automatically configured for the users. This option is based on the stateless autoconfiguration in which the switch uses information in router advertisement messages to configure an IPv6 address. The address will be a concatenation of first 64 bits from the router advertisement source address with the Extended Unique Identifier (EUI-64).	Uncheck
DHCPv6	By checking this box, an IPv6 address and related fields will be automatically assigned from a DHCPv6 server in the network. This is a stateful auto configuration in which the switch will generate a DHCP solicit message to the ALL-DHCP-Agents multicast address to find DHCPv6 server. Otherwise, users can set up the IPv6 address manually.	Uncheck
Manual	By checking this box, users must provide Global Unicast Address, Prefix Length, and Gateway address in the following fields. Note that when this option is checked, the next three fields will become active for setting.	Uncheck
Global Unicast Address	Set an IPv6 address that is routable across the Internet and its three high-level bits are 001. The IPv6 address is in the format 2XXX::/3.	NULL
Prefix Length	Set a prefix length for the IPv6 address in previous field.	NULL
Gateway	Set the IPv6 address of an IPv6 Gateway	NULL
Manual DNS	By checking this box, user must manually provide Primary and Secondary DNS addresses for IPv6. Note that when this option is checked, the next two fields will become active for setting.	Uncheck

Label	Description	Factory Default
Primary DNS	Set the primary DNS IPv6 address to be used by your network.	NULL
Secondary DNS	Set the secondary DNS IPv6 address. The Ethernet switch will locate the secondary DNS server if it fails to connect to the Primary DNS Server.	NULL

2.3.4 Ping

Atop’s managed switch provides a network tool called Ping for testing network connectivity in this subsection. Ping is a network diagnostic utility for testing reachability between a destination device and the managed switch. Note that this utility is only for IPv4 address. The Ping utility for IPv6 will be provided in the next subsection. Figure 2.18 shows the user interface for using the Ping command.

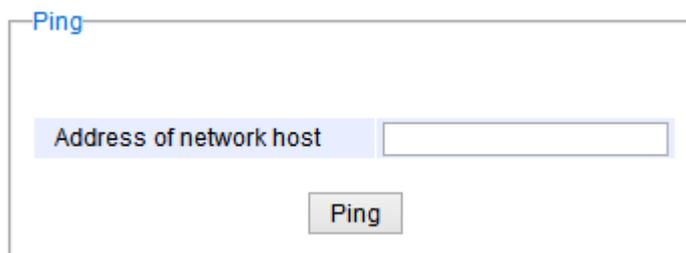


Figure 2.18 Ping Webpage

Users can enter an IP address or a domain name into the field to verify network connectivity as shown in Figure 2.19. After entering the IP address/name, please click “Ping” button to run the ping function. Example of successful ping result is shown in Figure 2.20 while a failure ping result is depicted in Figure 2.21.

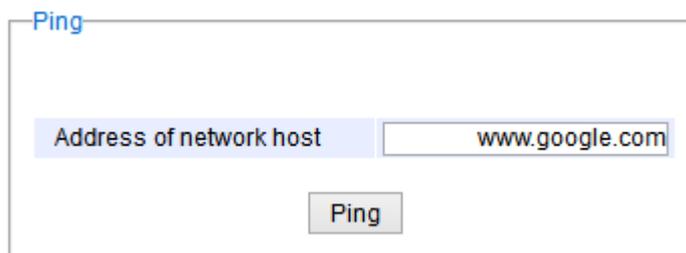


Figure 2.19 Example of Ping Command

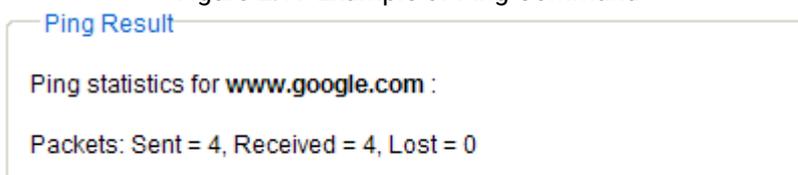


Figure 2.20 Example of successful ping command result

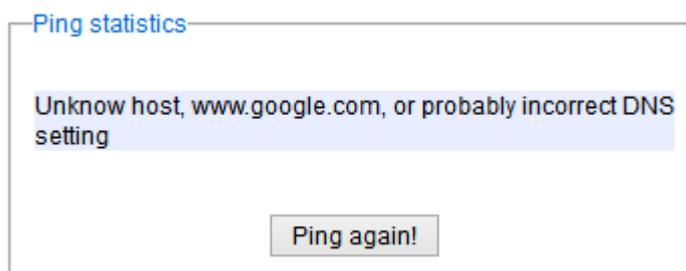


Figure 2.21 Example of unsuccessful ping command result

***Note:**

If users enter a domain name instead of an IP address, they should assign a DNS first. This can be done through **Administration** → IP Setting as shown in Section 2.3.2.

2.3.5 Ping6

Ping6 is a corresponding network diagnostic utility for testing reachability between a destination device and the managed switch in IPv6 network. Figure 2.22 shows the user interface for using the Ping command.

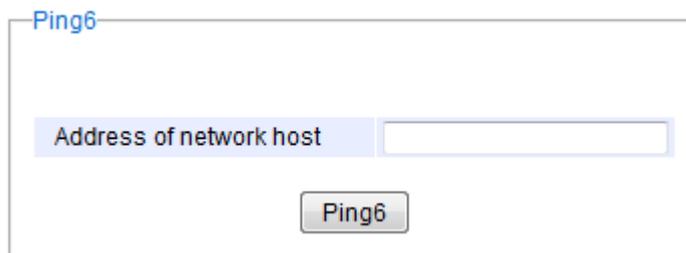


Figure 2.22 Ping6 Webpage

Users can enter an IPv6 address into the field to verify network connectivity. After entering the IPv6 address, please click **"Ping6"** button to start the ping function. Examples of successful ping6 results are shown in Figure 2.23.

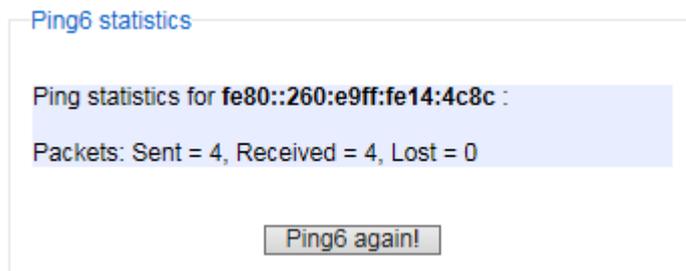


Figure 2.23 Example of Successful Ping6 Result

2.3.6 Mirror Port

In order to help the network administrator keeps track of network activities, the managed switch supports port mirroring, which allows incoming and/or outgoing traffic to be monitored by a single port that is defined as a **mirror port**. Note that the mirrored network traffic can be analyzed by a network analyzer or a sniffer for network performance or security monitoring purposes. Figure 2.24 shows the Mirror Port webpage. The descriptions of port mirroring options are summarized in Table 2.8.

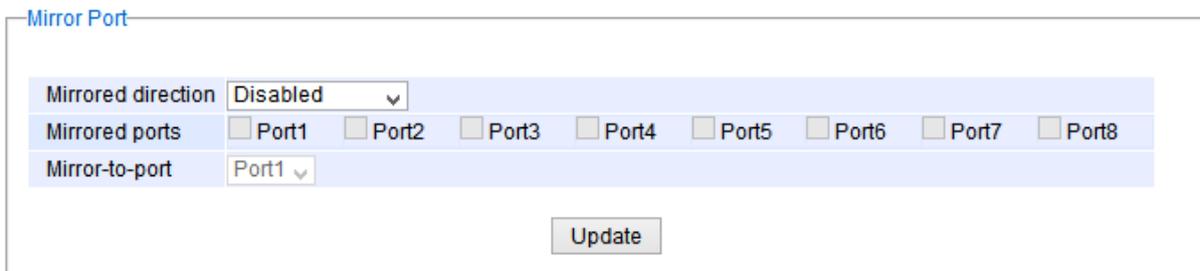


Figure 2.24 Mirror Port Webpage

***Note:**

Overflow will occur if the total throughput of the monitoring ports exceeds what the mirror port can support.

Table 2.8 Description of Port Mirroring Options

Label	Description	Factory Default
Monitored direction	Select the monitoring direction. - Disable : To disable port monitoring. - Input data stream : To monitor input data stream of monitored ports only. - Output data stream : To monitor output data stream of monitored ports only - Input/Output data stream : To monitor both input and output data stream of monitored ports	Disabled
Monitored Port	Select the ports that will be monitored	Unchecked all
Mirror-to-port	Select the mirror port that will be used to monitor the activity of the monitored ports	Port1

2.3.7 System Time

Atop's industrial managed switch has internal calendar (date) and clock (or system time) which can be set manually or automatically. Figure 2.25 shows the System Time and SNTP webpage. The users have options to configure **Current Date** and **Current Time** manually. There is a drop-down list of **Time Zone** which can be selected for the local time zone. If the switch is deployed in a region where daylight saving time is practiced (see note below for explanation), please check the **Enable** option for **Daylight Saving Time**. Then, the users will have to enter the **Start Date**, **End Date**, and **Offset** in hour(s).

The screenshot shows a web form for configuring system time and SNTP. The fields are as follows:

- Current Date:** 2008 / 12 / 10 (ex: YYYY/MM/DD)
- Current Time:** 2 : 27 : 5 (ex: 18:00:30)
- Time Zone:** (GMT+08:00)Taipei
- Daylight Saving Time:** Enable
- Start Date:** -- / -- / -- / -- (Month / Week / Date / Hour)
- End Date:** -- / -- / -- / -- (Month / Week / Date / Hour)
- Offset:** 0 hour(s)
- Enable SNTP:**
- NTP Server 1:** time.nist.gov (ex: time.nist.gov)
- NTP Server 2:** time-A.timefreq.bldrdoc.gov (ex: time-A.timefreq.bldrdoc.gov)
- Time Server Query Period:** 259200 seconds(60~259200), (72:00:00)
- Enable NTP Server:**

Buttons: Update, Refresh

Figure 2.25 Webpage for Setting System Time and SNTP

For automatically date and time setting, the users can enable Simple Network Time Protocol (SNTP) by checking the **Enable SNTP** option (see note below for explanation). Then, the users must enter the NTP Server 1 and NTP Server 2 which will be used as the reference servers to synchronize date and time to. The users can specify the Time Server Query Period for synchronization which is in the order of seconds. The value for this period will depend on how much clock accuracy the users want the switch to be. Finally, the managed switch can become a network time protocol server for the local devices by checking the box behind the **Enable NTP Server** option. Description of each option is provided in Table 2.9.

Table 2.9 Descriptions of the System Time and the SNTP

Label	Description	Factory Default
Current Date	Allows local date configuration in yyyy/mm/dd format	None
Current Time	Allows local time configuration in local 24-hour format	None
Time Zone	The user's current local time	(GMT+08:00) Taipei
Daylight Saving	Enable or disable Daylight Saving Time function	Unchecked
Start Date	Define the start date of daylight saving	NULL

Label	Description	Factory Default
End Date	Define the end date of daylight saving	NULL
Offset	Decide how many hours to be shifted forward/backward when daylight saving time begins and ends. See note below.	0
Enable SNTP	Enables SNTP function. See note below.	Unchecked
NTP Server 1	Sets the first IP or Domain address of NTP Server.	time.nist.gov
NTP Server 2	Sets the second IP or Domain address of NTP Server. Switch will locate the 2nd NTP Server if the 1st NTP Server fails to connect.	Time-A.timefreq.blrdoc.gov
Time Server Query Period	This parameter determines how frequently the time is updated from the NTP server. If the end devices require less accuracy, longer query time is more suitable since it will cause less load to the switch. The setting value can be in between 60 – 259200 (72 hours) seconds.	259,200 seconds
Enable NTP Server	This option will enable network time protocol (NTP) daemon inside the managed switch which allows other devices in the network to synchronize their clock with this managed switch using NTP.	Unchecked

***Note:**

- **Daylight Saving Time:** In certain regions (e.g. US), local time is adjusted during the summer season in order to provide an extra hour of daylight in the afternoon, and one hour is usually shifted forward or backward.
- **SNTP:** Simple Network Time Protocol is used to synchronize the computer systems' clocks with a standard NTP server. Examples of two NTP servers are *time.nist.gov* and *time-A.timefreq.blrdoc.gov*.

2.3.8 Modbus Setting

Atop's managed switch can be connected to a Modbus network using Modbus TCP/IP protocol which is an industrial network protocol for controlling automation equipment. The managed switch's status and settings can be read and written through Modbus TCP/IP protocol which operates similar to a Management Information Base (MIB) browser. The managed switch will be a Modbus slave which can be remotely configured by a Modbus master. The Modbus slave address must be set to match the setting inside the Modbus master. In order to access the managed switch, a **Modbus Address** must be assigned as described in this subsection. A Modbus memory mapping table, which lists all the register's addresses inside the managed switch and their descriptions, is provide in 7 Modbus Memory Map. Figure 2.26 shows the Modbus Setting webpage.

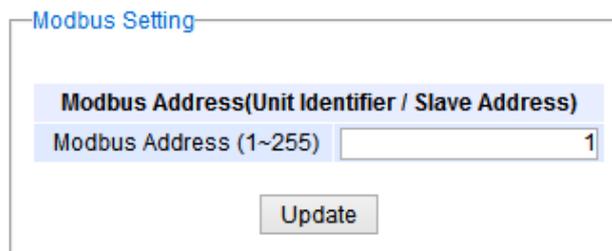


Figure 2.26 Webpage for Setting the Modbus Address

Figure 2.26 shows the webpage that users can set up the Modbus ID address. Users can use Modbus TCP/IP compatible applications such as **Modbus Poll** to configure the switch. Note that Modbus Poll can be download from <http://www.modbustools.com/download.html>. The Modbus Poll 64-bit version 7.0.0, Build 1027 was used in this document. Atop does not provide this software to the users. Tutorial of Modbus read and write examples are illustrated below.

***Note:** The switch only supports Modbus function code 03, 04 (for Read) and 06 (for Write).

Read Registers (This example shows how to read the switch’s IP address.)

Address	Data Type	Read/Write	Description
0x0051 (81)	2 words	R	IP Address of switch Ex: IP = 10.0.50.1 Word 0 Hi byte = 0x0A Word 0 Lo byte = 0x00 Word 1 Hi byte = 0x32 Word 1 Lo byte = 0x01

Figure 2.27 Mapping Table of Modbus Address for Switch’s IP Address

1. Make sure that a supervising computer (Modbus Master) is connected to your target switch (Modbus Slave) over Ethernet network.
2. Launch **Modbus Poll** in the supervising computer. Note a registration key may be required for a long-term use of Modbus Poll after 30-day evaluation period. Additionally, there is a 10-minute trial limitation for the connection to the managed switch.
3. Click **Connect** button on the top toolbar to enter Connection Setup dialog by selecting **Connect...** menu as shown in Figure 2.28.

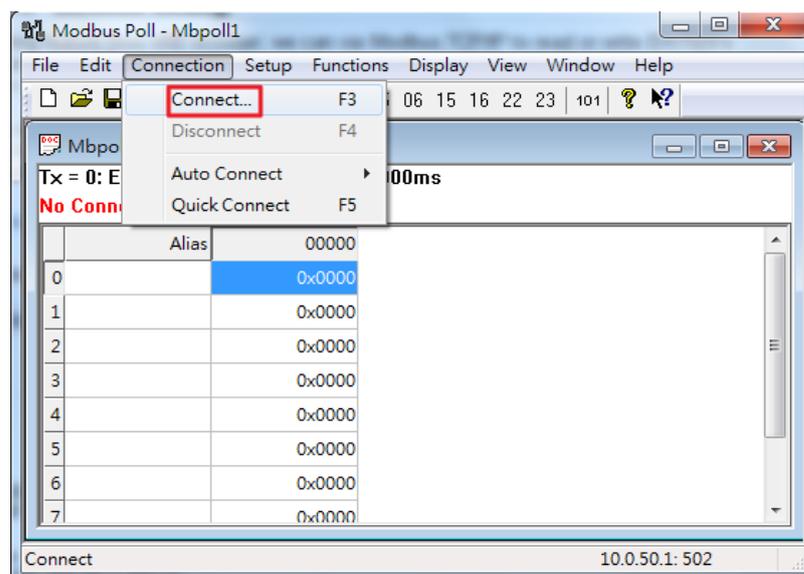


Figure 2.28 Entering Connection Setup Menu of the Modbus Poll

4. Select **Modbus TCP/IP** as the **Connection** mode and enter the switch’s IP address inside the **Remote**

Modbus Server's IP Address or Node Name field at the bottom as shown in Figure 2.29. The Port number should be set to 502. Then click OK button.

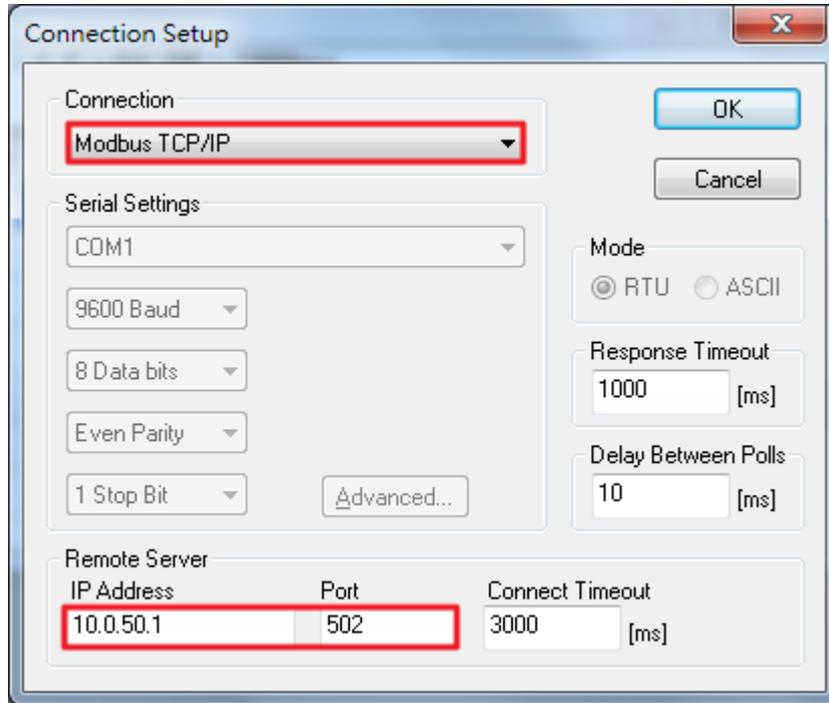


Figure 2.29 Modbus Poll Connection Setup

5. On the window Mbpoll1, select multiple cells from row 0 to row 2 by clicking on cells in second column of row 0 and row 2 while holding the shift key as shown in Figure 2.30.

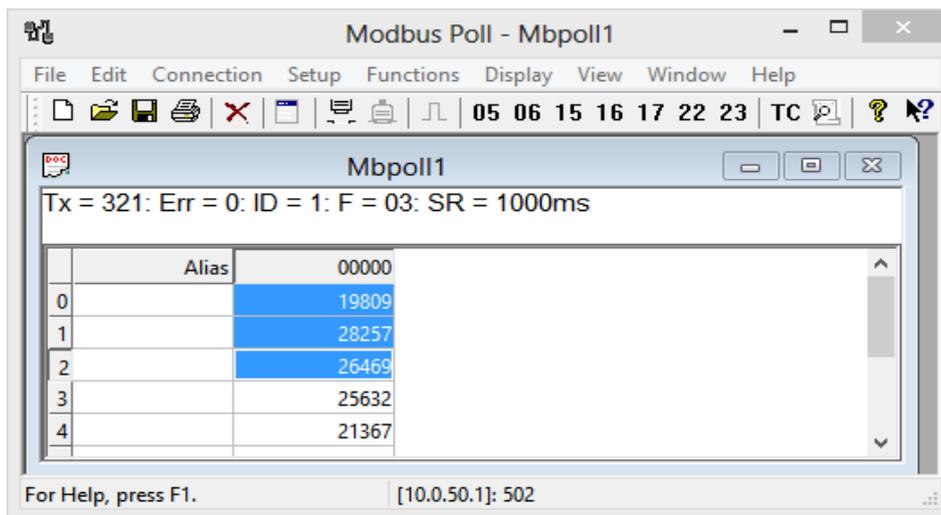


Figure 2.30 Multiple Cell Section in Modbus Poll

6. Set Display mode of the selected cells in previous step to HEX (hexadecimal) by selecting Display pull-down menu and choosing the Hex as shown in Figure 2.31.

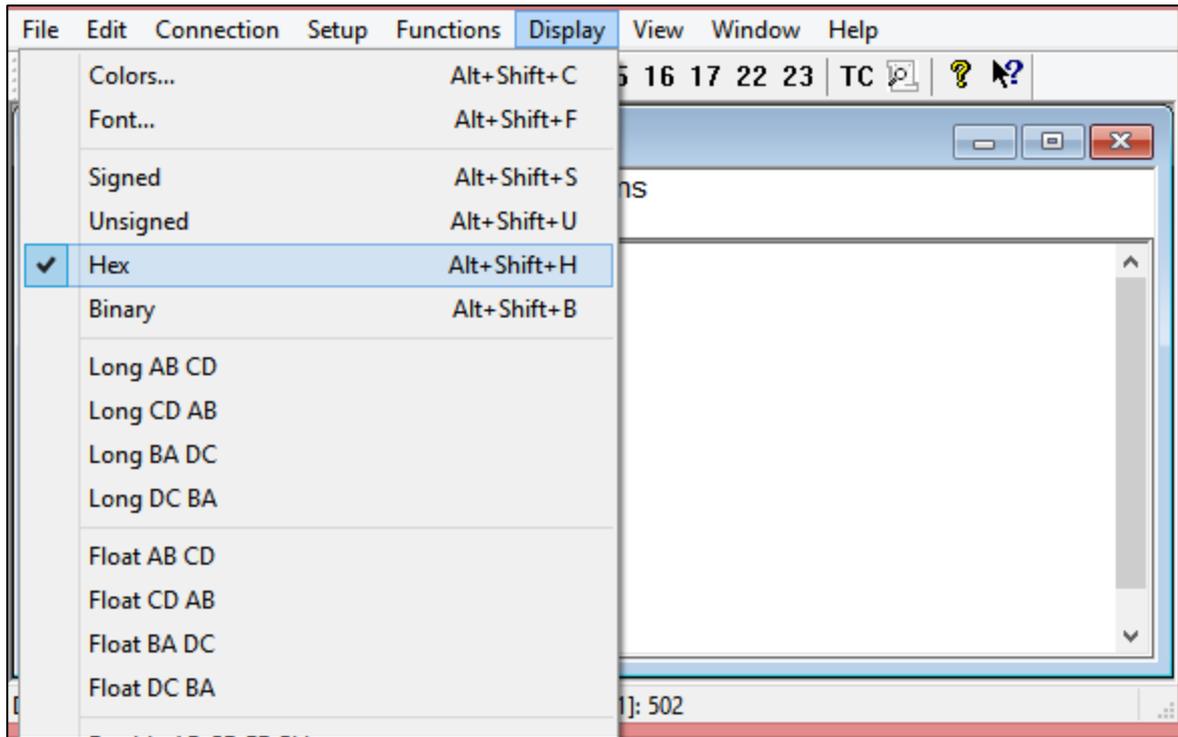


Figure 2.31 Set Display Mode to Hex in Modbus Poll

- Click on the **Setup** pull-down menu and choose **Read/Write Definition...** as shown in Figure 2.32.

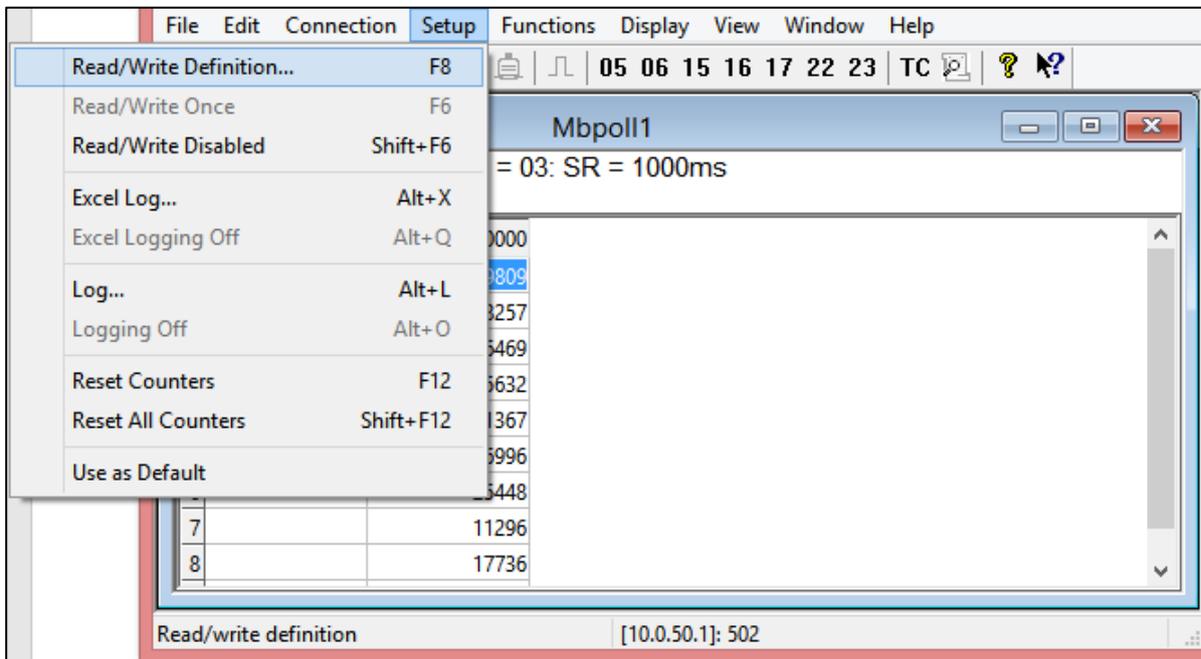


Figure 2.32 Modbus Poll Setup Read/Write Definition

- Enter the **Slave ID** in the Modbus Poll function as shown in Figure 2.33, which should match the Modbus Address = 1 entered in Figure 2.26 in Section 2.3.8 (Modbus Setting).

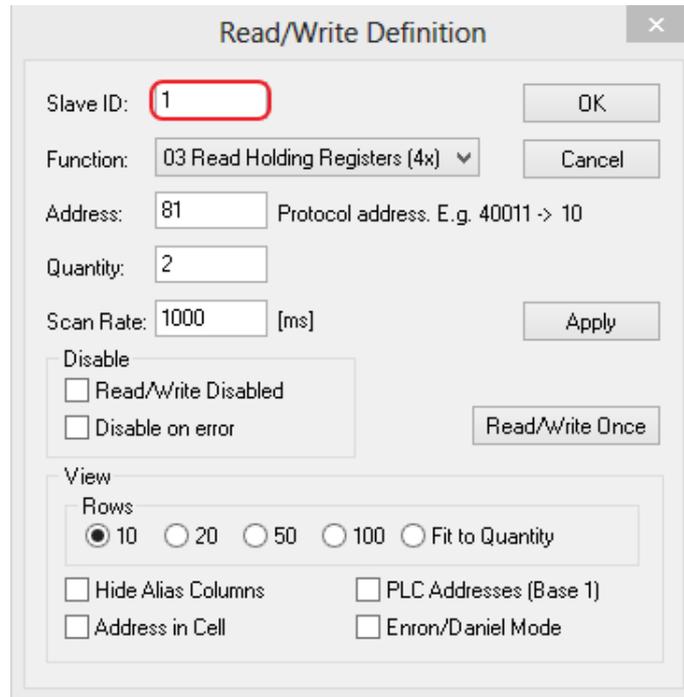


Figure 2.33 Slave ID in the Modbus Poll Function is set to 1

9. Select **Function 03** or **04** because the managed switch supports function code 03 and 04 as shown in Figure 2.34.

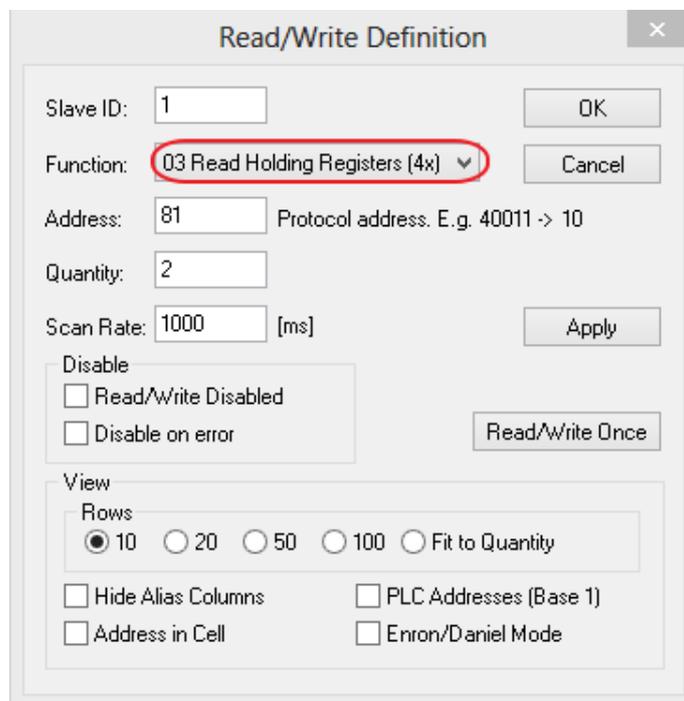


Figure 2.34 Set Code 03 in the Modbus Poll Function

10. Set starting **Address** to 81 and **Quantity** to 2 as shown in Figure 2.35.

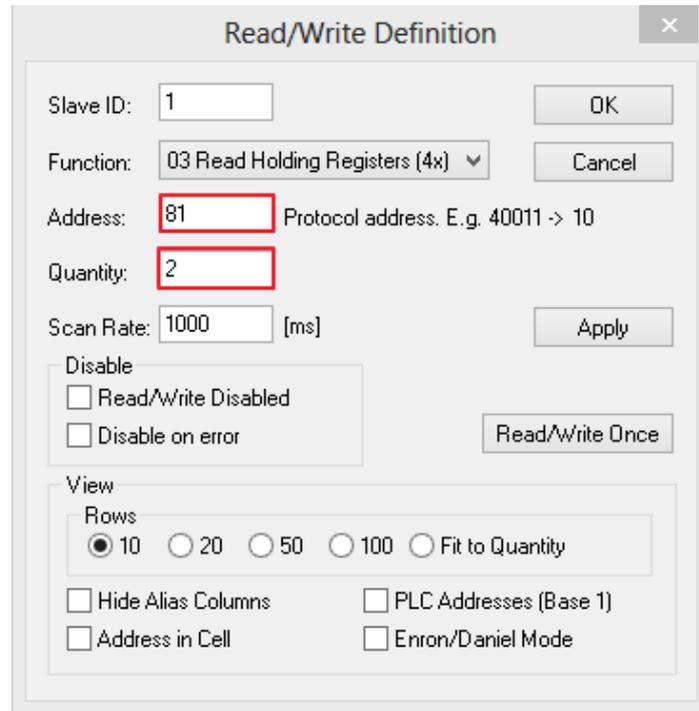


Figure 2.35 Setup Starting Address and Quantity in Modbus Poll

11. Click **OK** button to read the IP address of the switch.

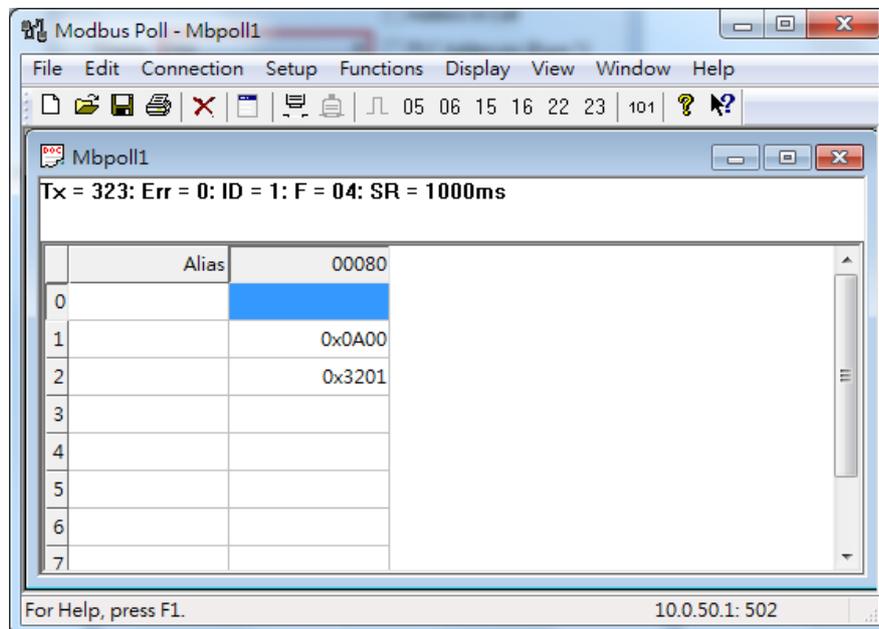


Figure 2.36 Modbus Memory Address 81 and 82 are the location of EHG7508's IP Address

12. Modbus Poll will get the values 0x0A, 0x00, 0x32, 0x01, which means that the switch's IP is 10.0.50.1 as shown in Figure 2.36.

Write Registers (This example shows how to clear the switch's Port Count (Statistics).)

Address	Data Type	Read/Write	Description
0x0100 (256)	1 word	W	Clear Port Statistics 0x0001: Do clear action

Figure 2.37 Mapping Table of Modbus Address for Clearing Port Statistics

1. Check the switch's Port TX/RX counts in **Port Statistics** page (described in Section 2.5.4) as shown in Figure 2.38.

Port Statistics

Port	Enable	Link	Tx	Tx Error	Tx Rate(Kbps)	Rx	Rx Error	Rx Rate(Kbps)
Port1	On	Up	11700	0	0	35115	0	0
Port2	On	Down	0	0	0	0	0	0
Port3	On	Down	0	0	0	0	0	0
Port4	On	Down	0	0	0	0	0	0
PortG1	On	Down	0	0	0	0	0	0
PortG2	On	Down	0	0	0	0	0	0

Figure 2.38 Port Count in Port Statistics Webpage

2. Click function **06** on the toolbar as shown in Figure 2.39.

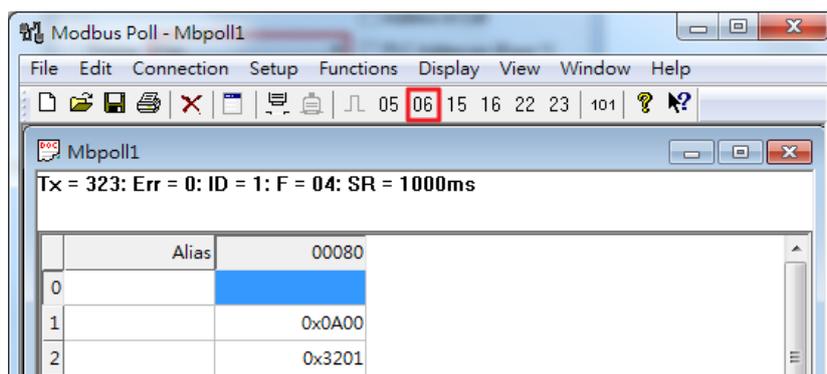


Figure 2.39 Click on Function 06 in the Modbus Poll

- Set **Address** to 256 and **Value (HEX)** to 1 as shown in Figure 2.40, then click “**Send**” button.

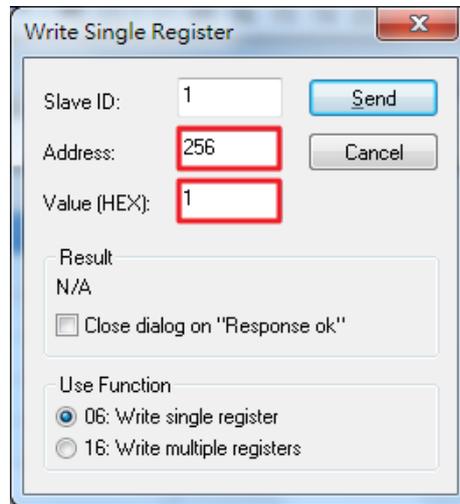


Figure 2.40 Use Modbus Poll to Clear Switch’s Port Count

- Check **Port Statistics** (described in Section 2.5.4) in the managed switch’s Web UI as shown in Figure 2.41. The packet count is now cleared.

Port Statistics

Port	EnableLink	Tx	Tx Error	Tx Rate(Kbps)	Rx	Rx Error	Rx Rate(Kbps)
Port1	On	Up	8	0	0	27	0
Port2	On	Down	0	0	0	0	0
Port3	On	Down	0	0	0	0	0
Port4	On	Down	0	0	0	0	0
PortG1	On	Down	0	0	0	0	0
PortG2	On	Down	0	0	0	0	0

Figure 2.41 Cleared Port Statistics

2.3.9 Precision Time Protocol (PTP)

The Precision Time Protocol (PTP) is a high-precision time protocol. It can be used with measurement and control systems in local area network that require precise time synchronization. This menu is divided into two submenus: **PTP Setting** and **H/W PTP** as shown in Figure 2.42.

- Administration
 - Password
 - IP Setting
 - IPv6 Setting
 - Ping
 - Ping6
 - Mirror Port
 - System Time
 - Modbus Setting
- PTP
 - PTP Setting
 - H/W PTP
- SSH
- Telnet
- DIP Switch

Figure 2.42 PTP's Submenu

2.3.9.1 PTP Setting

The PTP can be set in this PTP Setting webpage. Figure 2.43 shows the PTP Configuration webpage in which the user can configure PTP and check its status. The lower part of Figure 2.43 allows the users to enable or disable the PTP function per port and check their current status.

To enable PTP on the managed switch, please check the **Enabled** box behind the **State** option as shown in Figure 2.43. Note that the PTP will not be enabled per port if this State option is not checked. Please see description of PTP configuration in Table 2.10 and description of PTP port information in Table 2.11. Note that after setting the desired PTP options, please click **Update** button to allow the new configuration to take effect.

PTP Configuration

State	<input type="checkbox"/> Enabled
Version	1
Clock Mode	End-to-End
Transport	IPV4
Sync Interval	1 seconds
Clock Stratum	3
Clock Class	248
priority 1	128
priority 2	128
UTC Offset	0
Offset To Master	0 ns
Grandmaster UUID	0-60-e9-14-4d-b9
Parent UUID	0-60-e9-14-4d-b9
Clock Identifier	DFLT

PTP Port

Port	Enabled	Status
Port1	Enabled	Disabled
Port2	Enabled	Disabled
Port3	Enabled	Disabled
Port4	Enabled	Disabled
PortG1	Enabled	Disabled
PortG2	Enabled	Disabled

Port	Mode
1	Disabled
2	
3	
4	
G1	
G2	

Figure 2.43 PTP Setting Webpage, example taken from EH75XX series

Table 2.10 Description of PTP Setting

Label	Description	Factory Default
State	Enabled/Disable the PTP function. This is the main option that needs to be enabled so that the port's PTP function will work according to other parameters defined in this table (Table 2.10).	Unchecked

Version	Set the PTP operation version. Note that v1 (IEEE 1588-2002) and v2 (IEEE 1588-2008) are supported.	1
Clock Mode	Select clock type of the PTP (Precision Time Protocol). The switch has four modes: End-End Boundary Clock, End-End Transparent Clock (TC), Peer-Peer Boundary Clock, and Peer-Peer Transparent Clock (TC).	End-to-End
Transport	Select Ethernet (layer 2) multicast transport or layer 3 (UDP/IPv4) multicast transports for PTP (Precision Time Protocol) messages.	IPV4
Sync Interval	Set the interval of the sync packet transmitted time. Small interval causes too frequent sync, which will cause more load to the device and network.	1
Clock Stratum	Set the Clock Stratum value. The lower values take precedence to be selected as the master clock in the best master clock algorithm (BMCA).	3
Clock Class	Clock Class represents clock's accuracy level. It is an attribute of an ordinary or boundary clock. It denotes time traceability or frequency distributed by the grandmaster clock. Please refer to IEEE 1588-2008, Table 5 for definitions, allowed values, and interpretation.	248
priority 1	Set the clock priority 1 (PTP version 2). The lower values take precedence to be selected as the master clock in the best master clock algorithm, 0 = highest priority, 255 = lowest priority.	128
priority 2	Set the clock priority 2 (PTP version 2). The lower values take precedence to be selected as the master clock in the best master clock algorithm (BMCA), 0 = highest priority, 255 = lowest priority.	128
UTC Offset	Coordinated Universal Time (UTC) offset value	0
Offset to Master	The offset time to the master clock	None
Grandmaster UUID	The Grandmaster UUID for PTP version 1	None
Parent UUID	The parent master UUID for PTP version 1	None
Clock Identifier	The clock identifier for PTP version 1	None

Table 2.11 Description of PTP Port Setting

Label	Description	Factory Default
Port	Port number	-
Enabled	This is the port's mode information which indicates whether the port's PTP function is enabled or disabled.	Enabled
Status	This is PTP's per port operation status. If the per port function is enabled, but the status is still disabled, please enable the PTP master option (State option in Table 2.10).	Disabled
Mode	Enabled/Disabled PTP per port function	Disabled

2.3.9.2 Hardware PTP Setting

This subsection allows the user to enable the hardware Transparent Clock (TC). The TC can correct variable switch latency. This can be done by measuring the time that a PTP event message has spent in the switch called residence time. The residence time is reported to the receiver by the PTP event message itself. For this purpose, a new message field has been added called Correction Field which is a type of time interval that can be used to accumulate residence time along the path (possibly after multiple switches) of the message. To enable the hardware transparent clock, check the box behind **H/W TC Enabled** and then click on the **Update** button as shown in Figure 2.44.

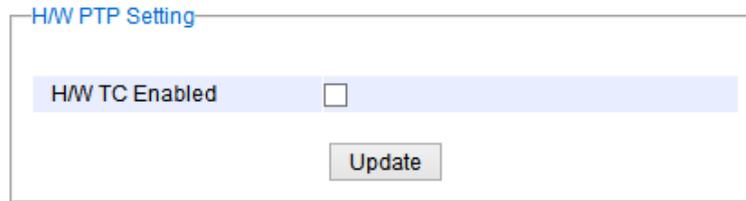


Figure 2.44 Hardware PTP Setting

2.3.10 Secure Shell - SSH

The managed switch can be managed using command line interface (CLI) as described in Chapter 4. The users have option to remotely connect to the managed switch using either secure shell (SSH) or Telnet through any of its port. In this subsection, SSH will be introduced and then Telnet will be discussed in the next subsection. SSH was designed to replace Telnet and other insecure remote shell protocols that sends data or command in plaintext. SSH uses encryption to secure its data or command over an unsecure network.

To enable the SSH, please check the **Enabled** box behind the **SSH** option in Figure 2.45. At the beginning, the Server will send a public key to a Client, and the Client will check if the received public key is correct. If it is not correct, the Server will refuse the connection. Please click "**Generate**" button to change and regenerate the Server Key then obtain another public key from Server as shown in Figure 2.45.

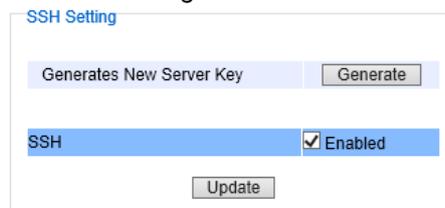


Figure 2.45 SSH Setting Webpage

Note:

1. The managed switch supports both SSH version 1 (SSH1) and SSH version 2 (SSH2).
2. The server key is re-generated when the managed switch is reset to its factory default setting or a received key is non-existent.

SSH version 1 and SSH version 2 share the following features:

1. Client programs that use SSH can perform remote logins, remote command execution, and secure file copying across a network.
2. Several selectable encryption algorithms and authentication mechanisms are supported by the SSH.
3. An SSH agent can cache keys for easy access in later session.

A number of new features are added to SSH version 2 for a stronger and more comprehensive product. These features include:

1. Encryption ciphers, i.e. Triple Data Encryption Standard (3DES) and Advanced Encryption Standard (AES).
2. The use of sound cryptographic Message Authentication Code (MAC) algorithms for integrity checking. Examples of secure hash (functions) algorithms which are MAC algorithms in SSH version 2 are the Message Digest algorithm 5 (MD5) and Secure Hash Algorithm 1 (SHA-1).
3. Support for public key certificates.

2.3.11 Telnet

This subsection allows the users to set the Telnet option for the managed switch. The command line interface (CLI) configuration using Telnet (as described in Chapter 4) or SSH (previous section) are the same except that the SSH

encrypts the communication data. For the Telnet administration, the managed switch only provides the enable or disable function selectable in this webpage. The default setting for Telnet is enabled. Clicking on the **Update** button when you change the option to update it on the managed switch. Figure 2.46 shows the Telnet setting webpage. Note that the users are recommended to use SSH instead of Telnet for higher security protection of your managed switch.



Figure 2.46 Telnet Setting Webpage

2.3.12 DIP Switch

This subsection reports the status of the DIP switch on the top of managed switch's housing. Figure 2.47 shows the DIP switch webpage. The bottom portion allows the users to enable or disable the physical control of the DIP Switch by checking on the **DIP Switch Control** option. This is another easy and convenient way to configure ERPS or iA-Ring or Compatible-Ring using the DIP Switches instead of modifying configuration on a web browser. After checking or unchecking the option, please click **Update** button to allow the setting to take effect on the managed switch.

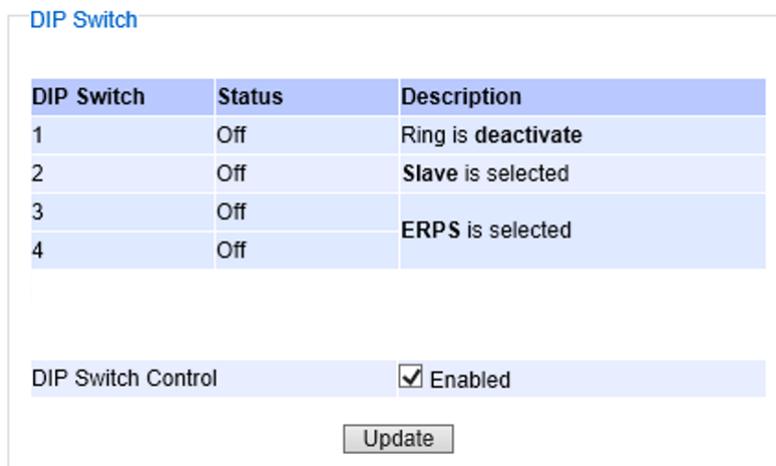


Figure 2.47 DIP Switch Status Webpage

2.4 Forwarding

There are many network technologies for forwarding packets over network. In this industrial managed switch, three main technologies are implemented: QoS, rate control, and storm control. Figure 2.48 depicts the submenu under the Forwarding section.

QoS Setting

Mode	<input type="radio"/> Strict Priority	<input checked="" type="radio"/> Weighted Round-Robin	<input type="radio"/> Deficit Round-Robin
Weights		Q0 : 2 packets	Q0 : 4 kbytes
		Q1 : 1 packets	Q1 : 2 kbytes
		Q2 : 4 packets	Q2 : 8 kbytes
		Q3 : 8 packets	Q3 : 16 kbytes
		Q4 : 16 packets	Q4 : 32 kbytes
		Q5 : 32 packets	Q5 : 64 kbytes
		Q6 : 64 packets	Q6 : 128 kbytes
		Q7 : 127 packets	Q7 : 254 kbytes
Packet Classification Scheme			
Classification Type	Both 802.1p CoS and DiffServ ▼		
Update			

Figure 2.48 Forwarding Dropdown Menu

2.4.1 QoS

Quality of Service (QoS) is the ability to provide different priority to different applications, users, or data flows. QoS guarantees a certain level of performance to a data flow by using the following metrics: transmitted bit rate, bit error rate, delay, jitter, and probability of packet dropping. QoS guarantees are important if the network capacity is insufficient, especially for application that requires certain bit rate and is delay sensitive. For any network that is best effort, QoS cannot be guaranteed, except that resource is more than sufficient to serve users.

Controlling network traffic needs a set of rules to help classify different types of traffic and define how each of them should be treated as they are being transmitted. This managed switch can inspect both 802.1p Class of Service (CoS) tags and DiffServ tags called Differentiated Services Code Point (DSCP) to provide consistent classification.

In the QoS section, three QoS mechanisms are included: queuing methods or packet scheduling disciplines in **Setting** section, **CoS Queue Mapping** section, and **DSCP Mapping** section, as shown in Figure 2.49. Table 2.12 summarizes the descriptions of QoS Setting.

- Forwarding
 - QoS
 - Setting
 - CoS Queue Mapping
 - DSCP Mapping
 - Rate Control
 - Storm Control

Figure 2.49 QoS Dropdown Menu

Table 2.12 Descriptions of QoS Setting

Label	Description	Factory Default
Setting	Queuing Methods (packet scheduling disciplines) includes Strict Priority , Weighted Round-Robin , and Deficit Round Robin	Weighted Round-Robin

	See notes in the following subsection for detailed descriptions and comparison.	
Header Mapping	CoS Queuing Mapping and DSCP Mapping For 802.1p CoS only, switch only checks Layer 2 (L2) 802.1p CoS priority bits. For DiffServ, switch checks DiffServ Code Point (DSCP). See notes below for a detailed description.	802.1p CoS only

2.4.1.1 QoS Setting

Three types of queuing methods are configurable in this managed switch: Strict Priority, Weighted Round-Robin, and Deficit Round-Robin.

In **Strict Priority**, the QoS scheduler allows the highest priority queue to preempt other queues as long as there are still packets waiting to be transmitted in the highest priority queue. This mode guarantees that traffic in the highest queue is always transmitted first. Only if the high priority queues are empty, the lower priority queues can be transmitted. Queue 0 (Q0) to Queue 7 (Q7) are ranked from the lowest priority queue to the highest priority queue. Therefore, packets in Q7 will be all transmitted first before packets in Q6, and packets in Q6 will all be sent first before packets in Q5, and so on in this order.

Weighted Round Robin (WRR) is the simplest approximation of generalized processor sharing (GPS). In WRR, each packet flow or connection has its own packet queue in a network interface controller. It ensures that all service classes have access to at least some configured amount of network bandwidth to avoid bandwidth starvation. But WRR has a limitation, as it is unfair with variable length packets. It only provides the correct percentage of bandwidth to each service class only if all of the packets in all the queues are the same size or when the mean packet size is known in advance. Usually, a weight of each queue is set proportion to requested bit rate. Each queue is served proportionally to its weight for a service cycle.

Deficit WRR (DWRR) addressed the limitation of WRR on unfairness over variable size. Each queue is configured with a weight, a deficit counter (total number of bytes that the queue is permitted to transmit each time visited by the scheduler), and a quantum of service (bytes). DWRR scans all non-empty queues in sequence. When a non-empty queue is selected, its deficit counter is incremented by its quantum value. Then, the value of the deficit counter is the maximal number of bytes that can be sent at this turn. If the deficit counter is greater than the packet's size at the head of the queue, this packet can be sent and the value of the counter is decremented by the packet size. Then the size of the next packets is compared to the counter value. Once the queue is empty or the value of the counter is insufficient, the scheduler will skip to the next queue. If the queue is empty, the value of the deficit counter is reset to 0. If the packet size is too small, the scheduler has to visit queues too many times before serving a queue. But if the packet size is too large, some short-term unfairness may arise. It is fair only over a time scale longer than a round time. At the shorter time scale, some flows may get more service. Small packet size or high transmission speed reduce the round time.

Figure 2.50 depicts the QoS Setting webpage. By default, the QoS in the managed switch works under the Strict Priority mode. For Weighted Round Robin, packet weights of Q0 to Q7 are set in term of packet as followings.

- COS Q0 = 2 packets
- COS Q1 = 1 packet
- COS Q2 = 4 packets
- COS Q3 = 8 packets
- COS Q4 = 16 packets
- COS Q5 = 32 packets
- COS Q6 = 64 packets
- COS Q7 = 127 packets

Weight of Deficit Round Robin is double the number of packets of WRR, but it is in term of Kbytes instead as shown in the last column of Figure 2.50.

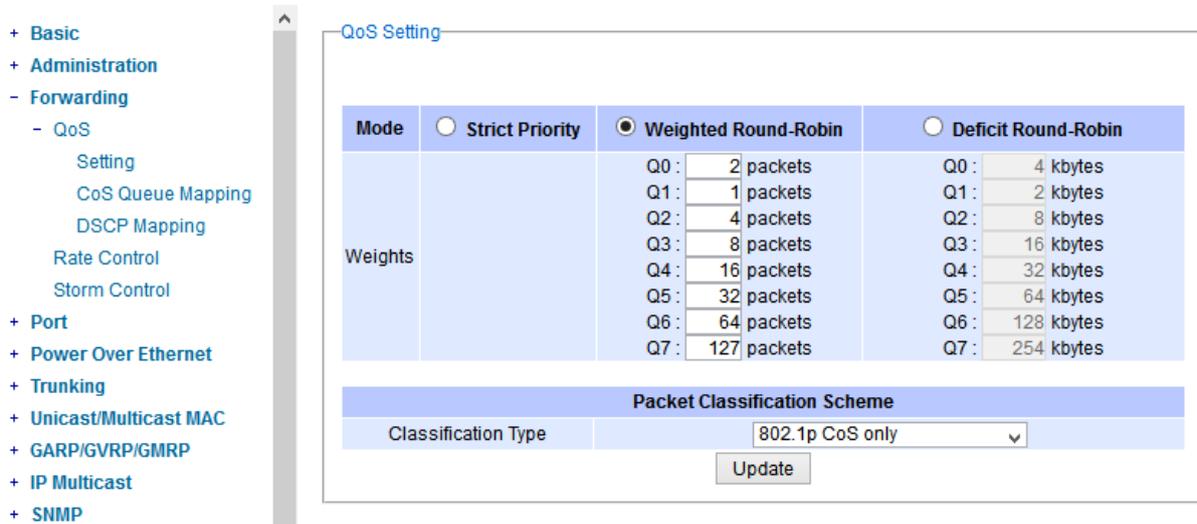


Figure 2.50 QoS Setting Webpage

At the bottom of the QoS Setting webpage in Figure 2.50, the users can select the packet classification scheme that will be used by the managed switch. There are two classification types to choose from the drop-down list: **802.1p CoS only** or **Both 802.1p CoS and DiffServ**. The default classification type is **802.1p CoS only**. Note that after changing the schedule discipline, setting the desired weights if any for the WRR or DWRR, or selecting the classification type, please click on the **Update** button to enable them on the switch.

2.4.1.2 CoS Queue Mapping

802.1p CoS is the QoS technique developed by the IEEE P802.1p working group, known as Class of Service (CoS) mechanism at Media Access Control (MAC) level. It is a 3-bit field called the priority code point (PCP) within an Ethernet frame header (Layer 2) when using VLAN tagged frames as defined by IEEE 802.1Q. It specifies a priority value between 0 and 7 that can be used by QoS to differentiate traffic. When this option is enabled, the switch inspects the 802.1p CoS tag in the MAC frame to determine the priority of each frame.

The switch can classify traffic based on a valid 802.1p (CoS - Class of Service) priority tag. These options allow users to map Priority Code Point (PCP) within an Ethernet frame header to different CoS priority queues as shown in Figure 2.51. The user can choose the desired CoS Priority Queue from the drop-down list from Q1 to Q7 for each PCP value. Descriptions of priority queue in CoS Queue Mapping page are summarized in Table 2.13.

PCP value	CoS Priority Queue
0	Q0 ▾
1	Q1 ▾
2	Q2 ▾
3	Q3 ▾
4	Q4 ▾
5	Q5 ▾
6	Q6 ▾
7	Q7 ▾

Update

Figure 2.51 Mapping Table of CoS Webpage

Table 2.13 Priority queue descriptions

Label	Description	Factory Default
PCP	Priority Code Point within the Ethernet frame header. PCP 0 is the lowest priority and 7 is the highest priority.	PCP 0 -> Q0 PCP 1 -> Q0 PCP 2 -> Q1 PCP 3 -> Q1
CoS Priority Queue	The priority queue that a specific Ethernet frame needs to be assigned into.	PCP 4 -> Q2 PCP 5 -> Q2 PCP 6 -> Q3 PCP 7 -> Q3

2.4.1.3 DSCP Mapping

DiffServ/ToS stands for Differentiated Services/Type of Services. It is a networking architecture that specifies a simple but scalable mechanism for classifying network traffic and providing QoS guarantees on networks. DiffServ uses a 6-bit Differentiated Service Code Point (DSCP) in the 8-bit differentiated services field (DS field) in the IP header for packet classification purposes. The DS field and ECN field replace the outdated IPv4 TOS field in IPv4 to make per-hop behavior decisions about packet classification and traffic conditioning functions, such as metering, marking, shaping, and policing.

The RFCs (Request for Comments) do not dictate the way to implement Per-Hop Behaviors (PHBs). Atop implements queuing techniques that can base their PHB on the IP precedence or DSCP value in the IP header of a packet. Based on DSCP or IP precedence, traffic can be put into a particular service class. Packets within a service class are treated the same way.

DiffServ allows compatibility with legacy routers, which only supports IP Precedence, since it uses the DiffServ Code Point (DSCP), which is the combination of IP precedence and Type of Service fields.

TOS (Type of Service) of the switch can be configured with the default queue weights as shown in Figure 2.52. Note that the TOS consists of DSCP (Differentiated Service Code Point (6 bits)) and ECN (Explicit Congestion Notification (2 bits)). The users can assign TOS values (**DSCP**) to predefined queue types (**Priority**) manually using DSCP Mapping web page in Figure 2.52. The priority number can be between 0 to 7 where the number 7 is the highest priority and 0 is the lowest priority. After assigning any new priority to a DSCP, please click the **Update** button at the bottom of the page to allow the new mapping to take effect.

DSCP Mapping

DSCP	Priority	DSCP	Priority	DSCP	Priority	DSCP	Priority
0x00(0)	0	0x01(1)	0	0x02(2)	0	0x03(3)	0
0x04(4)	0	0x05(5)	0	0x06(6)	0	0x07(7)	0
0x08(8)	1	0x09(9)	1	0x0A(10)	1	0x0B(11)	1
0x0C(12)	1	0x0D(13)	1	0x0E(14)	1	0x0F(15)	1
0x10(16)	2	0x11(17)	2	0x12(18)	2	0x13(19)	2
0x14(20)	2	0x15(21)	2	0x16(22)	2	0x17(23)	2
0x18(24)	3	0x19(25)	3	0x1A(26)	3	0x1B(27)	3
0x1C(28)	3	0x1D(29)	3	0x1E(30)	3	0x1F(31)	3
0x20(32)	4	0x21(33)	4	0x22(34)	4	0x23(35)	4
0x24(36)	4	0x25(37)	4	0x26(38)	4	0x27(39)	4
0x28(40)	5	0x29(41)	5	0x2A(42)	5	0x2B(43)	5
0x2C(44)	5	0x2D(45)	5	0x2E(46)	5	0x2F(47)	5
0x30(48)	6	0x31(49)	6	0x32(50)	6	0x33(51)	6
0x34(52)	6	0x35(53)	6	0x36(54)	6	0x37(55)	6
0x38(56)	7	0x39(57)	7	0x3A(58)	7	0x3B(59)	7
0x3C(60)	7	0x3D(61)	7	0x3E(62)	7	0x3F(63)	7

Update

Figure 2.52 Mapping Table of DSCP and ECN Webpage

2.4.2 Rate Control

The users have options to set the Rate Control for each port on the managed switch as shown in Figure 2.53. The rate control mechanism will set a limit or maximum data rate which the port can transmit. Moreover, the rate control can be imposed on both directions: the incoming traffic (**Ingress**) and the outgoing traffic (**Egress**). However, there are some restrictions on the values that can be set on these two rate control parameters. Here is the summary of the rules for Rate Control settings:

- The outgoing (Egress) and incoming (Ingress) values have to be set between 0 and 102,400 (for 100 Mbps) or 1,024,000 (for 1000 Mbps).
- The value 0 is set to turn off the rate control mechanism.
- The values have to be integer and multiple of 64 when the transmission rate is less than 1,792 Kbps. For example: 64 Kbps, 128 Kbps, 512 Kbps, and 1,792 Kbps.
- The values have to be integer and multiple of 1,024 when the transmission rate is between 1,792 Kbps and 102,400 Kbps (for 100Mbps) or 106,496 Kbps (for 1000M). Ex: 2,048Kbps, 3,072 Kbps... 102,400Kbps.
- The values have to be integer and multiple of 8,192 when the transmission rate is greater than 106,496 Kbps.

The screenshot shows a web interface titled "Rate Control". It contains a table with the following structure:

Port	Rate Control(Kbps)	
	Ingress	Egress
<input type="checkbox"/> All	0	0
Port1	0	0
Port2	0	0
Port3	0	0
Port4	0	0
Port5	0	0
Port6	0	0
Port7	0	0
Port8	0	0

Below the table, there is a note: "The value must be in 64Kbps increments. (Ex. 64, 128, etc.)" and an "Update" button.

Figure 2.53 Rate Control Webpage

Table 2.14 provides descriptions of rate control setting. Note that after configuring the rate control in each port, please click on the **Update** button to enable it on the switch.

Table 2.14 Descriptions of Rate Control Setting

Label		Description	Factory Default
Port		Port number on the managed switch.	-
Rate Control (Kbps)	Ingress	Sets limits on its transmission rates for the incoming (Ingress) traffic. Note that the unit is in kilo-bits per second (Kbps).	0 (Disabled)
	Egress	Sets limits on its transmission rates for the outgoing (Egress) traffic. Note that the unit is in kilo-bits per second (Kbps).	0 (Disabled)

2.4.3 Storm Control

This subsection provides the storm control or storm filter features of the managed switch. Storm control prevents traffic on a LAN from being disrupted by ingress traffic of broadcast, multicast, and destination lookup failure (DLF) on a port. Figure 2.54 depicts the Storm Control webpage. The users can impose the same limiting parameters on all ports at the same time by clicking on the box in front of the **all** line and set the storm control data rate under each limiting column (DLF, Multicast, Broadcast). The storm control limiting can also be independently control on each port. Note that the limiting value of 0 means that the storm control is disable and the value must be in multiples of 64kbps. Additional ingress storm traffic will be dropped after the limit has reached.

Storm Control

Port	Storm Control(Kbps)		
	DLF limiting	Multicast limiting	Broadcast limiting
<input type="checkbox"/> All	0	0	0
Port1	0	0	0
Port2	0	0	0
Port3	0	0	0
Port4	0	0	0
Port5	0	0	0
Port6	0	0	0
Port7	0	0	0
Port8	0	0	0

The value must be in 64Kbps increments. (Ex. 64, 128, etc.)

Update

Figure 2.54 Storm Control Webpage

Table 2.15 summarizes the descriptions of storm control. Table 2.16 summarizes the descriptions of limiting parameters for storm control.

Table 2.15 Descriptions of Storm Control

Label	Description	Factory Default
All	Enable or Disable the storm control or filter on all ports at the same time. The limiting data rate for each type of storm packets (DLF , Multicast , and Broadcast) can be controlled by changing the number under each column. Note that the value must be in multiples of 64kbps.	Uncheck and Disable
Port1 - Port8	Set the limiting data rate of storm packets that can be controlled for each Port, which are DLF , Multicast , and Broadcast . Note that the value must be in multiples of 64kbps. See notes below for the detailed description and comparison.	Disable

Table 2.16 Descriptions of Limiting Parameters

Label	Description	Factory Default
DLF limiting (Destination Lookup Failure)	DLF limiting (0~9876480) Kb	0 (Disable)
Multicast limiting	Multicast limiting (0~9876480) Kb	0 (Disable)
Broadcast limiting	Broadcast limiting (0~9876480) Kb	0 (Disable)

Type of Storm Packets:

- **DLF: Destination Lookup Failure.** The switch will always look for a destination MAC address in its MAC Table

first. In case that a MAC address cannot be found in the MAC Table, which means DLF occurs, the switch will forward the packets to all ports that are in the same LAN.

- **Multicast:** This type of transmission sends messages from one host to multiple hosts. Only those hosts that belong to a specific multicast group will receive it. Network devices that support multicast send only one copy of the information across the network until the delivery path that reaches group members diverges. At these diverging points, multicast packets will be copied and forwarded. This method helps reducing high traffic volumes due to large number of destinations, using network bandwidth efficiently.
- **Broadcast:** Messages are sent to all devices in the network.

2.5 Port-related settings

Atop's industrial managed switch provides full control on all of its network interfaces. In this section, the users can enable or disable each port and set preferred physical layer mode such as copper or fiber. Moreover, the users will be able to configure negotiation mechanism, data rate (speed), duplexing, and flow control for each port. All port's status and statistics can be viewed in this section. Figure 2.55 illustrates the Port webpage. The Port section is subdivided into four subsections which are:

- Port Setting
- Port Status
- Mini-GBIC Port Status
- Port Statistics

- + Basic
- + Administration
- + Forwarding
- Port
 - Setting
 - Port Status
 - Mini-GBIC Port Status
 - Port Statistics
- + Power Over Ethernet
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- + VLAN

Port Setting

Port	Enabled	Mode	Negotiation	Speed	Duplex	Flow Control
Port1	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port2	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port3	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port4	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port5	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾
Port6	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾
Port7	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾
Port8	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾

Update

Figure 2.55 Port Dropdown Menu

2.5.1 Port Setting

Port Setting webpage is shown in Figure 2.56. The users can control the state of each port by checking on the corresponding **Enable** box. The possible physical layer connections of each port are listed on the **Mode** column. In some of Atop’s managed switches (EH75xx Series), the users can then select one of the physical media to be a preferred mode of operation. For instance, a gigabit Ethernet port (PortG1) can support either copper or fiber physical layer connections. The users can click on the radio button behind the Fiber option to set the fiber optical mode as its preferred physical medium connection. Note that when both modes are selected, this means that the port is a combo port. However, the example in Figure 2.56 is based on EHG7508-4PoE-4SFP which does not have a combo port and cannot select preferred mode of operation.

Port Setting

Port	Enabled	Mode	Negotiation	Speed	Duplex	Flow Control
Port1	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port2	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port3	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port4	<input checked="" type="checkbox"/>	Fiber	Auto ▾	1000 ▾	Full ▾	Off ▾
Port5	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾
Port6	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾
Port7	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾
Port8	<input checked="" type="checkbox"/>	Copper	Auto ▾	1000 ▾	Full ▾	Off ▾

Update

Figure 2.56 Port Setting Webpage

Next on the fourth column of Figure 2.56, the users can select from the dropdown list the port’s **Negotiation** mechanism which can be either **Auto** or **Force**. When selecting the **Force** negotiation, the port’s speed and duplexing will be locked to the settings configured by the users. On the other hand, the **Auto** negotiation will allow the switch to determine the actual speed and duplexing for that port. Note that the Gigabit Small Form-factor Pluggable (SFP) Port of the EH Series switch is downward compatible with 125/155Mbps Transceivers; however, the speed needs to be set to 100 manually. The Gigabit SFP Port of the EHG/EMG Series is not downward compatible.

On the fifth column, the transmission **Speed** of each port can be chosen from the dropdown list which could be **10**, **100**, or **1000** Mbps. The default speed is set to the highest possible rate in Mbps. Next the port’s duplexing (**Duplex**) can be either **Full duplex** or **Half duplex**. The **Half duplex** option allows one-way communication at a time, while the **Full duplex** option allows simultaneous two-way communication.

Each port can set the **Flow Control** mechanism to either **On** or **Off** on the eighth column. This flow control will be useful to avoid packet loss when there is a network congestion. However, the **Flow Control** setting is **Off** by default. After configuring the port setting, please click on the **Update** button to enable any of your new configuration on the switch. Descriptions of port setting options are summarized in Table 2.17.

Table 2.17 Descriptions of Port Settings

Label	Description	Factory Default
Port	Port number on the managed switch.	-
Enable	Check the box to allow data to be transmitted and received through this port	All ports are enabled
Mode	Copper and/or Fiber modes. When both Copper and Fiber are listed, it means that this is a Combo port	Depend
Negotiation	Choose from either Force or Auto . See description in the paragraph above.	Auto-negotiation is enabled to all ports.
Speed	Select either 10 , 100 , or 1000Mbps	Highest Speed
Duplex	Select either Half or Full Duplex. See description in the paragraph above.	Full-Duplex
Flow Control	Either on or off . The Flow Control mechanism can be enabled (On) to avoid packet loss when congestion occurs.	Off

2.5.2 Port Status

The overview of port status on the managed switch can be viewed in this webpage. The users can compare the actual status and the configured options described in previous subsection for each port. The rate control (ingress and egress) can be configured based on the instructions on Section 2.4.2. Figure 2.57 shows the Port Status webpage. Note that the last column also reports the security status whether it is turned on or off on each port, which can be either static security or 802.1x (See how to set security option for each port in Section 2.17). To check the latest status of all port, click the **Refresh** button either on the top or the bottom of the webpage.

Port Status

Refresh

Port	Mode	Enabled	Link	Negotiation		Speed		Duplex		Flow Control		Rate Control		Security
				Config	Actual	Config	Actual	Config	Actual	Config	Actual	Ingress	Egress	
Port1	F	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off
Port2	F	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off
Port3	F	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off
Port4	F	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off
Port5	C	Yes	Up	Auto	Auto	1000	1000	Full	Full	Off	Off	Off	Off	Off
Port6	C	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off
Port7	C	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off
Port8	C	Yes	Down	Auto	-	1000	-	Full	-	Off	-	Off	Off	Off

Refresh

Figure 2.57 Port Status Webpage

The header in each column and its possible values of the ports's status are listed here:

- **Mode** (Copper (C) or Fiber (F))
- **Enable** (Yes or No)
- **Link** (Up or Down)
- **Negotiation** (Auto or Force)
- **Speed** (unit: Mbps)
- **Duplex** (Full or Half)

- **Flow Control** (On or Off)
- **Rate Control** (On or Off)
- **Security** (On or Off): Either static security or 802.1x port security is turned on or off.

2.5.3 Mini-GBIC Port Status

The Small Form-factor Pluggable (SFP) port is sometimes referred to as a Mini-GBIC (**G**iga **B**itrate Interface Converter). In this subsection, all Mini-GBIC ports status can be shown if supported by the managed switch. Figure 2.58 depicts the Module (or Mini-GBIC Port) Status webpage. Note that the status here only provides the Ethernet compliance codes and vendor name. The link status (up or down) can be viewed in the previous subsection.

SFP Port	Description		
Port 1	-		
Port 2	-		
Port 3	-		
Port 4	-		

Figure 2.58 Mini-GBIC Port Status Webpage

2.5.4 Port Statistics

The Port Statistics are summarized in this webpage as shown in Figure 2.59. The users can use this subsection to help them diagnose the problem such as link quality of each port. The key statistics are the total number of normal (**OK**) frames, the number of discarded (**Error**) frames, and the speed of the transmission (**Rate** in Bps) for both transmitted (**Tx**) and received (**Rx**) traffic in each port. To clear or reset all the statistics to zero on this page, click on the **Clear** button. To obtain the latest statistics on this page, click on the **Refresh** button.

Port	Enabled	Link	Tx			Rx		
			OK (frames)	Error (frames)	Rate (Bps)	OK (frames)	Error (frames)	Rate (Bps)
Port1	Yes	Down	0	0	0	0	0	0
Port2	Yes	Down	0	0	0	0	0	0
Port3	Yes	Down	0	0	0	0	0	0
Port4	Yes	Down	0	0	0	0	0	0
Port5	Yes	Up	29277	0	0	65070	0	0
Port6	Yes	Down	0	0	0	0	0	0
Port7	Yes	Down	0	0	0	0	0	0
Port8	Yes	Down	0	0	0	0	0	0

Figure 2.59 Port Statistics Webpage

The header in each column and its possible values of the ports's statistics are listed here:

- **Enable** (Yes or No): The port is enabled (Yes) or disabled (No).
- **Link** (Up or Down): Actual link status of the port.
- **Tx OK (frames)**: Total number of packets transmitted.
- **Tx Error (frames)**: The number of outbound packets which were chosen to be discarded even though no errors have been detected to prevent them from being transmitted.
- **Tx Rate (Bps)**: Speed of transmission in Bytes per second.

- **Rx OK (frames)**: Total number of packets (not including faulty packets) received.
- **Rx Error (frames)**: Total number of faulty packets (including Oversize, Undersize, Frame Check Sequence (FCS), Alignment, Jabber and Fragment Errors in packets) received.
- **Rx Rate (Bps)**: Receiving speed in Bytes per second.

2.6 Power over Ethernet

Power over Ethernet (PoE) is an optional function for the managed switches which enables the switch to provide power supply to end devices called Powered Device (PD) connected on the other side of the Ethernet ports. This means that the electrical power is delivered along with data over the Ethernet cables. This will be useful for the end devices that are located in the area that has no power supply and the users can save additional wiring for the end devices. To find out whether this function is supported or not by your managed switch, please look for the keyword “PoE” in Atop’s model name. If the switch has “PoE” in its model name, it means that the switch is a Power Sourcing Equipment (PSE) that can provide power output to a Powered Device (PD). Figure 2.60 shows the Power over Ethernet dropdown menu.

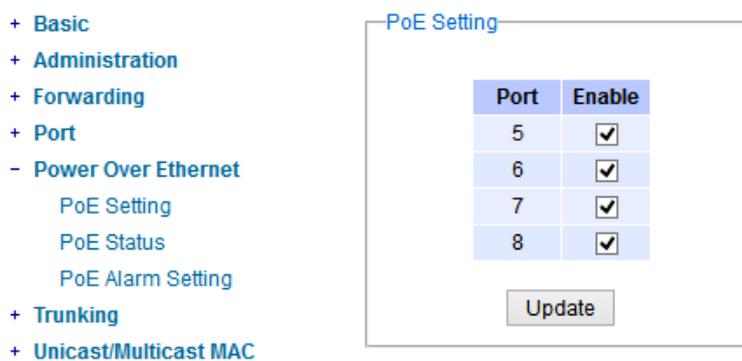


Figure 2.60 Power over Ethernet Dropdown Menu example on EHG7508-4SFP-4PoE

2.6.1 PoE Setting

The PoE function for each port in the supported managed switch model can be set in this webpage as shown in Figure 2.61. The users can check the **Enable** box for corresponding port. Please also click on the **Update** button to allow the setting on PoE taking effect on the switch.



Figure 2.61 PoE Setting Webpage example on EHG7508-8PoE

***Note** that the number of ports depends of the EHG model of the user’s managed switch.

Table 2.18 Descriptions of PoE Setting

Label	Description	Factory Default
Port1	Enable or Disable PoE function of the Port 1	Enable
Port2	Enable or Disable PoE function of the Port 2	Enable
Port3	Enable or Disable PoE function of the Port 3	Enable
Port4	Enable or Disable PoE function of the Port 4	Enable
Port5	Enable or Disable PoE function of the Port 5	Enable
Port6	Enable or Disable PoE function of the Port 6	Enable
Port7	Enable or Disable PoE function of the Port 7	Enable
Port8	Enable or Disable PoE function of the Port 8	Enable

2.6.2 PoE Status

This webpage summarizes the status of each PoE port. For example, in Figure 2.62, **Port8** was enabled and is supplying power to a Class 2 Powered Device (PD) indicated under the **Classification** column. The PD device is rated at 49V and 33mA. The total power consumption for this PD is 1.617W. To check the status of the PoE port, please click on the **Refresh** button. Table 2.19 provides descriptions of each column in the table of PoE Status.

Port	Enable Status	Power Status	Classification	Voltage(V)	Current(mA)	Power(W)
Port1	Enable	Off	N/A	0	0	0.000
Port2	Enable	Off	N/A	0	0	0.000
Port3	Enable	Off	N/A	0	0	0.000
Port4	Enable	Off	N/A	0	0	0.000
Port5	Enable	Off	N/A	0	0	0.000
Port6	Enable	Off	N/A	0	0	0.000
Port7	Enable	Off	N/A	0	0	0.000
Port8	Enable	On	Class 2	49	33	1.617

Refresh

Figure 2.62 PoE Status Webpage, example on EH7508-8PoE

Table 2.19 Descriptions of PoE Status

Label	Description	Factory Default
Port	Port number	-
Enable Status	Enable or Disable PoE function	Enable
Power Status	On when there is a power device on the other end or Off when there is no PD on the other end.	-
Classification	Display the classification of power device on the other end	-
Voltage (V)	Display the voltage supplied to this port in Volts	-
Current (mA)	Display the current supplied to this port in milli-Amperes	-
Power (W)	Display the power supplied to this port in Watts	-

2.6.3 PoE Alarm Setting

Alarm events can be set up to warn on unintended interruption in the PoE function or change(s) in status of the PoE power device (PD) or exceeding of total power level set in this webpage. Figure 2.63 shows the PoE Alarm Setting webpage in which the user can set the total power value in Watts that the managed switch can detect and trigger an alarm. Then, the users will have options to enable all alarm events or individual alarm event. There are three categories of **PoE Alarm Event** listed here: **PoE PD Power On**, **PoE PD Power Off**, and **Detect Total Power**. The users also have choices for notification of the alarm(s) by Relay, Email, or Alarm LED. The user can check the corresponding box for each type of notification. Please refer to Table 2.20 for the descriptions of PoE Alarm Setting. Note that the alarm events can also be found in the Event Log (when “Enabled” is checked - see explanation in Section 2.24.1.2) or notified by Email (when “Email” is checked - see explanation in Section 2.24.2.2). When “Relay”, “Alarm” and “Email” are checked, eventlog will show Warning/Alarm log.

Figure 2.63 PoE Alarm Setting

Table 2.20 Descriptions of PoE Alarm Setting

Label		Description	Factory Default
Detect Total Power Value		Set the total power value in Watts which will trigger alarm event. Note that the value '0' means that the alarm event will not trigger.	0
Enable		Check the box(s) to enable alarm event	Unchecked
PoE Alarm Event	Select All	Check the box in front of this option to enable all alarm events	-
	PoE PD Power On	Check the box in front of this option to enable alarm event when PoE PD is power on.	-
	PoE PD Power Off	Check the box in front of this option to enable alarm event when PoE PD is power off.	-
	Detect Total Power	Check the box in front of this option to enable alarm event when managed switch can detect total power exceeding the value set in the Detect Total Power Value above.	-
Relay		Check the box in this column so that alarm will turn on an external relay circuit.	Unchecked
Email		Check the box in this column so that alarm will send out an email notification.	Unchecked
Alarm LED		Check the box in this column so that alarm will turn on an external LED circuit.	Unchecked

2.7 Trunking

The managed switch supports Link Trunking, which allows one or more links to be combined together as a group of links to form a single logical link with larger capacity. The advantage of this function is that it gives the users more flexibility while setting up network connections. The bandwidth of a logical link can be doubled or tripled. In addition, if one of links in the group is disconnected, the remaining trunked ports can share the traffic within the trunk group. This function creates redundancy for the links, which also implies a higher reliability for network communication. Figure 2.64 shows the Trunking dropdown menu.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- Trunking
 - Setting
 - LACP Status
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- + VLAN
- + Security
- + ERPS/Ring
- + LLDP
- + PROFINET
- + EtherNet/IP
- + Client IP Setting
- + System

Trunking Status

Group ID	LACP Enabled	Hash Type	Ports	LACP Active
Empty				

Fiber Trunking Setting

Group ID	Enable LACP	Hash Type	Ports	LACP Active
Trk1 ▾	<input type="checkbox"/>	Src/dst MAC ▾	Port1 ▲ Port2 Port3 Port4 ▾	Port1 ▲ Port2 Port3 Port4 ▾
Add				

Warning : Changing the trunk setting might affect the setting of the Port-Based VLAN.

Copper Trunking Setting

Group ID	Enable LACP	Hash Type	Ports	LACP Active
Trk3 ▾	<input type="checkbox"/>	Src/dst MAC ▾	Port7 ▲ Port8 ▾	Port7 ▲ Port8 ▾
Add				

Warning : Changing the trunk setting might affect the setting of the Port-Based VLAN.

Figure 2.64 Trunking Dropdown Menu

2.7.1 Trunking Setting

In this subsection, the user can create new trunking assignment(s) and remove existing trunking assignment(s). Figure 2.65 illustrates the **Trunking Setting** webpage. The top part of the page called **Trunking** lists existing trunk(s) which can be removed by pressing the **Remove** button in the last column. Each line of the trunking provides information about the group of links (Trunk) based on **Group ID** labelled with **Trkx** where **x** is the integer number between 1 to 8. The managed switch can support up to 8 trunk groups. Note that for the difference media types (for example Fast Ethernet, Gigabit Ethernet and Fiber), port trunking needs to be combined separately. Therefore,

there are two sections for creating trunking: **Fast Ethernet Trunking Setting** and **Giga Ethernet Trunking Setting** as shown in the lower sections of the webpage.

Trunking

Group ID	LACP	Hash Type	Ports	LACP Active	Remove?
Trk1	Yes	Src/Dst MAC	6,7		Remove

Fast Ethernet Trunking Setting

Group ID	LACP	Hash Type	Ports	LACP Active
Trk1	<input type="checkbox"/>	Src/dst MAC	Port2 ▲ Port3 ▲ Port4 ▲ Port5 ▲ Port8 ▲ Port9 ▲ Port10 ▲ Port11 ▲	Port2 ▲ Port3 ▲ Port4 ▲ Port5 ▲ Port8 ▲ Port9 ▲ Port10 ▲ Port11 ▲

Apply

Warning : Changing the trunk setting might affect the setting of the Port-Based VLAN.

Giga Ethernet Trunking Setting

Group ID	LACP	Hash Type	Ports	LACP Active
Trk7	<input type="checkbox"/>	Src/dest MAC	PortG1 ▲ PortG2 ▲ PortG3 ▲ PortG4 ▲	PortG1 ▲ PortG2 ▲ PortG3 ▲ PortG4 ▲

Apply

Warning : Changing the trunk setting might affect the setting of the Port-Based VLAN.

Figure 2.65 Trunking Setting Webpage, example with EH7520

The users have an option to enable Link Aggregation Control Protocol (LACP) which is an IEEE standard (IEEE 802.3ad, IEEE 802.1AX-2008) by checking on the box under the LACP column for each group. LACP allows the managed switch to negotiate an automatic bundling of links by sending LACP packets to the LACP partner or another device that is directly connected to the managed switch and also implements LACP. The LACP packets will be sent within a multicast group MAC address. If LACP finds a device on the other end of the link that also has LACP enabled, it will also independently send packets along the same links enabling the two units to detect multiple links between themselves and then combine them into a single logical link. During the detection period LACP packets are transmitted every second. Subsequently, keep alive mechanism for link membership will be sent periodically. Each port in the group can also operate in either LACP active or LACP passive modes. The LACP active mode means that the port will enable LACP unconditionally, while LACP passive mode means that the port will enable LACP only when an LACP partner is detected. Note that in active mode LACP port will always send LACP

packets along the configured links. In passive mode however, LACP port acts as “speak when spoken to”, and therefore can be used as a way of controlling accidental loops (as long as the other device is in active mode). To enable trunking over multiple ports, the users can follow the steps below:

- Step 1: Select Trkx (x = 1 to 8) from Group ID dropdown list.
- Step 2: Choose whether to enable LACP (IEEE standard, Link Aggregation Control Protocol).
- Step 3: Select the Hash Type from the dropdown list.
- Step 4: Select specific ports to be in this trunk group from the text box.
- Step 5: Select specific ports in this trunk group to be LACP active.
- Step 6: Click **Apply** button to set the configuration on the managed switch.

Descriptions of trunking settings are summarized in Table 2.21.

Table 2.21 Descriptions of Trunking Settings

Label	Description
Group ID	Up to 8 trunk groups can be created: Trk1~Trk8. Note that it is not possible to mix Fast Ethernet ports and Gigabit Ethernet ports into the same trunk group.
LACP	Enable/Disable LACP (Link Aggregation Control Protocol). Brief explanation of LACP is discussed in previous paragraph.
Hash Type	The hash result determines which port to use for a specific frame. The available hash options are: Src MAC, Dst MAC, Src/dst MAC, Src IP, Dst IP, and Src/dst IP.
Ports	Specify the member ports for this trunking group. Please hold Control key to select more than one port at a time.
LACP Active	Specify which ports within the group should be in LACP Active mode. The ports that are not selected will be in LACP Passive mode.
Apply	Click Apply button to confirm the changes.
Remove	Click this button to remove any existing trunking group.

2.7.2 LACP Status

Figure 2.66 lists the current switch’s trunking information. At the top of the page, the status of LACP on the managed switch is reported whether it is enabled or disabled. Next, the users can also specify the system priority here. LACP uses the system priority with the switch’s MAC address to form the system ID and also during negotiation with its LACP partner. The LACP system ID is the combination of the LACP system priority value (defined in this webpage) and the MAC address of the managed switch. The system priority determines which managed switch makes the decisions on ports that will be bundled into a logical link. The lowest value determines who has higher priority and is in charge. The table of LACP status provides information per port which are port number, status of LACP, group ID, and LACP partner. Table 2.22 explains the descriptions of LACP status. To change system priority, enter the desired number in the number box behind the system priority field and then click **Update** button. To obtain the latest status of the LACP, click on the **Refresh** button.

LACP Status

LACP	Disabled
System Priority (0~65535)	32768

Port	LACP	Group ID	LACP Partner
Port1	Disabled		
Port2	Disabled		
Port3	Disabled		
Port4	Disabled		
Port5	Disabled		
Port6	Disabled		
Port7	Disabled		
Port8	Disabled		

Figure 2.66 LACP Webpage

Table 2.22 Descriptions of LACP Status

Label	Description	Factory Default
System Priority	Indicate the system priority value of the managed switch in the range of 1 ~ 65535. System priority is used during the negotiation with other systems. System priority and switch's MAC address is used to form a system ID. Note that a higher number means a lower priority.	32768
Group ID	Show which trunk group that this port belongs to.	-
LACP	Disabled: LACP is disabled. Passive: LACP will only passively respond to LACP requests. Active: LACP will be actively searching for LACP Partner.	-
LACP Partner	Indicates whether a LACP Partner can be located on the other side.	-

2.8 Unicast/Multicast MAC

The managed switch is a network device which operate at the OSI layer 2 or medium access control (MAC) layer. It forwards frames of OSI layer 2 based on the MAC addresses. Generally, the layer 2 switch will learn about the destination MAC addresses of the end devices which are connected to the switch over time based on the exchanged traffic. For instance, in the beginning if the switch does not know which port a destination MAC address is, it will forward or broadcast a frame to all of its ports and wait for a response from end device connected to one of the port. This way the switch will learn of the MAC address and corresponding port number. Later on, the switch will forward the frame to the destination port only thus saving the traffic on other ports.

The managed switch typically maintains the learned MAC addresses in its memory which is usually called a MAC Address table. In this section, the managed switch allows the users to control the MAC Address table by adding static MAC addresses into the table or filtering certain MAC addresses so that they will not be forwarded by the managed switch. Atop's manage switch also provides the users with the ability to set the MAC address age-out manually. Note that the age-out period is a duration of time that a learned MAC address will be maintained in the MAC address table before it was removed to save the memory.

The MAC addresses that can be managed by the switch can be both Unicast and Multicast MAC addresses. This section will briefly explain the concept of Unicast and Multicast forwarding as well as their benefits. Please see Figure 2.67 for illustrations of the Unicast versus the Multicast concept.

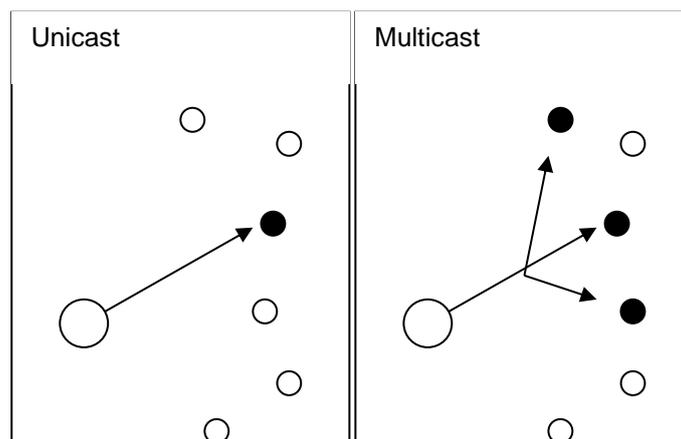


Figure 2.67 Unicast vs. Multicast

- **Unicast:** This type of transmission sends messages to a single network destination identified by a unique MAC address. This method is simple with one source and one destination.
- **Multicast:** This type of transmission is more complicated. It sends messages from one source to multiple destinations. Only those destinations or hosts that belong to a specific multicast group will receive the multicast packets. In addition, networks that support multicast send only one copy of the information across the network until the delivery path that reaches group members diverges. At these diverging points, multicast packets will be copied and forwarded. This method can manage high volume traffic with different destinations while using network bandwidth efficiently. Multicast filtering improves the performance of networks that carry multicast traffic.

Figure 2.68 shows the Unicast/Multicast dropdown menu which allows the users to manage and view the status of MAC address table.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- + Trunking
- Unicast/Multicast MAC
 - Add Static MAC
 - Black-List MAC
 - MAC Aging Time
 - MAC Table
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree

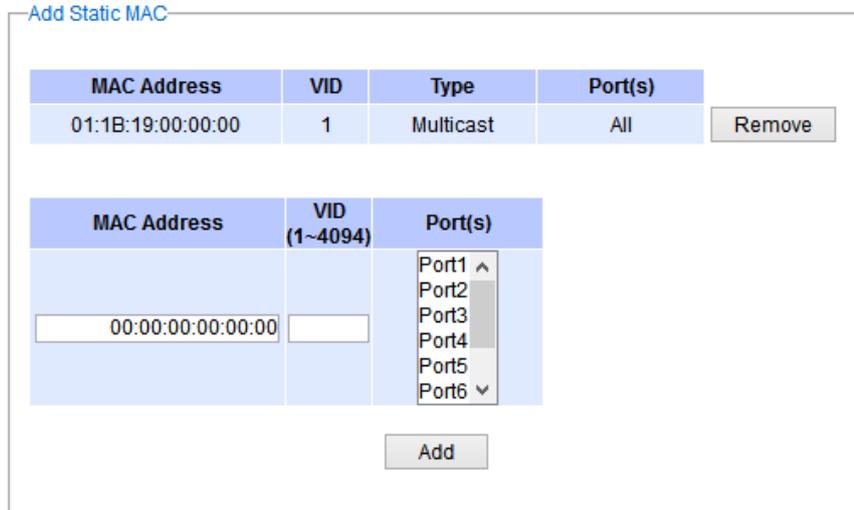


Figure 2.68 Unicast/Multicast Dropdown Menu

2.8.1 Add Static MAC

The managed switch allows the users to manually add static MAC addresses into its memory. The static MAC addresses will enable the managed switch to forward the traffic based on the MAC addresses in its memory to the destination port with specific virtual local area network (VLAN) identification (VID). Following the simple steps here to add a static MAC address.

- Step 1: Enter a **MAC Address** which can be either Unicast or Multicast MAC Address.
- Step 2: Specify VLAN ID (**VID**).
- Step 3: Select the ports to apply this static MAC address. Use **Ctrl-key** to add more than one port.
- Step 4: Click on **Add** button.

Figure 2.69 depicts the **Add Unicast/Multicast MAC** webpage. There is an example of a table of static MAC address in the upper part of the webpage where the last column of the table has **Remove** buttons for each entry. The users can remove any existing static MAC address by clicking on the **Remove** button. The lower part of the webpage is where the user can enter a new static **MAC address** along with its VLAN ID (**VID**) as outlined by the procedure above. Table 2.23 summarizes the fields in this Add Static MAC webpage.

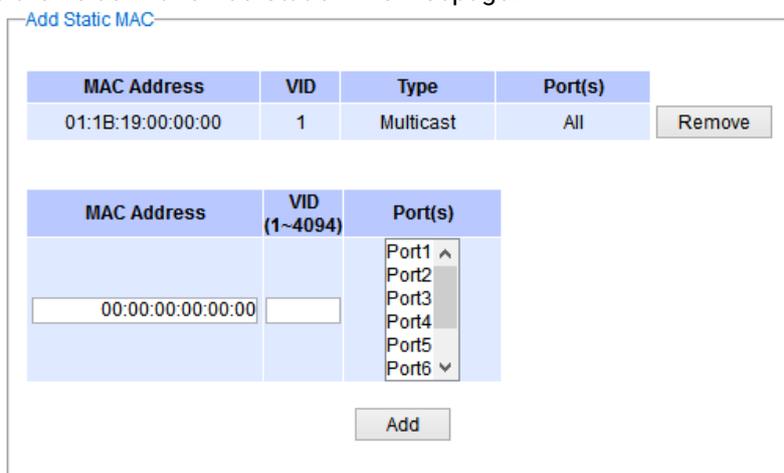


Figure 2.69 Add Static MAC Webpage

Table 2.23 Description of fields in Add Static MAC Webpage

Label	Description
MAC address	Enter a MAC address manually
VID	Specify VLAN ID that this static MAC belongs to (1 - 4096)
Type	Multicast or Unicast MAC address
Port(s)	Define which ports to apply this static MAC address
Add	Confirm and add the MAC address by clicking on this button
Remove	Click on this button to remove existing static MAC address in the table

2.8.2 Black-List MAC

As discussed earlier, the managed switch also allows users to set MAC filtering manually. Figure 2.70 shows the Black-List MAC webpage. The upper part of the page is the table of existing filtered MAC address where the users can remove the filter by clicking on the **Remove** button on each entry. The lower part of the page is where a new **source MAC address** that the users would like to filter can be entered into the MAC filtering table (black-list). Table 2.24 summarizes the fields in the **MAC Filter** webpage.

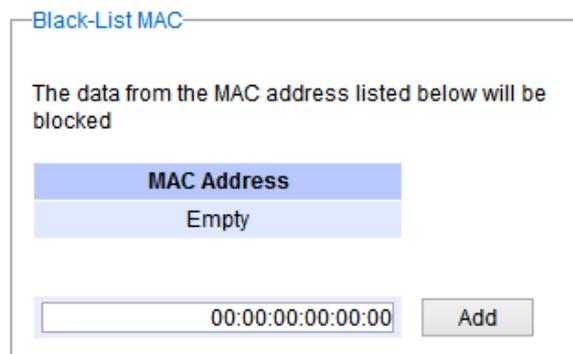


Figure 2.70 Black-List MAC Setting Webpage

Table 2.24 Descriptions of MAC Filtering Webpage

Label	Description
MAC Address	Enter MAC address to be black-listed or filtered manually
Remove	Remove the corresponding entry in MAC filtering table
Add	Add a MAC addresses to the MAC filtering table

2.8.3 MAC Aging Time

This function allows users to set MAC address age-out or aging time manually as shown in Figure 2.71. The users can specify the **Age-out Time** between 0 and 600 seconds in the following field. Note that the default value of age-out time is 300 seconds. In the managed switch, a MAC address table is stored in the memory to map a MAC address and a port number to forward frames. The aging time is the duration of time to keep MAC addresses in the MAC address table. For a longer aging time, the learned MAC address will stay in the memory longer. As a result, the switch will be able to forward the frames to a specific port quickly instead of forwarding to all ports to prevent frame flooding. A shorter aging time will allow the switch to free up the old MAC addresses in the table to learn

new MAC addresses. This will be useful when there are large number of MAC addresses (or end devices) in the network and when the traffic between any two end devices are short-lived.

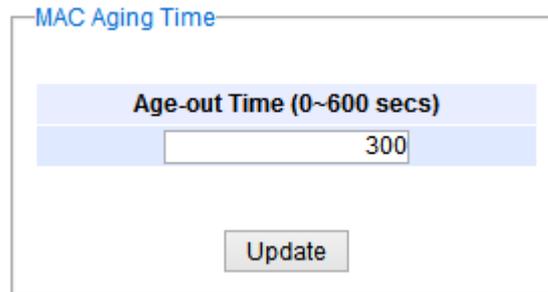


Figure 2.71 MAC Aging Time Webpage

2.8.4 MAC Table

Information of current Unicast and Multicast MAC addresses in the memory (MAC Table) of the managed switch is displayed in this webpage as shown in Figure 2.72. The list of Unicast MAC addresses is shown first and follows by the list of Multicast MAC addresses. If there are more entries to be displayed, the users can click on the **Next Page** button to see other entries. The users also have an option to clear dynamic entries in the MAC address table by clicking on the **Clear Dynamic Entries** button at the bottom of the webpage. The descriptions of the MAC Address table are summarized in Table 2.25.

Unicast MAC Address	VLAN	Type	Port(s)
00:60:E9:19:52:AA	1	Static	cpu
3C:97:0E:31:56:C2	1	Dynamic	Port5

Multicast MAC Address	VLAN	Type	Port(s)
01:00:5E:02:03:04	1	Static	Port2, Port3, Port6
01:1B:19:00:00:00	1	Static	All

Figure 2.72 MAC Table Webpage

Note: The static multicast address can be set from “Add Static MAC” (Section 2.8.1) in “Unicast/Multicast MAC” (Section 2.8) or from “Static IP Multicast” (Section 2.10.4) in “IP multicast” (Section 0).

Table 2.25 Descriptions of MAC Address Table

Label	Description
Unicast/Multicast MAC	Displays MAC address
VLAN	Displays VLAN ID
Type	Displays whether the MAC address is dynamic or static. Note that dynamic is the address that is learned automatically, while static is the address that is entered by the users.
Ports	Displays which port that this MAC address belongs to
Clear Dynamic Entries	Clears all Dynamic MAC addresses by clicking this button

Next Page	Clicking on this button to continue to the next page when there are more MACs available
------------------	---

2.9 GARP/GVRP/GMRP

This page includes three options, **GARP**, **GVRP**, and **GMRP** settings. Main concept of all three protocols are to eliminate unnecessary network traffic by preventing transmission/retransmission to unregistered users. These functions are enabled by default. They can only be disabled if no MAC addresses are added in the multicast group table.

GARP: Generic Attribute Registration Protocol, previously called **Address Registration Protocol**, is a LAN protocol that defines procedures by which end stations and switches can register and de-register attributes, such as network identifiers or addresses with each other. Every end station and switch thus has a record, or list, of all the other end stations and switches that can be reached at a given time. Specific rules are used to modify set of participants in the network topology, or so called reachability tree.

GVRP: GARP VLAN Registration Protocol. GVRP is similar to GARP, but work with VLAN instead of other network identifiers. It provides a method to exchange VLAN configuration information with other devices and conforms to IEEE 802.1Q.

GMRP: GARP Multicast Registration Protocol provides a mechanism that allows bridges (or switches in this case) and end stations to dynamically register group membership information with the MACs of bridges (switches) attached to the same LAN segment and for that information to be disseminated across all bridges (switches) in the Bridged (switched) LAN that supports extend filtering services. GMRP provides a constrained multicast flooding facility similar to IGMP snooping. The difference is that IGMP is IP-based while GMRP is MAC-based.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- + Trunking
- + Unicast/Multicast MAC
- GARP/GVRP/GMRP
 - Multicast Group Table
 - GARP Setting
 - GVRP Setting
 - GMRP Setting

Multicast Group Table

VID	MAC Address	Static Ports	GMRP Dynamic Ports
1	01:1B:19:00:00:00	All	

Figure 2.73 GARP/GVRP/GMRP Dropdown Menu

2.9.1 Multicast Group Table

In this subsection, the list of MAC addresses which were dynamically registered by GMRP into the Multicast Group Table can be viewed. The multicast group table in Figure 2.74 displays the following information for each MAC Address: VLAN ID (VID), Static Port(s), and GMRP Dynamic Port(s). The user can clear the table by clicking on the Clear GMRP Dynamic Entries button or obtain the latest update on the table by clicking on the Refresh button.

Multicast Group Table

VID	MAC Address	Static Ports	GMRP Dynamic Ports
2	01:00:5E:8F:FF:FF	1	
2	33:33:00:00:00:01	1	
23	01:00:0C:CC:CC:CC	6	
2	FB:FF:FF:FF:FF:FF	5	

Clear GMRP Dynamic Entries Refresh

Figure 2.74 Multicast Group Table

2.9.2 GARP Setting

Figure 2.75 shows GARP Setting webpage where different Timers (Join, Leave, and LeaveAll) can be set. All devices that are exchanging attributes must set these timers to the same values. Note that the GARP Timer values are in multiple of 10 milliseconds. Table 2.26 summarized the descriptions and values of all Timers for GARP setting. Please click the **Update** button after setting your new values.

GARP Setting

Join Time (10~65535)	<input type="text" value="20"/>	in 10ms
Leave Time (10~65535)	<input type="text" value="60"/>	in 10ms
LeaveAll Time (10~65535)	<input type="text" value="1000"/>	in 10ms

Update

Rule of GARP Timer:
The Leave time must be $\geq 2 \times$ the Join time
The LeaveAll time must be $>$ the Leave time

Figure 2.75 GARP Setting Webpage

Table 2.26 Descriptions of GARP Timer Settings

Label	Description	Factory Default
Join Timer	Indicates the GARP Join timer , in 0 ~ 65535 seconds	20 in 10ms
Leave Timer	Indicates the GARP Leave timer , in 0 ~ 65535 seconds	60 in 10ms
Leave All Timer	Indicates the GARP Leave All timer , in 0 ~ 65535 seconds	1000 in 10ms

2.9.3 GVRP Setting

In this section, GVRP can be enabled on the switch and then it can be enabled for all ports or specific port(s) and trunking group(s). The multicast IP address with designated VLAN ID can be accessed from each port. Figure 2.76 and Figure 2.77 below illustrate GVRP Setting and Statistics. When GVRP is enabled, the switch which is an end

node of a network needs to add static VLANs locally. Others switches can dynamically learn the rest of the VLANs configured elsewhere in the network via GVRP.

GVRP Setting

GVRP Enabled

Port	Enable GVRP
All	<input type="checkbox"/>
Port1	<input type="checkbox"/>
Port2	<input type="checkbox"/>
Port3	<input type="checkbox"/>
Port4	<input type="checkbox"/>
Port5	<input type="checkbox"/>
Port6	<input type="checkbox"/>
Port7	<input type="checkbox"/>
Port8	<input type="checkbox"/>

Update

Figure 2.76 GVRP Setting Box with Port Enabling

GVRP Statistics

Type	Packets
Rx Join Empty	0
Tx Join Empty	0
Rx Join In	0
Tx Join In	0
Rx Empty	0
Tx Empty	0
Rx Leave In	0
Tx Leave In	0
Rx Leave Empty	0
Tx Leave Empty	0
Rx Leave All	0
Tx Leave All	0

Clear

Figure 2.77 GVRP Statistics

To enable GVRP in Figure 2.76, check the **Enabled's** box and then select the desired port(s) by flagging the corresponding checkbox(es). Please click **Update** button to save the change to the switch. Figure 2.77 provides summarized statistics on the packet count of GVRP based on the following packet types: Rx Join Empty, Tx Join Empty, Rx Join In, Tx Join In, Rx Empty, Tx Empty, Rx Leave In, Tx Leave In, Rx Leave Empty, Tx Leave Empty, Rx Leave All, and Tx Leave All. To clear the statistics on this table, please click on the **Clear** button at the bottom of the table. Table 2.27 describes the GVRP setting's options.

Table 2.27 GVRP Setting Descriptions

Label	Description	Factory Default
GVRP	Enables or disables GVRP protocol Enables GVRP, the switch must be in 802.1q VLAN mode	Disabled
Port	Enables or disables GVRP on each port. If users have already defined trunking group (e.g. Trk1), it can also be selected to be enabled. If you check the All Port's box, all ports will be enabled.	All ports are disabled
Clear Statistics	Clears all GVRP statistics counts	Clears the record

2.9.4 GMRP Setting

The users can use this subsection to enable GMRP and enable GMRP for all ports or specified port(s) and trunking group(s) as shown in Figure 2.79. To enable GMRP in Figure 2.78, check the **Enabled's** box and then select the desired port(s) by flagging the corresponding checkbox(es). Please click **Update** button to save the change to the switch.

GMRP	
GMRP	<input type="checkbox"/> Enabled
Port	GMRP
All	<input type="checkbox"/>
Port1	<input type="checkbox"/>
Port2	<input type="checkbox"/>
Port3	<input type="checkbox"/>
Port4	<input type="checkbox"/>
Port5	<input type="checkbox"/>
Port6	<input type="checkbox"/>
Port7	<input type="checkbox"/>
Port8	<input type="checkbox"/>

Figure 2.78 GMRP Setting Box

The GMRP Statistics can also be viewed on the bottom of this page as shown in Figure 2.79. The GMRP Statistics provides summarized statistics on the packet count of GMRP based on the following packet types: Rx Join Empty, Tx Join Empty, Rx Join In, Tx Join In, Rx Empty, Tx Empty, Rx Leave In, Tx Leave In, Rx Leave Empty, Tx Leave Empty, Rx Leave All, and Tx Leave All. To clear the statistics on this table, please click on the **Clear** button at the bottom of the table. Table 2.28 briefly describes GMRP setting and statistics.

GMRP Statistics

Type	Packets
Rx Join Empty	0
Tx Join Empty	0
Rx Join In	0
Tx Join In	0
Rx Empty	0
Tx Empty	0
Rx Leave In	0
Tx Leave In	0
Rx Leave Empty	0
Tx Leave Empty	0
Rx Leave All	0
Tx Leave All	0

Clear

Figure 2.79 GMRP Statistics

Table 2.28 Descriptions of GMRP Settings and Statistics

Field	Field Description	Factory Default
GMRP	You can enable or disable GMRP by enabling the checkbox. To enable GMRP, the switch must be in 802.1q VLAN mode.	Disabled
Port	You can enable or disable GMRP on specified ports by clicking the corresponding checkbox. If you have already defined a trunking group (e.g. Trk1), you can also enable it. If you check the All Port's box, all ports will be enabled.	All Ports are disabled.
Clear Statistics	You can clear all GMRP Statistics	Clears the records

2.10 IP Multicast

The managed switch supports Internet Group Management Protocol (IGMP) which is a communication protocol used on IP version 4 networks to establish multicast group memberships among switches in the network. IGMP is an integral part of IPv4 multicast. It operates above the network layer of OSI model. One of the most important features related to this protocol is IGMP snooping, which is supported by the managed switch and greatly strengthens network functionality. The IGMP snooping is a process of “listening” to IGMP network traffic. By listening to conversations between different devices, it maintains a map of links and IP multicast streams. This means that multicast traffic may be filtered from the links of the managed switch which do not need them. Therefore, IGMP snooping enables the managed switch to only forward multicast traffic to the links that have requested it. Three additional multicast mechanisms are support by L3 managed switch, which are DVMRP, PIM (Protocol-Independent Multicast), and Static IP Multicast. This section contains three submenus as shown in Figure 2.80 which are:

- IGMP
- DVMRP
- PIM
- Static IP Multicast

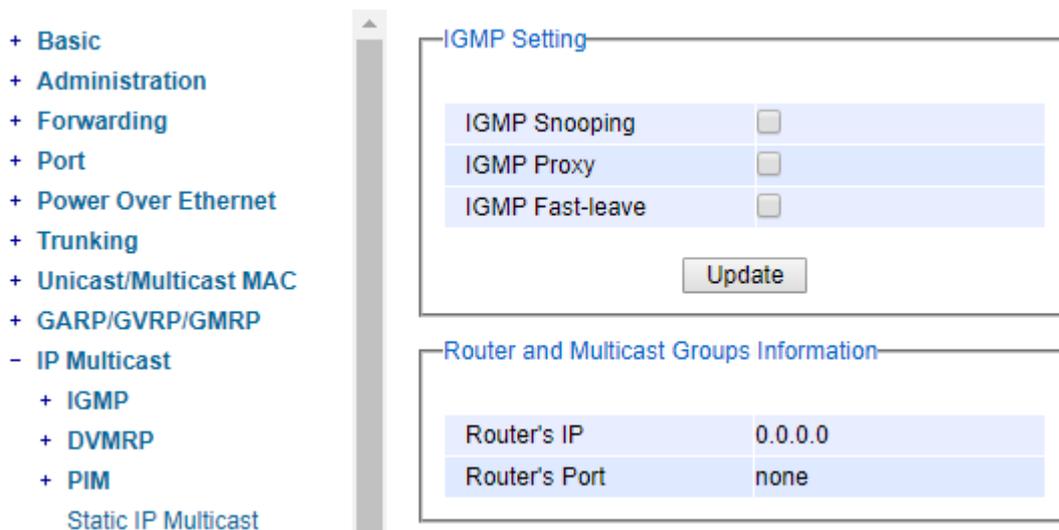


Figure 2.80 IP Multicast Dropdown Menu

2.10.1 IGMP

The **IGMP** (Internet Group Management Protocol) submenu is further divided into three options which are: **Setting**, **IP Multicast Table**, and **Statistics**. Figure 2.81 shows the three options under the IGMP submenu.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- IP Multicast
 - IGMP
 - Setting
 - IP Multicast Table
 - Statistics
- + DVMRP
- + PIM
 - Static IP Multicast

Figure 2.81 IGMP's Options

2.10.1.1 IGMP Settings

This webpage allows the users to set IGMP features on the managed switch as shown in Figure 2.82. There are three features that can be enabled: **IGMP Snooping**, **IGMP Proxy**, and **IGMP Fast-leave**. After checking the desired feature's boxes, please click on the **Update** button to allow the options to take effect. The lower part of the page lists **Router and Multicast Groups Information** which are router's IP and port information. Table 2.29 summarizes the descriptions of IGMP's Settings.

IGMP Setting

IGMP Snooping	<input type="checkbox"/>
IGMP Proxy	<input type="checkbox"/>
IGMP Fast-leave	<input type="checkbox"/>

Router and Multicast Groups Information

Router's IP	0.0.0.0
Router's Port	none

Figure 2.82 IGMP Setting Webpage

Table 2.29 Descriptions of IGMP's Settings

Label	Description	Factory Default
IGMP Snooping	Check the box to enable IGMP snooping	Disabled
IGMP Proxy	Check the box to enable IGMP proxy. See note below.	Disabled
IGMP Fast-leave	Check the box to enable IGMP Fast-leave. See note below.	Disabled

Label	Description	Factory Default
Router's IP	Display the multicast router's IP address	-
Router's Port	Display the port that is connected to multicast router	-

***NOTE:**

IGMP Snooping is a feature that enables the managed switch to listen in on IGMP conversation between hosts and a multicast enabled router. IGMP snooping allows the managed switch, which is placed in between these hosts and the multicast enabled router, to only forward multicast traffic to the links that have solicited them. Therefore, it is designed to prevent hosts connected to the managed switch's ports from receiving traffic for a multicast group that they have not explicitly joined. It provides managed switch with a mechanism to prune multicast traffic from links that do not contain a multicast listener. This is useful for bandwidth-intensive IP multicast application.

IGMP Proxy works as an intermediate server, as shown in Figure 2.83. When it receives a membership query message from the router, it sends a membership report message to the router port. When it receives a membership report message from a computer in a new multicast group, it sends a membership report message back to the router port. When it receives a leave group message from a computer which is the only one in the group, it sends a leave group message to the router port and removes the computer from multicast group. Proxy is like a middle man that handles information about multicast group in between routers and computers.

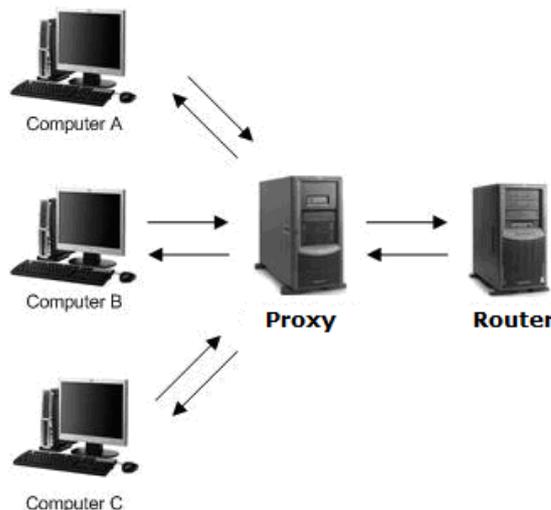


Figure 2.83 Example of IGMP Proxy

IGMP Fast-leave: When a leave group message is received, the ports in the group will be immediately removed from the IP multicast entry.

2.10.1.2 IGMP IP Multicast Table

This webpage provides information about IGMP membership table and IP multicast table. Figure 2.84 depicts the IGMP's IP Multicast Table webpage. The upper table is an IGMP membership table and the lower table is IP multicast table which contain both static configured IP multicast addresses and dynamically joined IP multicast addresses. The static configured port is manually added by the users, while the dynamically joined port is added by the managed switch's IGMP snooping feature. To get the latest update information on each table please click on the **Refresh** button.

IGMP IP Multicast Table

IGMP membership table (0 entries)			
IP Multicast Address	VID	Joined Port	Life Time
Empty			

IP multicast table		
IP Multicast Address	VID	Joined Port
Empty		

Figure 2.84 IGMP's IP Multicast Table Webpage

Figure 2.85 shows examples of IGMP membership table and IP multicast table. Note that the display format in Figure 2.85 is from an early version of managed switch firmware which may have a slightly different display format from Figure 2.84. These tables are based on the information in the memory of the managed switch. The IGMP membership table contains IP Multicast Address, VLAN ID (VID), Joined Port (port number) and Life Time. Note that the Life Time is in the unit of second. The IP multicast table has only IP Multicast Address, VLAN ID (VID), and Joined Port. Note that the joined port can be labelled with (S) or (D) which refer to as Static Configured or Dynamically Joined, respectively.

IP Multicast Table

IGMP membership table: (The total entry is 3)

IP Multicast Address	Vlan ID	Life Time	Join Port
224.0.0.251	1	219	10
224.0.1.60	1	220	10
239.255.255.250	1	219	10

IP multicast table:

IP Multicast Address	Vlan ID	Join Port
224.0.0.251	1	10(D)
224.0.1.60	1	10(D)
239.255.255.250	1	10(D)

Join Port - (S):Static Configured, (D):Dynamic Joined

Figure 2.85 Example of IGMP's IP Multicast Table

2.10.1.3 IGMP Statistics

This webpage provides information about IGMP statistics as shown in Figure 2.86. The users can view the number of IGMP packets in different categories: Rx Total, Rx Valid, Rx Invalid, Rx General Queries, Tx General Queries, Rx Group-Specific Queries, Tx Group-Specific Queries, Rx Leaves, Tx Leaves, Rx Reports, Tx Reports, and Rx Others. The users can reset the numbers in all categories by clicking on the **Clear** button.

IGMP Statistics

Type	Packets
Rx Total	0
Rx Valid	0
Rx Invalid	0
Rx General Queries	0
Tx General Queries	0
Rx Group-specific Queries	0
Tx Group-specific Queries	0
Rx Leaves	0
Tx Leaves	0
Rx Reports	0
Tx Reports	0
Rx Others	0

Clear

Figure 2.86 IGMP Statistics Webpage

Example of IGMP statistics are shown in Figure 2.87. Note that the display format in Figure 2.87 is from an early version of managed switch firmware which may have a slightly different display format from Figure 2.86. It shows the statistical values of IGMP packets which the managed switch received and transmitted over time. Table 2.30 summarizes the descriptions of the IGMP statistics.

IGMP Statistics

Type	Packets
Rx Total	8
Rx Valid	8
Rx Invalid	0
Rx General Queries	4
Tx General Queries	4
Rx Group-specific Queries	0
Tx Group-specific Queries	0
Rx Leaves	0
Tx Leaves	0
Rx Reports	4
Tx Reports	6
Rx Others	0

Clear

Figure 2.87 Example of IGMP's Statistics

Table 2.30 Descriptions of IGMP Statistics

Statistics Label	Description	Factory Default
Rx Total	Total number of IGMP packets received by the managed switch	-
Rx Valid	Number of valid IGMP packets received by the managed switch	-
Rx Invalid	Number of invalid IGMP packets received by the managed switch	-

Statistics Label	Description	Factory Default
Rx General Queries	Number of IGMP's Membership General Query packets received by the managed switch	-
Tx General Queries	Number of IGMP's Membership General Query packets transmitted by the managed switch	-
Rx Group Specific Queries	Number of IGMP's Membership Group Specific Query packets received by the managed switch	-
Tx Group Specific Queries	Number of IGMP's Membership Group Specific Query packets transmitted by the managed switch	-
Rx Leaves	Number of IGMP's Leave Group packets received by the managed switch	-
Tx Leaves	Number of IGMP's Leave Group packets transmitted by the managed switch	-
Rx Reports	Number of IGMP's Membership Report packets received by the managed switch	-
Tx Reports	Number of IGMP's Membership Report packets transmitted by the managed switch	-
Rx Others	Number of IGMP's other packets received by the managed switch	-

2.10.2 DVMRP

Distance Vector Multicast Routing Protocol (DVMRP) is a routing protocol for IP multicast packets. It is described in RFC 1075 as an interior gateway protocol (IGP) within a multicast domain and is derived from Routing Information Protocol (RIP), which is suitable for use within an autonomous system. DVMRP uses the Internet Group Management Protocol (IGMP) to exchange routing information with other routers. It operates via a reverse path flooding technique in which it sends a copy of received IGMP message (containing routing information) out through each interface except the one at which the message arrived. By using flooding technique, the DVMRP may not scale very well in some network topologies. DVMRP creates a routing table with route entries that map between multicast group (IP address) and source address. The purpose of DVMRP is to keep track of the return paths to the source of multicast datagrams. DVMRP router dynamically discovers their Neighbors by sending Neighbor probe messages periodically to an IP multicast group address that is reserved for all DVMRP routers.

To enable DVMRP on EHG76XX, you first need to configure at least two VLAN interfaces, set all relevant parameters for the interfaces such as IP addresses, DVMRP VLAN and enable IP Routing. We present these steps in detail as follows:

1. Add at least two VLANs in **802.1Q VLAN** menu as described in Section 2.14.2.1. Figure 2.88 shows examples of three VLAN settings which are named vlan10, vlan20, and vlan30. Note that this is only for illustration. For each VLAN, you need to set the **Name** and VLAN identifier (**VID**). Then, select one or multiple **Member Ports** from the list for that VLAN. For **Tagged Ports**, you can select one or multiple ports from the list or leave it empty when you do not want to add VLAN tag to the outgoing packet (the packet will assume the native VLAN number). Note that you can select multiple ports from the list by selecting desired ports while holding the Ctrl-key. Importantly, all the configured VLAN ports should to be removed from the DEFAULT member port list. Finally, click **Add/Modify** button to add a new entry to the upper table in Figure 2.88

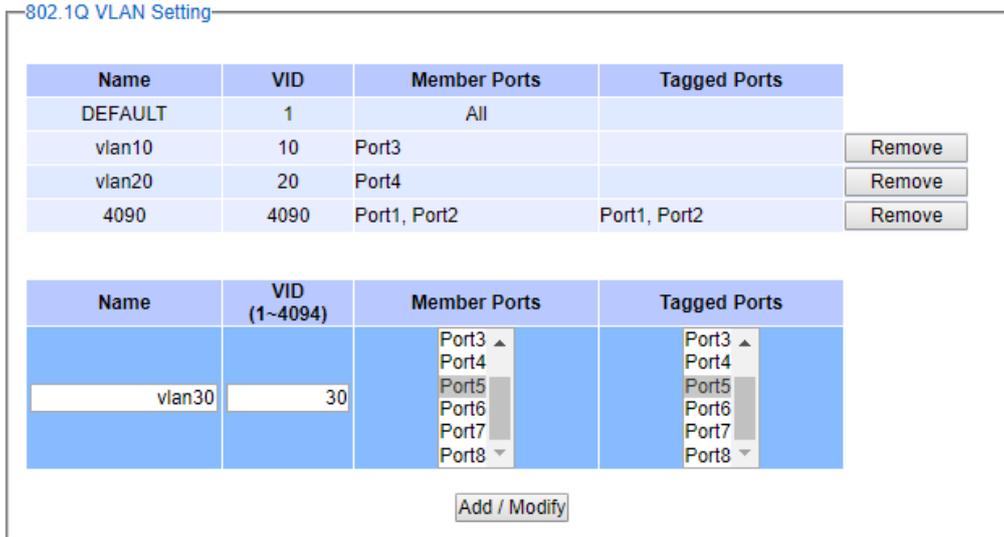


Figure 2.88 Example of Setting 802.1Q VLAN Interface for Multicast Routing

- Setting the Port VLAN ID (**PVID**) or native VLAN number for port in **PVID Setting** menu as described in Section 2.14.2.2. The **PVID** must be the same as the VLAN identifiers (**VID**) set in previous step for multicast routing. Figure 2.89 depicts example of setting Port 3 and Port 4 with PVID = 10 and 20, respectively. You can assign one or multiple ports to the same Port VLAN ID (PVID). The Port VLAN ID can be the number from 1 to 4094. Note that the default value of Port VLAN ID is 1.

PVID Setting

Port	PVID
Port1	1
Port2	1
Port3	10
Port4	20
Port5	1
Port6	1
Port7	1
Port8	1

Port	PVID (1~4094)
Port1 ▲ Port2 Port3 Port4 Port5 Port6 ▼	Select vlan ▼

Update

Figure 2.89 Example of Setting Port VLAN ID (PVID) for Multicast Routing

- Assign IP addresses for VLANs which were set in the first step in **IP Setting** submenu under **Administration** menu as described in Section 2.3.2. Figure 2.90 shows example of assigned IP Addresses and Subnet Masks for VLAN identifier (VID) = 10 and 20 which were set for multicast routing.

IP Interface

DHCP	<input type="checkbox"/>
Static IP Address	<input type="text"/>
Subnet Mask	<input type="text"/>
VID	Select vlan ▼

Update

DHCP	IP Address	Subnet Mask	VID	
Disabled	11.0.50.10	255.255.0.0	10	Remove
Disabled	10.0.50.1	255.255.0.0	1	Remove
Disabled	12.0.50.20	255.255.0.0	20	Remove

Figure 2.90 Example of IP Address Setting for VLAN Interfaces used in Multicast Routing

- Configure DMVRP Interfaces as explained in the next subsection.

5. To enable DVMRP process on EHG76XX, you can click on the **Enable** button on the DVMRP menu inside the **Running Status** box as shown in Figure 2.91.

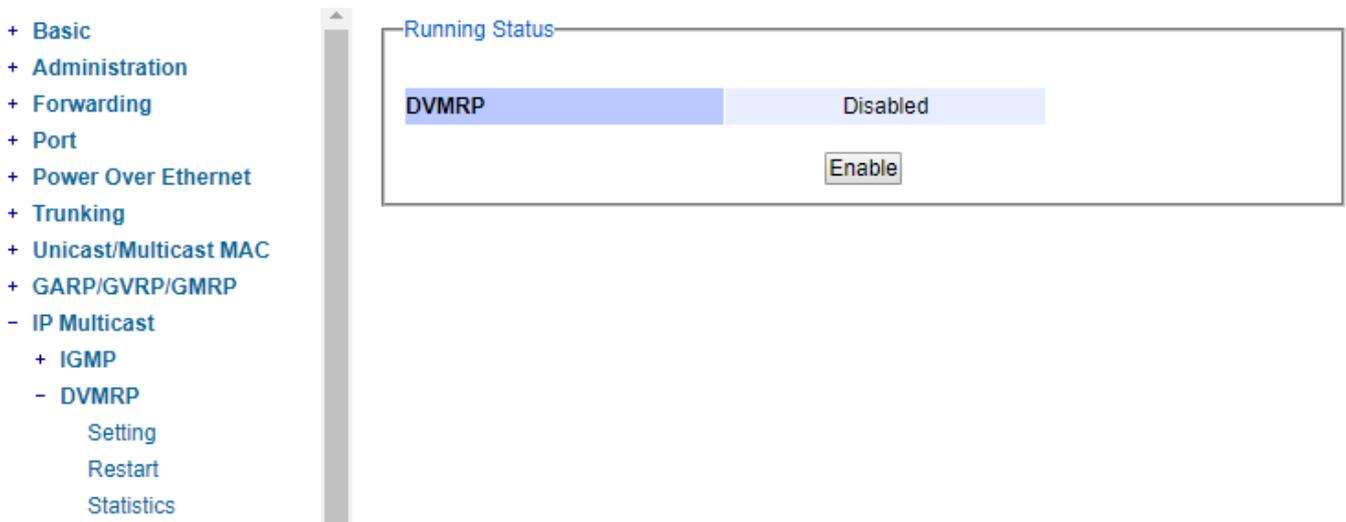


Figure 2.91 DVMRP Running Status Web Page

Note that you will be notified with an error message as shown in Figure 2.92 if the minimum of two DVMRP VLAN interfaces were not configured as described in Step 1 to 5, and you are trying to enable the DVMRP on this **DVMRP Running Status** box.

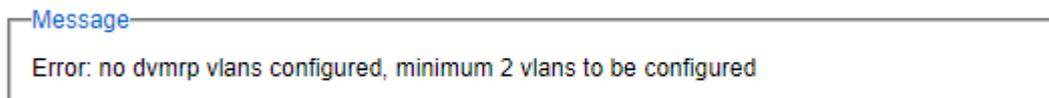


Figure 2.92 Error Message When Enabling DVMRP with no DVMRP VLANs

2.10.2.1 DVMRP Setting

On this submenu, it allows you to add or remove VLAN interface(s) from DVMRP interface(s). Figure 2.93 illustrates the **DVMRP Setting** web page that consists of two parts: the **DVMRP Settings** and the table of DVMRP interface(s). To add a VLAN interface to the **DVMRP Setting**, you first select a **VLAN ID** from the drop-down list and fill in a desired **Route Matric** between 1 and 31. The **Route Metric** is the cost of the path (or VLAN interface) through which the packet will be sent. Note that the default metric is 1. Then click on the **Add VLAN** button inside the **DVMRP Settings** box. Note that you must already configure DVMRP VLAN interfaces first as described in previous subsections.

To remove a VLAN interface from the DVMRP Setting, you can check the corresponding box in front of a VLAN entry inside the lower part of the web page. Then, click on the **Delete** button. To check the latest configuration of the DVMRP Settings, you can click on the **Update** button to refresh the web page.

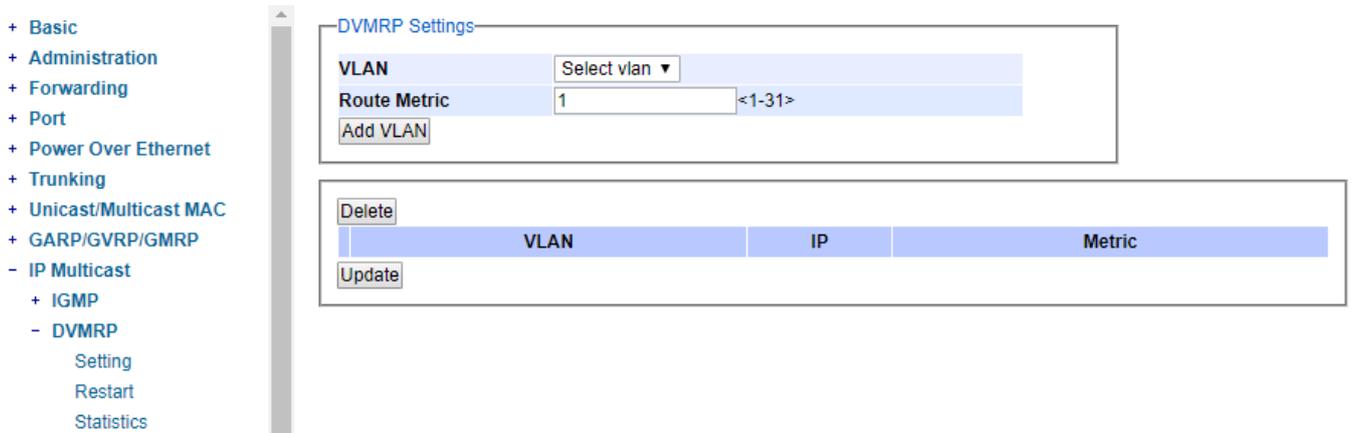


Figure 2.93 DVMRP Setting Web Page

2.10.2.2 DVMRP Restart

Figure 2.94 shows the **DVMRP Restart** submenu that allows you to restart the DVMRP process inside the EH67XX Layer-3 Managed Switch by simply clicking on the **Restart** button.

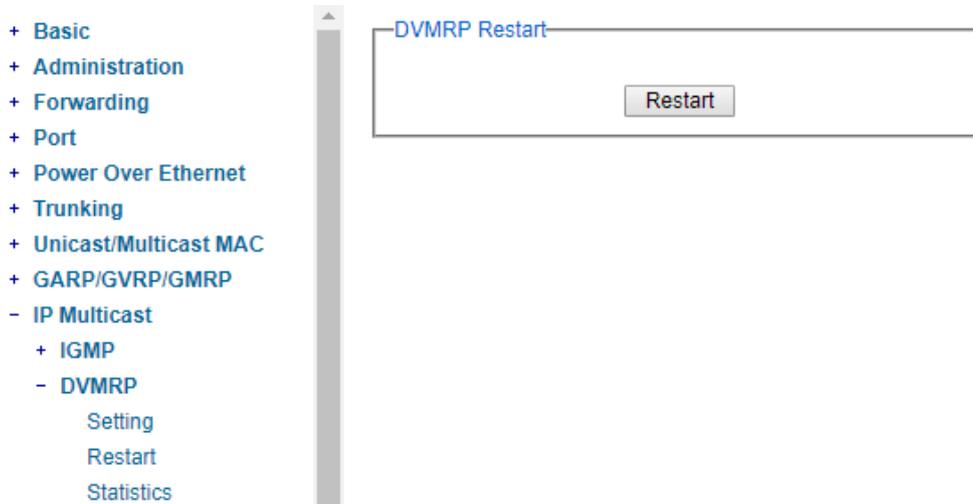


Figure 2.94 DVMRP Restart Web Page

2.10.2.3 DVMRP Statistics

Under **DVMRP Statistics** web page as shown in Figure 2.95, you can view the DVMRP Routing Table or **Multicast Routing Table**. Inside the table, there are entries of mapping between **Source**'s IP address and IP address of **Multicast Group**. Note that if the DVMRP was not enabled, the multicast routing table will not be available and the web page will display an error message as shown in Figure 2.96.

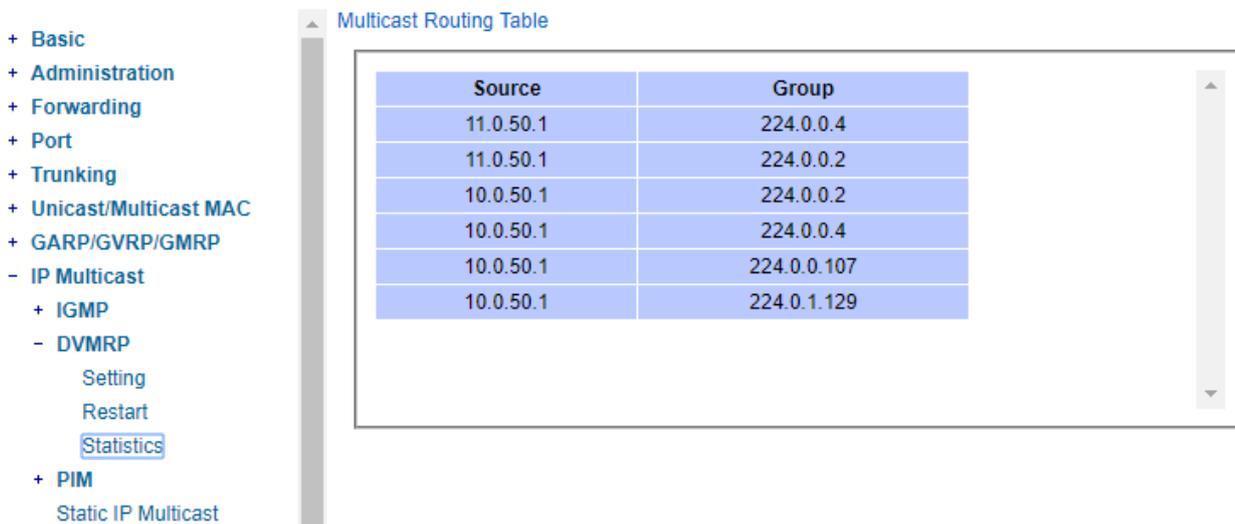


Figure 2.95 DVMRP Statistics Web Page

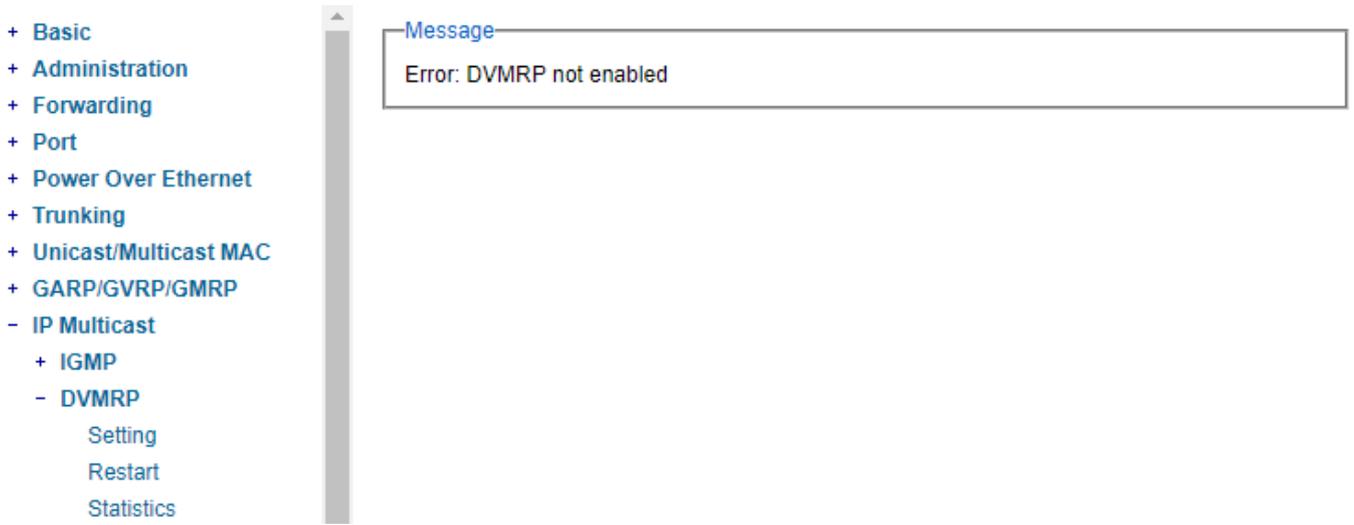


Figure 2.96 Error Message on DVMRP Statistics Web Page

2.10.3 PIM

Protocol Independent Multicast (PIM) is a set of multicast routing protocols developed for large heterogeneous inter-networks. Routers or Layer-3 switches that utilize PIM will interact to create and maintain multicast distribution trees that help forwarding IP multicasting packets to members of multicast group. It is efficient for multicasting topology that multicasting senders and group members are distributed sparsely across wide area and inter-domain internets. PIM is not dependent on any particular unicast routing protocol and uses soft-state reliability mechanisms to adapt to changing in network conditions and group memberships. It does not perform topology discovery by itself and does not build its own routing table. Instead, PIM uses existing unicast routing tables which can be computed by any unicast routing protocol in use on the network for reverse path forwarding. It utilizes the traditional IP multicast model of receiver-initiated membership and supports both group-shared and shortest-path trees.

EHG76XX Layer-3 Managed Switch supports three modes of operation for Protocol Independent Multicast (PIM) routing protocols which are Sparse Mode (SM), Source-Specific Multicast (SSM) mode, and Dense Mode (DM). Figure 2.97 shows the submenus under the PIM menu.

- PIM
 - Querrier
 - IGMP join/leave
- Sparse Mode
 - Setting
 - Statistics
 - Restart
- Rendezvous Point
 - Bootstrap
 - Static
- SSM
 - Setting
 - Restart
 - Statistics
- Dense Mode
 - Setting
 - Restart
 - Statistics

Figure 2.97 PIM Menu and Its Submenus

To enable PIM on EHG76XX Layer-3 Managed Switch, you first need to configure at least two VLAN interfaces for PIM Sparse Mode and PIM Dense Mode or at least one VLAN interface for PIM Source Specific Multicast (SSM) mode. Additionally, all relevant parameters for multicast routing must be configured such as VLAN's IP addresses, IGMP mechanism, and IP routing function. Note that before enabling any of the three PIM modes, you will also need to go through the **Setting** web page under each PIM mode too. We summarize these steps in detail as follows:

1. Setting up VLANs in 802.1Q VLAN menu as described in Section 2.14.2.1. Figure 2.98 shows examples of three VLAN settings which are named vlan10, vlan20, and vlan30. Note that this is only for illustration. For each VLAN, you need to set the **Name** and VLAN identifier (**VID**). Then, select one or multiple **Member Ports** from the list for that VLAN. For **Tagged Ports**, you can select one or multiple ports from the list or leave it empty when you do not want to add VLAN tag to the outgoing packet (the packet will assume the native

VLAN number). Note that you can select multiple ports from the list by selecting desired ports while holding the Ctrl-key. Finally, click **Add/Modify** button to add a new entry to the upper table in Figure 2.98.

802.1Q VLAN Setting

Name	VID	Member Ports	Tagged Ports	
DEFAULT	1	All		
vlan10	10	Port3		Remove
vlan20	20	Port4		Remove
4090	4090	Port1, Port2	Port1, Port2	Remove

Name	VID (1~4094)	Member Ports	Tagged Ports
vlan30	30	Port3 ▲ Port4 Port5 Port6 Port7 Port8 ▼	Port3 ▲ Port4 Port5 Port6 Port7 Port8 ▼

Add / Modify

Figure 2.98 Example of Setting 802.1Q VLAN Interface for PIM Protocol

- Setting the Port VLAN ID (**PVID**) or native VLAN number for port in **PVID Setting** menu as described in Section 2.14.2.2. The **PVID** must be the same as the VLAN identifiers (**VID**) set in previous step for multicast routing. Figure 2.99 depicts example of setting Port 3 and Port 4 with PVID = 10 and 20, respectively. You can assign on or multiple ports to the same Port VLAN ID (PVID). The Port VLAN ID can be the number from 1 to 4094. Note that the default value of Port VLAN ID is 1.

PVID Setting

Port	PVID
Port1	1
Port2	1
Port3	10
Port4	20
Port5	1
Port6	1
Port7	1
Port8	1

Port	PVID (1~4094)
<div style="border: 1px solid gray; padding: 2px;"> Port1 ▲ Port2 Port3 Port4 Port5 Port6 ▼ </div>	Select vlan ▼

Update

Figure 2.99 Example of Setting Port VLAN ID (PVID) for PIM

- Assign IP addresses for VLANs which were set in the first step in **IP Setting** submenu under **Administration** menu as described in Section 2.3.2. Figure 2.100 shows example of assigned IP Addresses and Subnet Masks for VLAN identifier (VID) = 10 and 20 which were set for multicast routing.

IP Interface

DHCP

Static IP Address

Subnet Mask

VID

Update

DHCP	IP Address	Subnet Mask	VID	
Disabled	11.0.50.10	255.255.0.0	10	Remove
Disabled	10.0.50.1	255.255.0.0	1	Remove
Disabled	12.0.50.20	255.255.0.0	20	Remove

Figure 2.100 Example of IP Address Setting for VLAN Interfaces used in PIM

- The IP routing or L3 routing function must be enabled on the EHG76XX Layer-3 managed switch as shown in

- Figure 2.101. This is required for Protocol Independent Multicast (PIM) because it does not have topology discovery mechanism. This can be done in **Setting** submenu under **IP Routing** menu as described in Section

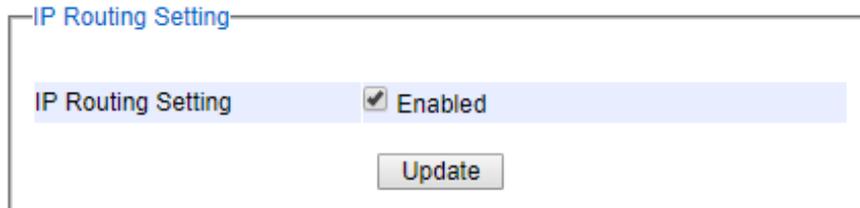


Figure 2.101 Enabling of IP Routing Function in Layer-3 Managed Switch for PIM

- Configure the **IPv4 Static Routing** as described in Section 2.22.2 for desired IPv4 multicast address range such as 239.0.0.0 and subnet mask 255.0.0.0 for the VLAN interface used in PIM.

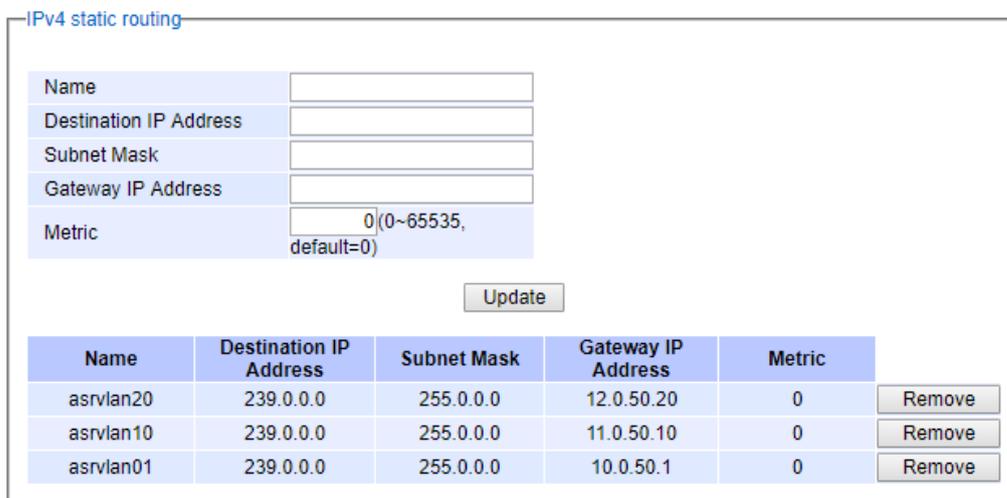


Figure 2.102 Example of Adding Static Routes for PIM

- Alternatively, configure OSPF as described in Section 2.22.4 如下
- Configure the desired mode of PIM as described in Section 2.10.3.3 and/or Section 2.10.3.4, and/or Section 2.10.3.5.

2.10.3.1 Querier

To enable any of the PIM mode, you will need to configure **IGMP Querier Settings** as shown in Figure 2.103. This interval is the time between IGMP queries when the EHG76XX Layer-3 Managed Switch is elected as querier. The value can be set from 12 to 60 seconds.

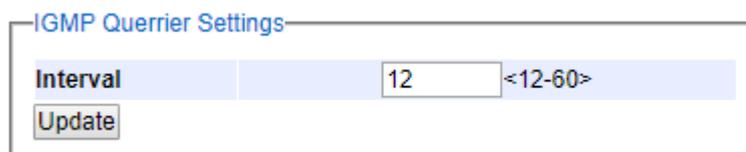


Figure 2.103 PIM's IGMP Query Interval Setting Web Page

2.10.3.2 IGMP join/leave

This web page as shown in Figure 2.104 called **IGMP join/leave** allows you to manually send IGMP Join or IGMP Leave messages. You will need to configure the fields in the message which are **VLAN** identifier, multicast **Group Address**, **Source Address**, and type of message which can be either **Join** or **Leave**. Note that the “*” in the Source Address field means any source. The PIM Join message can be use in PIM Sparse Mode (next subsection) to notify the Rendezvous Point (RP) that there is a host or a downstream router or Layer-3 switch that want to join a multicast group. When you finished configured the message, please clicking on **Send** button to send the message. This page can be used for sending Join/leave message for any mode of the PIM.

Send IGMP Join/Leave	
VLAN	Select vlan ▼
Group Address	232.0.0.1
Source Address	*
Join/Leave	Select Join/Leave ▼
Send	

Figure 2.104 IGMP Join/Leave Web Page

2.10.3.3 Sparse Mode

PIM Sparse Mode (SM) uses the concept of **Rendezvous Point (RP)** as a meeting point for any routers or Layer-3 switches that will involve in multicasting as multicast source and receivers. The RP can be manually configured as **Static Rendezvous** or can be automatically discover in the network using some protocols such as **Bootstrap Rendezvous**. Each router or Layer-3 switch that receives multicast traffic from a source will forward it to the RP. Routers or Layer-3 switches in PIM SM will not forward any multicast traffic unless some node requests it. Each router or Layer-3 switch called **Designated Router (DR)** that would like to receive multicast traffic will have to send or forward a PIM Join message to the RP.

PIM Sparse Mode (PIM SM) explicitly builds unidirectional root path tree (RPT) or shared distributed tree rooted at a Rendezvous Point (**RP**) per multicast group. PIM SM can optionally create shortest-path tree per source so that the router or Layer-3 switch can switch to Source Path Tree (SPT) or **Shortest-Path Tree (SPT)** which is the most optimal path. This switch operation can remove the RP from the shared distributed tree and get multicast traffic directly from the multicast source. Note that receivers that never switch to shortest-path tree are effectively running Core Based Trees (CBT).

PIM SM generally scales fairly well for wide-area usage. The RP helps reduce the amount of states in other non-RP routers or switches in the network. However, all routers or Layer-3 switches in PIM SM domain must provide mapping to a Rendezvous Point router/switch.

shows the menu and submenus for **PIM Sparse Mode** which consists of **Setting, Statistics, Restart** and **Rendezvous Point**.

- Sparse Mode
 - Setting
 - Statistics
 - Restart
- Rendezvous Point
 - Bootstrap
 - Static

Figure 2.105 Menu and Submenus of PIM Sparse Mode

To enable PIM Sparse Mode on EHG76XX Layer-3 Managed Switch, you can click on the **Enable** button inside the **Running Status** box on the **Sparse Mode** submenu under **PIM** as shown in Figure 2.106. However, you will also need to set up PIM Sparse Mode **Setting** such as PIM SM VLAN interfaces, hello interval, RP election, and STP switch-over mechanisms first as described in the next section (Section 2.10.3.3.1).



Figure 2.106 PIM Sparse Mode Running Status Web Page

Note that if you did not follow the steps described in Section 0 and Section 2.10.3.3.1 before enabling PIM Sparse Mode here. You will be notified by error messages such as the IP routing is not enabled as shown in Figure 2.107 or no PIM SM VLAN interface is configured as shown in Figure 2.108.

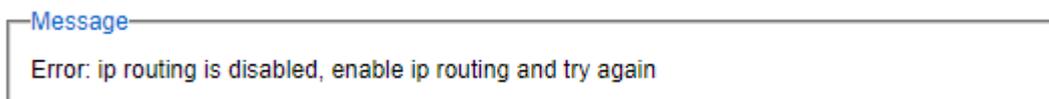


Figure 2.107 Error Message when IP Routing function is not enabled



Figure 2.108 Error Message when no Sparse-Mode VLAN was configured

2.10.3.3.1 Setting

PIM Sparse Mode (SM) configuration and its VLAN interface settings must be configured in this **Setting** web page before enabling it in previous section. **PIM SM Setting** web page is divided into three parts: **PIM SM Settings**, **PIM SM VLAN Settings**, and **Sparse Mode Settings** as shown in Figure 2.109.

The first part called **PIM SM Settings** contains three PIM SM options which are Rendezvous Point (**RP Election**), Shortest-Path Tree (**SPT switch-over**), and **Hello Interval**. In **RP Election** option, you can choose how the PIM SM choose an RP from either **Static Rendezvous** or **Bootstrap Rendezvous**. The **SPT switch-over** option can be configured as either **Never** or **Immediate**. If SPT switch-over is immediate, the Layer-3 managed switch will change to receive multicast traffic from the shortest path tree. The **Hello Interval** is the time between transmission of Hello message that allows Layer-3 managed switch to advertise their existence as PIM routing device on all PIM-enabled interface. This will allow neighboring PIM routers/switches to learn about it. The value of Hello Interval is between 30 to 18724 seconds. The default value of Hello Interval is 30 seconds.

The second part called **PIM SM VLAN Settings** is used to configure VLAN interface for PIM SM. Note that you will need to configure VLAN interface as described in Section 0 so that you can select that particular VLAN interface from the **VLAN** drop-down list in this part. For each PIM SM VLAN interface, you will have to configure Designated Router (**DR Priority**), **Route Distance**, and **Route Metric**. By default, every PIM interface has an equal probability (priority = 1) of being selected as the DR. Configuring the interface's DR Priority helps ensure that changing an IP address does not alter forwarding model.

The third part called **Sparse Mode Settings** is a table of all current PIM Sparse Mode interfaces. Inside this part, you can remove any of the VLAN interface entries by checking the box in front of that entry and clicking **Delete** button. To view the latest list of PIM SM interfaces, simply clicking on the **Update** button. Description of parameters in PIM Sparse Mode Settings are summarized in Table 2.31.

PIM SM Settings

RP Election	Select rp election ▼
SPT switch-over	Never ▼
Hello Interval	30 <30-18724>

PIM SM VLAN Settings

VLAN	Select vlan ▼
DR Priority	1 <1-4294967294>
Route Distance	101 <1-255>
Route Metric	1024 <1-1024>

Sparse Mode Settings

	VLAN	IP	DR Priority	Route Distance	Route metric	RP Election	STP Switch-over	Hello Interval
<input type="checkbox"/>	10	11.0.50.10	10	101	1024	Bootstrap	Never	30
<input type="checkbox"/>	20	12.0.50.20	1	101	1024	Bootstrap	Never	30

Figure 2.109 PIM Sparse Mode Setting Web Page

Table 2.31 Descriptions of PIM Sparse Mode Settings

Label	Description	Factory Default
RP Election	PIM SM Rendezvous Point election methods: Static or Bootstrap	-
SPT Switch-over	Shortest path switch-over is enabled/disabled	Enabled
Hello Interval	PIM Hello messages are sent periodically on each PIM-enabled interface. They allow a router to learn about neighboring PIM routers on each interface.	30 seconds
DR Priority	When there are multiple PIM routers on the same LAN the DR (Designated Router) is usually elected based on the highest numerical IP address. This setting can be used to control the DR Priority option in PIM Hello messages, When the DR Priority option is advertised by all PIM routers on the same LAN the highest priority router wins the DR election, regardless of its IP. If any router does not advertise the DR Priority option, or the same priority is advertised by more than one router, the protocol falls back to using the IP address.	1
Route Metric	When there are multiple PIM enabled routers on a shared segment, it is possible that these routers encounter duplicate multicast traffic. PIM assert messages which are triggered when you receive a multicast packet on the Outgoing Interface List (OIL). These assert messages contain metrics which are then used to calculate who will become assert winner. When comparing assert_metrics, the rpt_bit_flag, metric_preference, and route metric fields are compared in order, where the first lower value wins. If all fields are equal, the primary IP address of the router that sourced the Assert message is used as a tie-breaker, with the highest IP address winning.	1
Route Distance	The default route distance option has nothing to do with system default route, it is rather the default value for unicast routing protocol's administrative distance. It is used in PIM assert election to determine upstream router .	1

2.10.3.3.2 Statistics

This web page as shown in Figure 2.110 provides information related to PIM Sparse Mode such as **Neighbor Table**, **Multicast Routing Table** and **Local Candidate Rendezvous Point Set**. The **Neighbor Table** will contain entries of VLANs, IP Addresses, and Neighbor IP Addresses which the Layer-3 Managed Switched learned from its neighbor’s Hello message. The **Multicast Routing Table** summarizes the total number of multicast group based on **Group’s** IP Address and displays the Rendezvous Point (**RP**) **Address**, **Source**, and the state of multicast routing (which is represented by **(*,*)** notion). Note that Source is the address of node that sends multicast traffic to a multicast group. Also note that the state of multicast routing can be:

- (S,G) pronounced as “S comma G” which is the multicast routing table state for a shortest path tree rooted at the source. The incoming interface for this entry is the reverse path forwarding (RPF) interface to S. There is a (S,G) for each source sending to each group.
- (S,*) pronounced as “S comma star” which is a multicast routing table state for each source sending to any group. The incoming interface for this entry is the RPF interface to S.
- (*,G) pronounced as “star comma G” which is the multicast routing table state for the RP tree. The incoming interface for this entry is the RPF interface to the RP for sparse-mode groups. There is one (*,G) for each group.

The **Local Candidate Rendezvous Point Set** is a table that lists all known RP addresses in the network connected to Layer-3 Managed Switch. However, at the top of this table there is the current Bootstrap Router (BSR) IP address. Each entry in the table (each RP) will have information about **Incoming**, **RP Group** Address, **RP Priority**, and **Hold Time**.

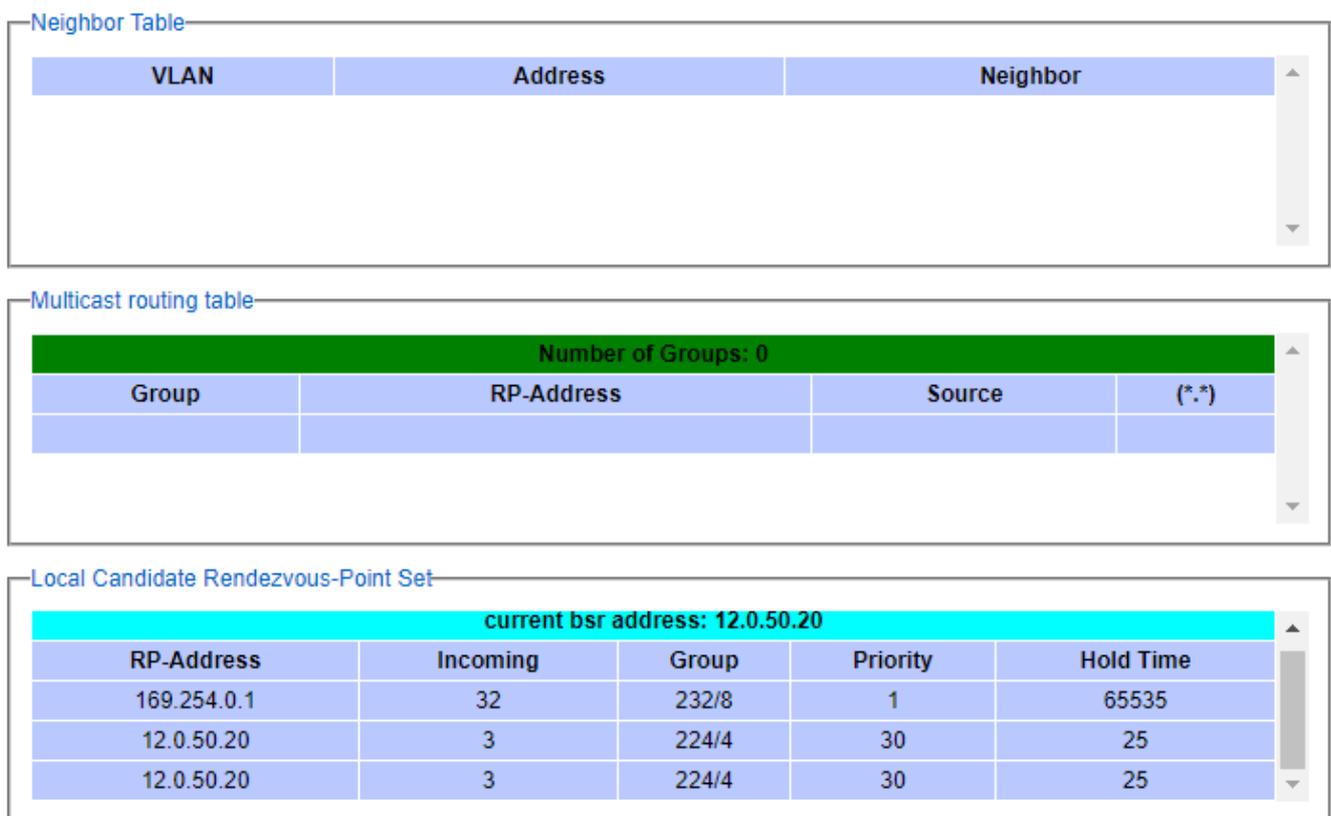


Figure 2.110 PIM Sparse Mode Statistics Web Page

Note that if the PIM Sparse Mode was not enabled as described in previous sections, you will be informed by an error message as shown in Figure 2.111.



Figure 2.111 Error Message when PIM Sparse Mode was not enabled

2.10.3.3.3 Restart

Figure 2.112 shows the **PIM Sparse Mode Restart** submenu that allows you to restart the PIM SM process inside the EH76XX Layer-3 Managed Switch by simply clicking on the **Restart** button.

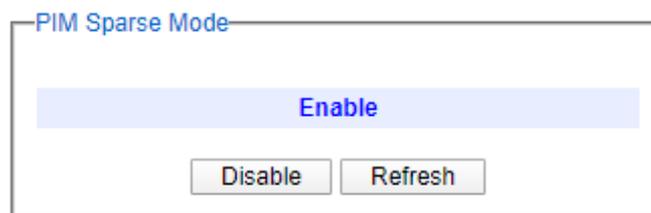


Figure 2.112 PIM Sparse Mode Restart Web Page

2.10.3.3.4 Rendezvous Point

EH76XX Layer-3 Manage Switch currently supports two methods for Rendezvous Point (RP) setup for PIM Sparse Mode which are bootstrapping (**Bootstrap**) and **Static**. Note that RP is a router or switch that is a meeting point for multicast groups that operate in sparse mode. There could be more than one RP per multicast group and a router could be the RP for multiple multicast groups.

2.10.3.3.5 Bootstrap

EH76XX Layer-3 Manage Switch can utilize Bootstrap Router (BSR) protocol for automatic Rendezvous Point (RP) selection. This is according to the **RP Election** option that is set to **Bootstrap Rendezvous** as described in Section 2.10.3.3.1. You can configure any one of its VLAN interface to become the candidate for **Bootstrap Router (C-BSR)** by selecting the desired VLAN from the drop-down list as shown in **Rendezvous Point Bootstrap Settings** box of Figure 2.113. Each candidate **BSR** will advertise its **BSR Priority**, **IP Address**, and hash value to its neighbor. A candidate BSR that hears a higher-priority candidate BSR than itself then suppresses its sending of further BSR messages for some time.

The single remaining candidate BSR in the network then becomes the elected BSR and its BSR messages inform all the other routers in the domain that it is the elected BSR. To avoid BSR message looping in the network, when Layer-3 switch received BSR message on one interface (Reverse Path Forwarding), it will not accept the same BSR message from other interfaces (non-Reverse Path Forwarding). Additionally, BSR message with lower priority will be dropped. The **BSR Priority** can be set with value from 0 to 255. Default **BSR Priority** is 0.

Candidate RP routers or Layer-3 switches in the network will start sending unicast RP advertisement with their list of multicast groups to the elected BSR. Note that BSR is not responsible for electing the best RP for each multicast group. However, BSR will advertise the received information about RPs and corresponding multicast groups to all

PIM routers/layer-3 switches. Other PIM routers/layer-3 switches in the network will choose appropriate RP for each group.

The screenshot displays the configuration interface for Rendezvous Point Bootstrap. It is divided into three main sections:

- Rendezvous Point Bootstrap Settings:** This section contains three input fields: 'VLAN' set to 1, 'BSR Priority' set to 3, and 'RP Priority' set to 30. Each field has a range indicator '<0-255>'. An 'Update' button is located to the right of the RP Priority field.
- Rendezvous Point Bootstrap Group Address:** This section has a 'Group Address' field containing '0.0.0.0' and a subnet mask field containing '24'. An 'Add' button is positioned to the right of the subnet mask field.
- Rendezvous Point Bootstrap Group Address:** This section features a list box containing two entries: '239.0.0.0/8' and '224.0.0.0/4'. A 'Delete' button is located to the right of the list box.

Figure 2.113 Rendezvous Point Bootstrap Settings Web Page

On the same page, you can also configure the same VLAN (selected as BSR above) as a Rendezvous Point (RP) by setting the **RP Priority** inside the **Rendezvous Point Bootstrap Settings** as shown in Figure 2.113. The **RP Priority** can be set with value from 0 to 255. Default **RP Priority** is 0. Once configuring all information, clicking on **Update** button. The next two parts on this page are dedicated to adding and removing multicast Group Addresses to the candidate BSR or candidate RP. To add a **Group Address**, you can enter the multicast IP address and its number of subnet mask bits then click on the **Add** button. Note that multiple Group Addresses can be added to the same BSR and RP. The Layer-3 switch will start advertising itself as the RP for multicast groups. To remove a **Group Address** from the list, you can select it from the list in Figure 2.113 and then click on the **Delete** button.

2.10.3.3.6 Static

This **Static** web page under the **Rendezvous Point** menu allows you to configure one or multiple static RPs. You can fill in the **RP Static Address** and its corresponding multicast **Group Address** as shown in Figure 2.114. Then clicking on the **Add** button to add a new entry into the list or table in the **Rendezvous Point Static Settings** box. To remove any existing static RP from the list, you can check the box in front of that particular entry and then clicking on the **Delete** button.

The screenshot shows a web interface for configuring Rendezvous Point (RP) static settings. It is divided into two main sections. The first section, titled "Add Rendezvous Point Static Address", contains two input fields: "RP Static Address" with the value "0.0.0.0" and "Group Address" with the value "224.0.0.0 / 24". Below these fields is an "Add" button. The second section, titled "Rendezvous Point Static Settings", contains a "Delete" button and two columns labeled "RP Address" and "Group Address".

Figure 2.114 Rendezvous Point Static Setting Web Page

2.10.3.4 SSM

PIM Source Specific Mode (**SSM**) uses a subset of PIM Sparse Mode and IGMP version 3 (IGMPv3). It allows a client to receive multicast traffic directly from a source which is more secure and scalable. PIM SSM only supports the one-to-many multicasting model. Thus, it is simpler than the PIM Sparse Mode. It is suitable for most broadcasting of content such as Internet video applications. An SSM group, called a channel, is identified as (S,G) where S is the source address and G is the group address. The IPv4 address range reserved for multicast group of SSM is 232.0.0.0/8 but it can technically be used in the entire 224/4 multicast address range.

PIM SSM builds shortest path trees (SPTs) rooted at the source immediately after receivers issued join message (or subscribing message) toward the source. It bypasses the procedures of Rendezvous Point (RP) connection as used in PIM SM and goes directly to the source-based distribution tree. Since PIM SSM does not rely on RP mechanism, it may require manual configuration or external method to learn in advance about the address of multicast source(s). In EHG76XX Layer-3 Managed Switch, you will need to know the **Source Address** and enter it in the **IGMP join/leave** message as described in Section 2.10.3.2.

Figure 2.115 shows the menu and submenus for **PIM SSM** which consists of **Setting**, **Restart** and **Statistics**.

- **SSM**
 - Setting
 - Restart
 - Statistics

Figure 2.115 Menu and Submenus of PIM SSM

To enable PIM Source Specific Mode (SSM) on EHG76XX Layer-3 Managed Switch, you can click on the **Enable** button inside the **Running Status** box on the **SSM** submenu under **PIM** as shown in Figure 2.116. However, you will need to prepare a VLAN interface as described in Section 0 (PIM) and also need to setup parameters for PIM Source Specific Mode VLAN in the **SSM Setting** page as explained in the next section. At least one SSM VLAN must be configured before enabling the PIM SSM.

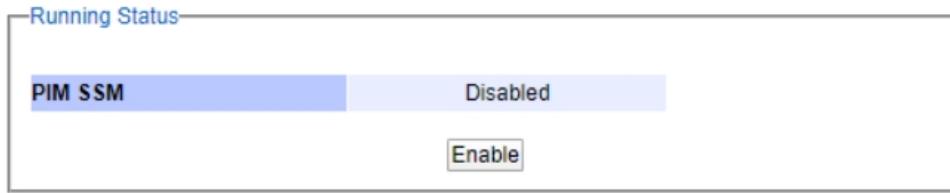


Figure 2.116 PIM Source Specific Mode Running Status Web Page

Note that if you did not follow the steps described in Section 0 (PIM) and Section 2.10.3.4.1 (SSM Setting) before enabling PIM Source Specific Mode here. You will be notified by error messages such as no SSM VLAN interface is configured as shown in Figure 2.117.



Figure 2.117 Error Message when no PIM SSM VLAN was configured

2.10.3.4.1 Setting

Before enabling the PIM Source Specific Mode in the previous subsection, you must configure PIM SSM's parameters and VLAN interface under the **PIM SSM Setting** web page as shown in Figure 2.118. There are four sections on this web page which are **PIM SSM Settings**, **PIM SSM Group Settings**, **PIM SSM VLAN Settings** and **SSM Settings**. The first section called **PIM SSM Settings** contains the **Hello Interval** which can be set from 30 to 18724 seconds. The default value for **Hello Interval** is 30 seconds. If you change the **Hello Interval** value, do not forget to click the **Update** button.

The second section called **PIM SSM Group Settings** is where you can specify the **Source Group Address** or the multicast group address and the number of bits for subnet mask. You can click the **Add** button to add this address to the **PIM SSM Group** or click the **Delete** button to remove it. The third section called **PIM SSM VLAN Settings** is where you configure a VLAN interface for the PIM SSM. Here you first select a VLAN ID from the drop-down list and then set the Designated Router (**DR**) **Priority**, **Route Distance** and **Route Metric**. Clicking on the Update button once all the parameters are set.

PIM SSM Settings

Hello Interval

<30-18724>

Update

PIM SSM Group Settings

Source Group Address
 /

Add Delete

PIM SSM VLAN Settings

VLAN	<input type="text" value="Select vlan"/>
DR Priority	<input style="width: 50px;" type="text" value="1"/> <1-4294967294>
Route Distance	<input style="width: 50px;" type="text" value="101"/> <1-255>
Route Metric	<input style="width: 50px;" type="text" value="1024"/> <1-1024>

Update

SSM Settings

Delete

	VLAN	IP	DR Priority	Route Distance	Route metric	Hello Interval
<input type="checkbox"/>	<input style="width: 40px;" type="text" value="10"/>	<input style="width: 80px;" type="text" value="11.0.50.10"/>	<input style="width: 40px;" type="text" value="1"/>	<input style="width: 40px;" type="text" value="101"/>	<input style="width: 40px;" type="text" value="1024"/>	<input style="width: 40px;" type="text" value="30"/>

Update

Figure 2.118 PIM Source Specific Mode (SSM) Setting Web Page

The last section is the list of configured PIM SSM VLAN interfaces. Figure 2.118 shows an example of SSM VLAN interface inside the **SSM Settings** box. If you want to remove an SSM VLAN interface, checking the box in front of that VLAN ID entry and then clicking on the **Delete** button. Clicking on the **Update** button to refresh the list.

2.10.3.4.2 Restart

Figure 2.119 shows the **PIM SSM Restart** web page that allows you to restart the PIM Source Specific Mode process inside the EHG76XX Layer-3 Managed Switch by simply clicking on the **Restart** button.

PIM SSM Restart

Restart

Figure 2.119 PIM Source Specific Mode Restart Web Page

Once you restarted the PIM SSM process, you can then manually send an IGMP Join message out to subscribe a known SSM multicast group or send an IGMP Leave message to unsubscribe SSM multicast group. Figure 2.120 shows an example of **IGMP join/leave** web page in which a IGMP Join Message is prepared to be sent with Source Address = 10.0.60.70 and Group Address = 232.4.4.4 with VLAN ID = 1.

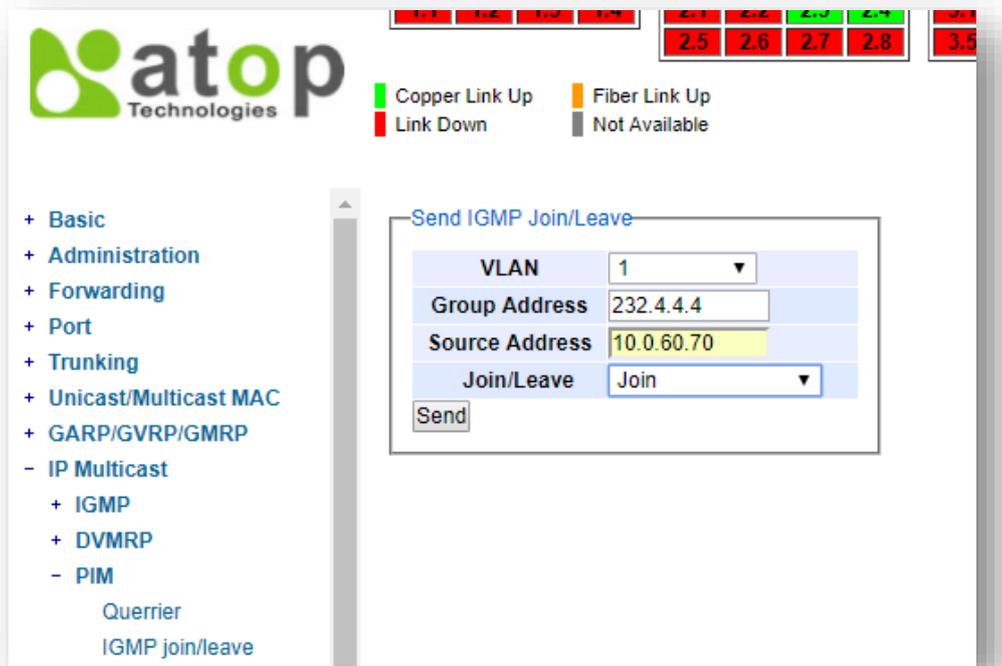


Figure 2.120 Example of Sending IGMP Join to an SSM Source Address

2.10.3.4.3 Statistics

Under SSM's **Statistics** web page as shown in Figure 2.121, you can check the current PIM SSM's **Neighbor Table** and **Multicast routing table** on the EH76XX Layer-3 Managed Switch. The **Neighbor Table** will list the **Neighbor's** IP address that can be discovered through each SSM **VLAN** Interface and its corresponding VLAN's IP **Address**. Inside the **Multicast routing table**, you can see the **number of SSM Groups** and the list of Groups which has three columns: **Group** address, **Source** address and the state of the multicast routing with notation "(*,*)". Note that (S,G) pronounced as "S comma G" which is a multicast routing table state for a source sending to a group. The incoming interface for this entry is the RPF interface to S.

The screenshot shows two tables. The first table, titled 'Neighbor Table', has three columns: VLAN, Address, and Neighbor. It contains one row with VLAN 1, Address 10.0.50.1, and Neighbor 10.0.50.2. The second table, titled 'Multicast routing table', has a header row 'Number of Groups: 1' and three columns: Group, Source, and (*,*). It contains two rows with Group 232.4.4.4, Source 10.0.60.70, and state (S,G).

VLAN	Address	Neighbor
1	10.0.50.1	10.0.50.2

Number of Groups: 1		
Group	Source	(*,*)
232.4.4.4	10.0.60.70	(S,G)
232.4.4.4	10.0.60.70	(S,G)

Figure 2.121 PIM Source Specific Mode (SSM) Statistics Web Page

Note that if the PIM SSM was not enabled and configured properly, when you click on the SSM's **Statistics** web page, you will be notified with the error message as shown in Figure 2.122.



Figure 2.122 Error Message on Statistics web page when PIM SSM was not enabled

2.10.3.5 Dense Mode

PIM Dense Mode (PIM DM) is a multicast routing protocol which is designed under the assumption that the receivers for any multicast group are distributed densely throughout the network. Its assumption is opposite to the PIM Sparse Mode. As a PIM protocol, PIM DM utilizes unicast routing tables built by other routing protocol. PIM DM control message processing and data packet forwarding is integrated with PIM SM operations such that a single router or Layer-3 switch can run different PIM modes for different multicast groups.

Multicast packet is initially sent to all hosts in the network. PIM DM relies on Reverse Path Multicasting (RPM) in which multicast packet is forwarded if the receiving interface is the one used to forward unicast packets to the source of the packet. If not, the packet is dropped. This mechanism prevents forwarding loops from occurring. The multicast packet is then forwarded out on all other interfaces. PIM Dense Mode uses explicit trigger grafts/prunes to manage its source-based acyclic tree. Routers that do not have any interested hosts then send PIM Prune messages to remove themselves from the tree. Note that grafts are messages sent towards known sources and used by new members to add themselves onto an existing distribution tree. Prunes are messages sent toward a source by a router when it wants to leave the distribution tree.

A node in PIM DM such as EH76XX will create a multicast forwarding entry for a particular source-rooted distribution tree when a data packet from that source to the group first arrives. PIM DM only uses source-based trees. As a result, it does not use Rendezvous Points (RPs), which makes it simpler than PIM SM to implement and

deploy. It is an efficient protocol when most receivers are interested in the multicast data but it does not scale well across larger domains in which most receivers are not interested in the data.

Figure 2.123 shows the menu and submenus for **PIM Dense Mode** which consists of **Setting**, **Restart** and **Statistics**.

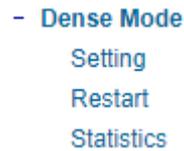


Figure 2.123 PIM Dense Mode Menus

To enable PIM Dense Mode on EHG76XX Layer-3 Managed Switch, you can click on the **Dense Mode** submenu under **PIM** as shown in Figure 2.124. Then inside the **Running Status** box, clicking on the **Enable** button. However, you will also need to set up VLAN Interface as described in Section 0 and perform PIM Dense Mode **Setting** such as PIM DM VLAN interfaces, route preference and route metric first as described in the next section (Section 2.10.3.5.1).



Figure 2.124 PIM Dense Mode's Running Status Web Page

If the IP routing was not enable, the PIM Dense Mode cannot be enabled as shown in Figure 2.125. To enable the IP routing, you can enable this function in Section 2.22.1. If you did not configure PIM Dense Mode VLANs, you will be notified with the error message as shown in Figure 2.126.

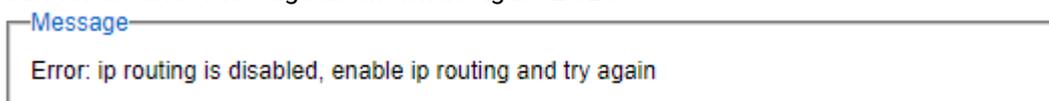


Figure 2.125 Error Message when IP Routing is Disabled

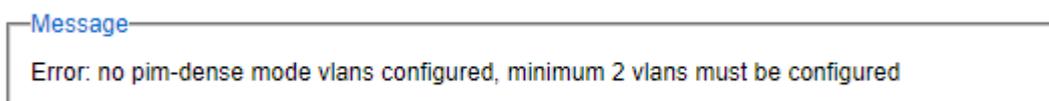


Figure 2.126 Error Message when It has insufficient configured VLANs

2.10.3.5.1 Setting

This **PIM DM Setting** web page as shown in Figure 2.127 is used to configure VLAN interface for PIM DM. This setting has to be done before enabling the PIM DM in the previous section. Inside the upper part (**PIM DM Settings** box), you first select **VLAN ID** from the drop-down list and enter the **Route Preference** and the **Route Metric**. Note that the **Route Preference** is used by assert elections to determine upstream routers. **Route Reference** can be configured with the value from 1 to 255 and the default value is 101. The **Route Metric** is the cost of the path through which the packet is to be sent. The Route Metric can be selected with the value from 1 to 1024 and the default value is 1024. After finished configuring an VLAN interface for PIM DM, you should click on the **Add VLAN** button. The configured interface will be listed in the lower part of the page. You can remove a VLAN interface for PIM DM from the list by checking the box in front of that VLAN entry and clicking on **Delete** button. To obtain the latest status of the PIM DM Settings, you can click on the **Update** button.

PIM DM Settings

VLAN	Select vlan ▼
Route Preference	101 <1-255>
Route Metric	1024 <1-1024>

Add VLAN

Delete				
	VLAN	IP	Preference	Metric
<input type="checkbox"/>	1	10.0.50.1	101	1024

Update

Figure 2.127 PIM Dense Mode Settings Web Page

2.10.3.5.2 Restart

Figure 2.128 shows the **PIM Dense Mode Restart** web page that allows you to restart the PIM Dense Mode process inside the EH76XX Layer-3 Managed Switch by simply clicking on the **Restart** button.

PIM Dense Mode Restart

Restart

Figure 2.128 PIM Dense Mode Restart Web Page

2.10.3.5.3 Statistics

Under Dense Mode's **Statistics** web page as shown in Figure 2.129, you can check the current PIM Dense Mode's **Neighbor Table** and **Multicast routing table** on the EH76XX Layer-3 Managed Switch. The **Neighbor Table** will list the **Neighbor's IP address** that can be discovered through each PIM DM **VLAN's IP Address**. Inside the **Multicast routing table**, you can see the **number of PIM Dense Mode Groups** and the list of Groups which has two columns: **Source address** and **Group address**.

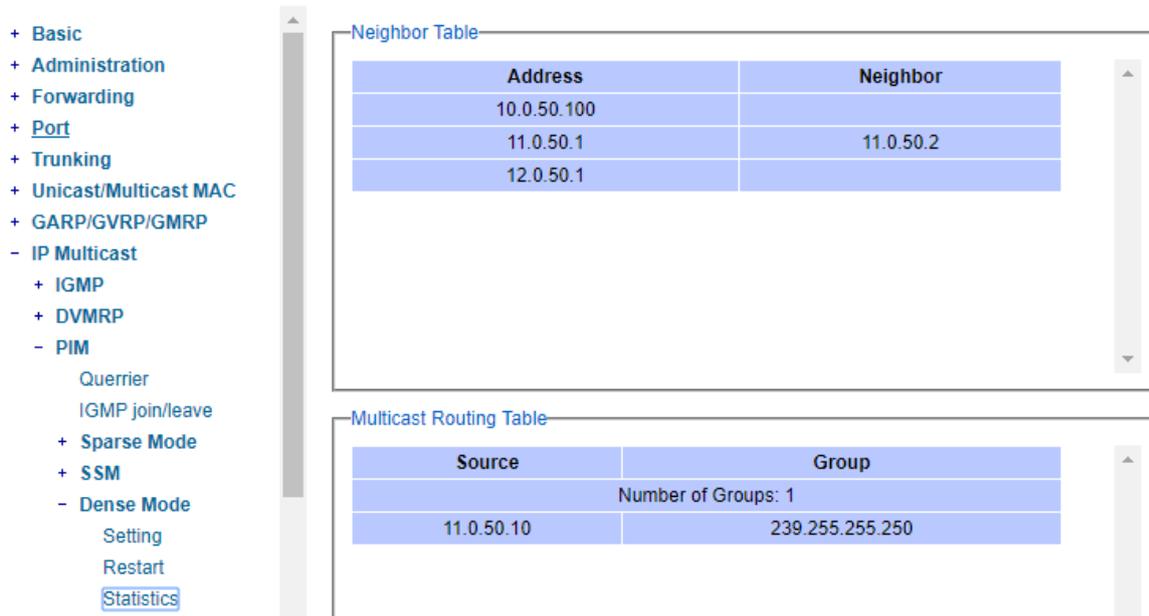


Figure 2.129 PIM Dense Mode Statistics Web Page

Note that if the PIM Dense Mode was not enabled and configured properly, when you clicked on the Dense Mode's **Statistics** web page, you will be notified with the error message as shown in Figure 2.130.



Figure 2.130 Error Message when PIM Dense Mode is not enabled.

2.10.4 Static IP Multicast

This subsection allows the users to manually add new or remove existing static IP multicast and the joined port(s). Figure 2.131 shows the Static IP Multicast webpage where the upper part of the page is a table of existing IP Multicast Address entries and the lower part of the page contains the fields for adding new IP Multicast Address entry to the table. The users are required to supply the IP Multicast Address, VLAN ID (**VID**), and the lists of the port numbers which will join the static IP multicasting group (joined port).

Static IP Multicast

IP Multicast Address	VID	Joined Port
Empty		
<input type="text"/>	<input type="text"/>	Port1 ^ Port2 Port3 Port4 Port5 Port6 v

Example of IP Multicast Address:
IP Multicast Address: 224.2.3.4

Figure 2.131 Static IP Multicast Setting Webpage

An example of an entry of IP multicast group is shown in Figure 2.132 where there is an existing IP Multicast Address of 224.2.3.4 which belongs to VLAN 1 and has port number 2, 3, and 6 in the group. The following procedures outline how to add a new IP multicast group. For example, an IP multicast group address is 224.1.1.1 and the joining ports are Port1, Port2 and Port5 with VLAN =1.

- First, the users should enter the IP = 224.1.1.1 in the **IP Multicast Address** column.
- Then, the users should enter the VLAN ID = 1 in the **VLAN ID (VID)** column.
- Then, while holding the “Ctrl” key on the keyboard, click on all corresponding port numbers under the Join Port column (Port1, Port2, and Port5 in this example) to select which port(s) will join in the IP multicast group.
- Finally, click on the button. The IP address is then added as it shows on Figure 2.132.
- To remove an existing static IP multicast address from the table, click the button of that entry.

These procedures are similar to the procedures for adding or removing the Unicast/Multicast MAC address explained in Section 2.8.1. The only difference is that the IP multicast address has the form of 224.XX.XX.XX. Note that IPv4 multicast address (Class D) is in between 224.0.0.0 and 239.255.255.255.

Static IP Multicast

IP Multicast Address	VID	Joined Port	
224.2.3.4	1	Port2, Port3, Port6	Remove

IP Multicast Address	VID	Joined Port	
<input type="text"/>	<input type="text"/>	<input type="text"/>	

Add

Example of IP Multicast Address:
IP Multicast Address: 224.2.3.4

Figure 2.132 Example of Static IP Multicast Setting

2.11 SNMP

Simple Network Management Protocol (SNMP) is a protocol for managing devices on IP networks. It exposes management data in the form of variables on the managed systems which describe the system configuration. These variables can then be queried or defined by the users. The SNMP is used by network management system or third-party software to monitor devices such as managed switches in a network to retrieve network status information and to configure network parameters. The Atop's managed switch support SNMP and can be configured in this section. The SNMP setting has four categories and its dropdown menu is shown in Figure 2.133, which are:

- SNMP Agent
- SNMP V1/V2c Community Setting
- Trap Setting
- SNMP V3 Authentication (Auth.) Setting

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- SNMP
 - Setting
- + Spanning Tree
- + VLAN
- + Security
- + ERPS/Ring
- + LLDP
- + PROFINET
- + EtherNet/IP
- + Client IP Setting
- + System

SNMP Agent

SNMP Enabled

Update

SNMP V1/V2c Community setting

String	Permission Type	
public	read-all-only	Remove
private	read-write-all	Remove

String	Permission Type	
<input style="width: 95%;" type="text"/>	<input style="width: 95%;" type="text" value="read-all-only"/>	Add

Figure 2.133 SNMP Dropdown Menu

2.11.1 SNMP Agent

To enable SNMP agent on the managed switch, please check the **Enabled** box and click **Update** button as shown in Figure 2.134. The SNMP version 1 (V1), version 2c (V2c) and version 3 are supported by Atop’s managed switches as summarized in Table 2.32. Basically, SNMP V1 and SNMP V2c have simple community string-based authentication protocol for their security mechanism, while SNMP V3 is improved with cryptographic security.

SNMP Agent

SNMP Enabled

Update

Figure 2.134 SNMP Enabling Box

Table 2.32 Description of SNMP Setting

Label	Description	Factory Default
SNMP	Check the box to enable SNMP V1/V2c/V3.	Disabled

2.11.2 SNMP V1/V2c Community Setting

The managed switch supports SNMP V1, V2c, and V3. SNMP V1 and SNMP V2c use a community string matching for authentication. This authentication will allow network management software to access the information or data objects defined by Management Information Bases (MIBs) on the managed switch. Note that this simple authentication is considered a weak security mechanism. It is recommended to use SNMP V3, if possible. There are two levels of authentications or permission type in EHG7XXX series, which are read-all-only or read-write-all. For example, in our default setting as shown in Figure 2.135, an SNMP agent, which is a network management software module residing on the managed switch, can access all objects with read-all-only permissions using the string *public*. Another setting example is that the string *private* has permission of read-write-all.

This community string option allows the users to set a community string for authentication or remove existing community string from the list by clicking on the **Remove** button at the end of each community string item. The users can specify the string names on the **String** field and the type of permissions from the dropdown list as shown in Figure 2.135.

Table 2.33 briefly provides descriptions of SNMP's community string setting.



Figure 2.135 SNMP Community Strings

Table 2.33 Descriptions of Community String Settings

Label	Description	Factory Default
(Community) Strings	Define name of strings for authentication. Max. 15 Characters	Public (read-all-only) Private (read-write-all)
Permission Type	Choose a type from the dropdown list: read-all-only and read-write-all. See notes below for a briefed explanation.	-

***NOTE:**

Read-all-only: permission to read OID 1 Sub Tree.

Read-write-all: permission to read/write OID 1 Sub Tree.

2.11.3 Trap Setting

The managed switch provides a trap function that allows switch to send notification to agents with SNMP traps or inform. The notifications are based on the status changes of the switch such as link up, link down, warm start, and could start. For inform mode, after sending SNMP inform requests, switch will resends inform request if it does not

receive response within 10 seconds. The switch will try re-send three times. This option allows users to configure SNMP Trap Setting by setting the destination IP Address of the Trap server, Port Number of the Trap server, and Community String for authentication. Figure 2.136 shows these Trap Setting's options. The first line enables the users to select the Trap Mode which can be either **Trap** or **Inform**. Please click on the **Update** button after selecting the desired Trap Mode. After entering all required fields for Trap Setting in the last line, please click on the **Add** button. Table 2.34 summarizes the descriptions of trap receiver settings.

Figure 2.136 Example of Trap Receiver Setting

Table 2.34 Descriptions of Trap Receiver Settings

Label	Description	Factory Default
Trap Mode	Choose between Trap and Inform	Trap
Trap server IP address	Enter the IP address of your Trap Server.	NULL
Port	Enter the trap Server service port.	162
Community String	Enter the community string for authentication. Max. 15 characters.	NULL

2.11.4 SNMPv3 Auth. Setting

As mentioned earlier, SNMP V3 is a more secure SNMP protocol. In this part, the users will be able to set a password and an encryption key to enhance the data security. When choosing this option, the users can configure SNMP V3's authentication and encryption. MD5 (Message-Digest algorithm 5) is used for authentication password and DES (Data Encryption Standard) is used for data encryption algorithm. Figure 2.137 shows the SNMP V3 Authentication Setting's options. The users can view existing SNMP V3 users' setting on the upper table where it provides information about user name, authentication type, and data encryption. The users have an option to remove existing SNMP V3 user by clicking on the **Remove** button in the last column of each entry. To add a new SNMP V3 user, the users have to select the user **Name** from the dropdown list which can be either **Admin** or **User**. Then, the authentication password with a maximum length of 31 characters has to be entered in the **Auth. Password** field and re-entered again in the **Confirmed Password** field. Note that if no password is provided, there will be no authentication for SNMP V3. Finally, the encryption key with a maximum length of 31 characters can be entered in the **Encryption Key** and re-entered again in **Confirmed Key** field. After filling all the required fields, please click on **Add** button to update the information on the managed switch. Table 2.35 lists the descriptions of SNMP V3 settings.

SNMP V3 Auth. Setting

Name	Authentication	Data Encryption	
admin	MD5	DES	Remove

Name	Auth. Password	Confirmed Password	Encryption Key	Confirmed Key
admin ▾	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Add

Figure 2.137 SNMPv3 Users' Options

Table 2.35 Descriptions of SNMP V3 Settings

Label	Description	Factory Default
Name	Choose from one of the following options: Admin: Administration level. User: Normal user level.	Admin
Auth. (Authentication) Password	Set an authentication password for the user name specified above. If the field is left blank, there will be no authentication. Note that the authentication password is based on MD5. Max. 31 characters.	NULL
Confirmed Password	Re-type the Authentication Password to confirm.	NULL
Encryption Key	Set encryption key for more secure protection of SNMP communication. Note that the encryption algorithm is based on DES. Max. 31 characters.	NULL
Confirmed Key	Re-type the Encryption Key	NULL

2.12 Spanning Tree

IEEE 802.1D Standard spanning tree functionality is supported by Atop's managed switches. The **Spanning Tree Protocol (STP)** provides a function to prevent switching loops and broadcast radiation at the OSI layer 2. A switching loop occurs in a network when there are multiple connections or redundant paths between two network switches or at least two ports are connected on both sides of the two network switches. The switching loop can create a broadcast radiation, which is the accumulation of broadcast and multicast traffics in a computer network. As broadcast and multicast messages are forwarded by bridges/switches to every port, the bridges/switches will repeatedly rebroadcast the broadcast messages, and this accumulation of traffic can flood the network. STP creates a spanning tree topology and disables those links of the network that are not part of the spanning tree, which leaves only a single active path between two nodes. This function can avoid flooding and increase network efficiency. Therefore, Atop's managed switches deploy spanning tree as a tool when the users set up connection or port redundancy or fault-tolerance in their network.

RSTP (Rapid Spanning Tree Protocol), IEEE 802.1W, is also supported in Atop's managed switches. It is an evolution of the STP, but it is still backwards compatible with standard STP. RSTP has the advantage over the STP. When there is a topology change such as link failure in the network, the RSTP will converge significantly faster to a new spanning tree topology. RSTP improves convergence on point-to-point links by reducing the Max-Age time to 3 times Hello interval, removing the STP listening state, and exchanging a handshake between two switches to quickly transition the port to forwarding state.

MSTP (Multiple Spanning Tree Protocol) is also a standard defined by the IEEE 802.1s that allows multiple VLANs to be mapped to a single spanning tree instance called MST Instance, which will provide multiple pathways across the network. It is compatible with STP and RSTP. To support lager network, MSTP groups bridges/switches into regions that appear as a single bridge to other devices. Within each region, there can be multiple MST instances. MSTP shares common parameters as RSTP such as port path costs. MSTP also help prevent switching loop and has rapid convergence when there is a topology change. It is possible to have different forwarding paths for different MST instances. This enables load balancing of network traffic across redundant links.

This section describes how to setup the spanning tree protocol (STP), rapid spanning tree protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Figure 2.138 depicts the dropdown menu for Spanning Tree.

The screenshot shows a web interface for configuring Spanning Tree. On the left is a navigation menu with the following items: + Basic, + Administration, + QoS, + Port, + Power Over Ethernet, + Trunking, + Unicast/Multicast MAC, + GARP/GVRP/GMRP, + IGMP/IP Multicast, + SNMP, - Spanning Tree (expanded), + VLAN, + Security, + ERPS/Ring, + LLDP, + PROFINET, + EtherNet/IP, + Client IP Setting, and + System. Under the expanded Spanning Tree menu, the following sub-items are visible: Setting, Bridge Info, Port Setting, and MSTP Instance. The main content area is divided into three sections:

- Mode Setting:** A dropdown menu labeled 'Mode' is set to 'STP'. Below it is an 'Update' button.
- Main Setting:** Contains a red warning note: "NOTE: Enable spanning-tree function maybe cause the Web disconnect more than 'Forward Delay Time x 2' seconds." Below the note are four settings:

Enabled	<input type="checkbox"/>
Priority (0~61440)	32768
Maximum Age (6~40)	20
Hello Time (in second, 1~10)	2
Forward Delay(in second, 4~30)	15

 An 'Update' button is located below the table.
- Per-port Setting:** A table showing port enablement:

Port	Port Enable
All	<input type="checkbox"/>
Port1	<input checked="" type="checkbox"/>

Figure 2.138 Spanning Tree Dropdown Menu

2.12.1 Spanning Tree Setting

The users can select the spanning tree mode which are based on different spanning tree protocols in this webpage. Figure 2.139 shows the mode setting for spanning tree. There are three spanning tree modes to choose from the dropdown menu, which are spanning tree protocol (STP), rapid spanning tree protocol (RSTP), and multiple spanning tree protocol (MSTP). After choosing the desired mode, please click **Update** button to allow the change to take effect.

The screenshot shows a web interface titled "Mode Setting". It contains a dropdown menu labeled "Mode" with "STP" selected. Below the dropdown is an "Update" button.

Figure 2.139 Spanning Tree Mode Setting

Under the mode setting, there is a box for Main Setting of spanning tree's parameters as showed in Figure 2.140. The users can enable or disable spanning tree protocol in the **Main Setting** by checking the box behind the **Enabled** option. The users can fine tune the **Priority**, **Maximum Age**, **Hello Time**, and **Forward Delay**. After configuring the spanning tree's main parameters, please click **Update** button to allow the change to take effect. The description of each parameter is listed in Table 2.36.

The screenshot shows a web interface titled "Main Setting". It contains a red note: "NOTE: Enable spanning-tree function maybe cause the Web disconnect more than 'Forward Delay Time x 2' seconds." Below the note is a table with five rows: Enabled (checkbox), Priority (0~61440) (32768), Maximum Age (6~40) (20), Hello Time (in second, 1~10) (2), and Forward Delay (in second, 4~30) (15). An "Update" button is at the bottom.

Enabled	<input type="checkbox"/>
Priority (0~61440)	32768
Maximum Age (6~40)	20
Hello Time (in second, 1~10)	2
Forward Delay(in second, 4~30)	15

Figure 2.140 Spanning Tree Main Setting for STP and RSTP

When the users change the spanning tree mode setting to **MSTP** and click the **Update** button in the **Mode Setting** box Figure 2.139, the **Main Setting** box in Figure 2.140 will be changed to Figure 2.141. The user can notice that the **Priority** field is disappeared while there are three more fields show up which are **Max Hops**, **Revision Level**, and

Region Name. Additionally, there will be a note add to the Per-port Setting box that currently MSTP mode does not support trunk port now.

Main Setting

NOTE: Enable spanning-tree function maybe cause the Web disconnect more than "Forward Delay Time x 2" seconds.

Enabled	<input type="checkbox"/>
Maximum Age (6~40)	20
Hello Time (in second, 1~10)	2
Forward Delay(in second, 4~30)	15
Max Hops (1~255)	120
Revision Level (0~65535)	0
Region Name	Region1

Update

Figure 2.141 Spanning Tree Main Setting for MSTP

Table 2.36 Descriptions of Spanning Tree Parameters

Label	Description	Default Factory
Enabled	Check the box to enable spanning tree functionality.	Disable
Priority	Enter a number to set the device priority. The value is in between 0 and 61440. The lower number gives higher priority.	32768
Maximum Age	Maximum expected arrival time for a hello message. It should be longer than Hello Time.	20
Hello Time	Hello time interval is given in seconds. The value is in between 1 to 10.	2
Forward Delay	Specify the time spent in the listening and learning states in seconds. The value is in between 4 to 30.	15
Max Hops (Only for MSTP)	The value is between 1 to 255.	120
Revision Level (Only for MSTP)	The value is between 0 to 65535.	0
Region Name (Only for MSTP)	Text string indicate the region name	Region1

The bottom part of the Spanning Tree Setting is the Per-port setting as shown in Figure 2.142. The users can enable spanning tree functionality individually on each port or on all port by checking on the box under the **Port Enable** column. The default setting is checking on all port. After making any change on the per-port setting, please click on the **Update** button to update the change on the managed switch.

Per-port Setting

Port	Port Enable
All	<input type="checkbox"/>
Port1	<input checked="" type="checkbox"/>
Port2	<input checked="" type="checkbox"/>
Port3	<input checked="" type="checkbox"/>
Port4	<input checked="" type="checkbox"/>
Port5	<input checked="" type="checkbox"/>
Port6	<input checked="" type="checkbox"/>
Port7	<input checked="" type="checkbox"/>
Port8	<input checked="" type="checkbox"/>

Update

Figure 2.142 Spanning Tree Per-port Setting for STP and RSTP

2.12.2 Bridge Info

Bridge Info (information) provides the statistical value of spanning tree protocol as shown in Figure 2.143. The information is further divided into two parts: Root Information and Topology Information. To check the latest information, please click on the **Refresh** button.

Table 2.37 and Table 2.38 summarize the descriptions of each entry in the root information table and topology information table, respectively.

Bridge Information

Root Information	
I am the Root	-
Root MAC Address	-
Root Priority	0
Root Path Cost	0
Root Maximum Age	0
Root Hello Time	0
Root Forward Delay	0

Topology Information	
Root Port	-
Num. of Topology Change	0
Last TC time ago	-

Refresh

Figure 2.143 Bridge Information Webpage

Table 2.37 Bridge Root Information

Label	Description	Factory Default
I am the Root	Indicator that this switch is elected as the root switch of the spanning tree topology	-
Root MAC Address	MAC address of the root of the spanning tree	-
Root Priority	Root's priority value: the switch with highest priority has the lowest priority value and it will be elected as the root of the spanning tree.	0
Root Path Cost	Root's path cost is calculated from the data rate of the switch's port.	0
Root Maximum Age	Root's maximum age is the maximum amount of time that the switch will maintain protocol information received on a link.	0
Root Hello Time	Root's hello time which is the time interval for RSTP to send out a hello message to the neighboring nodes to detect any change in the topology.	0
Root Forward Delay	Root's forward delay is the duration that the switch will be in learning and listening states before a link begins forwarding.	0

Table 2.38 Bridge Topology Information

Label	Description	Factory Default
Root Port	A forwarding port that is the best port from non-root bridge/switch to root bridge/switch. Note that for a root switch there is no root port.	-
Num. of Topology Change	The total number of spanning topology change over time.	0
Last TC time ago	The duration of time since last spanning topology change.	-

2.12.3 Port Setting

Spanning Tree Port Setting shows the configured value of spanning tree protocol for each port, as shown in Figure 2.144. The configured information for each port is state, role, path cost, path priority, link type, edge, cost, and designated information. To check the latest update on the statistics, please click on the **Refresh** button. Table 2.39 summarizes the descriptions of spanning three port setting. If Spanning Tree is enabled, the table below becomes editable. Use the **Update** button to save the settings.

Spanning Tree Port Setting

Port	State	Role	Path Cost		Pri	Link Type Config	P2P?	Edge		Designated				
			Config	Actual				Cost	P. Pri	Port	B. Pri	Bridge MAC		
Port1	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port2	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port3	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port4	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port5	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port6	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port7	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
Port8	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
PortG1	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
PortG2	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
PortG3	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-
PortG4	N/A	Non-STP	65535	0	0	Auto	No	<input type="checkbox"/>	No	0	0	-	0	-

Update Refresh

Figure 2.144 Spanning Tree Port Setting Webpage

Table 2.39 Descriptions of Spanning Tree Port Setting

Label	Description	Factory Default	
Port	The name of the switch port	-	
State	State of the port: 'Disc': Discarding - No user data is sent over the port. 'Lrn': Learning - The port is not forwarding frames yet, but it is populating its MAC Address Table. 'Fwd': Forwarding - The port is fully operational.	N/A	
Role	Non-STP or STP RSTP bridge port roles: 'Root' - A forwarding port that is the best port from non-root bridge to root bridge. 'Designated' - A forwarding port for every LAN segment. 'Alternate' - An alternate path to the root bridge. This path is different from using the root port. 'Backup' - A backup/redundant path to a segment whose another bridge port already connects. 'Disabled' - Note strictly part of STP, a network administrator can manually disable a port.	Non-STP	
Path Cost	Setting the path cost for each switch port		
	Config	Setting path cost (default: 0, meaning that using the system default value (depending on link speed))	0
	Actual	The actual value path cost (For STP and RSTP, please see Note 1 below and Table 2.40.)	0
Pri	Setting the port priority, used in the Port ID field of BPDU packet, value = 16 × N, (N:0~15) See Note 2 below.	128	
Link Type	The connection between two or more switches (for RSTP)		
	Config	Setting of the Link Type P2P: A port that operates in full-duplex mode is assumed to be point-to-point link. Non-P2P: A half-duplex port (through a hub) Auto: Detect link type automatically	Auto

	P2P?	Yes: This port is a Point-to-Point (P2P). No: This port is not Point-to-Point (Non-P2P).	No
Edge		Edge port is a port which no other STP/RSTP switch connect to (for RSTP). An edge port can be set to forwarding state directly.	
	Config	Edge functional is set: Yes or No	No
	Edge?	Yes: This port is an edge port. No: This port is not an edge port.	No
Designated		This shows some information of the best BPDU packet through this port.	
	Cost	Root path cost	0
	P. Pri. (Port Priority)	Port priority (high 4 bits of the Port ID), Value = 16 × N, (N: 0~15)	128
	Port	Interface number (lower 12 bits of the Port ID)	-
	Bri. Pri. (Bridge Priority)	Bridge priority, (value = 4096 × N, (N: 0~15)	32768
	Bridge MAC	The MAC address of the switch which sent this BPDU	-

Note:

1. In general, the path cost is dependent on the link speed. Table 2.40 lists the default values of path cost for STP and RSTP.

Table 2.40 Default Path Cost for STP and RSTP

Data Rate	STP Cost (802.1D -1998)	RSTP Cost (802.1W-2004)
4 Mbits/s	250	5,000,000
10 Mbits/s	100	2,000,000
16 Mbits/s	62	1,250,000
100 Mbits/s	19	200,000
1 Gbits/s	4	20,000
2 Gbits/s	3	10,000
10 Gbits/s	2	2,000

2. The sequence of events to determine the best received BPDU (which is the best path to the root).

- Lowest root bridge ID determines the root bridge.
- Lowest cost to the root bridge favors the upstream switch with the least cost to root.
- Lowest sender bridge ID serves as a tie breaker if multiple upstream switches have equal cost to root.
- Lowest sender port ID serves as a tie breaker if a switch has multiple (non-Ether channel) links to a single upstream switch.

Bridge ID = priority (4 bits) + locally assigned system ID extension (12 bits) + ID [MAC Address] 48 bits

The default bridge priority is 32768.

Port ID = priority (4 bits) + ID (Interface number)(12 bits)

The default port priority is 128.

2.12.4 MSTP Instance

MSTP enables the grouping and mapping of VLANs to different spanning tree instances. Therefore, an MST Instance (MSTI) is a particular set of VLANs that are all using the same spanning tree. Note that MSTI is identified by MSTI number and locally significant within MST region. Figure 2.145 illustrates the MSTP Instance webpage. In this section, the uses can add or remove MSTP instance. The upper part of the webpage is a table of existing MSTP

instance in the managed switch. The users can add a new MSTP instance by choosing an Instance ID from the dropdown list, enter the VLAN Identification number in the VID field, and set the desired priority in the Priority field. After filling all information, please click the **Add/Modify** button to update the MSTP instance. The procedure for setting up an MSTP instance is as follows:

- Enable MSTP protocol in Section 2.12.1
- Modify spanning tree main setting as described in Section 2.12.1
- Select ports that you want to enable MSTP function in Section 2.12.1.
- Add a Multiple Spanning Tree Instance (MSTI) in MSTP Instance webpage (this section).
 - Choose an Instance Identification
 - Add VLAN Identification numbers (VIDs) that will be member(s) of MSTP instance.
 - Set Priority value of the switch.
 - Click **Add/Modify** button.

Table 2.41 summarizes the descriptions of MSTP Information.

The screenshot shows the 'Multiple Spanning Tree Information' section of a web interface. On the left is a navigation menu with categories like Basic, Administration, QoS, Port, Power Over Ethernet, Trunking, Unicast/Multicast MAC, GARP/GVRP/GMRP, IGMP/IP Multicast, SNMP, Spanning Tree (with sub-items: Setting, Bridge Info, Port Setting, MSTP Instance), VLAN, Security, ERPS/Ring, LLDP, PROFINET, EtherNet/IP, Client IP Setting, and System. The main content area displays a table of MSTP information and a configuration form.

Instance	VID	Priority	Root Priority	Root MAC	Internal Root Path Cost	Root Port	Topology Change
CIST	1-4094	32768	32768	00:60:E9:17:3B:66	0	-	No

Instance ID	VID (1~4094)	Priority (0~61440)
CIST	<input type="text"/>	32768

Figure 2.145 MSTP Instance Webpage

Table 2.41 Description of MSTP Information

Label	Description	Factory Default
Instance ID	Choose from dropdown list of CIST (Common and Internal Spanning Tree) or choose value from 1 to 63	CIST
VID	Enter a value for VLAN ID between 1 to 4094	-
Priority	Enter a value for priority value for the managed switch between 0 - 61440. The lower value means the higher priority. If the priority value is 0, the switch will be the Root Bridge in this MSTI.	32768
Root Priority	Display root priority value	32768
Root MAC	Display MAC address of the Root Bridge	-

Internal Root Path Cost	Display internal root path cost	0
Root Port	Display root port	-
Topology Change	Display Yes or No	No

2.13 BGP

A **Border Gateway Protocol (BGP)** is a standardized exterior gateway protocol designed to exchange routing and reachability information among autonomous system (AS) on the Internet. It is an interdomain routing protocol that is designed to provide loop-free routing between organizations. There are totally four submenus under this menu including BGP Setting, BGP Neighbor Setting, BGP Proto Setting, and BGP IP Setting, as shown in Figure 2.146. Details of each submenu will be described in the following subsections.

- BGP
 - + **BGP Setting**
 - + BGP Neighbor Setting
 - + BGP Proto Setting
 - + BGP IP Setting

Figure 2.146 BGP Dropdown Menu

2.13.1 BGP Setting

The first menu under the **BGP** section is the **BGP Setting**. Within it, there are two submenus as shown in Figure 2.147. The submenus are Setting and Restart.

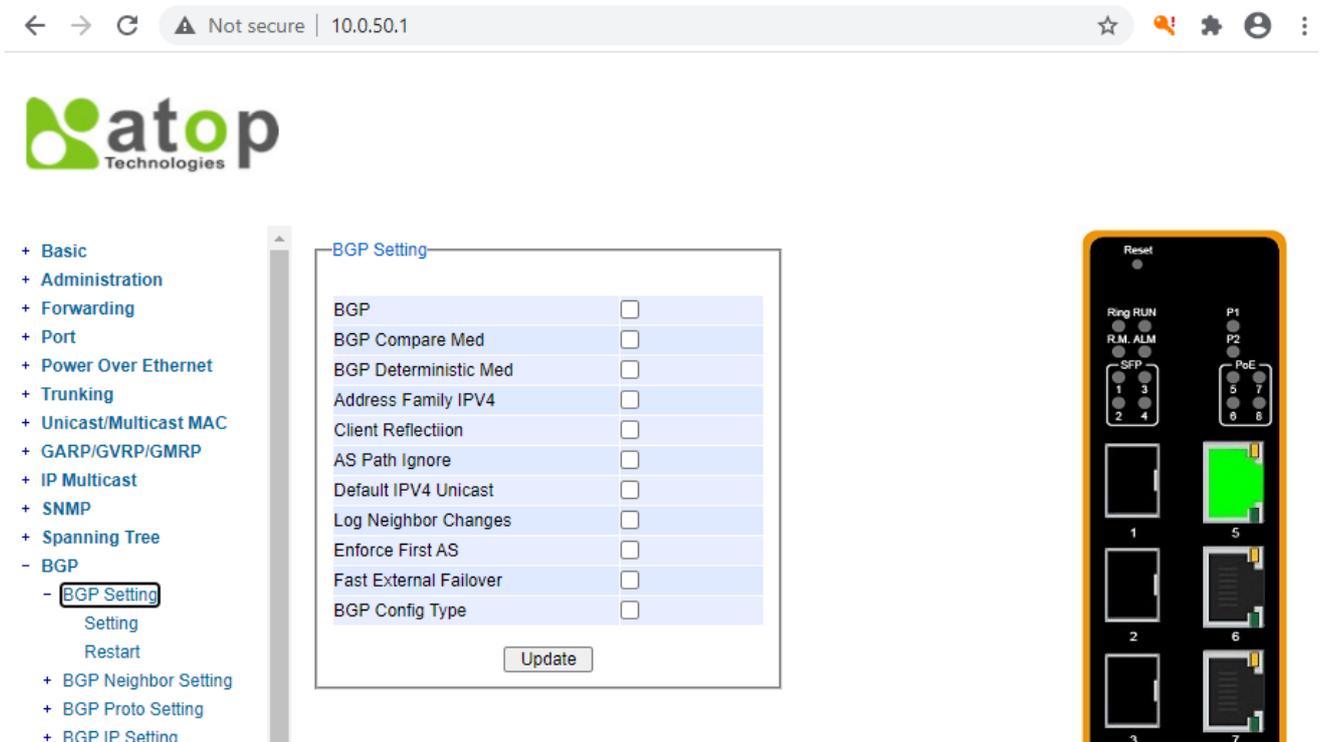


Figure 2.147 BGP Setting Submenu

2.13.1.1 Setting

In the first sub-menu of **BGP Setting** is **Setting** as shown in Figure 2.148. Here, user can click to select or de-select a check-box to enable or disable any of the following BGP features: BGP, BGP Compare Med, BGP Deterministic Med, Address Family IPV4, Client Reflection, AS Path Ignore, Default IPv4 Unicast, Log Neighbor Changes, Enforce

First AS, Fast External Failover, and BGP Config Type. After making any change, click on the **Update** button to take effect.

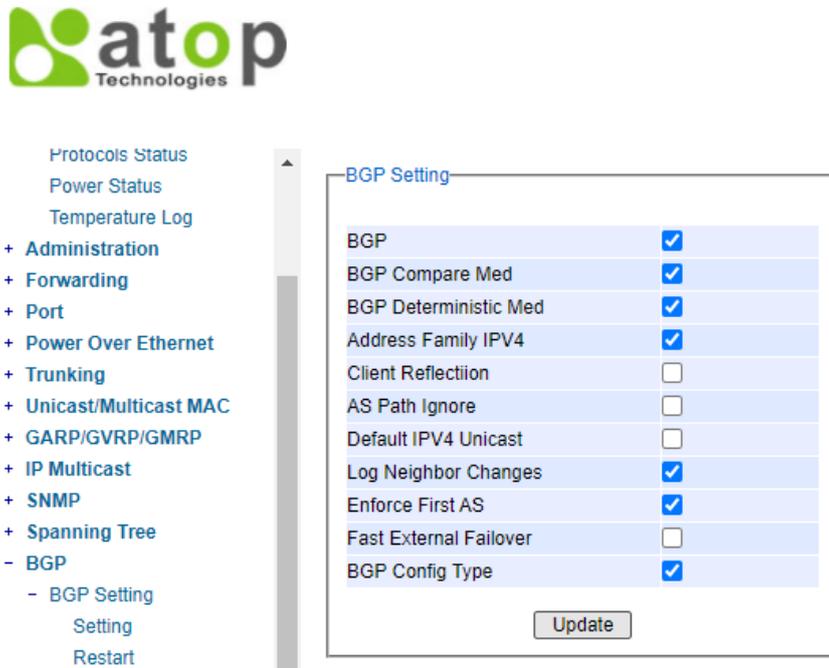


Figure 2.148 Setting inside the BGP-> BGP Setting Submenu

Table 2.42 Description of each Feature inside the BGP-> BGP Setting Submenu

Field	Description
Compare MED	When enabled this option, the switch will make sure that BGP compares the Multi-Exit Discriminator (MED) for paths from neighbors in different autonomous systems (ASs). MED is an external attribute of a route that indicates preferred path into an AS.
Deterministic MED	When enabled this option, the switch will make sure that BGP compares the Multi-Exit Discriminator (MED) variable when choosing among routes advertised by different peers in the same autonomous system (AS).
Address Family IPv4	This option allows the exchanging of IPv4 address family in BGP.
Client Reflection	This option allows configuring the routers as route reflectors. Route reflectors reduce the number of connections required in an AS. A single router (or two for redundancy) can be made a route reflector. Other routers in the AS need only to be configured as peers to them. A route reflector offers an alternative to the logical full-mesh requirement of internal border gateway protocol (IBGP). That is the route reflectors are used when all iBGP speakers are not fully meshed.
AS Path Ignore	This option allows a configuration that prevents a router from considering AS-path as a factor in the algorithm for choosing a route.
Default IPv4 Unicast	If this option is enabled, IPv4-unicast is activated for a peer and BGP exchanges IPv4 prefixes between the XHG76XX device and that peer. If this option is disabled, the BGP routing process will no longer exchange IPv4 addressing information with BGP neighbor routers. Note that disabling the exchange of IPv4 prefixes will also enable an IPv6 only BGP4+ network.
Log Neighbor Changes	If this option is enabled, changing status message will be logged without turning on debug bgp commands.
Enforce First AS	If this option is enabled, eBGP (External Border Gateway Protocol) updates in which the neighbor's AS number is not the first AS in the AS-path attribute will be denied.
Fast-External Failover	If this option is enabled, the BGP session is reset immediately when the interface used for BGP connection goes down.

BGP Config Type	If this option is enabled, the BGP Configuration Type can be configured.
------------------------	--

2.13.1.1 Restart

The second sub-menu of **BGP Setting** is **Restart** as shown in Figure 2.149. Here, user can click Restart button to restart BGP service.

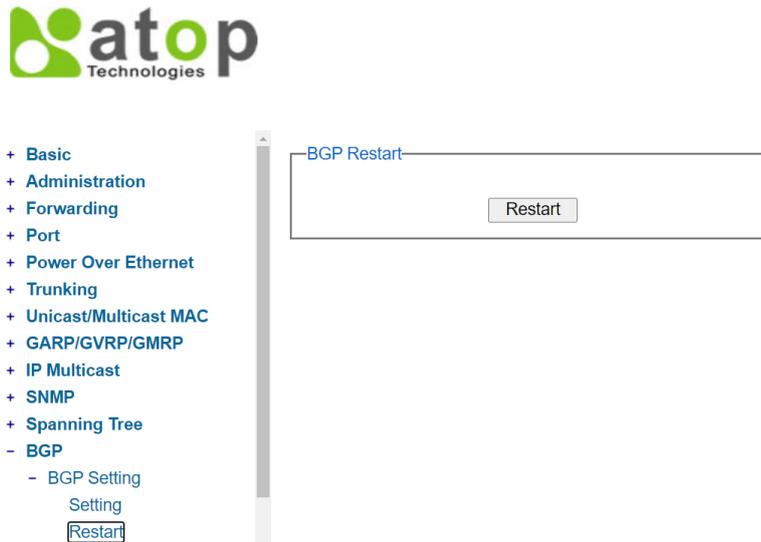


Figure 2.149 BGP Restart inside BGP->BGP Setting Submenu

Before clicking **BGP Restart** button, user should enable the IP Routing first. Otherwise, the error message will appear as shown below in Figure 2.150. To enable **IP Routing**, select **Enabled** and click **update** button within the **IP routing** menu to take the effect.



Figure 2.150 Error Message of BGP Restart

2.13.2 BGP Neighbor Setting

The second menu under the **BGP** section is the **BGP Neighbor Setting** as shown in Figure 2.151. Under this menu, there are fourteen submenus: Remote AS, Local AS, Description, Route map, Prefix list, Advertisement Interval, Timers, Allow AS IN, Password, Peer Group, Shutdown, Activate, Route Reflector client, and Remove Private AS.

- BGP
 - BGP Setting
 - Setting
 - Restart
 - **BGP Neighbor Setting**
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Figure 2.151 BGP Neighbor Setting Menu

2.13.2.1 Remote AS

The first sub-menu of **BGP Neighbor Setting** is **Remote AS**, as shown in Figure 2.152. The user can configure an internal or external BGP (iBGP or eBGP) peering relationship with another router. The user needs to fill in the information in two fields: Neighbor ID and Remote AS. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. Remote AS <1-4294967295> field is the the Neighbor's Autonomous System (AS) number. After entering new information, click the **ADD/Modify** button to change the setting.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - **BGP Neighbor Setting**
 - Remote AS**
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS

Neighbor Remote AS

Neighbor ID	Remote AS
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
Remote AS <1-4294967295>	<input type="text" value="0"/>

Figure 2.152 Remote AS Submenu inside the BGP Neighbor Setting

2.13.2.2 Local AS

The second sub-menu of **BGP Neighbor Setting** is **Local AS**, as shown in Figure 2.153. The user can configure a local AS number for the specified BGP or BGP4+ neighbor. The user needs to fill in the information in two fields: Neighbor ID and Local AS. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. *Local AS* field is the Neighbor's Autonomous System (AS) number which can be set from 1 to 4294967295. After the new information is entered, click the **ADD/Modify** button to change the setting.

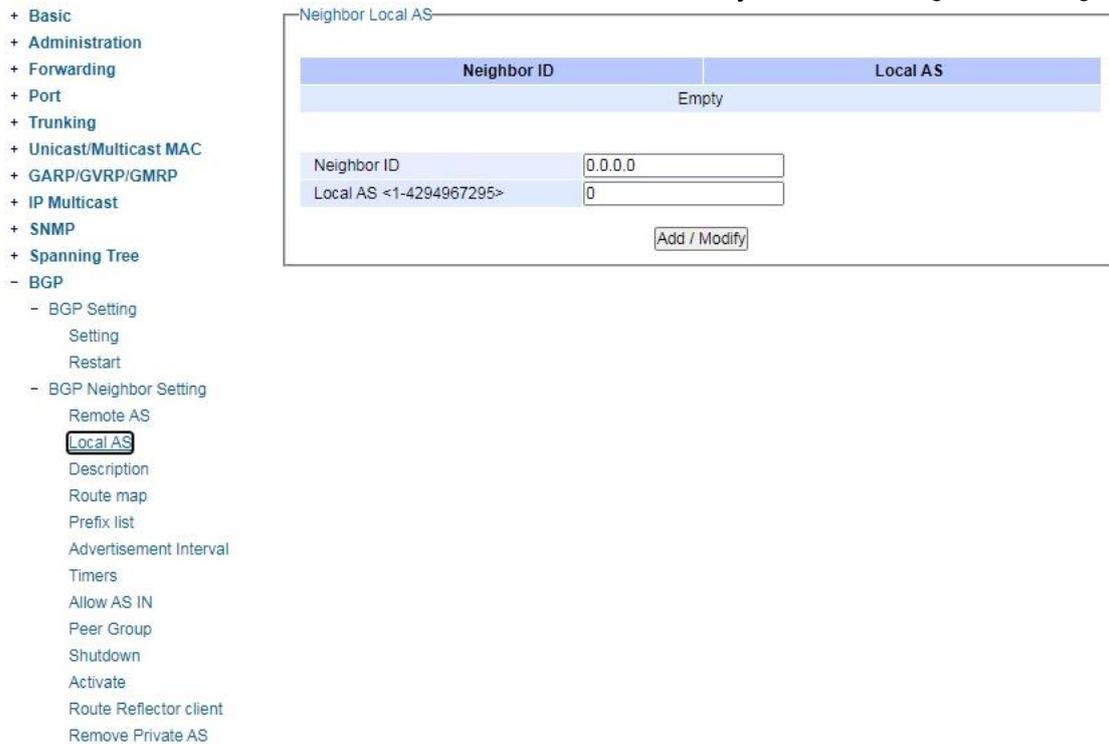


Figure 2.153 Local AS Submenu inside the BGP Neighbor Setting

2.13.2.3 Description

The third sub-menu of **BGP Neighbor Setting** is **Description**, as shown in Figure 2.154. By using this option, the device can associate a description with a BGP or a BGP4+ neighbor. Adding description to each neighbor is recommended for defining it. The user needs to fill in two fields: *Neighbor ID* and *Description*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. In the *Description* field, the user can input up to 80 characters to describe a neighbor. After new information is keyed in, click the **ADD/Modify** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description**
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS

Neighbor Description

Neighbor ID	Description
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
Description (WORD)	<input type="text"/>
<input type="button" value="Add / Modify"/>	

Figure 2.154 Description Submenu inside the BGP Neighbor Setting

2.13.2.4 Route Map

The fourth sub-menu of **BGP Neighbor Setting** is **Route Map**, as shown in Figure 2.155. The user can use this option to apply a route map to incoming/outgoing routes for BGP/BGP4+. The user needs to fill in two fields: *Neighbor ID* and *Mapname* and to select one dropdown input field called *Type*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. In the *Mapname* field, name of the route-map can be specified. For selectable *Type* field, "in" specifies that the access list will be applied to any incoming advertisements, and "out" specifies that the access list will be applied to any outgoing advertisements. After new information is keyed in or selected, click the **ADD/Modify** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Route Map

Neighbor ID	Name	Type
Empty		
Neighbor ID	<input type="text" value="0.0.0.0"/>	
Name	<input type="text"/>	
Type	<input type="button" value="In"/> <input type="button" value="Out"/>	
<input type="button" value="Add / Modify"/>		

Figure 2.155 Route Map Submenu inside the BGP Neighbor Setting

2.13.2.5 Prefix List

The fifth sub-menu of **BGP Neighbor Setting** is **Prefix List**, as shown in Figure 2.156. In this option, the user can set how to distribute BGP and BGP4+ neighbor information through a prefix list. The user needs to input and select information for three fields: *Neighbor ID*, *Name*, and *Type*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. In *Name* field, the user can specify name of the IP Prefix List. For selectable *Type* field, “in” specifies that the IP Prefix List will be applied to any incoming advertisements. “out” specifies that the IP Prefix List will be applied to any outgoing advertisements. After new information is keyed in or selected, click the **ADD/Modify** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS

Prefix List

Neighbor ID	Name	Type
Empty		

Neighbor ID	<input type="text" value="0.0.0.0"/>
Name	<input type="text"/>
Type	<input type="button" value="In"/> <input type="button" value="Out"/>

Figure 2.156 Prefix List Submenu inside the BGP Neighbor Setting

2.13.2.6 Advertisement Interval

The sixth sub-menu of **BGP Neighbor Setting** is **Advertisement Interval** as shown in Figure 2.157. In this option, the user can set the minimum interval of the iBGP/eBGP routing update for a given route. This option reduces the flapping of an individual route. The user needs to input two fields: *Neighbor ID* and *Advertisement Interval*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. In *Advertisement Interval* field, the user can set the value of an advertisement interval in seconds, ranging from 1 to 600. After the new information is keyed in, click the **ADD/Modify** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval**
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Advertisement Interval

Neighbor ID	Advertisement Interval
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
Advertisement Interval<1-600>	<input type="text" value="0"/>
<input type="button" value="Add /Modify"/>	

Figure 2.157 Advertisement Interval Submenu inside the BGP Neighbor Setting

2.13.2.7 Timers

The seventh sub-menu of **BGP Neighbor Setting** is **Timers** as shown in Figure 2.158. In this option, the user can configure timers to set keepalive, hold-time, and connection timer for a specific BGP or BGP4+ neighbor. Here, the user needs to input three fields: *Neighbor ID*, *Timer1*, and *Timer2*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. In *Timer1* field, the user can set frequency (in seconds) at which a router sends keepalive messages to its neighbor. The value can be set from 0 to 65535. In *Timer2* field, the user can set Interval (in seconds) after which it did not receiving any keepalive message, the router declares a neighbor is dead. The interval can be set from 0 to 65535. After the new information is keyed in, click the **ADD/Modify** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers**
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Timers

Neighbor ID	Timer1	Timer2
	empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>	
Timer1<0-65535>	<input type="text" value="0"/>	
Timer2<0-65535>	<input type="text" value="0"/>	

Figure 2.158 Timers Submenu inside the BGP Neighbor Setting

2.13.2.8 Neighbor Allow AS IN

The eighth sub-menu of **BGP Neighbor Setting** is **Allow AS IN**, as shown in Figure 2.159. The user can use this option to accept an AS_PATH with the specified Autonomous System (AS) number from inbound updates for both BGP and BGP4+ routes. Here, the user needs to input two fields: *Neighbor ID* and *Allow AS in*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. For *Allow AS in* field, the value can be set from 1 to 10. After the new information is keyed in, click the **ADD/Modify** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN**
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Allow AS IN

Neighbor ID	Allow AS IN
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
Allow AS IN <1-10>	<input type="text" value="0"/>

Figure 2.159 Allow AS IN Submenu inside the BGP Neighbor Setting

2.13.2.9 Peer Group

The tenth sub-menu of **BGP Neighbor Setting** is **Peer Group** as shown in 錯誤! 找不到參照來源。0. In this option, the user can add a BGP or a BGP4+ neighbor to an existing peer-group. Two fields are needed to be input: *Neighbor ID* and *Peer Group (Word)*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. In the *Peer Group* field, the user can enter the name of the peer-group, which will be applied on all peers in the specified group. Remember to click **ADD/Modify** Button to take the effect after the new information is keyed in.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group**
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Peer Group

Neighbor ID	Peer Group
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
Peer Group (WORD)	<input type="text"/>
<input type="button" value="Add / Modify"/>	

Figure 2.160 Peer Group Submenu inside the BGP Neighbor Setting

2.13.2.10 Shutdown

The eleventh sub-menu of **BGP Neighbor Setting** is **Shutdown**, as shown in 錯誤! 找不到參照來源。1. The user can disable a peering relationship with a BGP or BGP4+ neighbor. Only one field is needed to be filled here: *Neighbor ID*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. After the new information is keyed in, click the **ADD** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown**
 - Activate
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor ID
Empty

Neighbor ID

Figure 2.161 *Shutdown* Submenu inside the *BGP Neighbor Setting*

2.13.2.11 Activate

The twelveth sub-menu of **BGP Neighbor Setting** is **Activate**, as shown in 錯誤! 找不到參照來源。 2. In this option, the user can enable the exchange of BGP IPv4 routes with a neighboring router. Only one field is needed to be filled here: *Neighbor ID*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. After the new information is keyed in, click the **ADD** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate**
 - Route Reflector client
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Activate

Neighbor ID	
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
<input type="button" value="Add"/>	

Figure 2.162 Activate Submenu inside the *BGP Neighbor Setting*

2.13.2.12 Route Reflector Client

The thirteenth sub-menu of **BGP Neighbor Setting** is **Route Reflector Client**, as shown in 錯誤! 找不到參照來源。3. In this option, the user can configure the device as a BGP route reflector and configure the specified neighbor as its client. Only one field is needed to be filled here: *Neighbor ID*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. After the new information is keyed in, click the **ADD** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client**
 - Remove Private AS
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Peer Route Reflector Client

Neighbor ID	
Empty	
Neighbor ID	<input type="text" value="0.0.0.0"/>
<input type="button" value="Add"/>	

Figure 2.163 *Route Reflector Client* Submenu inside the *BGP Neighbor Setting*

2.13.2.13 Remove Private AS

The fourteenth sub-menu of **BGP Neighbor Setting** is **Remove Private AS**, as shown in 錯誤! 找不到參照來源。 . In this option, the user can remove the private Autonomous System (AS) number from external outbound updates. Only one field is needed to be filled here: *Neighbor ID*. *Neighbor ID* specifies the address of an IPv4 BGP neighbor in a dotted decimal format, e.g., A.B.C.D. After the new information is keyed in, click the **ADD** button to take the effect.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - BGP Setting
 - Setting
 - Restart
 - BGP Neighbor Setting
 - Remote AS
 - Local AS
 - Description
 - Route map
 - Prefix list
 - Advertisement Interval
 - Timers
 - Allow AS IN
 - Peer Group
 - Shutdown
 - Activate
 - Route Reflector client
 - Remove Private AS**
 - + BGP Proto Setting
 - + BGP IP Setting

Neighbor Peer Remove Private AS

Neighbor ID	Empty
Neighbor ID	<input type="text" value="0.0.0.0"/>
<input type="button" value="Add"/>	

Figure 2.164 Remove Private AS Submenu inside the BGP Neighbor Setting

2.13.3 BGP Proto Setting

The third menu under the **BGP** section is the **BGP Proto Setting** as shown in Figure 2.. Under it, there are thirteen submenus: BGP Router ID, Router BGP ASN, Set AS Path Prepend, BGP Timers, Dampening, Route Map, Network IP, Confed. Peers, Confed. Identifier, Aggregate IP, Maximum Path, Redistribute, and Match Setting.

- BGP
 - + BGP Setting
 - + BGP Neighbor Setting
 - BGP Proto Setting
 - BGP Router ID
 - Router BGP ASN
 - Set AS Path Prepend
 - BGP Timers
 - Dampening
 - Route Map
 - Network IP
 - Confed. Peers
 - Confed. Identifier
 - Aggregate IP
 - Maximum Path
 - Redistribute
 - Match Setting
 - + BGP IP Setting

Figure 2.165 BGP Proto Setting Menu

2.13.3.1 BGP Router ID

This sub-menu of **BGP Proto Setting** is called **BGP Router ID**, as shown in Figure 2.1606. In this option, the user can configure the router identifier (ID). In this option, only one field is needed to be filled here: *Router ID*. In *Router ID*, the user can specify the IPv4 address without mask for a manually configured router ID, in the format A.B.C.D. After the new information is keyed in, click the **ADD** button to take the effect.

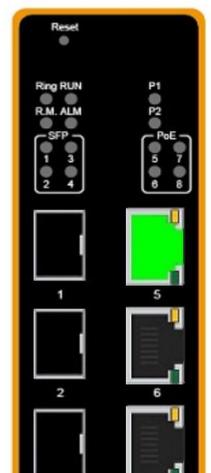
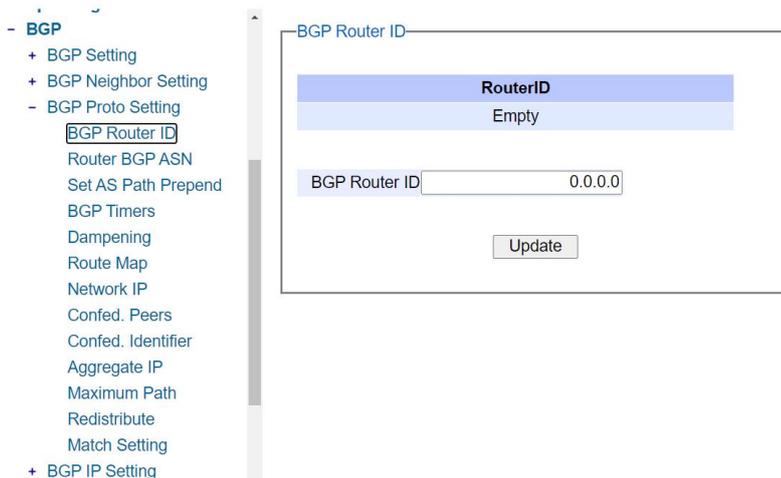


Figure 2.1606 BGP Router ID Submenu inside the BGP Proto Setting

2.13.3.2 Router BGP ASN

This sub-menu of **BGP Proto Setting** is called **Router BGP ASN**, as shown in Figure 2.1617. In this option, the user can set the BGP and BGP4+ connections for peers in the specified Autonomous System Number (ASN). In this

option, only one field is needed to be filled here: *Router BGP ASN*. In *Router BGP ASN* field, the user can specify an AS number, ranging from 1 to 4294967295. After the new information is keyed in, click the **ADD** button to take the effect.

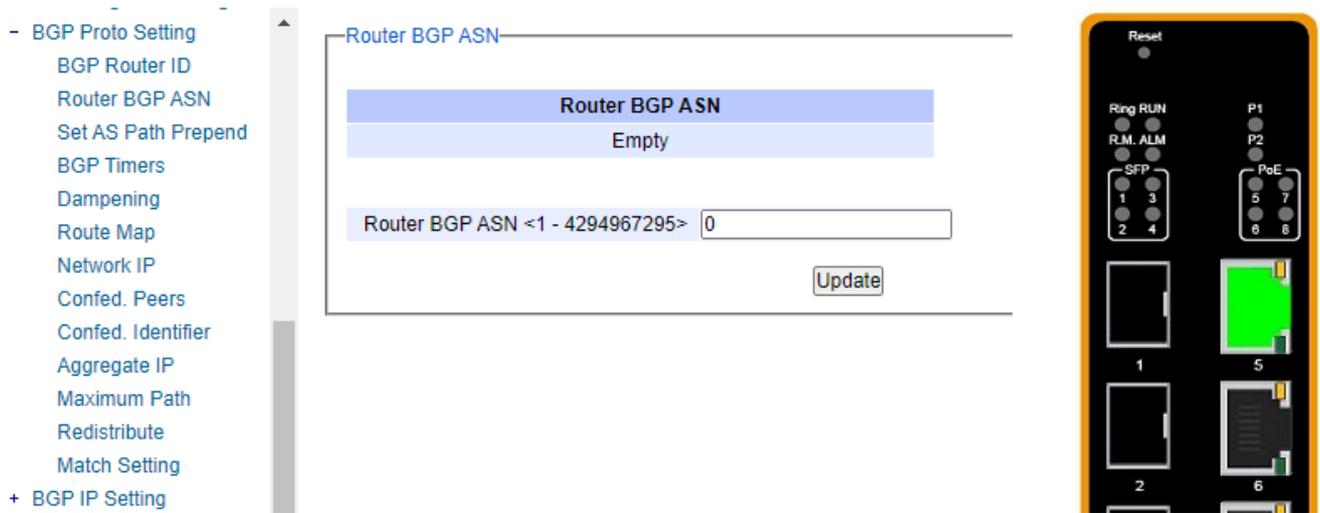


Figure 2.1617 Router BGP ASN Submenu inside the BGP Proto Setting

2.13.3.3 Set AS Path Prepend

This sub-menu of **BGP Proto Setting** is called **Set AS Path Prepend**, as shown in Figure 2.1628. In this option, the user can add or prepend an Autonomous System (AS) path set clause to a route map entry. In this option, two fields are needed to be filled here: *AS1*, *AS2*. In *AS1*, the user can input the peer's AS-number, ranging from 1 to 4294967295. In *AS2*, user can input number of times to insert, ranging from 1 to 10. After the new information is keyed in, click the **ADD** button to take the effect.

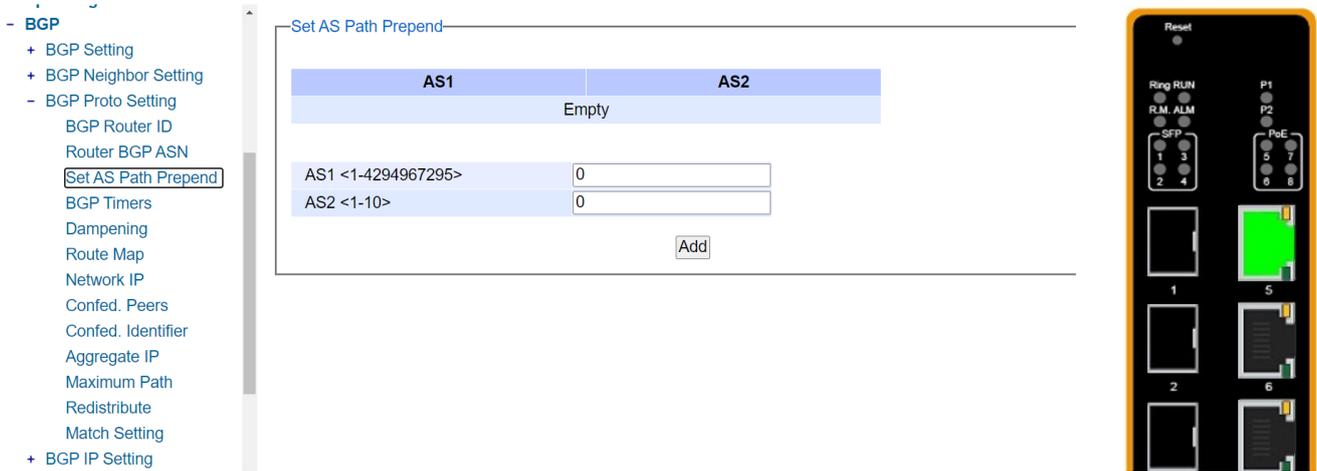


Figure 2.1628 Set AS Path Prepend Submenu inside the BGP Proto Setting

2.13.3.4 BGP Timers

This sub-menu of **BGP Proto Setting** is called **BGP Timers**, as shown in Figure 2.16369. In this option, the user can set values of the BGP keepalive timer and the holdtime timer. In this option, two fields are needed to be filled here: *Timers1* and *Timers2*. In *Timers1* field, the user can input the frequency of which the keepalive messages are sent to the neighbors, ranging from 0 to 65535. In *Timers2* field, user can input the interval of time which the neighbor is considered dead if keepalive messages are not received, ranging from 0 to 65535. After the new information is keyed in, click the **ADD** button to take the effect.

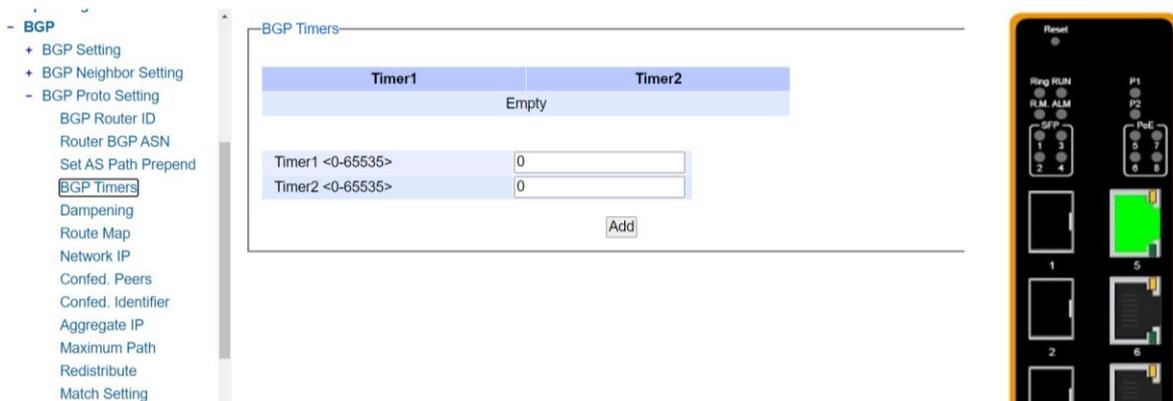


Figure 2.16369 BGP Timers Submenu inside the BGP Proto Setting

2.13.3.5 Dampening

This sub-menu of **BGP Proto Setting** is called **Dampening**, as shown in Figure 2.1640. In this option, the user can enable BGP and BGP4+ dampening and sets BGP and BGP4+ dampening parameters. BGP4+ dampening is available from the IPv6 Address Family Configuration mode. BGP dampening is available from the Router Configuration mode.

In this option, four fields are needed to be filled here: *Reachtime Half Life*, *Reuse Threshold*, *Suppress Threshold*, and *Max Suppress*. In *Reachtime Half Life* field, the user can specify the reachability half-life time in minutes. The

time for the penalty to decrease to one-half of its current value. This value is ranging from 1 to 45, and the default value is set to 15 minutes. In the Reuse *Threshold* field, the user can specify the reuse limit value. When the penalty for a suppressed route decays below the reuse value, the routes become unsuppressed. This value is ranging from 1 to 20000, and the default value for the reuse limit is set to 750. In the *Suppress Threshold* field, the user can specify the suppress limit value. When the penalty for a route exceeds the suppress value, the route is suppressed. Value of the suppress time is ranging from 1 to 20000 and the default value is set to 2000. In the *Max Suppress* field, the user can specify the max-suppress-time, or the maximum time that a dampened route is suppressed. This value is ranging from 1 to 255, and the default value is set to 4 times the half-life time (60 minutes). After the new information is keyed in, click the **ADD** button to take the effect.

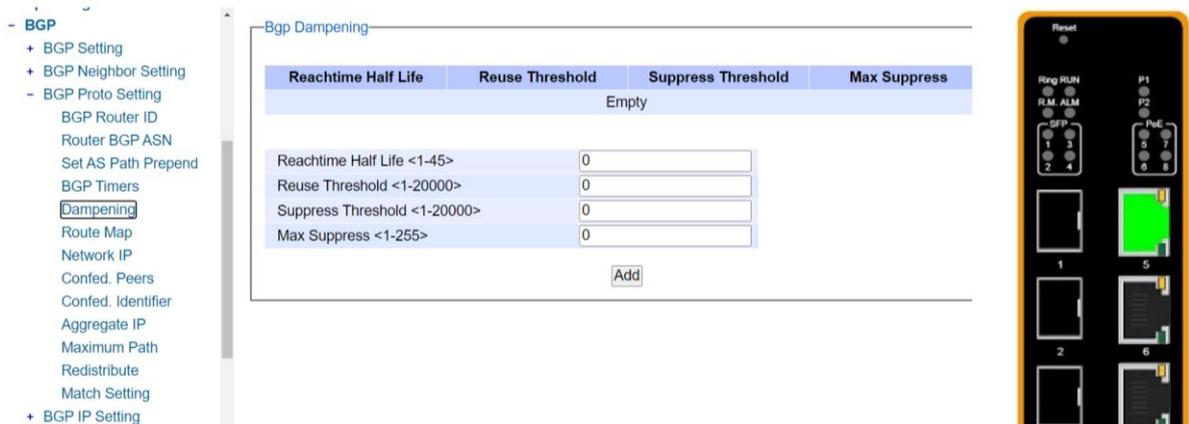


Figure 2.1640 Dampening Submenu inside the BGP Proto Setting

2.13.3.6 Route Map

This sub-menu of **BGP** is called **Route Map**, as shown in Figure 2.1651. In this option, the user can apply a route map to incoming or outgoing routes for BGP or BGP4+. Three fields are needed to be filled and selected here: *Name*, *List Type*, and *Sequence Number*. In *Name* field, the user can specify name of the route-map. In *List Type* field, the user can select whether Permit or Deny. In *Sequence Number* field, the user can specify that the access list applied to incoming or outgoing advertisements. After the new information is keyed in, click the **ADD** button to take the effect.

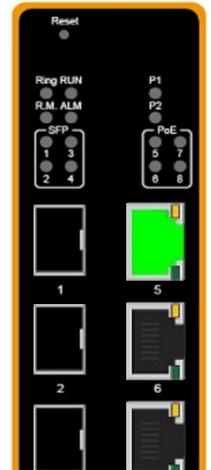
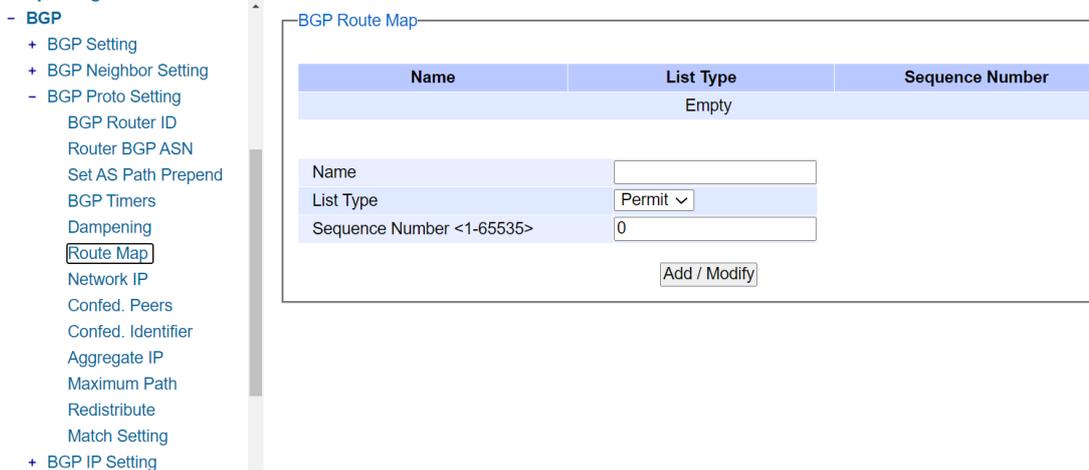


Figure 2.1651 Route Map Submenu Inside the BGP Proto Setting

2.13.3.7 Network IP

This sub-menu of **BGP Proto Setting** is called **Network IP**, as shown in Figure 2.166. In this option, the user can specify particular routes to be advertised into the BGP or BGP4+ routing process. In this option, two fields are needed to be filled here: *Network IP* and *Prefix*. In *Network IP* field, user can specify an IP address of the network in dotted decimal format A.B.C.D. In the *Prefix* field, IP prefix length of the network can be specified, ranging from 4 to 36. After the new information is keyed in, click the **ADD** button to take the effect.

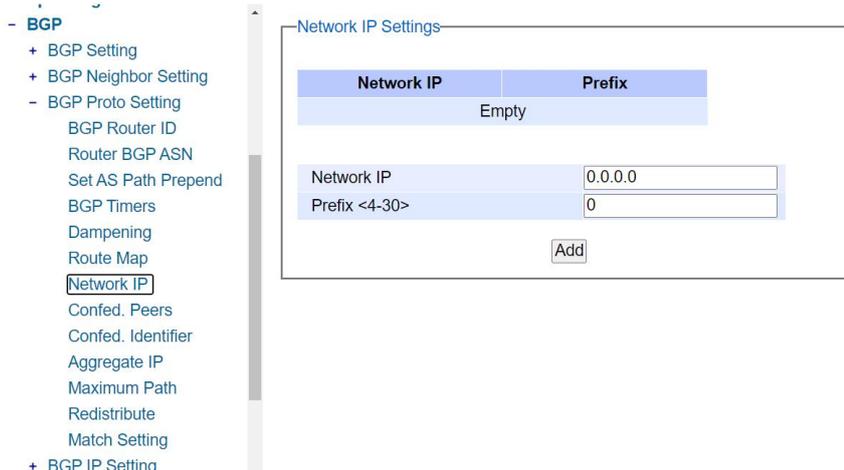


Figure 2.1662 Network IP Submenu inside the BGP Proto Setting

2.13.3.8 Confed. Peers

This sub-menu of **BGP Proto Setting** is called **Confed. Peers**, as shown in Figure 2.1673. In this option, the user can configure the Autonomous Systems (AS) that belongs to the same confederation as the current device. In this option, only one field is needed to be filled here: *Confederation Peers*. In *Confederation Peers* field, the user can

specify AS numbers of eBGP peers that are under same confederation but in a different sub-AS. The value ranges from 1 to 4294967295. After the new information is keyed in, click the **ADD** button to take the effect.

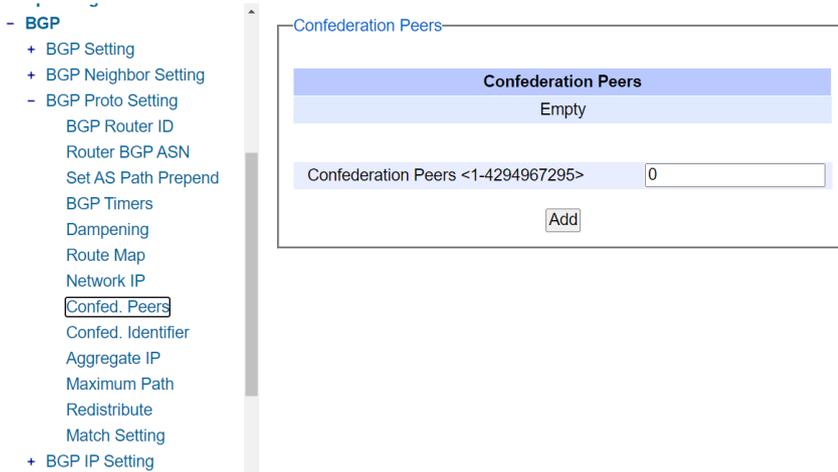


Figure 2.1673 Confed. Peers Submenu inside the BGP Proto Setting

2.13.3.9 Confed. Identifier

This sub-menu of **BGP Proto Setting** is called **Confed. Identifier**, as shown in Figure 2.1684. In this option, the user can configure a BGP confederation identifier. In this option, only one field is needed to be filled here: **Confederation Identifier**. In **Confederation Identifier** field, the user can set routing domain confederation AS number, ranging from 1 to 4294967295. After the new information is keyed in, click the **ADD** button to take the effect.

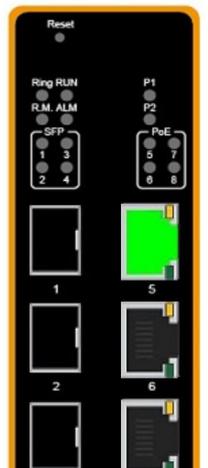
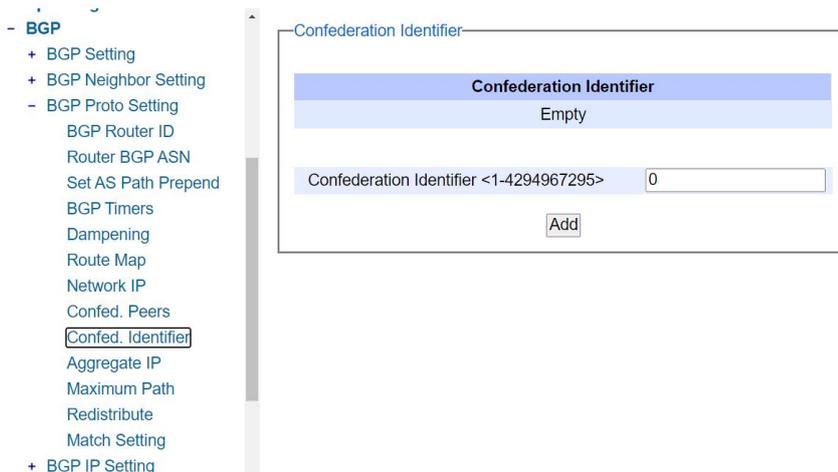


Figure 2.1684 Confed. Identifier Submenu inside the BGP Proto Setting

2.13.3.10 Aggregate IP

This sub-menu of **BGP Proto Setting** is called **Aggregate IP** as shown in Figure 2.1695. In this option, the user can add an aggregate route that can be advertised to BGP or BGP4+ neighbors. This command creates an aggregate entry in the BGP or BGP4+ routing table if the device learns, by any means, any routes that are within the range configured by the aggregate address/mask. In this option, three fields are needed to be filled and selected here:

Aggregate IP, Prefix, and List Type. In *Aggregate IP* field, the user can specify the aggregate IPv4 address and mask. In the *Prefix* field, prefix of the aggregate IP address can be entered here. In the *List Type* field, the user can select either Summary only or AS-Set from the drop-down options. In *Summary only* option, the user can filter more specific routes from updates. In *AS Set* option, the user can generate AS set path information. After the new information is keyed in, click the **ADD/Modify** button to take the effect.

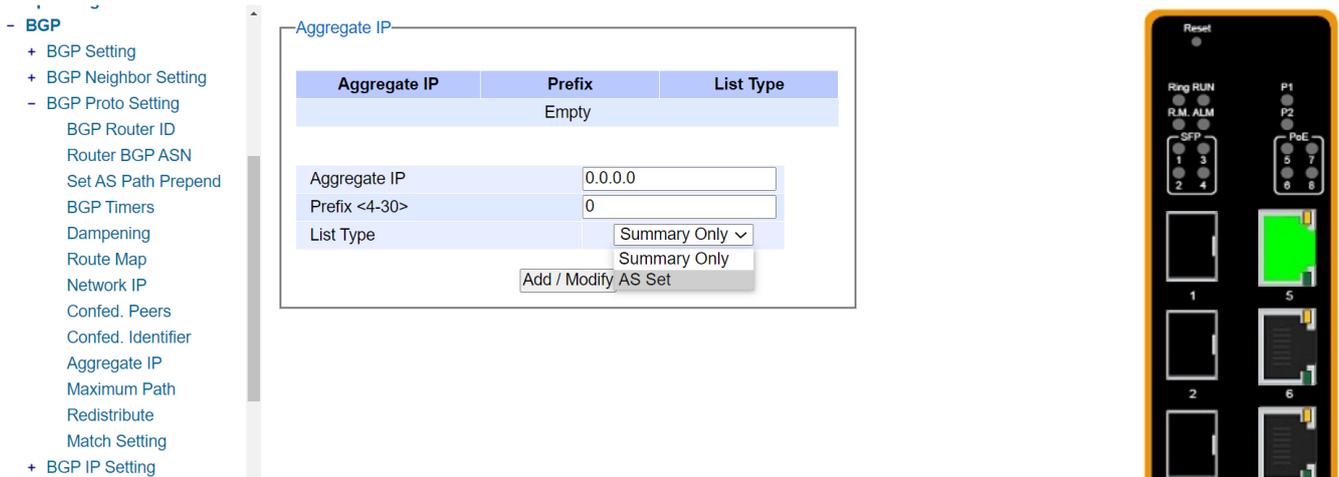


Figure 2.1695 *Aggregate IP* Submenu inside the *BGP Proto Setting*

2.13.3.11 Maximum Path

This sub-menu of *BGP Proto Setting* is called *Maximum Path* as shown in Figure 2.1706. In this option, the user can use this command to set the number of equal-cost multi-path (ECMP) routes for eBGP or iBGP. The user can install multiple BGP paths to the same destination to balance the load on the forwarding path. In this option, only one field is needed to be filled here: *Path Range*. In *Path Range* field, the user can specify the number of routes, 1. Note here that it supports only one route. After the new information is keyed in, click the **Update** button to take the effect.

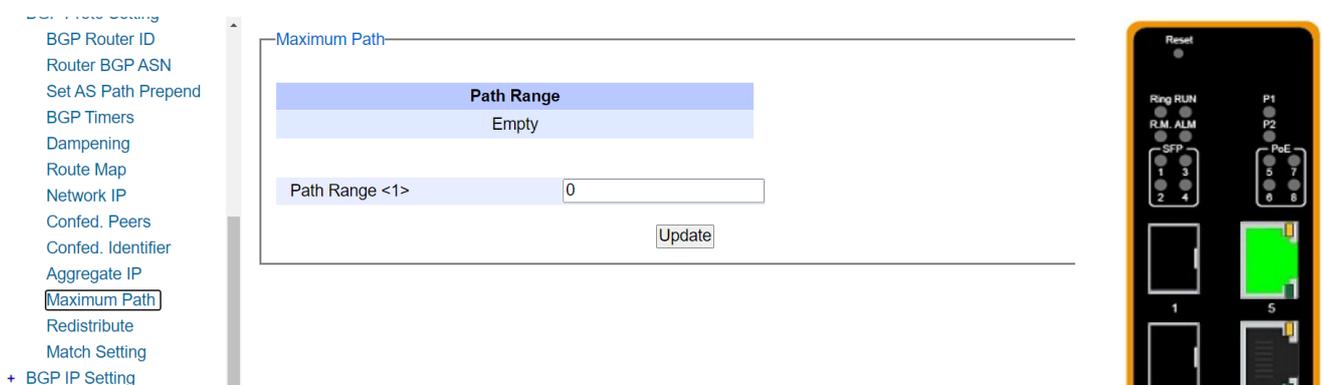


Figure 2.1706 *Maximum Path* Submenu inside the *BGP Proto Setting*

2.13.3.12 Redistribute

This sub-menu of *BGP Proto Setting* is called *Redistribute* as shown in Figure 2.1717. In this option, the user can inject routes from one routing process into a BGP or BGP4+ routing table. The user should configure the cluster-id in case of more than one route reflector per the BGP cluster. Usually, a cluster consists of one or more route

reflectors and its clients, where each cluster is identified by the router-id of its single route reflector. Only one field is needed to be selected here: *Name*. There are five options to choose from: *Kernel*, *Connected*, *Static*, *Rip*, and *OSPF*. In *Kernel* field, the user can specify the redistribution of connected routes for both BGP and BGP4. In *Connected* field, the user can specify the redistribution of connected routes for both BGP and BGP4+. In *Static* field, the user can specify the redistribution of Static routes for both BGP and BGP4+. In *Rip* field, the user can specify the redistribution of RIP information for BGP or RIPng information for BGP4+. In *OSPF* field, the user can specify the redistribution of OSPF information for BGP or OSPFv3 information for BGP4+. After the new information is keyed in, click the **ADD/Modify** button to take the effect.

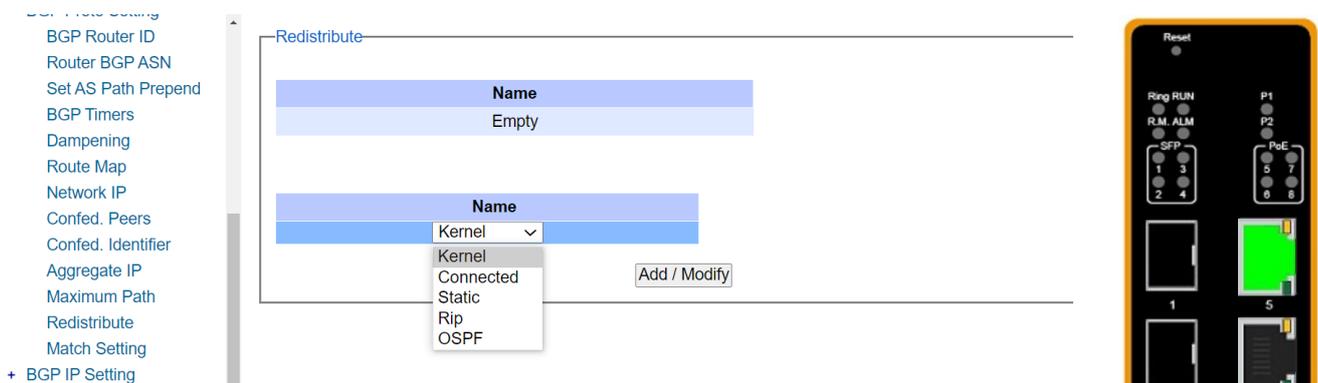


Figure 2.1717 Redistribute Submenu inside the BGP Proto Setting

2.13.3.13 Match Setting

This sub-menu of **BGP Proto Setting** is called **Match Setting**. There are three subsections under it: AS Path, Community Range, and Match Prefix List.

The first sub-menu of **Match** is **AS Path**, as shown in Figure 2.172. In this option, the user can use this command to add an autonomous system (AS) path match clause to a route map entry. The user can specify the AS path attribute value or values to match by specifying the name of an AS path access list. To create the AS path access list, enter Global Configuration mode and use the ip as-path access-list command. In this option, only one field is needed to be filled here: *AS Path (WORD)*. In *AS Path (WORD)*, the user can specify an AS path access list name. After the new information is keyed in, click the **ADD** button to take the effect.

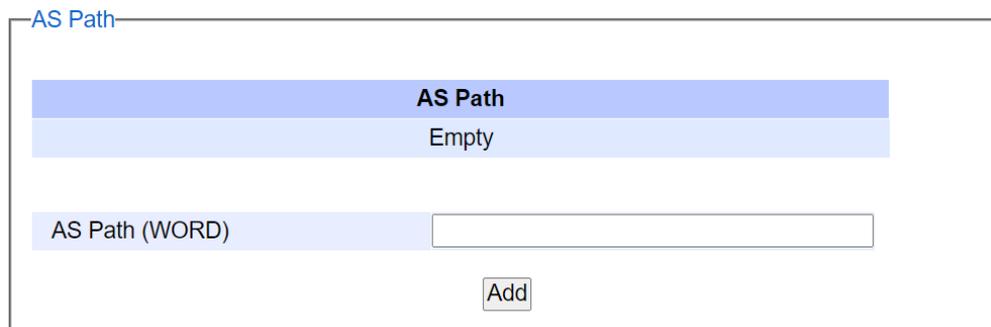


Figure 2.1728 AS Path Submenu inside the BGP Proto Setting -> Match Setting

The second sub-menu of **Match Setting** is **Community -> Range**, as shown in Figure 2.17379. In this option, the user can add a community match clause to a route map entry by specifying the community values to match through a community list. To create the community list, go to BGP->Match-> IP Community List submenu. In this option, two fields are needed to be selected and filled here: *Mode* and *Range*. In *Mode* field, the user can select the community list number of two modes: Standard (1-99) and Expanded (100-199). In *Range* field, the user can input a number according to its mode. After the new information is keyed in, click the **ADD** button to take the effect.

Figure 2.17379 Community Range Submenu inside the BGP Proto Setting -> Match Setting

The third sub-menu of **Match** is **Match Prefix List**, as shown in Figure 2.1740 In this option, the user can add an IP address prefix match clause to a route map entry. The prefix or prefixes can be specified to match by either one of the followings: 1) name of an access list, 2) name of a prefix list. Note here that the access list can be created by going to submenu BGP->Match-> IP Community List, and the prefix list can be created by going to submenu BGP->Match->Prefix List. In this option, only one field is needed to be filled here: *Prefix List WORD*. In the *Prefix List WORD* field, the user can use an IP prefix list to specify which prefixes to match. After the new information is keyed in, click the **ADD** button to take the effect.

Figure 2.1740 Match Prefix List Submenu inside the BGP Proto Setting -> Match Setting

2.13.4 BGP IP Setting

The fourth submenu under the **BGP** section is the **BGP IP Setting**. Under it, there are three submenus: IP Community List, IP Ext. Community List, and Prefix List, as shown in Figure 2.175.

- **BGP**
 - + BGP Setting
 - + BGP Neighbor Setting
 - + BGP Proto Setting
 - BGP IP Setting
 - IP Community List
 - Expanded
 - Standard
 - IP Ext.Community List
 - Expanded
 - Standard
 - Prefix List
 - List Name IP
 - List Name

Figure 2.175 Submenus inside the BGP IP Setting

2.13.4.1 IP Community List

This sub-menu of **BGP IP Setting** is called **IP Community List**. There are two submenus under it: Expanded and Standard.

The first sub-menu of **IP Community List** is **Expanded**, as shown in Figure 2.176.

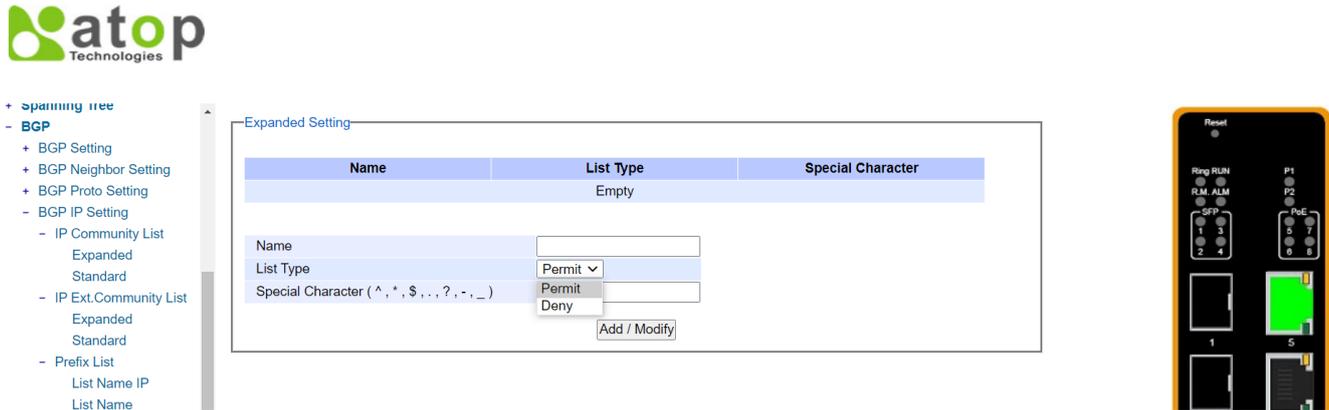


Figure 2.176 Expanded Submenus inside the BGP IP Setting -> IP Community List

In this option, the user can add an entry to an expanded BGP community-list filter. Three fields are needed to be filled and selected here: *Name*, *List Type*, and *Special Character* (^, *, \$, ., ?, -, _). In *Name* field, the user can specify an expanded community list entry. In *List Type* field, the user can choose *permit* or *deny* from the dropdown menu to accept or reject the community. In *Special Character* (^, *, \$, ., ?, -, _) field, the user can specify community attributes with regular expressions, where the details of each is shown in the table below. After the new information is keyed in, click the **Add/Modify** button to take the effect.

Table 2.41 Meanings of the Special Character Field

Symbol	Meanings
^	Caret is used to match the beginning of the input string. When used at the beginning of a string of characters, it negates a pattern match.
\$	Dollar sign is used to match the end of the input string.
.	Period is used to match a single character (white spaces included).
*	Asterisk is used to match none or more sequences of a pattern.
?	Question mark is used to match none or one occurrence of a pattern.
_	Underscore is used to match spaces, commas, braces, parenthesis, or the beginning and end of an input string.
-	Hyphen Separates the end points of a range.

The second sub-menu of **IP Community List** is **Standard**, as shown in Figure 2.177. In this option, the user can add an entry to a standard BGP community-list filter. Three fields are needed to be filled and selected here: *Name*, *List Type*, and *Community*. In *Name* field, the user can specify a standard community list entry. In *List Type* field, the user can specify either *deny* (to reject) or *permit* (to accept). In the *Community* field, user has the following options to select: *AS:VAL*, *local-AS*, *no-advertise*, and *no-export*. *AS:VAL* specifies the valid value for the community number. This format represents the 32-bit community value, where AS is the high order 16 bits and VAL is the low order 16 bits in digit format. *local-AS* specifies routes not to be advertised to external BGP peers. *no-advertise* specifies routes not to be advertised to other BGP peers. *no-export* specifies routes not to be advertised outside of the autonomous system boundary. After the new information is keyed in, click the **Add/Modify** button to take the effect.

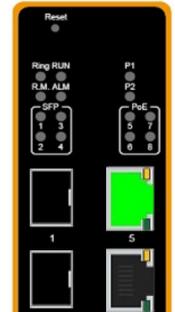
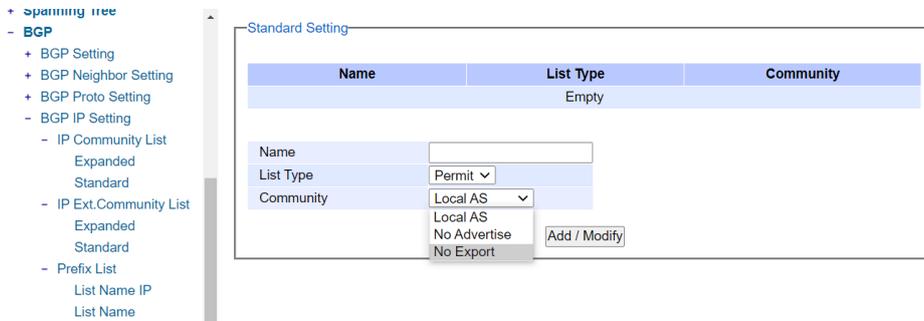


Figure 2.177 Standard Submenu inside the BGP IP Setting -> IP Community List

2.13.4.2 IP Ext. Community List

This sub-menu of **BGP IP Setting** is called **IP Ext. Community List**. There are two submenus under it: Expanded and Standard. The first sub-menu of **IP Ext. Community List** is **Expanded**, as shown in Figure 2.178.

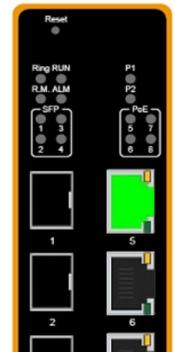
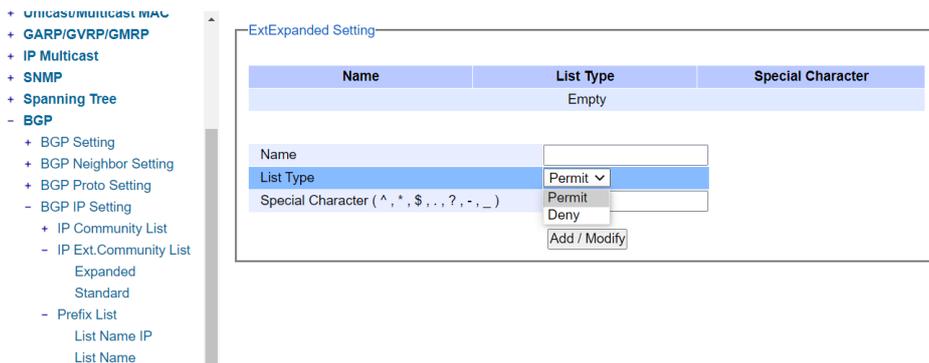


Figure 2.178 Expanded Submenu inside the BGP IP Setting -> IP Ext. Community List

In this option, the user can create or delete an expanded extended community list. In this option, three fields are needed to be filled and selected here: *Name*, *List Type*, and *Special Character* (^, *, \$, ., ?, -, _). In *Name* Field, the user can specify an expanded ext. community list entry. In *List Type* field, the user can choose either permit (to accept the extcommunity) or deny (to reject the extcommunity) options. In *Special Character* (^, *, \$, ., ?, -, _) field, the user can specify ext. community attributes with regular expression, where the details of each is shown in the table below. After the new information is keyed in, click the **Add/Modify** button to take the effect.

Table 2.41 Meanings of the Special Character Field

Symbol	Meanings
^	Caret is used to match the beginning of the input string. When used at the beginning of a string of characters, it negates a pattern match.
\$	Dollar sign is used to match the end of the input string.
.	Period is used to match a single character (white spaces included).
*	Asterisk is used to match none or more sequences of a pattern.
?	Question mark is used to match none or one occurrence of a pattern.
_	Underscore is used to match spaces, commas, braces, parenthesis, or the beginning and end of an input string.
-	Hyphen Separates the end points of a range.

The second sub-menu of **IP Ext. Community List** is **Standard**, as shown in Figure 2.161. In this option, the user can create and delete a standard extended community list. In this option, three fields are needed to be filled and selected here: **Name**, **List Type**, and **Community**. In **Name** field, the user can specify a standard extended community list entry. In **List Type** field, the user can select permit (accept the extended community) or deny (reject the extended community) options. In **Community** field, two options can be selected: **RT** or **SOO**. The user can choose **RT** to specify the route target of the extended community or **SOO** to specify the site of origin of the extended community. After the new information is keyed in, click the **ADD/Modify** button to take the effect.



- + Unicast/multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - + BGP Setting
 - + BGP Neighbor Setting
 - + BGP Proto Setting
 - BGP IP Setting
 - + IP Community List
 - IP Ext. Community List
 - Expanded
 - Standard
 - Prefix List
 - List Name IP
 - List Name

BGP ExtStandard

Name	List Type	Community
Empty		
Name	<input type="text"/>	
List Type	Permit	
Community	RT	
	SOO	
	Add/Modify	

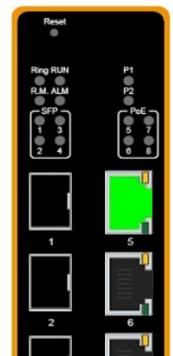


Figure 2.179 Standard Submenu inside the BGP IP Setting -> IP Ext. Community List

2.13.4.3 Prefix List

This sub-menu of **BGP IP Setting** is called **Prefix List**. There are two submenus under it: **List Name IP** and **List Name**. The first sub-menu of **Prefix List** is **List Name IP**, as shown in Figure 2.180. In this option, the user creates an entry for an IPv4 prefix list. In this option, five fields are needed to be filled and selected here: **Name**, **Sequence Number**, **List Type**, **IPv4 Address**, and **Prefix**. In **Name** field, the user can specify the name of a prefix list. In **Sequence Number** field, the user can specify the sequence number of the prefix list entry, which ranges from 1 to 429496725. In **List Type** field, the user can select permit or deny option from a drop-down menu to specify that the prefixes are included or excluded from the list. In **IPv4 Address** field, the user can specify an IPv4 address and a length of the network mask in dotted decimal format A.B.C.D/M. In **Prefix** field, the user can specify prefix of an IPv4 address to be matched, ranging from 4 to 30. After the new information is keyed in, click the **ADD** button to take the effect.



- + Unicast/multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- BGP
 - + BGP Setting
 - + BGP Neighbor Setting
 - + BGP Proto Setting
 - BGP IP Setting
 - + IP Community List
 - IP Ext. Community List
 - Expanded
 - Standard
 - Prefix List
 - List Name IP
 - List Name

BGP Prefix List IP

Prefix List Name	Sequence Number	List Type	IPv4 Address	Prefix
Empty				
Name	<input type="text"/>			
Sequence Number <1-4294967295>	0			
List Type		Permit		
IPv4 Address		Deny		
Prefix <4-30>				
				Add



Figure 2.180 List Name IP Submenu inside the BGP IP Setting -> Prefix List

The second sub-menu of **Prefix List** is **List Name**, as shown in Figure 2.181. In this web page, the user creates an entry for an IPv4 prefix list. Seven fields are needed to be filled and selected here: **Name**, **Sequence Number**, **List**

Type, IPv4 Address, Prefix, Prefix Listname, and Prefix Length. In Name field, the user can specify the name of a prefix list. In Sequence Number field, the user can specify the sequence number of the prefix list entry, which ranges from 1 to 429496725. In List Type field, the user can select permit or deny option from a drop-down menu to specify that the prefixes are included or excluded from the list. In IPv4 Address field, the user can specify an IPv4 address and a length of the network mask in dotted decimal format A.B.C.D/M. In Prefix field, the user can specify prefix of an IPv4 address to be matched, ranging from 4 to 30. In Prefix Listname field, the user can specify either ge or le to determine the minimum or maximum prefix length to be matched. In Prefix Length field, the user can specify value of the prefix length to be matched, ranging from 0 to 32. After the new information is keyed in, click the ADD button to take the effect.

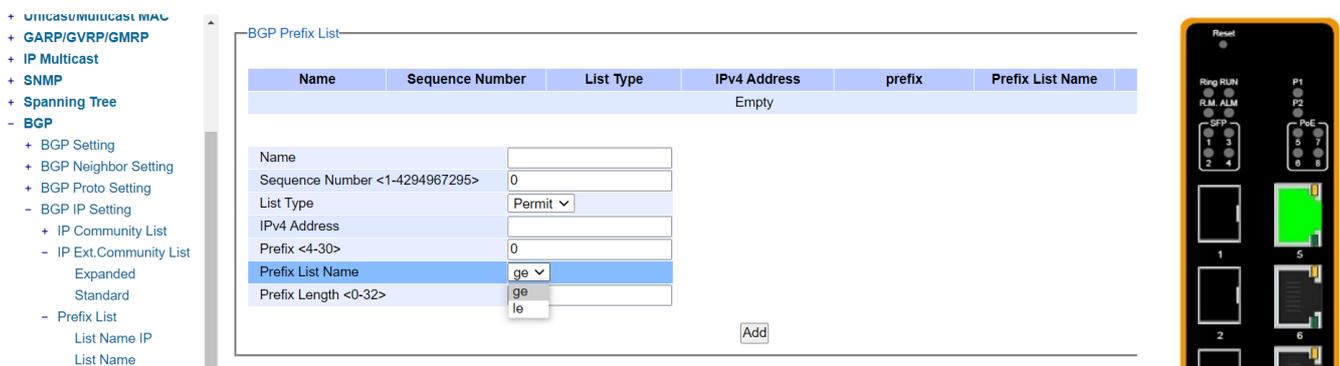


Figure 2.181 List Name Submenu inside the BGP IP Setting -> Prefix List

2.14 VLAN

A **Virtual Local Area Network (VLAN)** is a group of devices that can be located anywhere on a network, but all devices in the group are logically connected together. In other words, VLAN allows end stations to be grouped together even if they are not located on the same network switch. With a traditional network, users usually spend a lot of time on devices relocations, but a VLAN reconfiguration can be performed entirely through software. Also, VLAN provides extra security because devices within a VLAN group can only communicate with other devices in the same group. For the same reason, VLAN can help to control network traffic. Traditional network broadcasts data to all devices, no matter whether they need it or not. By allowing a member to receive data only from other members in the same VLAN group, VLAN avoids broadcasting and increases traffic efficiency (see Figure 2.182).

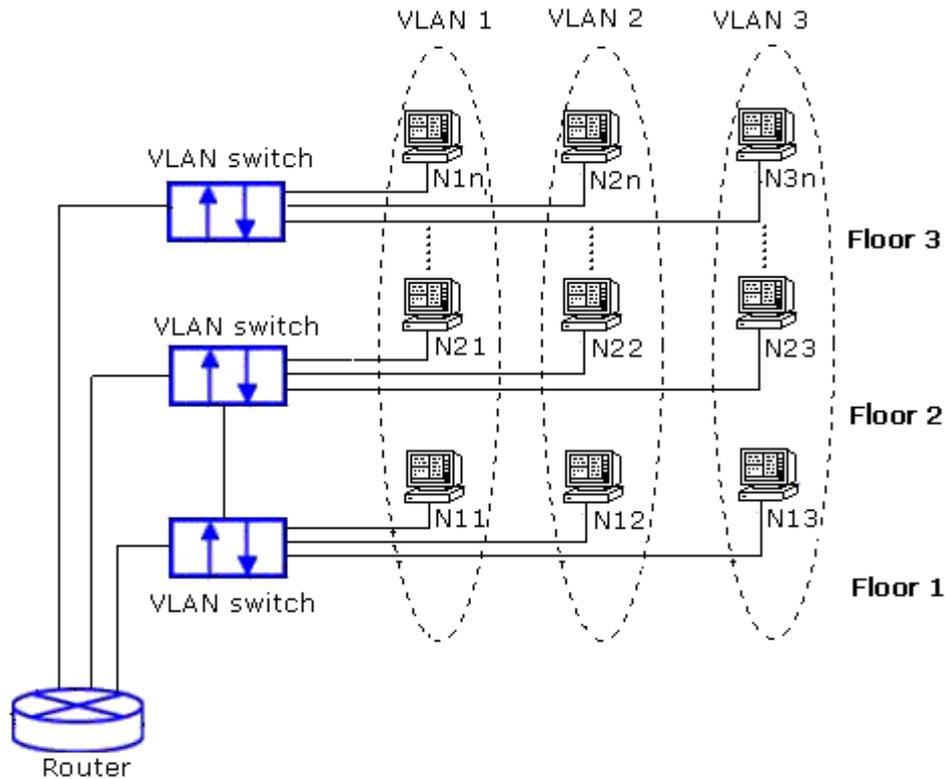


Figure 2.182 Example of VLAN Configuration

Atop's managed switch EHG7XXX series provide six approaches to create VLAN as follows:

- Tagging-based (802.1Q) VLAN
- Port-based VLAN
- MAC-based VLAN
- IP Subnet-Based VLAN
- Protocol-Based VLAN
- QinQ or Double Tagging-based VLAN

Figure 2.183 shows the drop-down menu under the VLAN section.

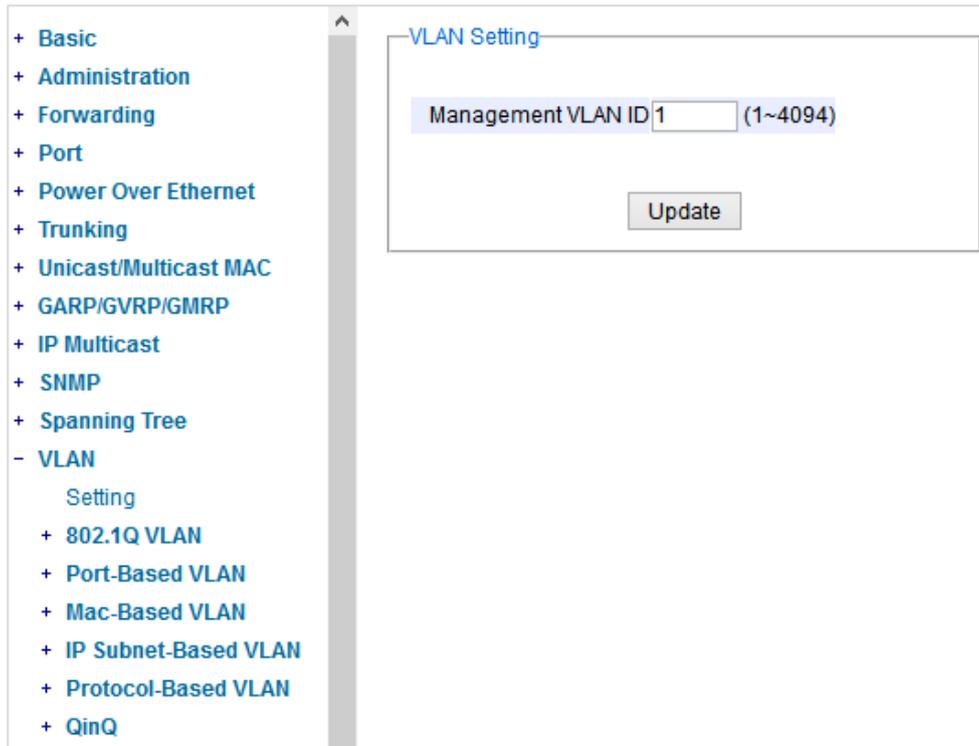


Figure 2.183 VLAN Dropdown Menu

2.14.1 VLAN Setting

The first menu under the VLAN section is the VLAN Setting. Here the management VLAN Identification number (ID) is configured based on the IEEE 802.1Q standard. The default value is VID = 1. Note that the ID can be the number from 1 to 4096. If the users change the management VLAN ID to other number, please click the **Update** button to set it on the managed switch. Figure 2.184 depicts the VLAN Setting webpage. Table 2.43 describes the VLAN Setting option.



Figure 2.184 VLAN Setting Webpage

Table 2.43 Description of VLAN Setting

Label	Description	Factory Default
Management VLAN ID	Configure the management VLAN ID that can be accessed this switch. Range from 1 to 4094.	1

2.14.2 802.1Q VLAN

Tagging-based (802.1Q) VLAN is the networking standard that supports virtual LAN (VLANs) on an Ethernet network. The standard defines a system of VLAN tagging for Ethernet frames and the accompanying procedures for bridges and switches in handling such frames. The standard also contains provisions for a quality of service prioritization scheme commonly known as IEEE 802.1Q.

VLAN tagging frames are frames with 802.1Q (VLAN) tags that specify a valid VLAN identifier (VID). Whereas, untagged frames are frames without tags or frames that carry 802.1p (prioritization) tags and only having prioritization information and a VID of 0. When a switch receives a tagged frame, it extracts the VID and forwards the frame to other ports in the same VLAN.

For a 802.1Q VLAN packet, it adds a tag (32-bit field) to the original packet. The tag is between the source MAC address and the EtherType/length fields of the original frame. For the tag, the first 16 bits is the Tag protocol identifier (TPID) field which set to a value of 0x8100 in order to identify the frame as an IEEE 802.1Q-tagged frame. This field is located at the same position as the EtherType/length field in untagged frames and is thus used to distinguish the frame from untagged frames. The next 3 bits is the Tag control information (TCI) field which refers to the IEEE 802.1p class of service and maps to the frame priority level. The next one bit is the Drop Eligible Indicator (DEI) field which may be used separately or in conjunction with PCP to indicate frames eligible to be dropped in the presence of congestion. The last 12 bits is the VLAN identifier (VID) field specifying the VLAN to which the frame belongs.

Under the 802.1Q VLAN menu, there are three submenus which are **Setting**, **PVID Setting**, and **VLAN Table** as shown in Figure 2.185.



Figure 2.185 802.1Q VLAN Dropdown Menu

2.14.2.1 802.1Q VLAN Settings

Figure 2.186 shows the 802.1Q VLAN Setting webpage which allow the users to add new tagged-based VLAN to the managed switch. Please follow the following procedure to setting up the 802.1Q VLAN on the switch.

1. Go to **802.1Q VLAN**, then select **Setting** submenu.
2. Fill in appropriate Name, VID, Member Ports, and Tagged Ports as show in Figure 2.186. The description of each fields is summarized in Table 2.44. Then, click **Add/Modify** button. Note to select multiple **Member Ports** or multiple **Tagged Ports**, press and hold the **Ctrl** key while selecting multiple ports.
3. Go to **802.1Q VLAN's PVID Setting** described in the next subsection.
4. Choose the same ports, and enter PVID (which is the same as VID), see Figure 2.187.

To remove any of the VLAN from the 802.1Q VLAN setting, click the **Remove** button at the end of that particular VLAN record as shown in Figure 2.186.

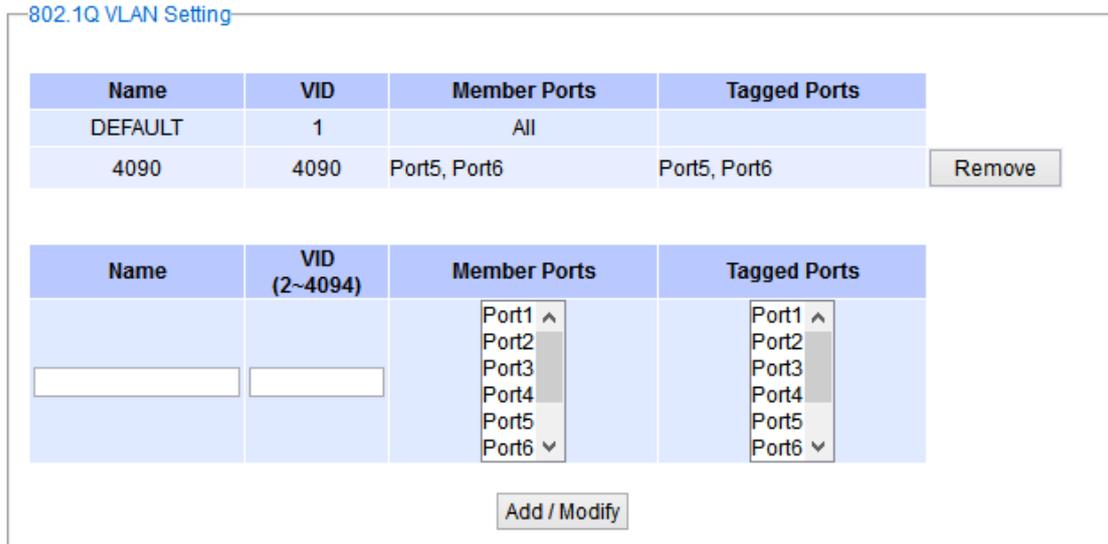


Figure 2.186 802.1Q VLAN's Setting Webpage

Table 2.44 Setting Descriptions of 802.1Q VLAN Settings

Label	Description	Factory Default
Name	The VLAN ID name that can be assigned by the user.	Factory Default
VID	Configure the VLAN ID that will be added in static VLAN table in the switch. The VLAN ID is in the range 2~4094.	Dependent
Member Ports	Configure the port to this specific VID.	All Ports
Tagged Ports	Configure the port that outgoing packet is tagged or untagged. Selected: The outgoing packet is tagged from this port. Unselected: The outgoing packet is untagged from this port.	Dependent

***NOTE:** Default settings only have VLAN ID on 1. To set VLAN ID to other value beside 1, users will have to assign ports to be in that VLAN group.

2.14.2.2 802.1Q VLAN PVID Settings

Each port is assigned a native VLAN number called the Port VLAN ID (PVID). When an untagged frame goes through a port, the frame is assigned to the port's PVID. That is the frame will be tagged with the configured VLAN ID defined in this subsection. Figure 2.187 shows the PVID Setting for 802.1Q VLAN where the upper table lists the current PVID assigned to each port. The users can configure the PVID by select either on or multiple ports (by clicking and holding the **Ctrl** key) and enter the desired PVID value between 2 to 4094. Please click **Update** button to allow the configuration to take effect on the switch. Table 2.45 summarizes the PVID Setting's descriptions.

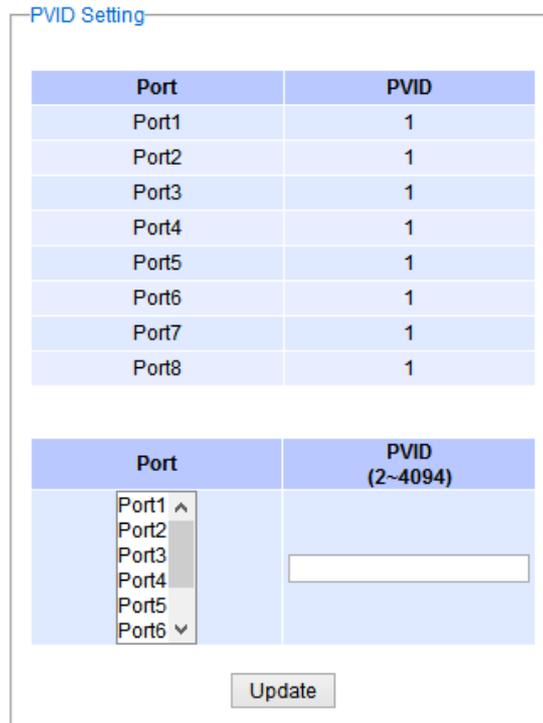


Figure 2.187 802.1Q VLAN PVID Setting Webpage

Table 2.45 Setting Descriptions of 802.1Q VLAN PVID

Label	Description	Factory Default
Port	Select specific port(s) to set the PVID value	-
PVID	Configure the default 802.1Q VID tag assigned to specific Port. The VLAN ID is in the range 1~4094.	1

2.14.2.3 802.1Q VLAN Table

This webpage shown in Figure 2.188 displays the 802.1Q VLAN table which lists all the VLANs that are automatically and manually added/modified to the managed switch. Figure 2.189 illustrates examples of the static and dynamic VLAN information of each VID. Table 2.46 summarizes the descriptions of VLAN Table.

VID	Static Member Ports	Static Tagged Ports
1	All	
4090	Port5, Port6	Port5, Port6

Figure 2.188 802.1Q VLAN Table Webpage

VLAN Table

VID	Static Member Ports	Static Tagged Ports	Dynamic Member Ports	Dynamic Tagged Ports
1	1,2,3,4,5,6,7,8,9,10			
200	1,2,3,4			
201	1,2,3,4			
101			9	9
102			9	9
103			9	9

Figure 2.189 Example of 802.1Q VLAN Table

Table 2.46 Descriptions of 802.1Q VLAN Table

Label	Description	Factory Default
VID	Indicate the VLAN ID number	Dependent
Static Member Ports	Indicate the member ports to this VID. This entry is created by user.	All ports
Static Tagged Ports	Indicate the ports that outgoing packet is tagged or untagged. Displayed: The outgoing packet is tagged from this port. Non-displayed: The outgoing packet is untagged from this port. This entry is created by user.	Dependent
Dynamic Member Ports	Indicate the member ports to this VID. This entry is created by GVRP (discussed in Section 2.9.3).	Dependent
Dynamic Tagged Ports	Indicate the member ports that outgoing packet is tagged or untagged. Displayed: The outgoing packet is tagged from this port. Non-displayed: The outgoing packet is untagged from this port. This entry is created by GVRP (discussed in Section 2.9.3).	Dependent

2.14.3 Port-Based VLAN

Port-Based VLAN (or Static VLAN equivalent) assignments are created by assigning ports to a VLAN. If a device is connected to a certain port, the device will be assigned a VLAN to that specific port. If a user changes the connected port, a new port-VLAN assignment must be reconfigured for this new connection. To setup port-based VLAN, please follow the following steps:

1. Click on **Port-Based VLAN setting** page as shown in Figure 2.190.
2. Select specific ports to be included in certain group by checking the corresponding box under the Member ports on particular row of port-based VLANs' Group ID. Note that if the users check the box under the Group ID column, all of the Member Ports will belong to that VLAN's Group ID.
3. Click on the **Update** button to allow the setting to take effect on the managed switch.

Port-Based VLAN Setting

Group ID	Member ports							
	1	2	3	4	5	6	7	8
1 <input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 2.190 Port-based VLAN Setting Webpage

2.14.4 MAC-Based VLAN

The managed switch also supports the ability to assign a VLAN ID (VID) to an untagged packet based on the source MAC address. This can be set in this sub-menu as shown in Figure 2.191. There are maximum 512 entries in the MAC-based VLAN table (Source MAC address + VLAN ID) in the lower part of this webpage. If the users enter a duplicated MAC address into the MAC-based VLAN table, the old VLAN ID will be overwritten by the new VLAN ID. The VLAN ID range is between 1 to 4096. If the source MAC address of a packet is matched with any entry inside the MAC-based VLAN table here, the mapped VLAN ID will be added to the packet.

MAC Based Setting

MAC Address	VID (1-4094)	
<input type="text"/>	<input type="text"/>	<input type="button" value="Add / Modify"/>
MAC Address	VID	
Empty		

Figure 2.191 MAC-Based VLAN Setting Webpage

2.14.5 IP Subnet-Based VLAN

This sub-menu allows the user to assign a VLAN ID to an untagged packet based on the source IP address and the prefix length which is called IP subnet-based VLAN. Figure 2.192 shows the webpage where the users can enter the IP address, prefix length and VLAN ID (VID) for creating a VLAN based on its IP subnet. The list of existing IP subnet-based VLAN is shown in the lower part of the webpage. This feature support maximum of 64 sets (IP address + Prefix length + VLAN ID). The VLAN ID (VID) range is between 1 to 4096. This VLAN setup feature supports both IPv4 and IPv6. If a duplicated pair of IP address and prefix length is entered into the table, there will be an error message. The prefix length of IPv4 is 0 to 32 while the prefix length of IPv6 is 0 to 64.

IP Subnet-Based Setting

IP Address	Prefix Length	VID (1~4094)	
<input type="text"/>	<input type="text"/>	<input type="text"/>	Add

IP Address	Prefix Length	VID
Empty		

Figure 2.192 IP Subnet-Based VLAN Setting Webpage

2.14.6 Protocol-Based VLAN

For the protocol-based VLAN, the switch supports 3 Ethernet packet frame types: Ethernet II, 802.3 LLC, and 802.3 SNAP. It uses the EtherType field (Protocol ID in these frames) to assign a VLAN ID for each untagged packet. There are two submenus for **Protocol-Based VLAN**: **Protocol to Group Setting** and **Group to VLAN Setting**.

2.14.6.1 Protocol to Group Settings

The users can add or modify the Group ID in this menu option, as shown in Figure 2.193. Here, the maximum of 16 rules are supported. "Protocol Group Setting" is used to define the protocol rule and assign a unique ID (Group ID). The value of **Group ID** is between 1 to 2147483646. The **Frame Type** can be **Ethernet**, **SNAP**, or **LLC**. The "Value" field in the webpage is the EtherType (Protocol ID).

Protocol Group Setting

Group ID (1~2147483646)	Frame Type	Value	
<input type="text"/>	Ethernet ▾	<input type="text"/>	Add

Group ID	Frame Type	Value
Empty		

Figure 2.193 Protocol to Group Setting Webpage

2.14.6.2 Group to VLAN Settings

The users can add or modify **Group ID** and for each port or multiple ports in this menu option, as shown in Figure 2.194. "Group to VLAN Setting" is used to map the **Group ID** to a VLAN ID (VID). This will map the FrameType and EtherType to a VLAN ID.

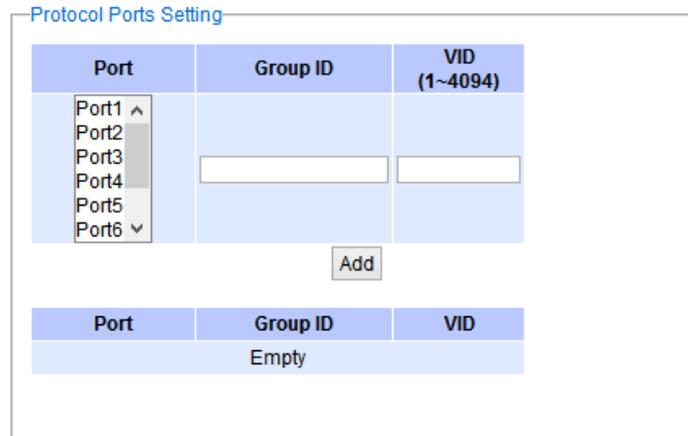


Figure 2.194 Group to VLAN Setting Webpage

2.14.7 QinQ

Originally the 802.1Q standard VLAN only allowed one VLAN tag appended in a packet. But the QinQ feature in this subsection allows two VLAN tags to be appended in a packet. The main purpose of the QinQ is for service providers to place additional VLAN tag as an external network identification and to keep the original customer's VLAN tag existed.

To understand the operation of QinQ VLAN setting, we will use an example of a network where there are two buildings called Building 1 and Building 2 that has two departments called Department A and Department B of the same company on both buildings. Department A want use the VLAN2 (TPID = 0x8100) for inside communication and Department B also want to use the VLAN2 (TPID = 0x8100) for inside communication but they do not want to communicate with each other.

The network administrators can enable the QinQ VLAN feature or double tagging VLAN function in the company managed switches. If Building 1 has the following switches: A1 (for Department A), B1 (for Department B), H1 (for Backbone network) and Building 2 has the following switches: A2 (for Department A), B2 (for Department B), and H2 (for Backbone network) then all of the switches can be configured as shown in Figure 2.195.

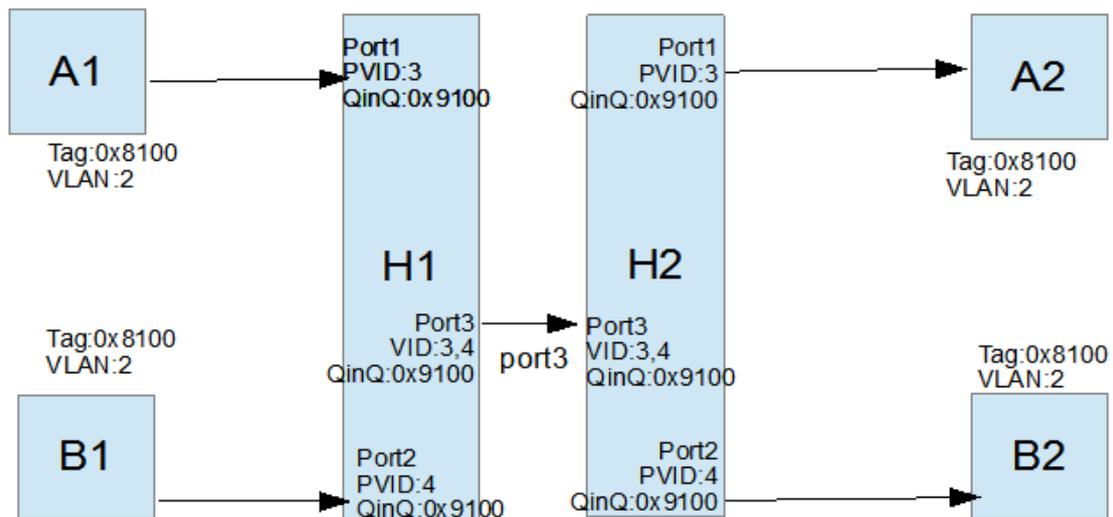


Figure 2.195 Example of QinQ Deployment

The operation of the network in Figure 2.195 based on QinQ VLAN setting rule can be described as follows.

1. Switch A1 and Switch B1 send some packets with VLAN tag (TPID=0x8100, VLAN ID=2) to H1.
2. The Switch H1 treats these received packets with VLAN tag (TPID=0x8100) as untagged packets because the receiving ports' QinQ TPID = 0x9100. These packets will be inserted the second VLAN tags (TPID=0x9100, VLAN ID = PVID).
3. The Switch H1 will switch these packets to Port3 (VLAN ID=3 or 4 depending on the incoming port number from A1 or B1).
4. The Switch H2 receives these packets and switches them by the VLAN rule. The packets with VLAN ID 3 will be sent to Port 1 and the packets with VLAN ID 4 will be sent to Port 2.
5. Before Switch H2 sends these packets out from Port 1 or Port 2, the VLAN tags (TPID=0x9100, VLAN ID=3 or 4) will be removed from these packets.

Figure 2.196 shows the QinQ Setting webpage where the QinQ function can be enabled for each port on the managed switch. When checking the corresponding enabled box behind each port, the TPID field will become active. The default TPID is set to 0x8100 which means that the QinQ feature is disable. To enable the QinQ for a port, the users need to set the TPID value. In general, it should be set to 0x9100 which must be different from the original tag's 0x8100 as described in Section 0. The TPID value should be between 0x0000 to 0xFFFF. When setting a trunk port with QinQ, it is not allowed each physical port with different QinQ setting. This means that the QinQ enabled fields and TPID fields of all physical ports in a trunk port must be the same.

The QinQ setting rule is summarized as follows:

- For ingress ports and egress ports, they use the TPID field to decide whether a packet is being with a VLAN tag or not.
 - A packet is untagged (without VLAN tag) if its TPID field is not the same as the TPID that we set for the port in the QinQ configuration.
 - A packet is tagged (with VLAN tag) if its TPID field is the same as the TPID that we set for the port in the QinQ configuration.
- Either tagged packet or untagged packet are processed by the general VLAN rule to tag a packet, untag a packet, or keep the same packet, and do the switching.
- When a packet is tagged with a VLAN tag. The tag's TPID is from the input port's QinQ setting and the tag's VLAN ID is from the input port's PVID setting.

QinQ Setting

Port	QinQ Enabled	TPID
Port1	<input type="checkbox"/>	8100
Port2	<input type="checkbox"/>	8100
Port3	<input type="checkbox"/>	8100
Port4	<input type="checkbox"/>	8100
Port5	<input type="checkbox"/>	8100
Port6	<input type="checkbox"/>	8100
Port7	<input type="checkbox"/>	8100
Port8	<input type="checkbox"/>	8100

Figure 2.196 QinQ Setting Webpage

After finish setting the QinQ feature for any of the port, please click the **Update** button to allow the setting take effect on the managed switch.

2.15 VRRP

Virtual Router Redundancy Protocol (VRRP) (RFC 3768) enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts. The VRRP routing platforms share the IP address corresponding to the default route configured on the hosts. At any moment, one of the VRRP routing platforms is the master (active) and the others are backups. An Example of VRRP configuration is depicted in Figure 2.197. If the master router fails, one of the backup routers will become the new master router. The master router provides a virtual default routing platform and enables traffic on the LAN to be routed without relying on a single routing platform. Using VRRP, a backup router can take over a failed default (master) router within a few seconds. This is performed automatically with the minimum required VRRP traffic and without any interaction with the hosts.

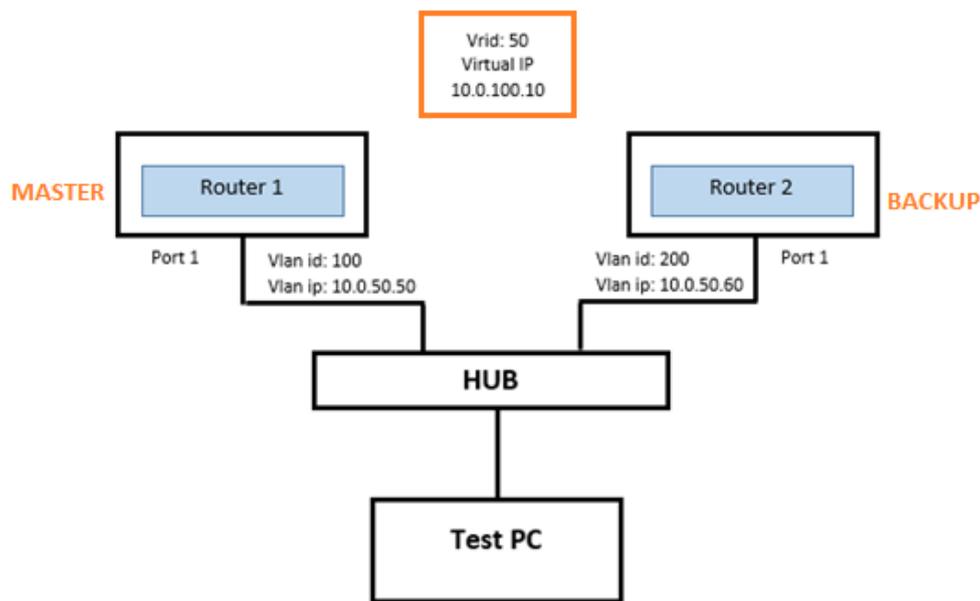


Figure 2.197 Overview of the VRRP

Figure 2.198 shows the dropdown menu for VRRP section on the EHG76XX L3 managed switch. The VRRP menu consists of the following options: VRRP, Setting, and Restart. These menus will allow the user to check the status of VRRP whether it is enabled or disabled, to configure the VRRP Virtual Router IDs and Virtual Interfaces, and to restart the VRRP.

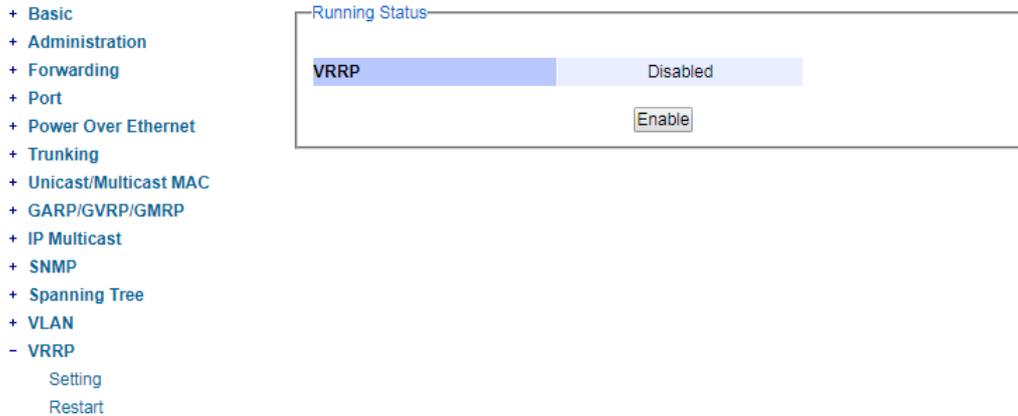


Figure 2.198 VRRP Dropdown Menu

2.15.1 VRRP

The VRRP main page as shown in displays the current status of VRRP under the **Running Status** box. If the VRRP is enabled and running, this page will allow the user to disable/stop the VRRP by clicking on **Disable** button. If the VRRP is disabled/not running, this page will allow the user to enable/run the VRRP by clicking on **Enable** button.

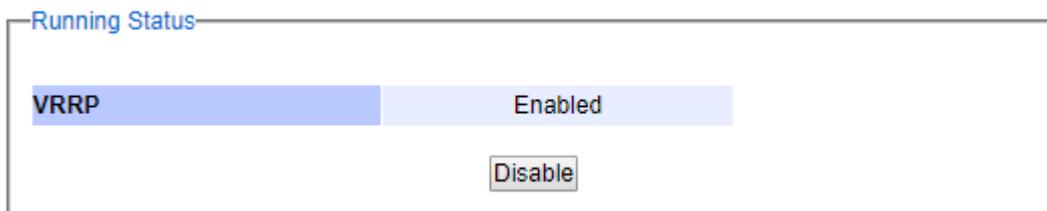


Figure 2.199 VRRP Running Status

2.15.2 Setting

In this VRRP's **Setting** web page, the user can configure the VRRP by adding new **Virtual Router**, adding new **VRRP Virtual interface** and modifying any **Current VRRP Settings**. Figure 2.200 shows the three boxes on the **Setting** web page.

Add Virtual Router

Enable Virtual MAC	<input type="checkbox"/>		
Virtual router id	53	VLAN	Select vlan ▼
State	Backup ▼	Preemption	Disable ▼
Priority	100	Advertisement interval	1
Authentication Type	None ▼	Authentication Code	

Add Virtual Router

VRRP Virtual interface

Virtual Router Id Virtual Router Id ▼

Virtual interface

Add Virtual Interface

Current VRRP Settings

Delete

Virtual router id	VLAN	Address	Netmask	Virtual MAC	Configured State	Running State	Preemption	Priority	Advertisement interval	Authentication Type	Authentication Code	Virtual interface
-------------------	------	---------	---------	-------------	------------------	---------------	------------	----------	------------------------	---------------------	---------------------	-------------------

Update

Figure 2.200 Setting in VRRP Menu

To add the virtual router, first the user needs to configure a VLAN with an IP interface. Then the user has an option to select the **Enable Virtual MAC** checkbox and can proceed to enter the **Virtual router id** (VRID). Note that the VRID is an 8-bit number which can be from 1 to 255. Then, existing **VLAN ID** can be selected from the dropdown list on the right column and can be the number in between 1 to 4096. Next the user can assign the **State** of the virtual router whether it is a **Master** or a **Backup** by choosing from the dropdown list. Next, the **Preemption** option can be selected as either **Disable** or **Enable**. This option allows a backup router to preempt a master router. Next the **Priority** is another 8-bit number indicate the priority value of the configured virtual router. The higher values represent the higher priority. VRRP routers configured as backup router must use priority values between 1 to 254. The default priority value for VRRP routers backing up a virtual router is 150. The priority value 255 is the highest priority. The priority value of 0 means that the master router does not want to participate. Next the **Advertisement interval** is the time interval in seconds and the default value is 10 second. It is also 8-bit number which means the interval can be between 1 to 255 seconds. Finally, the last two options are the **Authentication Type** and **Authentication Code**. The VRRP's **Authentication Type** can be either **None** or **Password** which can be selected from the dropdown list. The **Password Authentication Type** means that the VRRP will use 8 characters of plain text as **Authentication Code**. Thus, the user must enter the **Authentication Code** option as a string of 8 bytes. If the string is shorter than 8 bytes, the remaining space must be cleared to zero. When no user preferences are specified, the default values of the above options will be used. After entering all the required parameters, please click on the **Add Virtual Router** button.

The next step is to add a **Virtual Interface** to the **Virtual Router ID**. The user can select the desired **Virtual Router ID** from the dropdown list and then enter the IP address in the field behind the **Virtual Interface** as shown in the **VRRP Virtual Interface** box in Figure 2.201. Note that the **Virtual Router ID** can be created as described in the previous paragraph. Then, clicking on the **Add Virtual Interface** button to finish the setting.

Figure 2.201 VRRP Virtual Interface Box under VRRP's Setting

The last box at the bottom of the VRRP's **Setting** web page is the **current VRRP Settings** as shown in Figure 2.202 and Figure 2.203. Inside the box, it is a table listing all existing virtual router id configured in the EH76XX. Each entry comprises the following columns: **Virtual router id**, **VLAN**, **Address**, **Netmask**, **Configured State**, **Running State**, **Preemption**, **Priority**, **Advertisement interval**, **Authentication Type**, **Authentication Code**, and **Virtual Interface**.

Virtual router id	VLAN	Address	Netmask	Configured State	Running State	Preemption	Priority	Advertisement interval	Authentication Type
<input type="checkbox"/> 53	1	10.0.50.1	255.255.0.0	Backup	Disabled	Disable	150	10	None

Figure 2.202 Setting in VRRP Menu after Adding Virtual Router ID (Front part)

Netmask	Configured State	Running State	Preemption	Priority	Advertisement interval	Authentication Type	Authentication Code	Virtual interface
55.255.0.0	Backup	Disabled	Disable	150	10	None		10.0.50.52

Figure 2.203 Setting in VRRP Menu after Adding Virtual Router ID (Ending part)

To update or delete an existed entry, the checkbox in the front (before virtual router ID) must be selected first, before clicking on the **Update** button on the front of the entry or **Delete** button on the back of the entry. The user can perform the following instructions to update or delete some values in the existing entry.

- The **Priority** or the **Advertisement interval** can be modified by keying in the new values and clicking on the **"Update"** button on the bottom front.
- The **Configured state** and the **Preemption** can be modified by selecting value from the drop-down menu and clicking on the **"Update"** button.
- The **Authentication type** can be modified by selecting the value from the drop-down menu while the value of the **authentication code** can be modified by entering in a new string of 8 characters and clicking on the **"Update"** button.
- The **Virtual Interface** can be deleted by selecting the IP Address and clicking on the **"Delete"** button on the very right end of the entry.
- The **VRRP Virtual Router ID** can be deleted by selecting Virtual Router ID entry and clicking on the **"Delete"** button.
- The **VLAN ID** can only be modified to a new value if a new VLAN is already created.

2.15.3 Restart

VRRP needs to be restarted for any change in VRRP configuration to take effect. Figure 2.204 displays the **Restart** button in **VRRP Restart** web page. Clicking on the **Restart** button to restart VRRP.



Figure 2.204 Restart in VRRP Menu

2.16 DHCP Server

The user can set up a DHCP (Dynamic Host Configuration Protocol) server inside the EHG76XX industrial L3 managed switch. Multiple VLANs (Virtual Local Area Networks) can be configured as depicted in Figure 2.205. For each VLAN, the DHCP server's setting can support two DNS (Domain Name Server) servers, two Gateways (routers) and two NetBIOS servers. Inside each VLAN, the user can configure multiple dynamic IP address ranges and a static IP address for a specific MAC address.

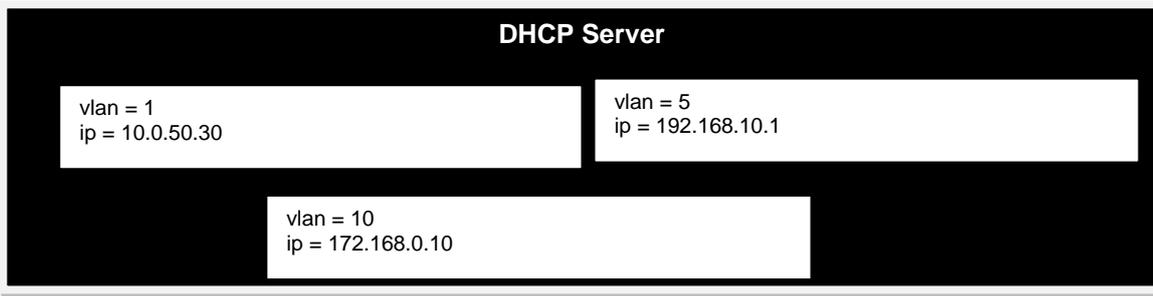


Figure 2.205 Multiple VLANs for a DHCP Server

Figure 2.206 shows the dropdown menu for **DHCP Server** section on the managed switch, which consists of **Setting**, **Clients**, and **Restart** submenus.



Figure 2.206 DHCP Server Dropdown Menu

Figure 2.207 shows the **DHCP Server**'s current status. If the DHCP server is enabled and running, the user can disable/stop the DHCP server by clicking on the **Disable** button below the **Running Status** box. Otherwise, if the DHCP server is disabled/not running, user can enable/run the DHCP server by clicking on the **Enable** button below the **Running Status** box. Note that the DHCP Server need to be configured in the next subsection before the user can enable the DHCP Server here.

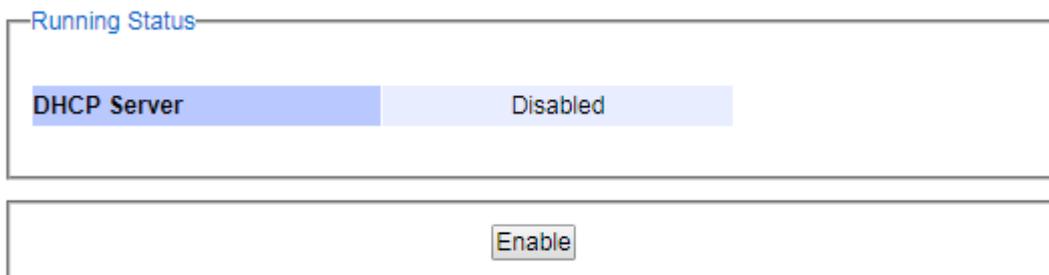


Figure 2.207 Status of the DHCP Server

2.16.1 Setting

In **Setting** dropdown submenu, the DHCP server inside the EHG76XX can be configured. As described earlier, each **VLAN** can be configured with **Lease Time**, two **Domain Name Servers**, two **Gateways**, and two **Netbios Servers** as shown in Figure 2.208. Note that the **Lease Time** is the duration of time that the IP address which is assigned to a client will be expired.

2.16.1.1 Adding VLAN

Configure DHCP Server			
VLAN	1	Lease Time	
Domain Name Server1		Domain Name Server2	
Gateway1		Gateway2	
Netbios Server1		Netbios Server2	
Add VLAN			

Figure 2.208 DHCP Server's Setting Submenu

Multiple **VLAN IDs** can be added to the **DHCP Server**. This will enable any client joining a specific **VLAN** to obtain an IP address from the **DHCP Server** inside the EHG76XX. Only VLANs that are already configured with IP interfaces can be added to the **DHCP server**. First, the user should select the **VLAN ID** from the dropdown list. The available option for **Lease Time** are: 1 Hour, 12 Hours, 1 Day, 7 Days, 15 Days, 30 Days, 45 Days, 90 Days, 120 Days. Then, the user should enter all the fields inside the **Configure DHCP Server** box. When no IP addresses are specified for **Domain Name Servers**, **Gateways**, and **Netbios Servers**, the default values which are set to 0.0.0.0 will be used. The default value of **Lease Time** is 3,200 seconds. Finally, clicking on the **Add VLAN** button will add a **VLAN** to the **DHCP server**.

The user can configure either dynamic or static IP address assignment by DHCP Server for each VLAN. These can be done under the **Add Dynamic IP** or **Add Static IP** boxes as shown in Figure 2.209 and Figure 2.210, respectively.

2.16.1.2 Adding Dynamic IP Address Ranges

To add dynamic IP address, the user need to select a specific **VLAN ID** from the dropdown list inside the **Add Dynamic IP** box as shown in Figure 2.209. Then, the user must enter a starting IPv4 address in the **Dynamic IP Start** field and enter an ending IPv4 address in the **Dynamic IP End** field. Finally, clicking on the **Add Dynamic IP** button to update the data.

Add Dynamic IP			
VLAN	Select vlan		
Dynamic IP Start		Dynamic IP End	
Add Dynamic IP			

Figure 2.209 Add Dynamic IP Address in DHCP Server's Setting Submenu

2.16.1.3 Adding Static IP Address

The user can add a static IP address for a client (host) that joins a VLAN under the DHCP Server. To add a new static IP address, first the user must select a **VLAN ID** from the dropdown list inside the **Add Static IP** box as shown in Figure 2.210. Then, the desired **Static IP** address, the **Host Name**, and the **MAC Address** of the host must be entered. Note that the **Host Name** must be entered without spaces in between. Finally, clicking on the **Add Static IP** button to update the entry into the DHCP Server.

Add Static IP

VLAN	1	Static IP	10.0.0.30	Host Name	dhcptest	MAC Address	FC:45:96:83:47:55
Add Static IP							

Figure 2.210 Add Static IP Address in DHCP Server's Setting Submenu

2.16.1.4 Modification of DHCP Server Configuration

To updating or deleting DHCP Server Configuration of a VLAN, the user can modify an entry in the list of **VLAN** inside the **Current DHCP Settings** box as shown in Figure 2.211. An entry must be selected by clicking on the checkbox in front of it. Then, the user can follow one of the instructions listed below to update or delete some values in the existing entry.

Current DHCP Settings

Delete

	VLAN	IP	Netmask	Lease Time	Dynamic Address Range	Static Addresses
<input type="checkbox"/>	1	10.0.50.30	255.255.0.0	3200	10.0.50.35 - 10.0.50.45	"10.0.0.30" FC:45:96:83:47:55

Update

Figure 2.211 Modify DHCP Server Configuration in DHCP Server's Setting Submenu

- Domain Name Servers and/or Gateways and/or Netbios Servers can be modified by keying in Domain Name Server (Domain Name Server 1 and/or Domain Name Server 2), and/or Gateway (Gateway1 and/or Gateway2), and/or Netbios (Netbios1 and/or Netbios2). Then, click an **"Update"** button.
- Dynamic IP address range can be deleted. However, one of the **Dynamic Address Ranges** must be selected from the dropdown list first. Then, clicking on the **"Delete"** button to remove that dynamic IP address range.
- Static IP address can be deleted. Once again, one of the **Static Addresses** must be selected from the dropdown list first. Then, clicking on the **"Delete"** button to remove that static IP address.
- A VLAN configuration in the DHCP Server can be deleted. However, one of VLAN entries must be selected first. To remove that VLAN configuration, then clicking on the **"Delete"** button.
- A VLAN can be modified into a new VLAN only if that new VLAN is already created.

2.16.2 Clients

In **Clients** dropdown submenu, the **DHCP Server's Client details** are displayed for each VLAN in a table format as shown in Figure 2.212. The columns in the table are **VLAN**, **Client Name** or host name, **IP Address**, **MAC** address, **Lease Start**, and **Lease End**. Note that all configured static IP addresses will always be listed in the table even though they are not assigned to any clients. However, the dynamic IP addresses which were already assigned to clients will be shown in the list.

DHCP Server Client details

VLAN	Client Name	Address	MAC	Lease Start	Lease End
1					
	-	10.0.50.36	50:7b:9d:9c:64:6b	2000/10/2 22:55:10	2000/10/2 22:55:20
	-	10.0.50.35	50:7b:9d:ca:2e:f6	2000/10/2 22:55:19	2000/10/2 22:55:29
	host1	*10.0.0.30	50:7B:9D:9C:64:6B	-	-
10					
	-	192.168.10.40	50:7b:9d:9c:64:6b	2000/10/2 23:11:29	2000/10/2 23:11:39

Figure 2.212 Client Menu in DHCP Server's Dropdown Menu

2.16.3 Restart

For the DHCP Server's configuration to take effect after any modification, the user needs to restart the DHCP server inside the EHG76XX. Click **Restart** button in **DHCP Restart** box under **Restart** dropdown submenu to restart the DHCP Server.



Figure 2.213 Restart Menu in DHCP Server's Dropdown Menu

2.17 Security

Three security features are provided in EHG7XXX series:

- Port Security (Static)
- 802.1X
- Access Control List (ACL)
- MACsec (Media Access Control Security or IEEE 802.1AE)

Figure 2.214 shows the dropdown menu for security section on the managed switch.

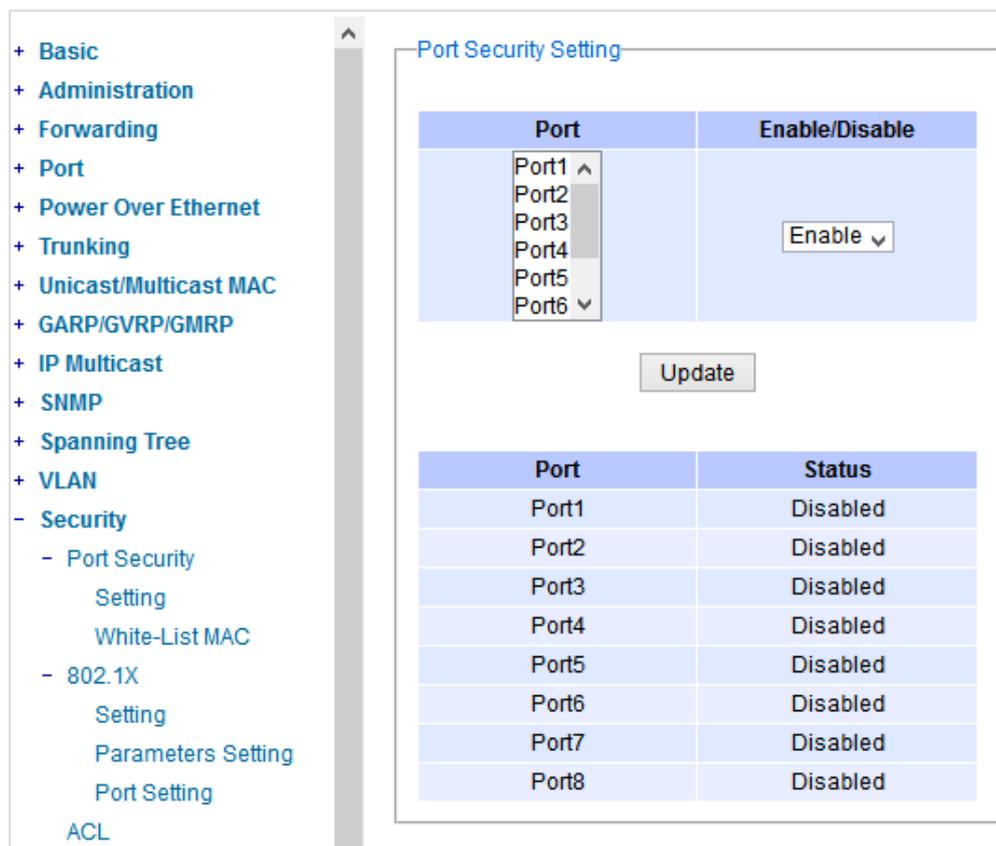


Figure 2.214 Security Dropdown Menu

2.17.1 Port Security

Port Security or static port security subsection allows the users to control security on each port of the managed switch and create a table of MAC addresses allowed to access the switch. The **Port Security** menu is subdivided into two sub-menus which are **Setting** and **White-List MAC**.

2.17.1.1 Port Security Settings

Figure 2.215 displays the Port Security Setting webpage where the users can enable or disable static security on one or multiple ports. To enable or disable multiple ports at the same time please hold the **Ctrl** key and select multiple ports under the **Port** list and choose **Enable** or **Disable** and then click **Update** button. The lower part of the Port Security Setting webpage shows the current status of security setting for each port on the managed switch.

Port Security Setting

Port	Enable/Disable
<ul style="list-style-type: none"> Port1 ^ Port2 Port3 Port4 Port5 Port6 v 	<div style="border: 1px solid gray; padding: 2px; display: inline-block;">Enable v</div>

Port	Status
Port1	Disabled
Port2	Disabled
Port3	Disabled
Port4	Disabled
Port5	Disabled
Port6	Disabled
Port7	Disabled
Port8	Disabled

Figure 2.215 Port Security Setting Webpage

2.17.1.2 Port Security White-List MAC

The White-List MAC webpage is depicted in Figure 2.216. The users can create a list of MAC address that will be allowed to access the managed switch. The users will need to specify the VLAN ID (VID) and port number for each particular MAC address added to this list. After entering all required fields, please click on the **Add** button to add the new MAC address into the white list. Please remember that the same MAC address cannot be assigned to two different ports. This will cause an error message. Note that if there are existing MAC address on the list and the users would like to remove them, please click on the **Remove** button at the end of each record. Image below summarizes the descriptions of the fields in White-List MAC webpage.

White-List MAC

MAC Address	VID	Port
Empty		

MAC Address	VID (1-4094)	Port
<input type="text"/>	<input type="text"/>	Port1 v

Figure 2.216 White-List MAC Webpage

Table 2.47 Description of Fields in White-List MAC Webpage

Label	Description
MAC Address	Type the suitable MAC address
Ports	Choose the desired ports
Remove	Option to remove the corresponding MAC address
Add	Click to add a MAC address
VLAN	Specify the corresponding VLAN address to MAC address

2.17.2 802.1X

802.1X is an IEEE standard for port-based Network-Access Control. It provides an authentication mechanism to devices that want to attach to a LAN or WLAN. This protocol restricts unauthorized clients from connecting to a LAN through ports that are opened to the Internet. The authentication basically involves three parties (see Figure 2.217): a supplicant, an authenticator, and an authentication server.

- **Supplicant:** A client device that requests access to the LAN.
- **Authentication Server:** This server performs the actual authentication. We utilize RADIUS (**R**emote **A**uthentication **D**ial-In **U**ser **S**ervice) as the authentication server.
- **Authenticator:** The Authenticator is a network device (i.e. the EH7XXX Industrial Managed Switch) that acts as a proxy between the supplicant and the authentication server. It passes around information, verifies information with the server, and relays responses to the supplicant.

The authenticator acts like a security guard to a protected network. The supplicant is not allowed accessing to the protected side of the network through the authenticator until the supplicant's identity has been validated and authorized. With 802.1X authentication, a supplicant and an authenticator exchange **EAP (Extensible Authentication Protocol)**, an authentication framework widely used by IEEE). Then the authenticator forwards this information to the authentication server for verification. If the authentication server confirms the request, the supplicant (client device) will be allowed to access resources located on the protected side of the network.

RADIUS: The RADIUS is a networking protocol that provides authentication, authorization and accounting (AAA) management for devices to connect and use a network service. Figure 2.217 shows a diagram of RADIUS authentication sequence.

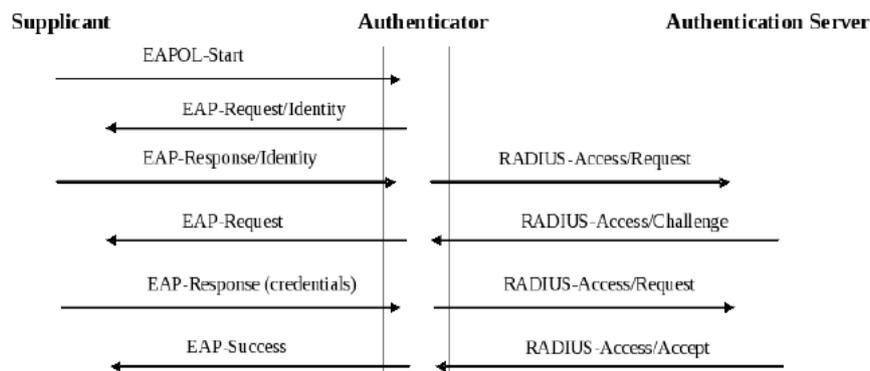


Figure 2.217 RADIUS Authentication Sequence

The **802.1X** option under the Security section is subdivided into three sub-menus which are: **Setting, Parameters Setting, and Port Setting.**

2.17.2.1 802.1X Settings

The 802.1X security mechanism can be enabled in this webpage as shown in Figure 2.218. When the users check the Enabled box, the rest of the option fields will become active. The users then have to enter all the required fields to configure the 802.1X Setting which are the IP address of RADIUS server, the RADIUS server's port number, RADIUS server's accounting port number, NAS identifier, and shared key. Summary of 802.1X Setting options are given in Table 2.48. After changing all the required fields, please click on the **Update** button.

Figure 2.218 802.1X Setting Webpage

Table 2.48 Descriptions of 802.1X Setting

Label	Description	Factory Default
802.1x	Choose whether to Enable 802.1X for all ports or not	Disabled
Radius Server IP	Set RADIUS server IP address	0.0.0.0
Server Port	Set RADIUS server port number. The range is 0 ~ 65535.	1812
Accounting Port	Set the accounting port number of the RADIUS server. The range is 0 ~ 65535.	1813
NAS Identifier	Specify the identifier string for 802.1X Network Access Server (NAS). Max. Of 30 characters.	Managed Switch
Shared Key	A shared key between the managed switch and the RADIUS Server. Both ends must be configured to use the same key. Max. Of 30 characters.	NULL
Confirm Shared Key	Re-type the shared key string.	Dependent

2.17.2.2 802.1X Parameters Settings

There are a number of 802.1X parameters that the users might want to fine tune. This can be done on this webpage as shown in Figure 2.219. These parameters are related to the authentication periods or timeout durations and maximum number of authentication requests. Table 2.49 summarizes the descriptions of these parameters and their default setting. Please clicking on the Update button after the users changed any of the parameters.

Label	Description	Factory Default
Quiet Period (10~65535)	Waiting time between requests when the authorization has failed. Range from 10 to 65535 seconds.	60
Tx Period (10~65535)	Waiting time for the supplicant's EAP response packet before retransmitting another EAP request packet. Range from 10 to 65535 seconds.	15
Supplicant Timeout (10~300)	Waiting time for the supplicant to response to the authentication server's EAP packet. Range from 10 to 300 seconds.	30
Server Timeout (10~300)	Waiting time for the authentication server to response to the supplicant's EAP packet. Range from 10 to 300 seconds.	30
Maximum Requests (2~10)	Maximum number of the retransmissions that the authentication server sends EAP request to the supplicant before the authentication session times out. Range from 2 to 10 seconds.	2
Reauth Period (30~65535)	Time between periodic re-authentication of the supplicant. Range from 30 to 65535 seconds.	3600

Figure 2.219 802.1X's Parameters Setting Webpage

Table 2.49 Descriptions of 802.1X Parameters

Label	Description	Factory Default
Quiet Period	Waiting time between requests when the authorization has failed. Range from 10 to 65535 seconds.	60
Tx Period	Waiting time for the supplicant's EAP response packet before retransmitting another EAP request packet. Range from 10 to 65535 seconds.	15
Supplicant Timeout	Waiting time for the supplicant to response to the authentication server's EAP packet. Range from 10 to 300 seconds.	30
Server Timeout	Waiting time for the authentication server to response to the supplicant's EAP packet. Range from 10 to 300 seconds.	30
Maximum Requests	Maximum number of the retransmissions that the authentication server sends EAP request to the supplicant before the authentication session times out. Range from 2 to 10 seconds.	2
Reauth Period	Time between periodic re-authentication of the supplicant. Range from 30 to 65535 seconds.	3600

2.17.2.3 802.1x Port Setting

The user can individually configure 802.1x security mechanism on each port of the EHG7XXX managed switch as shown in Figure 2.114. Each port can be set for any of the four authorization modes which are Force Authorization, Force Unauthorization, IEEE 802.1X Standard Authorization, and no authorization (N/A) as described in Table 2.48. The lower part of the webpage is a table display the current status of authorization mode and state of each port on the managed switch. To enable the 802.1X security on any of the port(s), click one of the port or press **Ctrl** key and click multiple ports on the list and choose the Authorization **Mode** from the pulldown list and click the **Update** button. To check the latest status of the 802.1X port setting, please click on the **Refresh** button.

Port	Mode	State
Port1	Standard Authorization	Initialize
Port2	Force Authorized	Initialize
Port3	Force Unauthorized	Initialize
Port4	N/A	Initialize
Port5	N/A	Initialize
Port6	N/A	Initialize
Port7	N/A	Initialize
Port8	N/A	Initialize

Figure 2.220 802.1x Port Setting Webpage

Table 2.50 Descriptions of 802.1X Port Setting

Label	Description	Factory Default
Port	Set specific ports to be configured.	Option
Mode	Choices: Force Unauthorized: Specify forced unauthorized Force Authorized: Specify forced authorized Standard Authorization: Specify authorization based on IEEE 802.1X N/A: Specify disable authorization	N/A

2.17.3 ACL

Access Control List (ACL) is the mechanism for network access control. The users configure the switch's filtering rules for accepting or rejecting some packets. Two types of filters are deployed in the EHG7XXX series:

- 1) by MAC layer, and
- 2) by IP layer.

The numbers of matching rules can be at most 128. However, the main important rules that are mostly exercise are follows. Rules for filtering by MAC layer includes MAC address, VLAN ID or Ether type. Whereas, rules for filtering by IP layer includes IP protocol, IP address, TCP/UDP port or Type of Service (TOS). When filtering is enabled, the matching rules are used to check whether the receiving packet is matched. If it is match, the packet will be rejected; otherwise it will be accepted. Note here that the matching rules later will be referred to as the entries of ACL.

The ACL webpage is depicted in Figure 2.221. To differentiate between each ACL entry, **Index** number from 1 to 128 is used. The ACL entry that has higher priority will be checked first before the lower priority. The **Name** field is for setting name of this rule. Type of filtering whether MAC layer ("**Mac Base**") and IP layer ("**IP Base**") can be set in the **Filter** field. Note that when change from Mac Base to IP Base the required parameters for ACL setting will be changed accordingly.

The screenshot shows the 'ACL Information' configuration page. It includes a form with the following fields and options:

- Index:** Input field with a hint '(1-128,empty:auto)'. Below the form are 'Add', 'Modify', and 'Remove' buttons.
- Name:** Input field.
- Filter:** Dropdown menu set to 'Mac Base'.
- Source MAC Address:** Two input fields labeled 'Address:' and 'Mask:'.
- Destination MAC Address:** Two input fields labeled 'Address:' and 'Mask:'.
- VLAN ID:** Input field with a hint '(1~4094)'. Below the form are 'Add', 'Modify', and 'Remove' buttons.
- VLAN Priority Tag:** Input field with a hint '(0~7)'. Below the form are 'Add', 'Modify', and 'Remove' buttons.
- Ether Type:** Input field with a hint '(0~FFFF)'. Below the form are 'Add', 'Modify', and 'Remove' buttons.
- Port:** A row of checkboxes for Port1, Port2, Port3, Port4, Port5, Port6, Port7, and Port8.
- Action:** Dropdown menu set to 'Deny'.

Below the form is a table with columns: Index, Name, Action, Src Mac, Dst Mac, VLAN ID, VLAN Priority, Ether Type. The table has navigation buttons: '<< Previous Page', 'Next Page >>', and 'Clear All'.

Figure 2.221 Security Access Control List Information Webpage (MAC Based Filtering)

The main ACL entries for filtering by MAC layer (also called L2 filtering) as shown in Figure 2.221 include MAC address, VLAN ID, VLAN Priority Tag and Ether Type. Table 2.51 describes definition of each in details. Here note that if any field is empty, that ACL entry will be ignored.

Table 2.51 Descriptions of Main ACL Entries for L2 Filtering in ACL Webpage

ACL Entry	Definition	Range
Source or Destination MAC Addresses	MAC address are the fields of the Ethernet frame header. The Mask item is a bit mask for comparing range.	For every non-zero bit in the Mask, its relative bit in the IP address will be compared. If the Mask is 0.0.0.0, then this condition is always accepted. If the Mask is empty, it is considered equal to the Mask of 255.255.255.255 and all of bits in the IP Address are compared.
VLAN ID	The VLAN ID field of 802.1Q VLAN tag in the Ethernet frame header. If the trunk ports	The item value is between 1~4094.

	are created, they will also be shown on the port list. If you want to select a trunk port, please make sure that there are no ACL entry using the physical ports which are belonging this trunk port.	
VLAN Priority Tag	The Priority field of 802.1Q VLAN tag in the Ethernet frame header.	The item value is between 0~7.
Ether Type	The Ethernet type field in the Ethernet frame header. The followings are examples. The value 0x8000 is an IPv4 packet. The value 0x86DD is an IPv6 packet. The value 0x8100 is an 802.1Q packet.	The item value is between 0~0xFFFF.

The main ACL entries for filtering by IP layer (also called L3 filtering) as shown in Figure 2.222 include IP Protocol, Source IP Address, Destination IP address, TCP/UDP Source Port, TCP/UDP Destination Port and TOS. Table 2.52 describes definition of each in details. Once again, note that if any field is empty, that ACL entry will be ignored.

ACL Information

Index	<input type="text"/>	(1-128,empty:auto)
Name	<input type="text"/>	
Filter	IP Base	▼
IP Protocol	<input type="text"/>	(0~65535)
Source IP Address	Address: <input type="text"/>	Mask: <input type="text"/>
Destination IP Address	Address: <input type="text"/>	Mask: <input type="text"/>
TCP/UDP Source Port	<input type="text"/>	(0~65535)
TCP/UDP Destination Port	<input type="text"/>	(0~65535)
TOS	<input type="text"/>	(0~63)
Port	<input type="checkbox"/> Port1 <input type="checkbox"/> Port2 <input type="checkbox"/> Port3 <input type="checkbox"/> Port4 <input type="checkbox"/> Port5 <input type="checkbox"/> Port6 <input type="checkbox"/> Port7 <input type="checkbox"/> Port8	
Action	Deny ▼	

Add Modify Remove

<< Previous Page Next Page >> Clear All

Index	Ind	Name	Action	Src Mac	Dst Mac	VLAN ID	VLAN Priority	Ether T
<	>	<						>

<< Previous Page Next Page >> Clear All

Figure 2.222 Security Access Control List Information Webpage (IP Based Filtering)

Table 2.52 Description of Main ACL Entries for L3 Filtering in ACL Webpage

ACL Entry	Definition	Range
IP Protocol	The Protocol field of the IPv4 packet header. The followings are examples. The value 1 is for an ICMP packet. The value 6 is for the TCP packet. The value 17 is for the UDP packet.	The item value is between 0~65535.
Source or Destination IP Addresses	The VLAN ID field of 802.1Q VLAN tag in the Ethernet frame header. The Mask item is a bit mask for comparing range.	For every non-zero bits in the Mask, its relative bit in the IP address will be compared. If the Mask is 0.0.0.0.0.0, then this condition is always accepted. If the Mask is empty, it is

		considered equal to the Mask of FF:FF:FF:FF:FF:FF and all of bits in the IP Address are compared
TCP/UDP Source Port / TCP/UDP Destination Port	The fields of TCP/UDP frame header. It is used to filter the application services. For example, the TCP Destination Port 21 is for the FTP service, the TCP Destination Port 23 is for the Telnet service and the TCP Destination Port 80 is for the HTTP service. To select which ports will follow the filter rule and what action to take, check the checkbox corresponding to that port and select choice of "Deny" or "Permit" in the action field. If this ACL entry is match, rejecting packet if 'Deny' is selected, and accepting packet if 'Permit' is selected.	The item value is between 0~65535.
TOS (Type of Service)	A Differentiated Service Code Point (DSCP) field in an IPv4 header. It is used for providing Quality of Service (QoS).	The item value is between 0~63.

Table 2.53 Summary of Label, Description, and Factory Default for Both ACL Filtering Method

LABEL	DESCRIPTION	FACTORY DEFAULT
Index	Priority (1-128)	NONE
Name	Max length 32	NONE
Filter	Mac Base/IP Base	Mac Base
Source MAC Address and Mask	A:B:C:D:E:F. is the MAC address. Mask is for bit mask checking. 0.0.0.0.0.0 is for accepting all. Empty is as FF:FF:FF:FF:FF:FF.	NONE
Destination MAC Address and Mask	A:B:C:D:E:F. is the MAC address. Mask is for bit mask checking. 0.0.0.0.0.0 is for accepting all. Empty is as FF:FF:FF:FF:FF:FF.	NONE
VLAN ID	1-4094	NONE
VLAN Priority Tag	0 ~ 7	NONE
Ether Type	0-FFFF	NONE
IP Protocol	0-65535	NONE
Source IP Address	A.B.C.D is the IP address. Mask is for bit mask checking. 0.0.0.0 is for accepting all. Empty is as 255.255.255.255.	NONE
Destination IP Address	A.B.C.D is the IP address. Mask is for bit mask checking. 0.0.0.0 is for accepting all. Empty is as 255.255.255.255.	NONE
TCP/UDP Source Port	0-65535	NONE
TCP/UDP Destination Port	0-65535	NONE
TOS	0-63	NONE
Port	1,2,3,4,5,6,7,8, trk1, trk2	NONE
Action	Deny/Permit	NONE

The users can **Add**, **Modify**, or **Remove** each ACL entry based on the Index number as shown in Figure 2.221 and Figure 2.222. The lower part of the ACL Information webpage is the list of all ACL entries The user can browse through the list by using the **Previous Page** and **Next Page** buttons To remove all of the ACL entries from the list, click on the **Clear All** button.

2.18 MACsec (802.1AE) * (selected devices only)

Selected versions, such as RHG76XX (in its secure modules) and EHG77XX series, support advanced security features that allow traffic encryption and high throughput. MACsec or Media Access Control Security is a security standard specified by IEEE also called IEEE 802.1AE. This IEEE MAC security standard provides connectionless user data confidentiality, frame data integrity, and data origin authenticity. MACsec can establish point-to-point security on Ethernet links between directly connected nodes. ATOP's Secure managed switches support this security feature and can be used to transparently secure an IEEE 802 LAN connection to a peer device (such as another managed switch) that also supports the MACsec.

MACsec defines two terms called secure channel and connectivity association when setting up a secure communication between two switches. A secure channel in MACsec is unidirectional and used for transmitting (outbound traffic) or receiving (inbound traffic) data. A connectivity association when MACsec is enabled consists of two secure channels: one for inbound traffic and one for outbound traffic.

The point-to-point links can be secured by MACsec after matching security keys are exchanged and verified between the ports on two different Secure managed switches. There are two modes for setting up the security keys.

1. Static Association Key (SAK):

The static secure association key (SAK) security mode is when the user manually configured the same static secure association key (SAK) on both sides of a connection. There is no key server in this mode and the key must be matched on the ports of both managed switches. This can be viewed as setting up two secure channels within a connectivity association. It is suggested to have a periodic manual key update in order to prevent the key to be broken by brute-force attack.

2. Connectivity Association Key (CAK):

The static connectivity association key (CAK) security mode is when the user configured a pre-shared key which consists of a connectivity association name (CKN) and a connectivity association key (CAK), which will be used to randomly generate a secure association key (SAK) later. The MACsec Key Agreement (MKA) protocol (defined in IEEE 802.1x standard) is responsible for maintaining MACsec on the link and chooses which managed switch on the link will become the key server. The key server then automatically creates a SAK that is shared with the other managed switch, and that SAK is used to secure the traffic between the link. The key server will periodically create and share a fresh SAK over the link for secure key changing. It is suggested to have a periodic manual key update in order to prevent the key to be broken by brute-force attack.

2.18.1 Static SAK

Static secure association key (SAK) setting webpage is shown in Figure 2.223. To enable secure association mode on Secure managed switch's port(s), first select **one or multiple ports** from the list under the Ports. Then, check the **Enabled** box. Then, enter the **Secure Channel Identifier (SCI)** with a 16-digit hexadecimal number (i.e., 0,1,2,...,a,b,c,d,e,f) and enter the **Secure Association Key (SAK)** with a 32-digit hexadecimal number. Finally, click on the **Add/Modify** button to add the setting to the table below.

The selected port(s) will use the given static SAK as the secure key to secure all the traffic. If any two managed switches have the same SCI and SAK, they can securely communicate. If there is any non-secured traffic that uses incorrect SCI and SAK, the traffic will be dropped by the ingress port of the switch. The description of the static SAK setting fields are summarized in Table .

Note that the static SAK mode and the static CAK mode are mutually exclusive mode. Each port can only be enabled in one of the two modes at a time.

The screenshot shows the 'Static SAK Setting' webpage. At the top, there is a table with columns: Ports, Enabled, SCI, and SAK. Below this is an 'Add / Modify' button. The main table lists ports from Port1 to Port8. Port3 is checked in the 'Enabled' column and has SCI and SAK values filled in. The other ports have '0' in the SCI and SAK columns.

Ports	Enabled	SCI	SAK
Port1	<input type="checkbox"/>		
Port2	<input type="checkbox"/>		
Port3	<input checked="" type="checkbox"/>	1234567890123456	12345678901234567890123456789012
Port4	<input type="checkbox"/>	0	0
Port5	<input type="checkbox"/>	0	0
Port6	<input type="checkbox"/>	0	0
Port7	<input type="checkbox"/>	0	0
Port8	<input type="checkbox"/>	0	0

Figure 2.223 Static SAK Setting Webpage

Table 2.54 Description of Static SAK Setting Webpage

Label	Description	Factory Default
Port	Set specific ports to be configured.	Option
Enabled	Check the box to enable static secure association key (SAK) mode for the selected port(s)	Unchecked
SCI	Secure Channel Identifier (SCI) is a 16-digit hexadecimal number. Note that if the user did not configure all digits of SCI, all remaining digits will be auto-configured to 0s.	0
SAK	Secure Association Key (SAK) is a 32-digit hexadecimal number. Note that if the user did not configure all digits of SAK, all remaining digits will be auto-configured to 0s.	0

2.18.2 Static CAK

Static connectivity association key (CAK) setting webpage is shown in Figure . To enable static connectivity association mode on Secure managed switch's port(s), first **select one or multiple ports** from the list under the Ports. Then, flag the **Enabled** checkbox. Once this is done, enter the **Connectivity Association Key Name (CKN)** with a 64-digit hexadecimal number (i.e., 0,1,2,...,a,b,c,d,e,f) and enter the **Connectivity Association Key (CAK)** with a 32-digit hexadecimal number. Finally, click on the **Add/Modify** button to add the setting to the table below.

The selected port(s) will use static CAK to operate MACsec Key Agreement (MKA) protocol for generating a Secure Association Key (SAK) between two managed switches. The generated SAK will be used to secure all the traffic

between the two switches. If any two switches have the same CKN and CAK, they can negotiate the SCI and the SAK for use in their secure traffic. If there is any non-secured traffic that uses incorrect SCI and SAK, the traffic will be dropped by the ingress port of the switch. The description of the static CAK setting fields are summarized in Table .

Note that Secure managed switch only supports two switch links in static CAK mode. Once again, the static SAK mode and the static CAK mode are mutually exclusive modes. Each port can only be enabled in one of the two modes at a time.

Ports	Enabled	CKN	CAK
Port1 - Port2 Port3 ▾	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>

Add / Modify

Port	Enabled	CKN	CAK
Port1	<input checked="" type="checkbox"/>	1234567890123456789012345678901234567890123456789012345678901234	12345678901234567890123456789012345678901234567890123456789012
Port2	<input type="checkbox"/>	0	0
Port3	<input type="checkbox"/>	0	0
Port4	<input type="checkbox"/>	123456789012345678901234567890123456789012345678901234	12345678901234567890123456789012345678901234567890123456789012
Port5	<input type="checkbox"/>	0	0
Port6	<input type="checkbox"/>	0	0
Port7	<input type="checkbox"/>	0	0
Port8	<input type="checkbox"/>	0	0

Figure 2.224 Static CAK Setting Webpage

Table 2.55 Description of Static CAK Setting Webpage

Label	Description	Factory Default
Port	Set specific ports to be configured.	Option
Enabled	Check the box to enable static connectivity association key (CAK) mode on the selected port(s)	Unchecked
CKN	Connectivity Association Key Name (CKN) is a 64-digit hexadecimal number. Note that if the user did not configure all digits of CKN, all remaining digits will be auto-configured to 0s.	0
CAK	Connectivity Association Key (CAK) is a 32-digit hexadecimal number. Note that if the user did not configure all digits of CAK, all remaining digits will be auto-configured to 0s.	0

2.19 ERPS Ring

Ethernet Ring Protection Switching (ERPS) is a protocol for Ethernet layer network rings. The protocol specifies the protection mechanism for sub-50ms delay time. The ring topology provides multipoint connectivity economically by reducing the number of links. ERPS provides highly reliable and stable protection in the ring topology, and it never forms loops, which can affect network operation and service availability. Figure 2.225 depicts an example of ring topology forming by four Atop's managed switch EH7520 series.

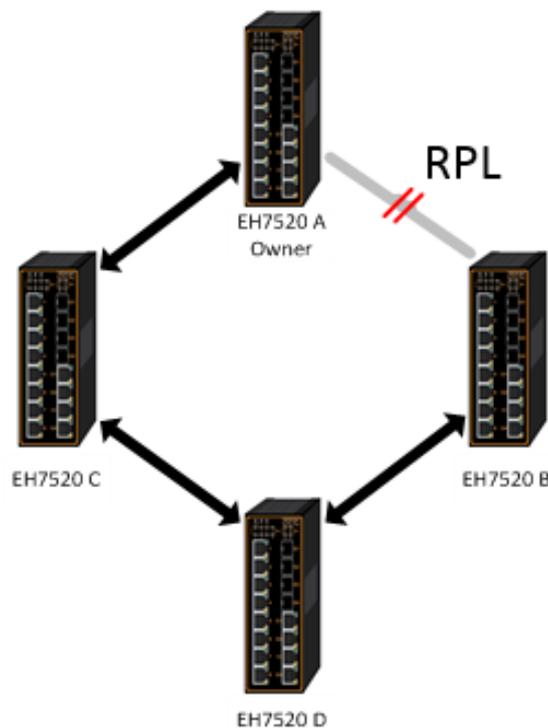


Figure 2.225 An Example of Ring Topology (Example made on EH7520)

Figure 2.225 shows that each Ethernet Ring Node is connected to its adjacent Ethernet Ring Nodes participating in the same Ethernet Ring using two independent links (i.e. two ways). In the Ethernet ring, loops can be avoided by guaranteeing that traffic may flow on all but one of the ring links at any time. This particular link is called Ring Protection Link (RPL). A control message called Ring Automatic Protection Switch (R-APS) coordinates the activities of switching on/off the RPL. Under normal conditions, this link is blocked by the Owner Node. Thus, loops can be avoided by this mechanism. In case an Ethernet ring failure occurs, one designated Ethernet Ring Node called the RPL Owner Node will be responsible for unblocking its end of the RPL to allow RPL to be used as a backup link. The RPL is the backup link when one link failure occurs.

Atop's EHGX series industrial managed switches provide a number of Ethernet ring protocol. The **ERPS/Ring** section is subdivided into five menus as shown in Figure 2.226, which are: **ERPS Setting**, **iA-Ring Setting**, **C-Ring Setting**, **U-Ring Setting**, and **Compatible-Chain Setting**.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- + VLAN
- + Security
- ERPS/Ring
 - ERPS Setting
 - iA-Ring Setting
 - C-Ring Setting
 - U-Ring Setting
 - Compatible-Chain Setting

ERPS Setting

ERPS	<input checked="" type="checkbox"/>	Enabled
Log	<input checked="" type="checkbox"/>	Enabled
UERPS	<input type="checkbox"/>	Enabled
Heartbeat Interval (50~10000)	<input type="text" value="50"/>	ms

RAPS VLAN	West Port	East Port	Node State	Configure State	
4090	Port5 (Forwarding)	Port6 (SF Blocking)	Protection	Enabled	<input type="button" value="Configure"/> <input type="button" value="Remove"/>

Add a new RAPS VLAN

RAPS VLAN	<input type="text"/>	<input type="button" value="Add"/>
-----------	----------------------	------------------------------------

Figure 2.226 ERPS/Ring Drowdown Menu

2.19.1 ESRP Setting

ERPS Setting webpage is shown in Figure 2.227. Note that the users should disable the **DIP Switch Control** in Section 2.3.12 first in order to set up ERPS parameters. To set up ERPS on the current managed switch, please follow the following steps:

1. Enable the ERPS by checking on the **ERPS's Enabled** checkbox.
2. If the users would like to keep the log, please also check the **Log's Enabled** checkbox.
3. Optionally, if the users want the switch to periodically check the status of the neighboring switches on the ring topology using heartbeat packets then the user can check the **UERPS's Enabled** checkbox. Note that when this feature is enabled, the recovery time of the ring topology may be longer.
4. Optionally, the users can fine tune the heartbeat interval by changing the default value 50 milli-seconds to the desired value.
5. Click on the **Update** button.
6. Skip down to **Add a new RAPS VLAN** section at the bottom of the webpage. Enter the desired **RAPS VLAN** ID in the field and click the **Add** button. The VLAN ID can be the value between 1 to 4094. Table 2.56 summarizes the fields in ERPS Setting webpage.

Figure 2.227 ERPS Setting Webpage

Table 2.56 Descriptions of ERPS Setting

Label	Description	Factory Default
ERPS	Choose whether to enable ERPS or not	Disabled
Log	Choose to enable log	Enabled
UERPS	Choose whether to enable UERPS. When UERPS is enabled, ring ports periodically sent a "heartbeat" packet to peer ring ports in order to determine whether the link path (etc. wireless bridge) is failure or alive. If peer ring port cannot receive "heartbeat" packets over 3 packets, the ring port will enter protection state. Note: This function affects the recovery time to more than 20 ms.	Disabled
Heartbeat Interval	Set the Heartbeat Interval. Range from 50 to 10000 milliseconds.	50 ms
RAPS VLAN	Create the ring by specifying the R-APS VLAN ID of the ring. VLAN ID ranges from 1 to 4094.	4090

- Click the **Configure** button on the right side of the webpage that corresponding to the RAPS VLAN that was entered in previous step. A new webpage will be displayed for the users to config additional parameters for **ERPS RAPS VLAN Setting** as shown in Figure 2.228.
- Configure the RAPS VLAN's **Status, West Port, East Port, RPL Owner, RPL Port, WTR Timer, Holdoff Timer, Guard Timer, MEL, and Propagate TC**. Detail description of these parameters are summarized in Table 2.57. Then, click **Update** button to finish the setting up of new RAPS VLAN.

Label	Value
RAPS VLAN	4090
Status	Enabled
West Port	Port5
East Port	Port6
RPL Owner	Disabled
RPL Port	None
WTR Timer (0~12)	0 min
Holdoff Timer (0~10000)	0 ms
Guard Timer (10~2000)	500 ms
MEL (0~7)	1
Propagate TC	Enabled

Update

Figure 2.228 ERPS RAPS VLAN Setting Webpage

Table 2.57 Description of ERPS VLAN Setting

Label	Description	Factory Default
ERPS VLAN	Indicate current RAPS VLAN ID to be configured	4090
Status	Choose to enable ERPS with this particular VLAN	Disabled
West Port	Choose the <i>West Port</i> of the RPL	Port1
East Port	Choose the <i>East Port</i> of the RPL	Port2
RPL Owner	Choose to enable Owner Function	Disabled
RPL Port	Select the <i>Owner Port</i> which is either West Port or East Port or None.	None
WTR Timer	Set the wait-to-restore (WTR) time of the ring in minutes. Lower value has lower protection time. Range of the WTR Timer is from 0 to 12 minutes.	5
Holdoff Timer	Set the holdoff time of the ring. Range of the Holdoff Timer is from 0 to 10000 milliseconds.	0
Guard Timer	Set the guard time of the ring. Range of the Guard Timer is from 0 to 2000 milliseconds.	500
MEL	Set the maintenance entity group level (MEL) of the ring. Range of MEL is from 0 to 7.	1
Propagate TC	Indicate the topology change propagation of the ring ability.	Enabled

2.19.1.1 Example of ERPS Settings

To allow the users to understand the setting up of ERPS on the EHG7XXX industrial managed switches, this subsection provides an example of ERPS setup with four Atop's managed switches as shown in Figure 2.229. Assuming that the ring network has EHG7XXX A, EHG7XXX B, EHG7XXX C, and EHG7XXX D. There is an RPL between EHG7XXX A and EHG7XXX B. Note that the figure is based on the EH7520 model but it is applicable to any of EHG7XXX models.

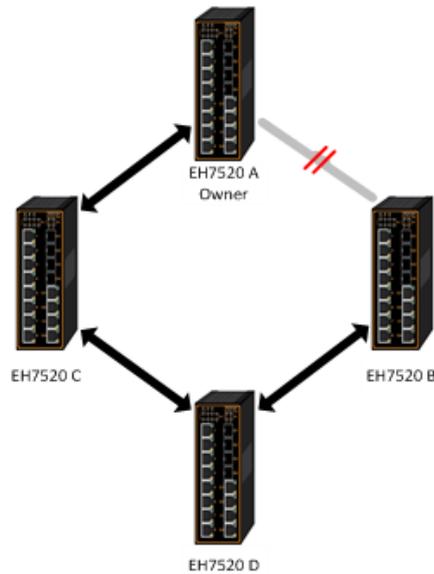


Figure 2.229 Example of Ring Topology for ERPS Setup (Example made on EH7520)

For each switch, please follow the procedure outline in previous section. First, enabling the ERPS and then add the RAPS VLAN = 8. On each managed switch, the users can configure ARPS VLAN Setting according to Table 2.58.

Table 2.58 Setting Configuration for Switch A, B, C and D

EHX7XXX	A	B	C	D
RAPS VLAN	8	8	8	8
ERPS RAPS	Enabled	Enabled	Enabled	Enabled
West Port	1	1	1	1
East Port	2	2	2	2
RPL Owner	Enabled	Disabled	Disabled	Disabled
RPL Port	West	None	None	None

2.19.1.2 UERPS Settings (Optional)

The following procedure outlines the **UERPS** Setting under the **ERPS Setting**. You can follow them as an exercise.

1. Prepare two managed switches (Switch A and Switch B). We will use Port 7 and Port 8 on both switches for redundancy.
2. Connect Switch A and Switch B to the network or PC so that you can access them. For simplicity, the users can use Port 1 for Web configuration on both switches.
3. Open Device Management Utility (described in Chapter 5) and change the IP address of Switch B or both switches such that the IP addresses will not be conflicting.
4. Open Switch A and B's WebUI and setup ERPS settings like the following. Enable ERPS, Log, and UERPS accordingly as shown in Figure 2.230. Then, press **Update** button for the changes to take effect.

ERPS	<input checked="" type="checkbox"/> Enabled
Log	<input checked="" type="checkbox"/> Enabled
UERPS	<input checked="" type="checkbox"/> Enabled
Heartbeat Interval	500 (50~10000 ms) <input type="button" value="Update"/>

RAPS VLAN	West Port	East Port	Node State	Configure State	Configure ?	Remove ?
4090	7(Forwarding)	8(Forwarding)	None	Enabled	<input type="button" value="Configure"/>	<input type="button" value="Remove"/>

RAPS VLAN	Add ?
<input type="text"/>	<input type="button" value="Add"/>

Figure 2.230 Example of Switch A's ERPS settings

5. On Switch A, Click **Configure** button on RAPS VLAN and input settings as shown in Figure 2.231.

RAPS VLAN	4090
Status	Enabled <input type="button" value="v"/>
West Port	Port7 <input type="button" value="v"/>
East Port	Port8 <input type="button" value="v"/>
RPL Owner	Enabled <input type="button" value="v"/>
RPL Port	East Port <input type="button" value="v"/>
WTR Timer	0 (0~12 min)
Holdoff Timer	0 (0~10000 ms)
Guard Timer	500 (10~2000 ms)
MEL	1 (0~7)
Propagate TC	Enabled

Figure 2.231 Example of Switch A's RAPS VLAN Settings

6. Open Switch B's WebUI and input settings for ERPS as shown in Figure 2.232.

RAPS VLAN	4090
Status	Enabled <input type="button" value="v"/>
West Port	Port7 <input type="button" value="v"/>
East Port	Port8 <input type="button" value="v"/>
RPL Owner	Disabled <input type="button" value="v"/>
RPL Port	None <input type="button" value="v"/>
WTR Timer	5 (0~12 min)
Holdoff Timer	0 (0~10000 ms)
Guard Timer	500 (10~2000 ms)
MEL	1 (0~7)
Propagate TC	Enabled

Figure 2.232 Example of Switch B's RAPS VLAN Setting

7. Connect Switch A's Port 7 to Switch B's Port 8, and connect Switch A's Port 8 to Switch B's Port 7 (like cross-over) for the redundancy port.

8. If everything is set up properly, you will find Switch A having the following ERPS state as shown in Figure 2.233. Also, it will automatically block Port 8 to prevent a network loop.

RAPS VLAN	West Port	East Port	Node State	Configure State	Configure ?	Remove ?
4090	7(Forwarding)	8(Blocking)	Idle	Enabled	Configure	Remove

Figure 2.233 Switch A's ERPS state

9. From here on, the users can add another bridge between the two managed switches.

2.19.2 iA-Ring Settings

The Atop's managed switch is designed to be compatible with iA-Ring protocol for providing better network reliability and faster recovery time for redundant ring topologies. It is in the same category as R Rings, but with its own protocol. It has been a successful development that reduces recovery time to less than 20 ms. iA-Ring can be used for any single ring, which is shown in the diagram below (Figure 2.234).

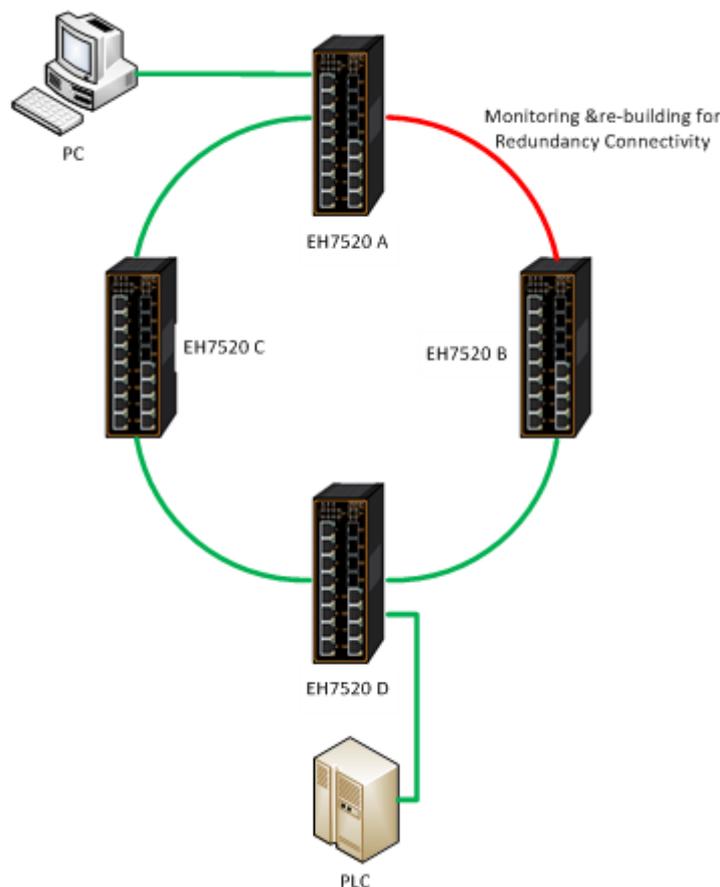


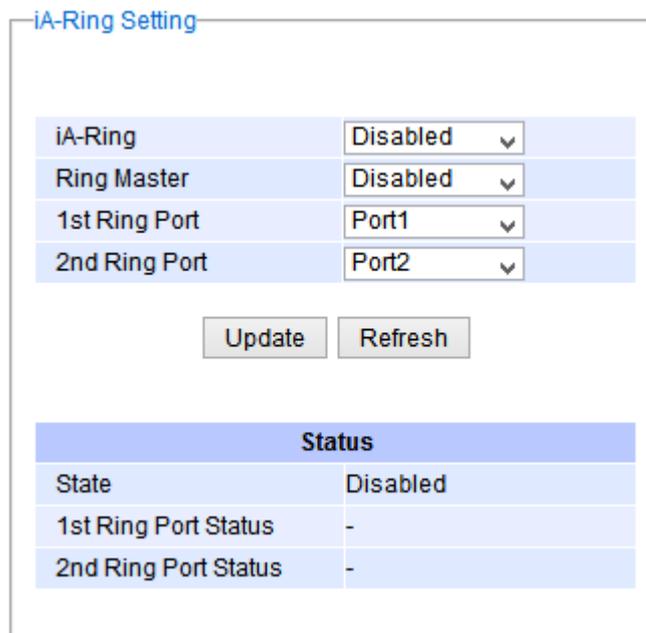
Figure 2.234 iA-Ring Example Topology (Example made on EH7520)

Figure 2.235 shows **iA-Ring Setting** webpage. The iA-Ring redundancy protocol can be enabled on this page. Note that the users should disable **DIP Switch Control** as described in Section 2.3.12 and disable **ERPS** as described in

Section 2.19.1 first in order to enable/configure iA-Ring parameters on the web browser. Please follow the simple steps below based on Figure 2.235 to setup the iA-Ring.

1. Enable the **iA-Ring** by selecting **Enabled** from the dropdown list.
2. Choose whether the current managed switch is going to be the **Ring Master** by enabling the **Ring Master** option.
3. Select the **1st Ring Port** from the dropdown list.
4. Select the **2nd Ring Port** from the dropdown list.
5. Click on the **Update** button to save the change and allow the configuration to take effect.
6. Check the latest status of the iA-Ring configuration by clicking on the **Refresh** button.

Note that the lower part of the iA-Ring Setting webpage shows the **Status** of the iA-Ring which provides its **State**, **1st Ring Port Status** and **2nd Ring Port Status**. The description of the iA-Ring setting is summarized in Table 2.59.



iA-Ring Setting	
iA-Ring	Disabled
Ring Master	Disabled
1st Ring Port	Port1
2nd Ring Port	Port2
<input type="button" value="Update"/> <input type="button" value="Refresh"/>	
Status	
State	Disabled
1st Ring Port Status	-
2nd Ring Port Status	-

Figure 2.235 iA-Ring Setting Webpage

Table 2.59 Descriptions of iA-Ring Setting

Label	Description	Factory Default
iA-Ring	Enable iA-Ring or disable iA-Ring.	Disabled
Ring Master	Enabled: Master Mode. Disabled: Slave Mode.	Disabled
1st Ring Port	Select the primary port for the iA-Ring.	Port1
2nd Ring Port	Select the backup port for the iA-Ring.	Port2

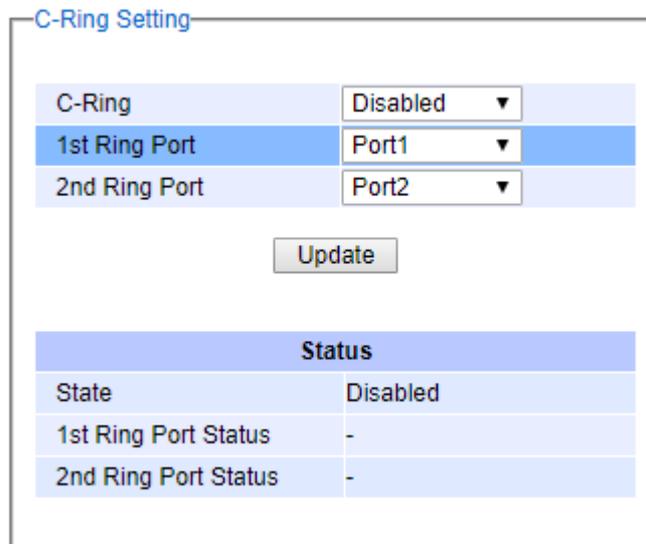
2.19.3 C-Ring (Compatible-Ring) Settings

Compatible-Ring (**C-Ring**) is similar to iA-Ring. The only difference is that it can be used for MOXA rings as well. For more information about this redundant ring protocol, please contact Atop Technologies.

Figure 2.236 shows how to set the Compatible-Ring (**C-Ring**) redundancy protocol. Note that the users should disable **DIP Switch Control** as described in Section 2.3.12 and **ERPS** as described in Section 2.19.1 first in order to enable/configure Compatible-Ring parameters on the web browser. Please follow the simple steps below based on Figure 2.236 to setup the C-Ring.

1. Enable the **C-Ring** by selecting **Enabled** from the dropdown list.
2. Select the **1st Ring Port** from the dropdown list.
3. Select the **2nd Ring Port** from the dropdown list.
4. Click on the **Update** button to save the change and allow the configuration to take effect.

Note that the lower part of the C-Ring Setting webpage shows the **Status** of the C-Ring which provides its **State**, **1st Ring Port Status** and **2nd Ring Port Status**. The description of the C-Ring setting is summarized in Table 2.60.



C-Ring Setting	
C-Ring	Disabled ▼
1st Ring Port	Port1 ▼
2nd Ring Port	Port2 ▼
Update	
Status	
State	Disabled
1st Ring Port Status	-
2nd Ring Port Status	-

Figure 2.236 Compatible-Ring (C-Ring) Setting Webpage

Table 2.60 Descriptions of Compatible-Ring Setting

Label	Description	Factory Default
C-Ring (Compatible-Ring)	Enables Compatible-Ring or disable Compatible-Ring	Disabled
1st Ring Port	Selects the primary port for the Ring	Port1
2nd Ring Port	Selects the backup port for the Ring	Port2

2.19.4 U-Ring

This section enables the setup of U-Ring (Unicast Ring) on the managed switch. The U-Ring could provide redundancy connection between two EH7XXX industrial managed switches which are not directly connected by physical wires but by two additional network devices on each switch. There are two examples of U-Ring application presented here to provide as guidelines when to choose this U-Ring feature.

First example is depicted in Figure 2.237 where there are two EH7520 managed switches. On each switch it is connected to two wireless Access Points (AP) via two different Ethernet LAN ports. Both wireless Access Points are connected to another two wireless Access Points as two separate wireless bridge connections. Based on Figure 2.237, EH7520 A has AP 1 on port 8 and AP 3 on port 7 while EH7520 B has AP 2 on port 7 and AP 4 on port 8. The AP 1 and the AP 2 are connected as wireless Bridge Connection 1 and the AP 4 and the AP 3 are connected as wireless Bridge Connection 2.

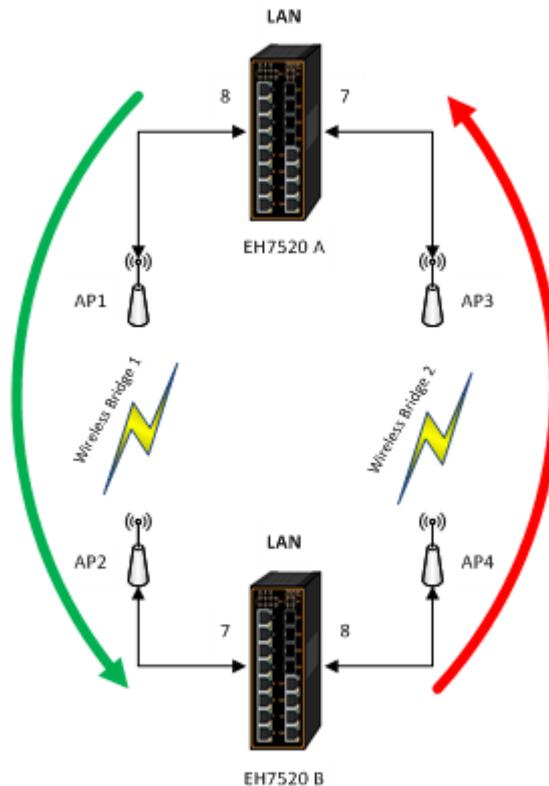


Figure 2.237 Example 1 of Two Wireless Bridge U-ring (Example made on EH7520)

Second example is illustrated in Figure 2.238 where there are also two EH7520 managed switches. On each switch it is connected to two wired Access Points (AP) via two different Ethernet LAN ports. Both wired Access Points are connected to another two wired Access Points as two separate wired bridge connections. Based on Figure 2.238, EH7520 A has AP 1 on port 8 and AP 3 on port 7 while EH7520 B has AP 2 on port 7 and AP 4 on port 8. The AP 1 and the AP 2 are connected as wired Bridge Connection 1 and the AP 4 and the AP 3 are connected as wired Bridge Connection 2. There are two physical lines between both pair of Aps. The U-ring protocol could be used in this environment. The different of this example from the previous example is that the AP_x could be:

- Unmanaged-switch
- Transceiver
- XDSL bridge

Note that care should be taken that if a dumb switch is used as an AP (Access Point). The one on the other side must be a dumb switch as well. Again, care should also be taken when connecting the cables to the ports.

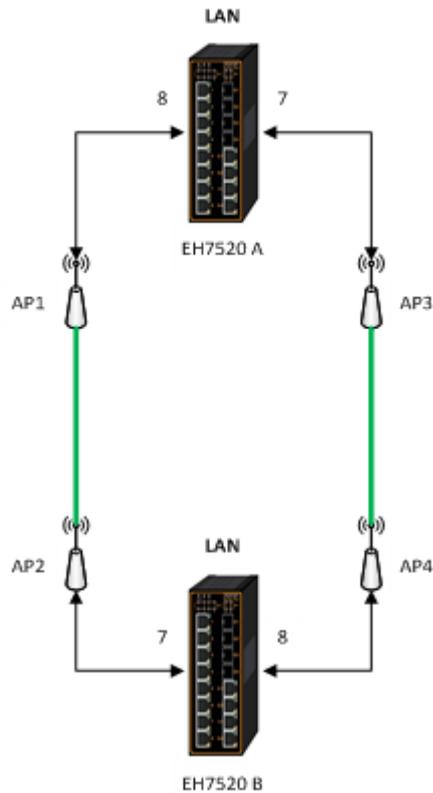
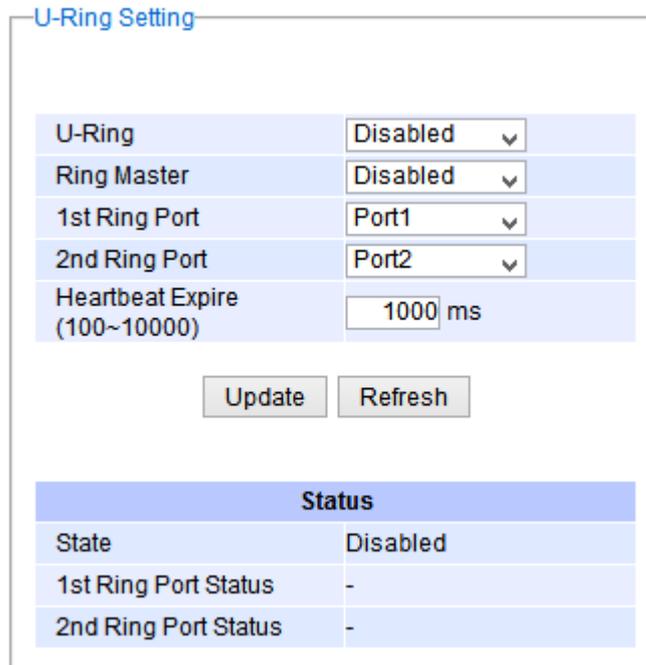


Figure 2.238 Example 2 of Two Wired Bridge U-ring (Example on EH7520)

To setup the U-Ring, the users need to configure a number of parameters on U-Ring Setting webpage as shown in Figure 2.239. Please follow the simple steps below to setup the U-Ring.

1. Enable the **U-Ring** by selecting **Enabled** from the dropdown list.
2. Choose whether the current managed switch is going to be the **Ring Master** by enabling the **Ring Master** option.
3. Select the **1st Ring Port** from the dropdown list.
4. Select the **2nd Ring Port** from the dropdown list.
5. Optionally, set the **Heartbeat Expire** period which could be between 100 to 10000 milliseconds. Note that the default period is 100 ms.
6. Click on the **Update** button to save the change and allow the configuration to take effect.
7. Check the latest status of the U-Ring configuration by clicking on the **Refresh** button.

Note that the lower part of the **U-Ring Setting** webpage shows the **Status** of the U-Ring which provides its **State**, **1st Ring Port Status** and **2nd Ring Port Status**. The description of the U-Ring setting is summarized in Table 2.61.



U-Ring Setting	
U-Ring	Disabled
Ring Master	Disabled
1st Ring Port	Port1
2nd Ring Port	Port2
Heartbeat Expire (100~10000)	1000 ms
<input type="button" value="Update"/> <input type="button" value="Refresh"/>	
Status	
State	Disabled
1st Ring Port Status	-
2nd Ring Port Status	-

Figure 2.239 U-Ring Setting Webpage

Table 2.61 Descriptions of U-Ring Setting

Label	Description	Factory Default
U-Ring	Enabled or disabled the Unicast ring.	Disabled
Ring Master	Enabled or disabled this switch as the Ring Master of the Unicast Ring. For Ring Slave configuration, leave this option as disabled.	Disabled
1 st Ring Port	Select which port on the managed switch will be the 1 st Ring Port.	Port1
2 nd Ring Port	Select which port on the managed switch will be the 2 nd Ring Port.	Port2
Heartbeat Expire	Time interval between checking-packets.	1000
Update	Click this button to allow the configuration to take effect.	-
Refresh	Obtain the latest status of the U-Ring Setting by clicking on this button.	-
State	Shows whether the device's state is normal or protected.	Disable
1 st Ring Port Status	Displays the status of the 1 st Ring Port.	-
2 nd Ring Port Status	Displays the status of the 2 nd Ring Port.	-

2.19.5 Compatible-Chain Settings

The **Compatible-Chain Setting** is provided on Atop's managed switches for compatible networking with Moxa switch's **Turbo Chain**. The MOXA's Turbo Chain is a technique that uses the chain network topology and links the two ends (two network devices such as industrial managed switches) of the chain to a common LAN. This can also be viewed as a form of Ring Topology. This Turbo Chain can provide redundancy on any type of network topology or on complex network topology such as multi-ring architecture. The Turbo Chain can create flexible and scalable topologies with a fast media-recovery time.

The first switch on the **Compatible-Chain** will have a **Role State** as **Head** switch. The other switches along the **Compatible-Chain** will have a **Role State** as **Member** switches. The last switch on the **Compatible-Chain** will have a **Role State** as **Tail** switch. For Head switch, the first port which is connected to the common LAN is called **Head Port**, while the second port which is connected to the next switch in the Compatible-Chain is called **Member Port**.

For **Member** switches, both ports of the Member switches are called **1st Member Port** and **2nd Member Port**. For **Tail** switch, the first port which is connected to another Member switch is call **Member Port**, while the second port which is connected to the common LAN is called **Tail Port**. In Turbo Chain configuration, the Head Port is the main path while the Tail Port is the backup path of the redundant topology. During no link-failure operation on the chain's path, all traffic will be forwarded to the Head Port to the common LAN. When there is a failure on the path of the chain, the Tail Port will be used for forwarding the traffic to the common LAN.

To configure Compatible-Chain, select the Compatible-Chain menu under the ERPS/Ring Section. Figure 2.240 shows the Compatible-Chain Setting webpage.

Role	Member
1st Ring Port Status	Forwarding
2nd Ring Port Status	Forwarding

Compatible-Chain	Disabled
Role State	Member
1st Member Port	Port1
2nd Member Port	Port2

Update

Figure 2.240 Compatible-Chain Setting Webpage

Please follow the simple steps below to setup the Compatible-Chain.

1. Enable the **Compatible-Chain** by selecting **Enabled** from the dropdown list.
2. Choose the **Role State** whether the current managed switch is going to be the **Head**, **Member** or **Tail** of the chain from the dropdown list of **Role State**.
3. If the current switch is the **Head** switch then select the **Head Port** from the dropdown list and select the **Member Port** from another dropdown list.
4. If the current switch is the **Member** switch then select the **1st Member Port** from the dropdown list and select the **2nd Member Port** from another dropdown list.
5. If the current switch is the **Tail** switch then select the **Tail Port** from the dropdown list and select the **Member Port** from another dropdown list.
6. Click on the **Update** button to save the change and allow the configuration to take effect.

Note that the upper part of the **Compatible-Chain Setting** webpage shows the **Status** of the current switch in the chain which provides its **Role**, **1st Ring Port Status** and **2nd Ring Port Status**. The description of the Compatible-Chain setting is summarized in Table 2.61.

Table 2.62 Descriptions of Compatible-Chain Setting

Label	Description	Factory Default
Role	Display the role of the current switch in the Compatible-Chain: Head, Tail, or Member.	Member
1 st Ring Port Status	Display the status of the 1 st Ring Port.	Forwarding
2 nd Ring Port Status	Display the status of the 2 nd Ring Port.	Forwarding
Compatible-Chain	Enabled or Disabled the Compatible-Chain Ring	Disable
Role State	Choose the role of the current switch in the compatible chain: Head, Tail, or Member.	Member
Head Port	Select a particular port from the dropdown list to be the Head Port of the compatible-chain.	Port1
Tail Port	Select a particular port from the dropdown list to be the Tail Port of the compatible-chain.	Port1
Member Port	Select a particular port from the dropdown list to be the Member Port of the compatible-chain.	Port2
1 st Member Port	Select a particular port from the dropdown list to be the Member Port of the compatible-chain.	Port1
2 nd Member Port	Select a particular port from the dropdown list to be the Member Port of the compatible-chain.	Port2

2.20 LLDP

Link Layer Discovery Protocol (LLDP) is an IEEE802.1ab standard OSI layer-2 protocol. LLDP allows Ethernet network devices to advertise details about themselves, such as device configuration, capabilities and identification. The advertise packets are periodically sent to directly connected devices on the network that are also using LLDP or so called its neighbors. LLDP is a “one hop” unidirectional protocol in an advertising mode.

LLDP information can only be sent to and received by devices, no solicit information or state changes between nodes. The device has a choice to turn on and off sending and receiving function independently. Advertised information is not forward on to other devices on the network. LLDP is designed to be managed with SNMP. Applications that use this protocol include topology discovery, inventory management, emergency services, VLAN assignment, and inline power supply.

Link Layer Discovery Protocol (LLDP) section consists of **LLDP Setting** and **LLDP Neighbors** as shown in Figure 2.241.

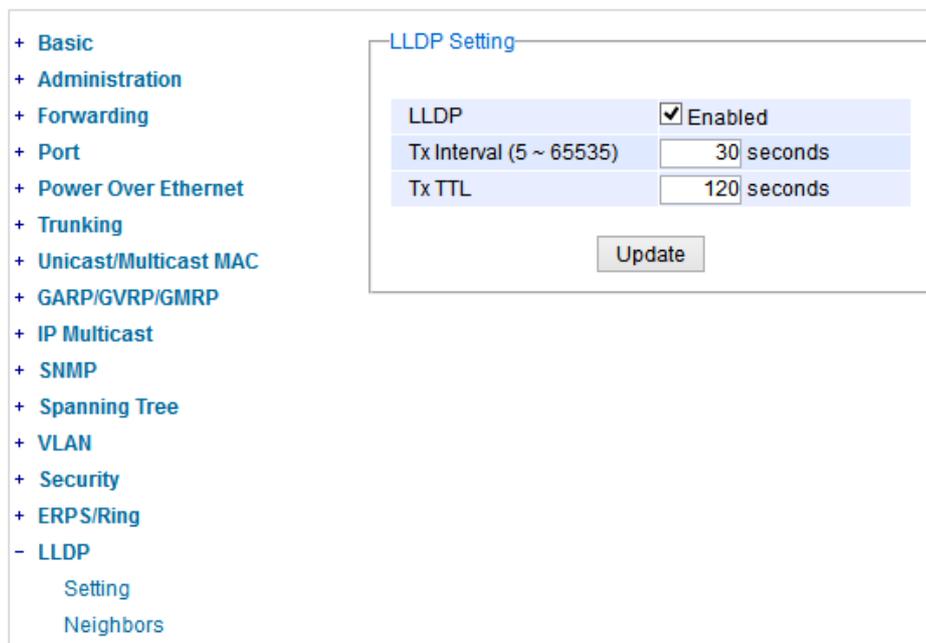


Figure 2.241 LLDP Dropdown Menu

2.20.1 LLDP Settings

In Figure 2.242, the LLDP Setting webpage allows users to have options for enabling or disabling the LLDP, as well as setting LLDP transmission parameters. This LLDP function should be enabled if users want to use Atop’s Device Management Utility (formerly called Device View) to monitor the switches’ topology of all LLDP devices in the network. For more information about using Device Management Utility, please refer to Chapter 5 of this document. Table 2.63 describes the LLDP Setting parameters which are transmit interval and transmit time-to-live of the LLDP advertisement packets.

Figure 2.242 LLDP Setting Webpage

Table 2.63 Descriptions of LLDP Setting

Label	Description	Factory Default
LLDP	Choose to either enable or disable LLDP.	Enabled
Tx Interval	Set the transmit interval of LLDP messages. Range from 5 to 65535 seconds.	30
TxTTL	<i>Tx Time-To-Live</i> . Amount of time to keep neighbors' information. The recommend TTL value is 4 times of <i>Tx Interval</i> . The information is only removed when the timer is expired. Range from 5 to 65535 seconds.	120

2.20.2 LLDP Neighbors

This menu allows the user to view the LLDP's neighbor information of the managed switch as shown in Figure 2.243. The Neighbor Information table contains Chassis ID, Port ID, Port Description, Device Name, Device Description and Management Address on each Port of the managed switch. The users can click on the **Refresh** button to get the latest Neighbor Information table or click on the **Clear** button to clear all the information on the display Neighbor Information table.

An example of neighbor information table is depicted in Figure 2.244. Note that this example is based on a display format of an early version of EH7520 managed switch in which System Name is changed to Device Name and System Description is changed to Device Description in the latest version of EH7XXX's firmware.

Table 2.64 summarizes the descriptions of each column of the LLDP's Neighbor Information.

Figure 2.243 LLDP Neighbors Webpage

Neighbors

Port	Neighbor Information					
	Chassis ID	Port ID	Port Description	System Name	System Description	Management Address
1						
2						
3						
4	00:60:E9:07:98:9D	3	Port 3	EH7510	Managed Switch EH7510	10.0.7.4
5						
6						
7						
8						
9	00:60:E9:07:98:99	10	Port 10	EH7510 1	Managed Switch EH7510	10.0.7.8
10	00:60:E9:07:98:9B	9	Port 9	EH7510	Managed Switch EH7510	10.0.7.6

Figure 2.244 Example of LLDP Neighbors Webpage

Table 2.64 Descriptions of LLDP Neighbors Webpage

Label	Description
Port	Indicates particular port number of the switch.
Chassis ID	Indicates the identity of the neighbor of this particular port.
Port ID	Indicates the port number of this Neighbor.
Port Description	Shows a textual description of the neighbor port.
Device Name	Indicates the device name/hostname of the Neighbor.
Device Description	Shows a more detailed description of the neighbor's device.
Management Address	Indicates neighbor's management IP address.

2.21 PROFINET

PROFINET (Process Field Net) is an open and advanced standard for the industrial automation based on the industrial Ethernet. PROFINET enables the users to exchange the process data with user's machines. In this case, instead of using fieldbus system, the users use the Ethernet as a communication mechanism. Figure 2.245 shows the dropdown menu of the PROFINET on an EHG7XXX industrial managed switch. There are three subsections under the **PROFINET** which are **Setting**, **I&M**, and **MRP**.

- + Basic
- + Administration
- + Forwarding
- + Port
- + Power Over Ethernet
- + Trunking
- + Unicast/Multicast MAC
- + GARP/GVRP/GMRP
- + IP Multicast
- + SNMP
- + Spanning Tree
- + VLAN
- + VRRP
- + DHCP Server
- + Security
- + ERPS/Ring
- + LLDP
- PROFINET
 - Setting
 - I&M
 - MRP
- + EtherNet/IP
- + IP Routing
- + Client IP Setting
- + System

The screenshot shows two configuration panels. The top panel, titled 'PROFINET', contains a table with the following data:

PROFINET	<input type="checkbox"/> Enabled
Device Name	EHG7608-4PoE-4SFP
DIP Switch State	Off

Below the table is an 'Update' button.

The bottom panel, titled 'Packet Priority', contains a table with the following data:

Priority	<input type="checkbox"/> Enabled	Queue: Q6 ▼
----------	----------------------------------	-------------

Below the table is an 'Update' button. A note below the table reads: 'The higher the queue number, the higher the precedence for scheduling.'

Figure 2.245 PROFINET Dropdown Menu

2.21.1 PROFINET Settings

The PROFINET can be enabled on the EHG7XXX industrial managed switch on this webpage. To enable the PROFINET, the users can check the **Enabled** box behind the **PROFINET** field. The webpage also displays the **Device Name** as shown in Figure 2.246. The PROFINET's **Packet Priority** can also be enabled on this webpage and priority **Queue** number can also be chosen from the dropdown list. Note that the higher the queue number, the higher the precedence for the packet scheduling.

The image shows two screenshots of a web interface. The top screenshot is titled 'PROFINET' and contains a table with the following data:

PROFINET	<input type="checkbox"/> Enabled
Device Name	EHG7608-4PoE-4SFP
DIP Switch State	Off

Below the table is an 'Update' button.

The bottom screenshot is titled 'Packet Priority' and contains a table with the following data:

Priority	<input type="checkbox"/> Enabled	Queue: Q6 ▼
----------	----------------------------------	-------------

Below the table is an 'Update' button. At the bottom of the screenshot, there is a blue text note: 'The higher the queue number, the higher the precedence for scheduling.'

Figure 2.246 PROFINET Setting Webpage

2.21.2 PROFINET's I&M

Identification and Maintenance (I&M) is an integral part of each PROFINET Device implementation. It provides standardized information about a device and its parts. I&M's Information is accessible through PROFINET Record Objects and is always bound to a sub module belonging to the item to be described. There are two I&M objects: I&M0 and I&M1. The I&M0 objects provide Vendor ID and Software (SW) Revision as shown in Figure 2.247. The I&M1 objects provide a non-volatile storage for PROFINET related information called Function Tag and Location Tag in which the users can enter the information and save them on the switch as shown in Figure 2.247. The information is stored by the device in non-volatile memory. After entering the desired information on the I&M1, please click the Update button to save them on the managed switch.

The image shows two screenshots of a web interface. The top screenshot is titled 'I&M0' and contains a table with the following data:

Vendor ID	0x24e
SW Revision	V4.25.0

The bottom screenshot is titled 'I&M1' and contains two input fields:

Function Tag	<input type="text"/>
Location Tag	<input type="text"/>

Below the input fields is an 'Update' button.

Figure 2.247 PROFINET I&M

2.21.3 PROFINET MRP

The Media Redundancy Protocol (MRP) is a data network protocol for Ethernet switch standardized by the International Electro technical Commission as IEC 62439-2. MRP is mostly used in and suitable for Industrial Ethernet applications. It allows rings of Ethernet switches to overcome any single failure with recovery time much faster than those achievable by Spanning Tree Protocol. It supports very fast failure recovery time. For example, a worst-case recovery time for 14 switches is about 10ms and for 50 switches is about 30ms.

The MRP includes following properties.

- It operates at the MAC layer of the Ethernet switches.
- It is a ring topology.
- Any single failure can be recovered.
- For switches in the network, there can be two roles:
 - Ring manager (MRM) – not available in Atop’s devices, please enquire Atop for further information
 - Ring client (MRC)
- For ring ports, there are three possible statuses: disabled, blocked, and forwarding.
 - Disabled ring ports drop all the received frames.
 - Blocked ring ports drop all the received frames except the MRP control frames.
 - Forwarding ring ports forward all the received frames.
- In normal case, one of the MRM ring ports is blocked to avoid looping and both ring ports of all MRCs are forwarding.
- When a path of the ring fail, the other port on the MRM will become active and forwarding.

The Media Redundancy Protocol (MRP) menu under the PROFINET section enables an implementation of a redundant PROFINET communication through ring topology without the need for switches. Figure 2.248 shows the MRP Setting webpage. Please follow the outlined steps here to setup the PROFINET’s MRP:

1. Enter a desired **VLAN** ID in the field at the bottom of the **MRP** Setting webpage and click **Add** button as shown in Figure 2.248.

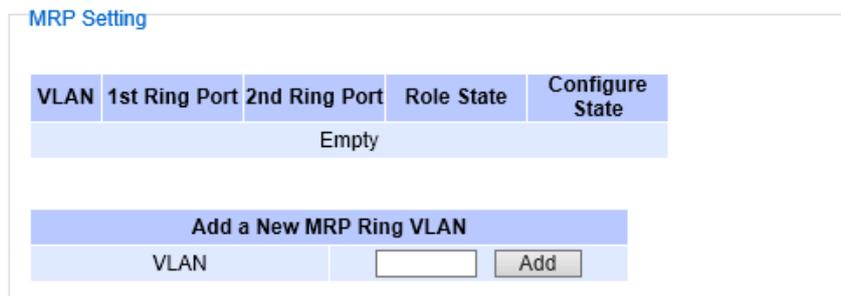


Figure 2.248 MRP Setting Webpage

2. After the MRP Ring is created with the desired VLAN, there will be an entry of the MRP VLAN on the table at the top of the page as shown in Figure 2.249. There will also be two new buttons at the end of the entry: **Configure** and **Remove**. The users can click on the Configure button the continue setting up the MRP Ring on the managed switch.

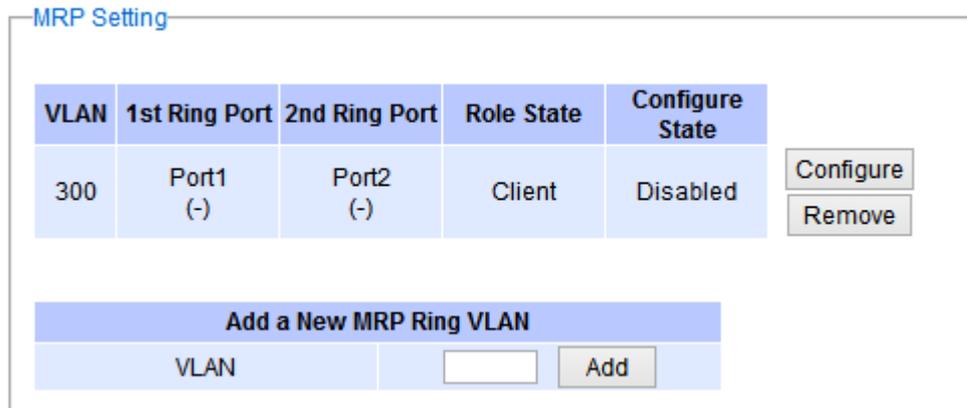


Figure 2.249 Example of PROFINET's MRP VLAN Entry

Table 2.65 Description of MRP Setting Webpage

Label	Description	Factory Default
VLAN	MRP Ring VLAN ID	Depend
Role State	Role status setting (Manager or Client)	Client
1st Ring Port	Port number and port status (Link Down, Blocked, Forwarding).	Port1
2nd Ring Port	Port number and port status (Link Down, Blocked, Forwarding).	Port2
Configure State	Enabled or Disabled state of MRP Ring function	Disabled

- After clicking the Configure button on the desired entry, a new webpage called MRP Ring Setting will show up as shown in Figure 2.250.

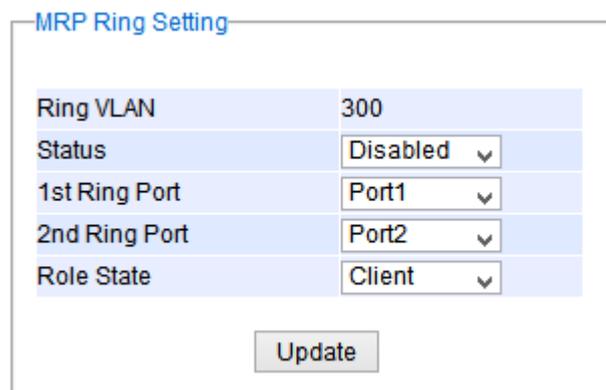


Figure 2.250 MRP Ring Setting Webpage

- Then, the users can set MRP Ring parameters for the current switch, which are the **Status**, **1st Ring Port**, **2nd Ring Port**, and **Role State** as described earlier. Table 2.65 summarizes the description of MRP Ring Setting parameters.
- Click on the **Update** button to allow the configuration to take effect. Note that if there is other ERPS Ring Topology already setting up on the managed switch there may be an error message popping up as shown in Figure 2.251. Therefore, the users should disable the ERPS/Ring (Section 2.19.1) and DIP Switch Control (Section 2.3.12) first before setting up this MRP Ring.



Figure 2.251 MRP Ring Setting Error Message

2.22 IP Routing (Layer-3 Switching Features)

In this menu, the user can enable IP routing protocol on the EHG76XX Industrial L3 Managed Switch. There are three routing mechanisms that can be enabled on the managed switch: **IPv4 Static Routing**, **RIP (Routing Information Protocol)**, and **OSPF (Open Shortest Path First)**. Figure 2.252 shows the **IP Routing** menu.

- IP Routing
 - Setting
 - IPv4 Static Routing
 - RIP Setting
- + OSPF Setting

Figure 2.252 IP Routing Menu

2.22.1 IP Routing's Setting

To enable the Internet Protocol (IP) routing or Layer-3 (L3) routing function on the EHG76XX Industrial L3 Managed Switch, select the **IP Routing** menu, click **Enabled** box behind the **IP Routing Setting** option, and press the **Update** button as shown in Figure 2.253. Note that the default value of IP Routing is disabled. This IP routing option should be enabled before any other IP routing functions (static routing in Section 2.22.2 and dynamic routing in Section 0 and Section 2.22.4) can be used.

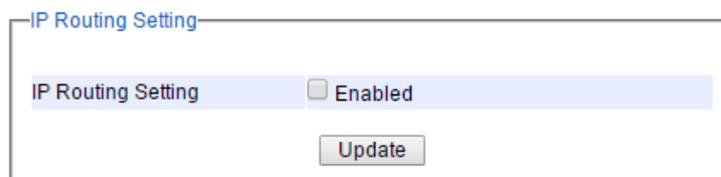


Figure 2.253 IP Routing Webpage

2.22.2 IPv4 Static Routing

Note: IPv4 Static Routing function is an old feature of firmware version 3.21 and is not available in firmware version 4.25.

Static routing is a form of routing based on IP address at OSI Layer 3 that occurs when a router uses a manually configured routing entry to forward packet. The users can define the routes by themselves by specifying what is the next hop (or the next router) based on IP address that the Layer 3 switch will forward data packet for a specific subnet. Note that to allow **IPv4 Static Routing** to operate properly, please enable the **IP Routing** function as described in Section 2.22.1 above first. If the **IP Routing** function is not enabled, there will be an error message showing up as illustrated in Figure 2.254.



Figure 2.254 Error message when IP Routing is disabled.

By default, there is no IPv4 static routing entry in the routing table of EHG76XX industrial L3 managed switch. When the users would like to add a new IPv4 static routing, first select the **IPv4 Static Routing** submenu under the **Administration** menu as shown in Figure 2.255. Then, enter a static routing name in the **Name** field. Then, fill in the IP related information, which are the **Destination IP Address**, **Subnet Mask**, and **Gateway IP Address**. Finally, enter the value of the Metric for this route. Note that the routing metric will be used by the L3 switch to make routing decision. The default value for this field is 0 or lowest metric which is equivalent to a route to a default gateway. Please click on the **Update** button to add the IPv4 static routing to the routing table of the L3 managed switch. An example of a static routing entry is shown in Figure 2.256. Descriptions of IPv4 Static Routing configurations are summarized in Table 2.66.

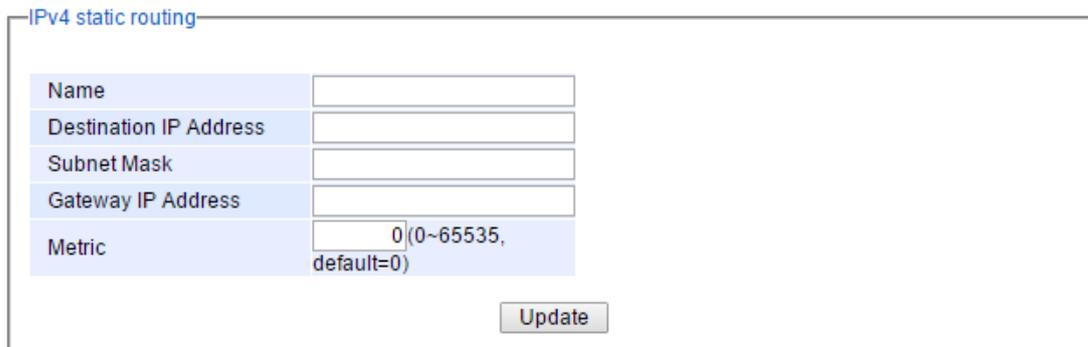


Figure 2.255 IPv4 Static Routing Webpage

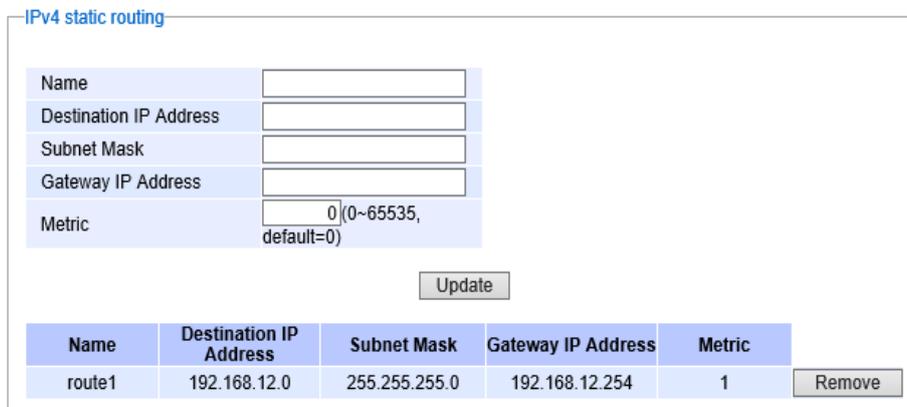


Figure 2.256 Example of an Entry in IPv4 Static Routing Table

Table 2.66 Descriptions of IPv4 Static Routing Settings

Label	Description	Factory Default
Name	Name of an IPv4 static route (Max. 16 Characters)	Blank
Destination IP Address	IPv4 address of the interface of the next hop or router such as 192.168.12.0	Blank
Subnet Mask	Subnet mask of the IPv4 interface such as 255.255.255.0	Blank
Gateway IP Address	IPv4 address of the gateway to the next hop such as 192.168.12.254	Blank
Metric	The routing metric which is used to by L3 managed switch to make routing decision.Value is between 0 and 65535.	0

2.2.2.3 RIP Setting

The Industrial L3 managed switch also implements a dynamic routing protocol to allow automatically learning and updating of routing table. In this subsection, one of the dynamic routing protocol can be setup by the users. Routing Information Protocol (RIP) is a distance vector-based routing protocol that can make decision on which interface the L3 managed switch should forward Internet Protocol (IP) packet and can share information about how to route traffic among network devices that use the same routing protocol. RIP sends routing-update messages periodically and when there is a change in network topology. RIP prevents routing loops by implementing a limit on the number of hops allowed in a path from source to destination. RIP can also be used to automatically build up a routing table.

To enable the RIP, first check the **Enable** box as shown in Figure 2.257. Then, select the **Version** of RIP protocol from the dropdown box. Note that EHG76XX support RIP **Version 1** and **Version 2**. Then, choose the corresponding box for **Distribution: Connected** or **Static**. Note that the Distribution option is to set which routing information the RIP will be used to populate its routing table. When the **Connected** box is selected, the RIP will add the connected routes (subnets directly connected to the EHG76XX's interface) to its routing table. When the **Static** box is selected, the RIP will add the static routes (configured in previous subsection) to its routing table. Finally, click on the **Update** button to allow the configuration of the RIP to take effect.

Figure 2.257 RIP Setting Webpage

2.2.2.4 OSPF Settings

Note: OSPF function is an old feature of firmware version 3.14 and is not available in firmware version 4.25.

OSPF (Open Shortest Path First) version 2 is another routing protocol supported by EHG76XX industrial L3 managed switch. It is described in RFC2328. OSPF is an IGP (Interior Gateway Protocol) which uses link states for route selection. It propagates link-state advertisements (LSAs) to its Neighbor switches. When compared with RIP (Routing Information Protocol) which is a distance vector-based routing protocol, OSPF can provide scalable

network support and faster convergence time for network routing state. OSPF is widely used in large networks such as ISP (Internet Service Provider) backbone and enterprise networks.

To configure OSPF under the EH76XX industrial L3 managed switch, the user can select the **OSPF Setting** submenu from the **Administration** menu as shown in the last item under the **Administration** menu in Figure 2.11. Under the **OSPF Setting** submenu, there are five more menus which are **Global Setting**, **Area Setting**, **Interface Setting**, **Virtual Link Setting**, and **Area Aggregation Setting** as shown in Figure 2.258.



Figure 2.258 OSPF Setting Submenu

2.22.4.1 OSPF Global Setting

To enable OSPF routing protocol on EH76XX, first the user should enable it on the **Global Setting** webpage as shown in Figure 2.259. Checking the **Enable** box to activate the OSPF function and entering the **Router ID** for your EH76XX industrial L3 managed switch. Note that the **Router ID** is in a form of IP address (not necessary be an actual IP address) or four groups of number between 0 and 255 which are separated by dots. This number can be any IP address which is only used by the OSPF process to uniquely identify the router. One algorithm for Router ID assignment is to choose the largest or smallest IP address assigned to the router. The last option for **OSPF Global Setting** is to enable re-distribution of routes into OSPF process which is called **Distribution** on the **Global Setting** webpage. Note that re-distribution is the use of a routing protocol to advertise routes that are learned by another routing protocol, static routes, or directly connected routes. The re-distribution of routes or **Distribution** in EH76XX can come from **Connected** routes, **Static** routes, and/or **RIP**'s routes. The user can check any or all boxes of the corresponding routes behind the **Distribution** option that you want to re-distribute into OSPF routing protocol. After finished setting up the OSPF, click on the **Update** button to allow the setup to take effect.

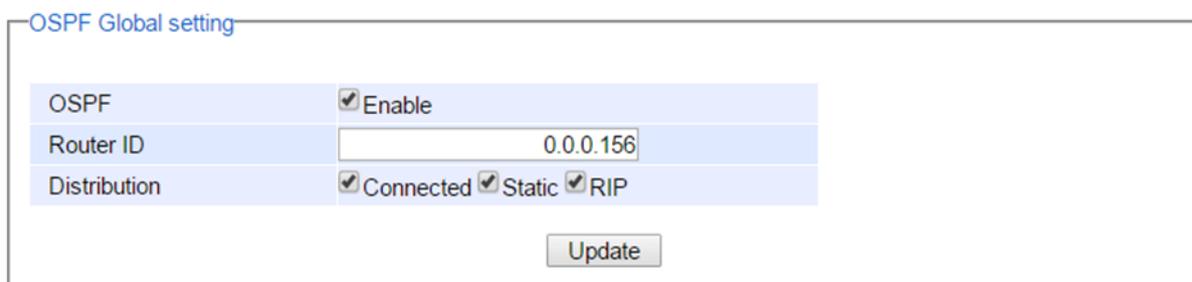


Figure 2.259 OSPF's Global Setting Webpage

Table 2.67 Descriptions of OSPF's Global Setting Webpage

Label	Description	Factory Default	Note/restriction
OSPF	Enable or disable OSPF	Disable	IP Routing must be enabled first before enable OSPF.

Router ID	Setting the Router ID in OSPF	Null	Router ID cannot be set to 0.0.0.0.
Distribution	Check corresponding box(es) for re-distribution of routes from another routing protocol (RIP), Static routes, and/or Connected routes into OSPF	Unchecked	N/A

2.22.4.2 OSPF Area Setting

An OSPF's area is a logical collection of OSPF networks, routers/switches, and links that have the same area identification number (**Area ID**). The OSPF network or domain can be divided into sub-domains called areas. Any switch or router within an area must keep a topological database for the area that it belongs. This area scheme is to restrict the propagation of routes and reduce the amount of resources required by each router/switch to maintain its link state database. The propagation of routes is done via different types of Link State Advertisements (LSAs). Some area types will limit the types of LSAs that can be advertised within an area. Generally, each area is connected to a central backbone which is called area zero or backbone area. An area is interface specific. A router/switch that has all of its interfaces within the same area is called an internal router (IR). Routers/switches that belong to multiple areas and connect these areas to the backbone area are called Area Border Routers (ABRs). A router that has interfaces in multiple areas is called an area border router (ABR). Routers that act as gateways (redistribution) between OSPF and other routing protocols (IGRP, EIGRP, IS-IS, RIP, BGP, Static) or other instances of the OSPF routing process are called autonomous system boundary router (ASBR). Any router can be an ABR or an ASBR.

On this webpage, the user can configure OSPF's area(s) as shown in Figure 2.260. The OSPF **Area ID** is defined in IP address format or four groups of number between 0 to 255 separated by dots. Typically, the backbone area is labelled as area 0.0.0.0. Next, the user can select the **Area Type** of OSPF which can be **Stub** area, **NSSA** (Not-So-Stubby-Area), or **Normal** area type. The **Normal** or standard area type is the area that has no restriction access to the rest of the network and switch(s)/router(s) in this area need to maintain a full link state database. Note that the backbone area is essentially a normal/standard area. For **Stub** area, there will be no external routes propagate into the area but a default route will be injected into the **Stub** area. This is to save the resource of the routers/switches within this area. For **NSSA** or Not-So-Stubby-Area, it is similar to the **Stub** area but still allow advertisement of external links from autonomous system boundary router (ASBR) to the area border router (ABR) connected to the NSSA. After finish configuring the OSPF Area, click on the **Add-Modify** button to save the **OSPF Area setting**. If the user wanted to remove an area, the user can click on the **Delete** button. A summary of all configured OSPF Area(s) is reported in the lower part of which is called **OSPF Area Table**.

OSPF Area setting

Area ID	<input type="text" value="0.0.0.3"/>
Area Type	<input type="text" value="Stub"/>
Metric <0-16777215>	<input type="text" value="0"/>

OSPF Area Table

Area ID	Area Type	Metric
0.0.0.3	Stub	0
0.0.0.4	NSSA	0
0.0.0.7	Normal	0

Figure 2.260 OSPF's Area Setting Webpage

Table 2.68 Descriptions of OSPF Area Setting Webpage

Label	Description	Factory Default	Note/restriction
Area ID	Setting of OSPF Area ID which is also in a form of IP address (4 groups of number between 0 and 255 separated by dots)	N/A	N/A
Area Type	Setting of OSPF Area Type which can be selected from Stub Area, NSSA (Not-So-Stubby-Area), and Normal option.	Stub	N/A
Metric	Routing metric which can set the value between 0 and 16777215.	0	Metric can only be set to 0 under the "Normal" Area Type

2.22.4.3 OSPF Interface Setting

This webpage as shown in Figure 2.261 allows the user to configure OSPF interface on the EHG76XX industrial L3 managed switch. Note that you need to configure a VLAN ID as discussed in Section 2.14.1 first for the **Interface Name** that will be used for OSPF. There are basic parameters on this webpage which are related to assigning area, setting priority, configuring hello protocol (keepalive mechanism), setting OSPF's packet authentication, and assigning metric or cost of the interface. To properly configuring the OSPF on an interface, you must assign that interface to an **Area ID**. Then, you should set the priority using number between 0 to 255 for the EHG76XX in the **Router Priority** field. The router with the highest priority will be elected as Designated Router (DR) on a network segment that belongs to on and only one OSPF area. Note that the DR election is performed using the Hello protocol which is a form of keepalive used by OSPF routers (or EHG76XX) in order to acknowledge their existence on a segment. The **Hello Interval** specifies the length of time, in seconds, between the hello packets that the EHG76XX sends on an OSPF interface. The **Dead Interval** is the number of seconds that the EHG76XX's Hello packets have not been seen before its neighbors declare the OSPF router down. OSPF requires these intervals to be exactly the same between two neighbors. If any of these intervals are different, these routers/switches will not become neighbors on a particular network segment.

OSPF Interface setting

Interface Name(e.g. Vlan 1 : 1)	<input type="text" value="1"/>
Area ID	<input type="text" value="0.0.0.0"/>
Router Priority <0-255>	<input type="text" value="1"/>
Hello Interval <1-65535>(sec)	<input type="text" value="10"/>
Dead Interval <1-65535>(sec)	<input type="text" value="40"/>
Auth Type	None ▾
Auth Key	<input type="text"/>
MD5 Key ID <1-255>	<input type="text" value="1"/>
Metric <1-65535>	<input type="text" value="1"/>

OSPF Interface Table

IFace	IP ADDR	Area ID	Router Pri	Hello IntV	Dead IntV	Auth Type	Auth Key	MD5 KeyID	Metric
vlan1	192.168.12.156	0.0.0.1	1	1	4	None		1	1
vlan2	192.168.2.156	0.0.0.0	1	10	40	Simple	444	1	1
vlan3	192.168.3.157	0.0.0.0	1	10	40	MD5	1234	1	1

Figure 2.261 OSPF Interface Setting Webpage

EHG76XX can be configured to enable or disable OSPF Authentication by selecting an **Auth Type**. The **Auth Type** or authentication type for EHG76XX can be **None**, **Simple**, or **MD5**. By default, EHG76XX sets the authentication to None which means that routing exchanges over a network is not authenticated. If the **Simple** authentication type is selected, the **Auth Key** which is a simple password must be entered. Note that EHG76XX and other switches or routers in the same area that want to participate in the routing domain must be configured with the same **Auth Key**. Note that the **Auth Key** is transmitted over the network; therefore, it is vulnerable to eavesdropping attack. It is strongly recommended that the user chooses the **MD5 Auth Type** because it is a cryptographic authentication which is more secure. This authentication type will use MD5 algorithm over OSPF packet, **Auth Key**, and **MD5 Key ID** to generate a message digest which will be appended to OSPF packet. The last parameter is the **Metric** or cost of the OSPF interface. The **Metric** is an indication of the overhead required to send packets across this interface which can be based on the bandwidth or the delay. It is inversely proportion to the bandwidth of that interface. That is the higher the bandwidth of the interface, the lower the metric value. After configuring each interface, please click **Add-Modify** button. If you want to remove an interfere, click on the **Delete** button. Table 2.69 summarizes the **OSPF Interface Setting** webpage.

Table 2.69 Descriptions of OSPF Interface Setting Webpage

Label	Description	Factory Default	Note/restriction
Interface Name	Set Interface Name	1	VLAN of interface must exist
Area ID	Set Area ID in a form of IP address (4 groups of number between 0 and 255 separated by dots)		N/A
Router Priority	Set Router Priority which can have a value between 0 to 255	1	If router priority is set to 0, it is a non-designated router (NDR). That is this interface will not be elected as Designated Router (DR) or Backup Designated Router (BDR).
Hello Interval	Set hello interval in second which can have a value between 1 to 65535.	10	N/A

Label	Description	Factory Default	Note/restriction
Dead Interval	Set dead interval in second which can have a value between 1 to 65535.	40	N/A
Auth Type	Set Authentication Type for the interface which can be None , Simple , or MD5 . Note that MD5 is more secure and recommended.	None	N/A
Auth Key	Set Authentication Key or password for OSPF interface according to the Auth Type selected in previous option. If Auth Type = None , Auth Key is empty or Null. If Auth Type = Simple or MD5 , please enter a password in this field.	Null	The Auth Key or password can be a string of up to 8 characters.
MD5 Key ID	Set MD5 Key ID that can be a value between 1 to 255.	1	N/A
Metric	Set Metric or cost of the OSPF interface which can have a value between 1 and 65535.	1	N/A

2.22.4.4 OSPF Virtual Link Setting

There are two use cases for virtual link in OSPF. First, it can be used to link an area that does not have a physical connection to the backbone because all areas in an OSPF autonomous system must be connected to the backbone area or area 0. The virtual link can be used to connect an area to the backbone area (area 0) through a non-backbone area. Second, it can be used to patch the backbone of OSPF in case that there is a discontinuity of area 0. That is the virtual links can connect two parts of a partitioned backbone through a non-backbone area. Note that the non-backbone area that you configure the virtual link is called a transit area. The transit area cannot be a stub area and must have full routing information.

To configure a virtual link for OSPF in EHG76XX industrial L3 managed switch, there are two parameters needed to be entered on **Virtual Link Setting** webpage as shown in Figure 2.262. First parameter is the **Transit Area ID** which is in the form of IP address or four groups of number separated by dots. The transit area is the area that your EHG76XX is directly connected to. Second parameter is the **Neighbor Router ID** which is also in the form of IP address. The Neighbor router is a router that is also connected to the same transit area and connected to the backbone area (or area 0) or another partition of the backbone. After entering both parameters, please click on the **Add** button to add an entry of virtual link to EHG76XX's **OSPF Virtual Link Table** as shown at the bottom of Figure 2.262. To remove a virtual link, please fill in the corresponding **Transit Area ID** and **Neighbor Router ID** then click on the **Delete** button to remove that entry from the **OSPF Virtual Link Table**. Table 2.70 summarizes the descriptions of **OSPF Virtual Link Setting** webpage.

OSPF Virtual Link setting

Transit Area ID	<input type="text" value="0.0.0.0"/>
Neighbor Router ID	<input type="text" value="0.0.0.0"/>

OSPF Virtual Link Table

Transit Area ID	Neighbor Router ID
0.0.0.2	0.0.0.3
0.0.0.7	0.0.0.3

Figure 2.262 OSPF Virtual Link Setting Webpage

Table 2.70 Descriptions of OSPF Virtual Link Setting Webpage

Label	Description	Factory Default	Note/restriction
Transit Area ID	Setting of Transit Area ID which is in a form of IP address (4 groups of number between 0 and 255 separated by dots)	0.0.0.0	The backbone area cannot be set as a transit area.
Neighbor Router ID	Setting of Neighbor Router ID which is in a form of IP address (4 groups of number between 0 and 255 separated by dots)	0.0.0.0	N/A

2.22.4.5 OSPF Area Aggregation Setting

The OSPF Area Aggregation is a technique that combines groups of routes with common addresses into single routing table entry. EHG76XX supports the uses of subnet masks to achieve OSPF area aggregation. The user can specify the **Area ID** and the **Destination Network** then select the Subnet Mask from the available entry from the drop-down list. Figure 2.263 shows an example of OSPF Area Aggregation Setting webpage with an **OSPF Area Aggregation Table**. The user can add a new entry into the table by filling the required fields and clicking on the **Add** button. To remove an entry, please fill in the corresponding fields and click **Delete** button. Table 2.71 summarizes the descriptions of **OSPF Area Aggregation Setting** webpage.

OSPF Area Aggregation setting

Area ID	<input type="text" value="0.0.0.0"/>
Destination Network	<input type="text" value="0.0.0.0"/>
Subnet Mask	<input type="text" value="4(240.0.0.0)"/>

Add Delete

OSPF Area Aggregation Table

Area ID	Destination Network	Network Mask
0.0.0.4	0.0.0.2	4(240.0.0.0)
0.0.0.4	0.0.0.2	8(255.0.0.0)
0.0.0.7	0.0.0.2	15(255.254.0.0)

Figure 2.263 OSPF Area Aggregation Setting Webpage

Table 2.71 Descriptions of OSPF Area Aggregation Setting Webpage

Label	Description	Factory Default	Note/restriction
Area ID	Set Area ID in the form of IP address	0.0.0.0	N/A
Destination Network	Set Destination Network in the form of IP address	0.0.0.0	N/A
Subnet Mask	Set Subnet Mask by selecting an entry from a drop-down list.	4(240.0.0.0)	Prefix: 4 - 30

2.22.4.6 OSPF Routing Table

This webpage shows the current OSPF Routing Table and Neighbor Table as depicted in Figure 2.264.

OSPF Routing Table

Destination	Next Hop	Interface Name	VID
0.0.0.157	192.168.12.157	Vlan1	1

OSPF neighbor Table

Neighbor ID	Priority	State	Neighbor IP Address	Interface
0.0.0.157	1	Full/DR	192.168.12.157	Vlan1

Figure 2.264 OSPF Routing Table Webpage

2.23 Client IP Setting

The EHG7XXX industrial managed switch has two different approaches for setting up the IP addresses for the devices connected to its ports. The following are the submenus under the **Client IP Setting** section:

1. **DHCP Relay Agent**,
2. **DHCP Mapping IP**.

Figure 2.265 shows the dropdown menus under the **Client IP Setting** section.



Figure 2.265 Client IP Setting Dropdown Menu

2.23.1 DHCP Relay Agent

A DHCP relay agent is a small program that relays DHCP/BOOTP messages between clients and servers on different subnets. DHCP/BOOTP relay agents are parts of the DHCP and BOOTP standards and function according to the Request for Comments (RFCs).

A relay agent relays DHCP/BOOTP messages that are broadcast on one of its connected physical interfaces, such as a network adapter, to other remote subnets to which it is connected by other physical interfaces. Figure 2.266 shows the **DHCP Relay Agent** setting webpage. The users can enter up to four DHCP/BOOTP server IP addresses in the fields: **Server IP 1**, **Server IP 2**, **Server IP 3**, and **Server IP 4**. Then the users can enable the DHCP Relay by checking the **Enabled** box behind the DHCP Relay option.

The users can also have a choice to enable DHCP's **Option 82** which is the DHCP Relay Agent Information Option. When this Option 82 is enabled, the switch will insert information about the client's network location into the packet header of DHCP request coming from the client on an untrusted interface. Then, the switch will send the modified request to the DHCP server. The DHCP server will inspect the option 82 information in the packet header and use it to generate the IP address or other parameters for the client. When the DHCP server returns the response to the switch, the switch will remove the option 82 information from the response packet and forward it to the client. The Option 82 Type field in Figure 2.266 can be chosen from **IP**, **MAC**, **Client-ID**, or **Other** in the dropdown list. When **Other** type is selected, the **Option 82 Value** field will become active for entering the desired value by the users. After finishing the DHCP Relay Agent setup, please click on the **Update** button to allow the change to take effect.

DHCP Relay Agent

Server IP 1	<input type="text" value="0.0.0.0"/>
Server IP 2	<input type="text" value="0.0.0.0"/>
Server IP 3	<input type="text" value="0.0.0.0"/>
Server IP 4	<input type="text" value="0.0.0.0"/>
DHCP Relay	<input type="checkbox"/> Enabled
Option 82	<input type="checkbox"/> Enabled
Option 82 Type	IP
Option 82 Value	<input type="text"/>

Figure 2.266 DHCP Relay Agent Webpage

2.23.2 DHCP Mapping IP

The user can reserve or map IP addresses to the device connected on the selected ports in this submenu. Figure 2.267 shows the DHCP Mapping IP webpage where the desired IP address can be entered into the field for each Port. After finishing the DHCP IP mapping to the port(s), please click on the **Update** button to allow the change to take effect.

Set IP by DHCP/BOOTP/RARP

Port	Desired IP address
Port1	<input type="text"/>
Port2	<input type="text"/>
Port3	<input type="text"/>
Port4	<input type="text"/>
Port5	<input type="text"/>
Port6	<input type="text"/>
Port7	<input type="text"/>
Port8	<input type="text"/>

Figure 2.267 DHCP Mapping IP Webpage

2.24 System

This last section on the WebUI interface of the EHG7XXX managed switch provides miscellaneous tools for network administrator to check the internal status of the switch via system log, warning, and alarm notification. It also allows the administration to perform device maintenance operations such as backing up and restoring device's configuration, updating the firmware, reversing the device to factory default setting, or reboot the system/device. Figure 2.268 shows all the dropdown menus under the **System** section.

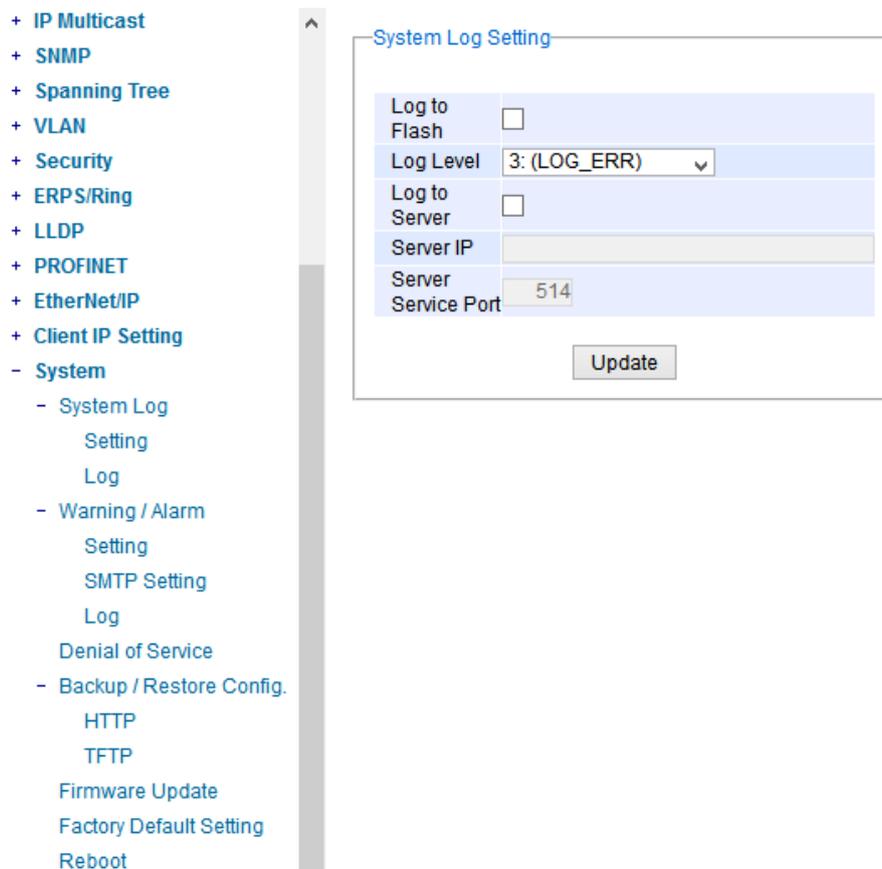


Figure 2.268 System Dropdown Menu

It is important for network administrators to know what's happening in their networks, and know where the events are happening. However, it is difficult to promptly locate network devices that are at the endpoints of systems. Thus, Ethernet switches connected to these devices play an important role of providing first-moment alarm messages to network administrators, so that network administrators can be informed instantaneously when accidents happen. Email alerts and relays outputs under the System section is used to provide fast and reliable warning alerts for administrators.

2.24.1 System Log

The submenus under the System Log are: **Setting** and **Log**.

2.24.1.1 System Log Settings

Figure 2.269 shows System Log related settings configuration. The actual recorded log event will be shown in Event Log on the next subsection. Here the users can enable how the log will be saved and/or delivered to other system. The log can be save to flash memory inside the managed switch and/or it can be sent to a remote log server. The users need to select the log level and provide the IP address of a remote log server and the service log service port. Please click on the Update button after finishing the setup. Table 2.72 describes the details of parameters setting for the system log.

Figure 2.269 System Log Setting Webpage

Table 2.72 Descriptions of System Log Settings

Label	Description	Factory Default
Enable Log Event to Flash	Checked: Saving log event into flash memory. The flash memory can keep the log event files even if the switch is rebooted. Unchecked: Saving log event into RAM memory. The RAM memory cannot keep the log event files after each reboot.	Uncheck
Log Level	Set the log level to determine what events to be displayed on the next webpage (Log). The level selection is inclusive. For example, if 3:(Log_ERR) is selected, all 0, 1, 2 and 3 log levels will be implied. Range from Log 0 to Log 7.	3:(LOG_ERR)
Enable System Log Server	Checked: Enable Syslog Server. Uncheck: Disable Syslog Server. If enabled, all recorded log events will be sent to the remote System Log server.	Uncheck
System Log Server IP	Set the IP address of Syslog server	0.0.0.0
System Log Server Service Port	Set the service port number of System Log server. Range from Port 1 to Port 65535.	514

2.24.1.2 System Log - Log

Figure 2.270 shows an example of all of the event's logs. Note that they are sorted by date and time. Table 2.73 provides explanation of each column and the button's functions on the System Log webpage.

System Log

Index	Date	Time	Up Time	Level	Event
1/13	2008.12.27	12:11:26	00d01h48m12s	ALERT	kernel: The ring detected signal fail. (RAPS VLAN: 4090,Port Number: 6)
2/13	2008.12.27	10:28:54	00d00h05m40s	ALERT	kernel: The ring detected signal fail cleared. (RAPS VLAN: 4090,Port Number: 5)
3/13	2008.12.27	10:28:54	00d00h05m40s	ALERT	kernel: Link Status: Port5 link is up, duplex=1, speed=1000.
4/13	2008.12.27	10:28:51	00d00h05m37s	ALERT	kernel: Link Status: Port5 link is down.
5/13	2008.12.27	10:28:51	00d00h05m37s	ALERT	kernel: The ring detected signal fail. (RAPS VLAN: 4090,Port Number: 5)
6/13	2008.12.27	10:23:33	00d00h00m19s	ALERT	syslog: Link Status: Port5 link is up, duplex=Full Duplex, speed=100
7/13	2008.12.27	10:23:33	00d00h00m19s	ALERT	syslog: Cold Start
8/13	2008.12.27	10:23:28	00d00h00m14s	ALERT	kernel: The ring detected signal fail cleared. (RAPS VLAN: 4090,Port Number: 5)
9/13	2008.12.27	10:23:26	00d00h00m12s	ALERT	syslog: Power Status: Power_2 is down
10/13	2008.12.27	10:23:26	00d00h00m12s	ALERT	syslog: Power Status: Power_1 is up
11/13	2008.12.27	10:23:25	00d00h00m11s	ALERT	kernel: The ring detected signal fail. (RAPS VLAN: 4090,Port Number: 6)
12/13	2008.12.27	10:23:25	00d00h00m11s	ALERT	kernel: The ring detected signal fail. (RAPS VLAN: 4090,Port Number: 5)
13/13	2008.12.27	10:23:24	00d00h00m11s	ALERT	syslog: System warning config. changed

Figure 2.270 Event Log Webpage

Table 2.73 Descriptions of Event Log

Label	Description
Index	Indicate the index of a particular log event
Date	Indicate the system date of the occurred event
Time	Indicate the time stamp that this event occurred
Up Time	Indicate how long the system (managed switch) has been up since this event occurred
Level	Indicate the level of this event
Event	Details description of this event
Previous Page	Display events on the previous page
Next Page	Display events on the next page
Show All	Click to display all events
Clear All	Click to clear all events
Download	Download or save the event log to the local computer

2.24.2 Warning/Alarm

The warning/alarm section consists of three subsections: **Setting**, **SMTP Setting**, and **Log**.

2.24.2.1 Warning/Alarm Settings

There are three different types of Warning or Alarm: Link Status Alarms, Power Status Alarms, and System Log Alarms as shown in Figure 2.271. The Link Status Alarms are related to the activities of particular port(s). Power Status Alarms keep track of power status of the switch based on the available input connectors. System Log Alarms are related to the overall functionalities of the switch. This webpage allows the users to configure how each type of the alarm events will be sent or notify the users. For link status and power status alarms, there are three possible notification methods via Relay, E-mail, and Alarm LED. For System Log alarms, there are only two possible

notification methods via Relay and E-mail. After finish configuring the alarms, please click the **Update** button. Note that there is an **Assert Relay** button which can be used to test an external Relay connected to the managed switch.

Warning / Alarm Setting

Relay Test:
Assert Relay

Update

[Link Status] Alarms			
Port	Relay	E-mail	Alarm Led
<input type="checkbox"/> All	Disabled ▾	Disabled ▾	Disabled ▾
Port1	Disabled ▾	Disabled ▾	Disabled ▾
Port2	Disabled ▾	Disabled ▾	Disabled ▾
Port3	Disabled ▾	Disabled ▾	Disabled ▾
Port4	Disabled ▾	Disabled ▾	Disabled ▾
Port5	Disabled ▾	Disabled ▾	Disabled ▾
Port6	Disabled ▾	Disabled ▾	Disabled ▾
Port7	Disabled ▾	Disabled ▾	Disabled ▾
Port8	Disabled ▾	Disabled ▾	Disabled ▾

[Power Status] Alarms			
Power	Relay	E-mail	Alarm Led
Power1	Disabled ▾	Disabled ▾	Disabled ▾
Power2	Disabled ▾	Disabled ▾	Disabled ▾

[System Log] Alarms		
Event	Relay	E-mail
Sys Log Level	Disabled ▾	Disabled ▾

Update

Figure 2.271 Webpage of Warning Event Selection

In Link Status Alarms, users have three conditions whether to send notifications via **Relay**, **E-mail**, or **Alarm LED** in case if Link is UP, Link is Down, or Link is UP/DOWN. Table 2.74 summarizes the link status alarm event selection. Note the users can enable the alarm events for all ports simultaneously by checking the box in front of the **All** entries.

Table 2.74 Descriptions of Link Status Alarm Event Selection

Label	Description	Factory Default
Port	Indicates each port number.	-
Port state event	<p>Disabled: Disables alarm function, i.e. no alarm message will be sent.</p> <p>Link Up: Alarm message will be sent when this port/link is up and connection begins.</p> <p>Link Down: Alarm message will be sent when this port/link is down and disconnected.</p> <p>Link Up/Down: Alarm message will be sent whenever there's a change, i.e. connection begins or connection disrupted.</p>	Disabled

In power status alarms, the users have two conditions to send notification (via **Relay**, **E-mail** and **Alarm LED**) which are **Power On**, or **Power Off**. Table 2.75 summarizes the Power Status Alarm event selection.

Table 2.75 Descriptions of Power Status Alarm Event Selection

Label	Description	Factory Default
Power	Indicate specific power supply	Disabled
Power status event	<p>Disable: Disables alarm function.</p> <p>Power On: Sends an alarm when power is turned on.</p> <p>Power Off: Sends an alarm when power is turned off.</p>	Disabled

In System Log Alarms, the users have can only send notification via **Relay** and **E-mail**. Table 2.76 describes the System Log Level which can be selected for the System Log Alarm event notification.

Table 2.76 Descriptions of System Log Alarm Event Selection

Label	Description	Factory Default
System log event	<p>Disable: Disable power status detection.</p> <p>0: (LOG_EMERG): Enable log level 0~7 detection.</p> <p>1: (LOG_ALERT): Enable log level 1~7 detection.</p> <p>2: (LOG_CRIT): Enable log level 2~7 detection.</p> <p>3: (LOG_ERR): Enable log level 3~7 detection.</p> <p>4: (LOG_WARNING): Enable log level 4~7 detection.</p> <p>5: (LOG_NOTICE): Enable log level 5~7 detection.</p> <p>6: (LOG_INFO): Enable log level 6~7 detection.</p> <p>7: (LOG_DEBUG): Enable log level 7 detection.</p> <p>See note below for specific log level description.</p>	Disabled

***NOTE:- Log levels** are inclusive. In other words, when log level is set to 0, an alarm is triggered whenever 0, 1, 2... 6, and/or 7 happens. When log level is set to 5, an alarm is triggered whenever 5, 6, and/or 7 happens.

- 0: Emergency: system is unstable
- 1: Alert: action must be taken immediately
- 2: Critical: critical conditions
- 3: Error: error conditions
- 4: Warning: warning condition
- 5: Notice: normal but significant condition
- 6: Informational: informational messages
- 7: Debug: debug-level messages

2.24.2.2 SMTP Settings

Simple Mail Transfer Protocol (SMTP) is an internet standard for email transmission across IP networks. In case any warning events occur as configured in Section 2.24.2.1, the system can send an alarm message to users by e-mail. Here, the users will be allowed to modify E-mail-related settings for sending the system alarms (Link Status, Power Status, and System Log), as shown in Figure 2.272.

SMTP Setting	
SMTP Server	<input type="text"/>
Authentication	<input type="checkbox"/>
TLS/SSL	<input type="checkbox"/>
User Name	<input type="text"/>
Password	<input type="text"/>
E-mail address of Sender	<input type="text"/>
Subject of Mail	<input type="text"/>
E-mail Address of 1st Recipient	<input type="text"/>
E-mail Address of 2nd Recipient	<input type="text"/>
E-mail Address of 3rd Recipient	<input type="text"/>
E-mail Address of 4th Recipient	<input type="text"/>

Figure 2.272 SMTP Setting Webpage

An example of SMTP Setting is shown in Figure 2.273. After entering all the necessary fields, please click on the Update button to allow the setting to take effect. Note that the users can try to send a Test E-mail according the SMTP setting on this webpage by clicking on the **Send Test E-mail** button. The description of each SMTP Setting parameter is summarized in Table 2.77.

SMTP Setting

SMTP Server	<input type="text" value="www.hibox.hinet.net"/>
Authentication	<input checked="" type="checkbox"/>
TLS/SSL	<input checked="" type="checkbox"/>
User Name	<input type="text" value="kenchang"/>
Password	<input type="password" value="••••••"/>
E-mail address of Sender	<input type="text" value="kenchang@atop.com.tw"/>
Subject of Mail	<input type="text" value="Switch #1 Alarm is occurred!"/>
E-mail Address of 1st Recipient	<input type="text" value="kenchang@atop.com.tw"/>
E-mail Address of 2nd Recipient	<input type="text" value="thomaslin@atop.com.tw"/>
E-mail Address of 3rd Recipient	<input type="text" value="weilang@atop.com.tw"/>
E-mail Address of 4th Recipient	<input type="text" value="arthurchuang@atop.com.tw"/>

Figure 2.273 Example of SMTP Setting

Table 2.77 Descriptions of SMTP Setting

Label	Description	Factory Default
SMTP Server	Configure the IP address of an out-going e-mail server	NULL
Authentication	Enable or disable authentication login by checking on the box. If enabled, SMTP server will require authentication to login. Thus, the users will also need to setup User Name and Password to connect to the SMTP server	Disable (Unchecked)
TLS/SSL	Enable or disable Transport Layer Security (TLS) or Secure Sockets Layer (SSL) which is an encryption mechanism for communication with the SMTP Server	Disable (Unchecked)
Username	Set the user name (or account name) to login. Max. 31 char.	NULL
Password	Set the account password for login. Max. 15 characters.	NULL
E-mail Address of Sender	Configure the sender e-mail address	NULL
Mail Subject	Type the subject of this warning message. Max. 31 characters.	NULL
E-mail Address of 1st Recipient	Set the first receiver's E-mail address.	NULL
E-mail Address of 2nd Recipient	Set the second receiver's E-mail address.	NULL
E-mail Address of 3rd Recipient	Set the third receiver's E-mail address.	NULL
E-mail Address of 4th Recipient	Set the fourth receiver's E-mail address.	NULL
Update	Update these modifications on the managed switch	-
Send Test E-mail	Send a test email to recipient(s) above to check accuracy.	-

2.24.2.3 Log

Managed switch warns its users in case any event occurs. A table called Warning/Alarm Log in this section displays the warning events as shown in Figure 2.274 Warning/Alarm Log Webpage. At the top of the table, the users can click on the **Reset Relay** button to turn off the Relay or click on the **Clear Log** to remove all entries in the **Warning/Alarm Log** table. To obtain the latest event on the able, the users have to click on the **Refresh** button.



Figure 2.274 Warning/Alarm Log Webpage

An example of **Warning/Alarm Log** table is shown in Figure 2.275. Note that the display format and buttons is slightly different from the current EGH7XXX format above. A short list of alarm messages is shown on the top portion of the web browser interface.

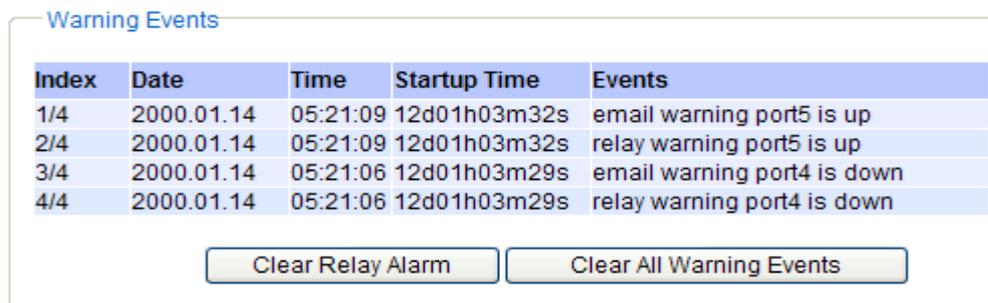


Figure 2.275 Example of Warning Events

Table 2.78 Descriptions of Warning/Alarm Log

Label	Description	Factory Default
Reset Relay	Sets Hardware Relay Alarm to off.	Relay is off
Clear Log	Clears all warning events that are displayed.	-
Refresh	Obtain the latest Warning / Alarm events	-
Index	Display the index of the Warning/Alarm events as an entry number over a total number of events	-
Date	The date that the alarm/event occurred.	-
Time	The time that the alarm/event occurred.	-
Startup Time	The duration of time since the start up time of the switch until the alarm/event occurred.	-
Events	Description of the alarm events	-

2.24.3 Denial of Service

Denial of Service (DoS) is a malicious attempt to make a machine or network resource unavailable to its intended users, such as to temporarily or indefinitely interrupt or suspend services of a host connected to the Internet. EHG7XXX industrial managed switch is designed so that users can filter out various types of attack as shown in Denial of Service setting webpage (Figure 2.276). The followings are some vulnerable attacks that can be prevented by the EHG7XXX switch function.

Denial of Service Setting	
Land packets (SIP=DIP)	<input type="checkbox"/> Enabled
TCP Fragment	<input type="checkbox"/> Enabled
TCP Flag	<input type="checkbox"/> Enabled
L4 Port	<input type="checkbox"/> Enabled
ICMP	<input type="checkbox"/> Enabled
Max ICMP Size	<input type="text" value="512"/> (0 to 1023)

Figure 2.276 Denial of Service Setting Webpage

First is the Local Area Network (LAND) DoS attack. LAND is a layer 4 DoS attack in which the attacker sets the source and destination information of a TCP segment to be the same. Specifically, TCP SYN packet is created such that the source IP and port are set to be the same as the destination address and port, which in turn is set to point to an open port on a Victim's machine. A vulnerable machine would receive such a message and reply to the destination address effectively sending the packet for reprocessing in an infinite loop. A vulnerable machine will crash and freeze due to the packet being repeatedly processed by the TCP stack. To enable/disable the protection against the Local Area Network (LAND) DoS attack, click **Enabled** box on LAND packet (SID=DID) function.

Second vulnerability attack is TCP fragmentation attacks also known as tear drop attack, which is targeting TCP/IP reassembly mechanism, preventing them from putting together fragmented data packets. As a result, the data packets overlap and quickly overwhelm the victim's servers, causing them to fail. To enable/disable the protection against the TCP fragment DoS attack, click **Enabled** box on TCP Fragment function. However, to set the mitigation method, some certain inputs are needed to set rules of filtering. For example, whether the first fragment is allowed or not and the minimum TCP header size that is allowed. In some datalink protocols such as Ethernet, only the first fragment contains the full upper layer header, meaning that other fragments look like beheaded datagrams. No additional overhead imposed over network because all fragments contains their own IP header. Only the first fragment contains the ICMP header and all remaining fragments are generated without the ICMP header.

The third vulnerability is called TCP flag DoS attack. The attack sends out TCP packets with flag indicating that they are ACK packets. This attack is similar to SYN flood except SYN flood also open a connection with the server. Although the devices are mostly tuned for more common attack as SYN flood. TCP flag DOS attack will force the server to keep dropping the packets, causing resource exhaustion. To enable/disable the protection against the TCP Flag DoS attack or called ACK flood, click **Enabled** box on TCP Flag function.

The fourth vulnerability is called L4 port DoS attack. There are various types of L4 port DoS attack. In UDP attack, a large number of UDP packets are sent to victim until it is overloaded. UDP-Lag attacks in bursts as to not hit the target offline completely. SUDP attack is the same as UDP but spoofs the request to make it harder to mitigate.

SYN/SSYN/ESSYM attacks are abuse the hand shake of the TCP protocol until the victim is overloaded. DNS/NTP/CHARGEN/SNMP attacks are an amplified UDP attack that abuses vulnerable server by sending a spoofed request with the targets IP as the sender. The servers then send the target the information overloading the system. To enable/disable the protection against all these L4 Port DoS attacks, click **Enabled** box on L4 Port function.

Last vulnerability is so called ICMP fragmentation attack. The attack involves the transmission of fraudulent ICMP packets that are larger than the network's MTU. In this switch, administrators can filter these packets out by enabling ICMP function and set **Maximum ICMP size** range from 512 to 1023 bytes. As these ICMP packets are fake, and are unable to be reassembled, the target server's resources are quickly consumed, resulting in server unavailability. To enable/disable the protection against the ICMP DoS attack, click **Enabled** box on ICMP function. Table 2.79 provides descriptions of the Denial of Service Setting.

Table 2.79 Descriptions of Denial of Service Setting

Label	Description	Factory Default
LAND packets	Enabled: Enabled prevention over the attack using TCP SYN packet that has the same source and destination's IP and port.	Disabled
TCP Fragment	Enabled: Enabled prevention over the TCP fragmentation attack which is targeting TCP/IP reassembly mechanism	Disabled
TCP Flag	Enabled: Enabled prevention over the TCP flag DOS attack which force the server to keep dropping the packets, causing resource exhaustion.	Disabled
L4 Port	Enabled: Enabled prevention over various types of L4 port DoS attacks that are intended to overload the server.	Disabled
ICMP	Enabled: Allow filtering ICMP that has packet size higher than the maximum ICMP size defined in the next field	Disabled
Max ICMP Size	512 to 1023 bytes	512

2.24.4 Backup/Restore Config.

In **Backup/Restore Config** function, the current configuration of the EHG7XXX industrial managed switch can be downloaded to a local computer and saved it as a backup. Additionally, the users can restore a previously backup configuration from a local computer to the EHG7XXX industrial managed switch. It will replace the current configuration. These backups and restore function can be done through two different protocols: **HTTP** or **TFTP**. Figure 2.277 depicts the **Backup/Restore Configuration** dropdown menu.

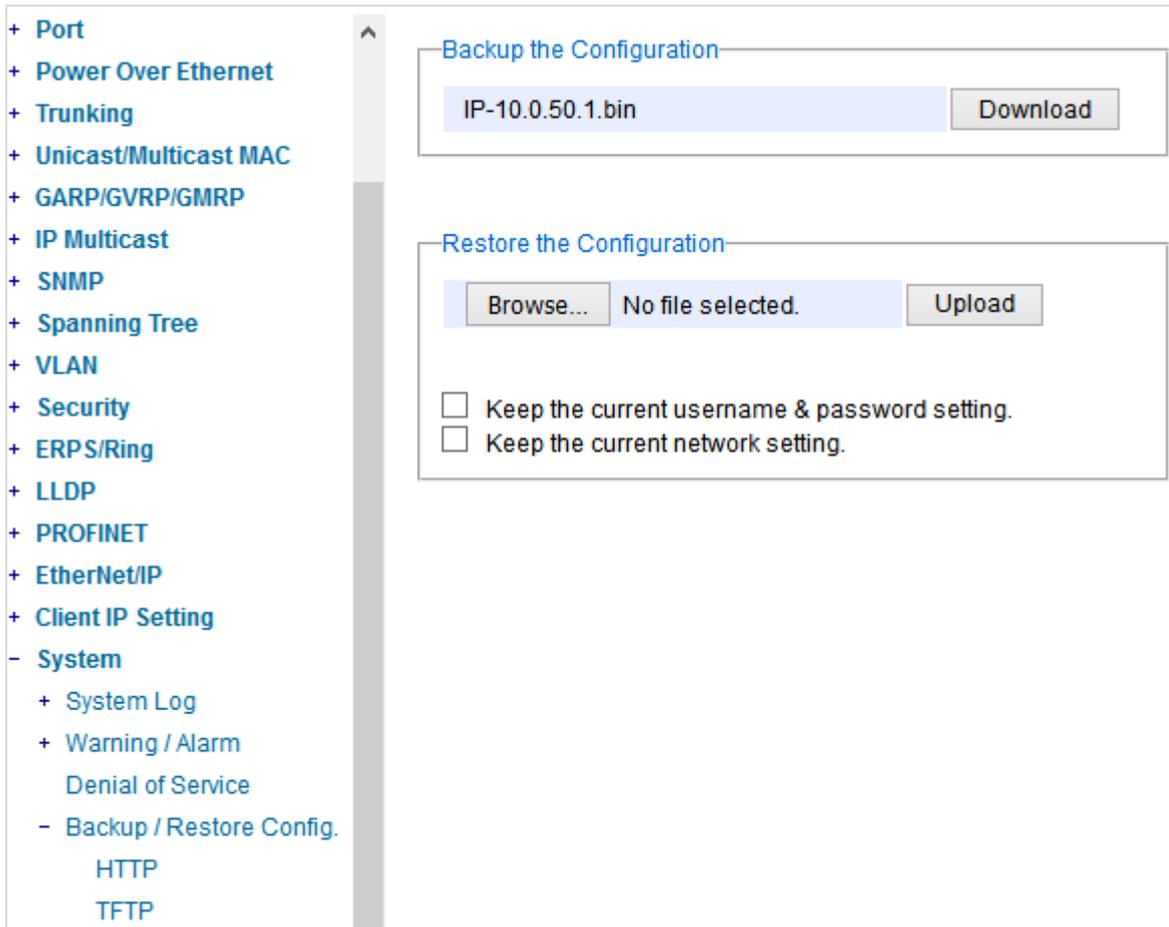


Figure 2.277 Backup/Restore Config. Dropdown Menu

2.24.4.1 Backup/Restore Config. Via HTTP

Figure 2.278 shows the webpage for Backup/Restore the configuration via HTTP. It is divided into two parts: **Backup the Configuration** and **Restore the Configuration**. When clicking on the **Download** button on the upper part of the page (**Backup the Configuration**), the users will be prompted to **Opening** the file name IP-10.0.50.1.bin by an application or to **Save File** to a destination. Choosing to Save File will back up the switch's current configuration to your local drive on the local computer.

To restore a configuration file to the switch, please move down to the **Restore the Configuration** part, then click the **Browse...** button to choose a configuration file from the local drive. Before clicking the **Upload** button, the users can check any of the options below the upload file which are to **Keep the current username & password setting** and to **Key the current network setting**. This will help prevent the users from the necessity to logging-in using a previously stored username, password or network configuration after settings are restored.

Backup the Configuration

IP-10.0.50.1.bin Download

Restore the Configuration

Browse... No file selected. Upload

Keep the current username & password setting.

Keep the current network setting.

Figure 2.278 Backup/Restore Configuration via HTTP

2.24.4.2 Backup/Restore Config. Via TFTP

Trivial File Transfer Protocol (TFTP) is designed to be small and easy to implement. The users are allowed to upload configuration settings to a TFTP server as a backup copy, and download these settings from a TFTP server when necessary to restore or replace the configuration of the EHG7XXX industrial managed switch. Figure 2.279 shows the TFTP webpage which is divided into three parts: **Download the Configuration from TFTP**, **Upload the Configuration to TFTP**, and **DHCP Option 66/67 Setting**. Table 2.80 summarizes the descriptions of TFTP Setting.

- To download a configuration file from a TFTP server, the user need to specify the IP address of the TFTP server and the Remote File Name. Then, click the **Download** button.
- To upload a configuration file from a TFTP server, the users need to specify the IP address of the TFTP server and the Desired File Name. Then, click the **Upload** button.
- The last part of the TFTP page is the DHCP Option 66/67 Setting. This feature enables the managed switch to learn of the TFTP Server Name and Boot filename, which is a data in DHCP IPv4 packet Option 66 (RFC2132), and Filename, which is a data in DHCP IPv4 packet Option 67 (RFC2132). Checking the **Enabled** box and then click on the **Update** button to set this feature.

Download the Configuration from TFTP

TFTP Server IP Address	<input style="width: 90%;" type="text" value="0.0.0.0"/>
Remote File Name	<input style="width: 90%;" type="text"/>

Upload the Configuration to TFTP

TFTP Server IP Address	<input style="width: 90%;" type="text" value="0.0.0.0"/>
Desired File Name	<input style="width: 90%;" type="text"/>

DHCP Option 66/67 Setting

Option 66/67	<input type="checkbox"/> Enabled
--------------	----------------------------------

Figure 2.279 Backup/Restore Configuration via TFTP

Table 2.80 Descriptions of TFTP Settings

Label	Description	Factory Default
TFTP Server IP Address	Sets the IP address of the remote TFTP server domain name.	NULL
Remote File Name	Type in name of the file to be downloaded.	NULL
Download	Click to start download remote configuration into the Switch.	-
Desired File Name	Type in name of the file to be uploaded.	NULL
Upload	Click to start upload Switch configuration to the remote TFTP server.	-
Option 66/67	Enable this option to allow the managed switch to learn of TFTP Server Name and the filename to be used from a DHCP packet	Disable
Update	Update the setting of DHCP Option 66/67 setting	-

2.24.5 Firmware Update

The users can update the device firmware via web interface as shown in Figure 2.280. To update the firmware, the users can download a new firmware from Atop's website and save it in a local computer. Then, the users can click **Browse...** button and choose the firmware file that is already downloaded. The switch's firmware typically has a ".dld" extension such as EHG7X0X-K150A150.dld. After that, the users can click **Update** button and wait for the update process to be done. Alternatively, the firmware update can also be performed using the Device Management Utility discussed in Chapter 5.

Note: please make sure that the switch is plug-in all the time during the firmware upgrade.

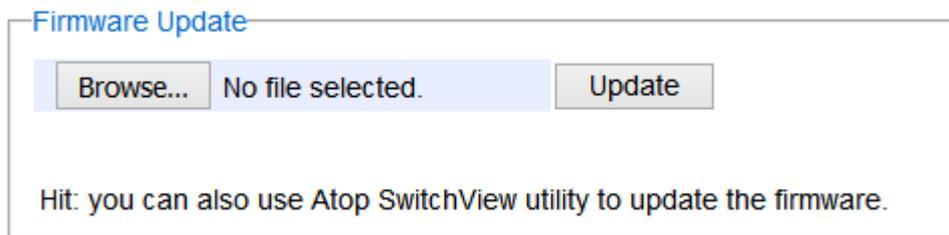


Figure 2.280 Firmware Update Webpage

2.24.6 Factory Default Setting

When the managed switch is not working properly, the users can reset it back to the original factory default settings by clicking on the **Reset** button as shown in Figure 2.281.

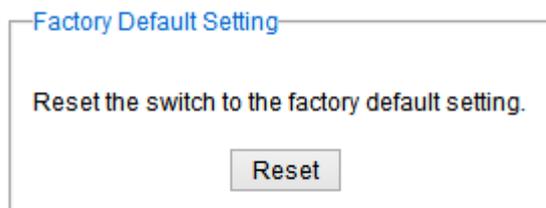


Figure 2.281 Factory Default Setting Webpage

2.24.7 Reboot

An easy reboot function is provided in this webpage requiring only one single click on the **Reboot** button as shown in Figure 2.282.

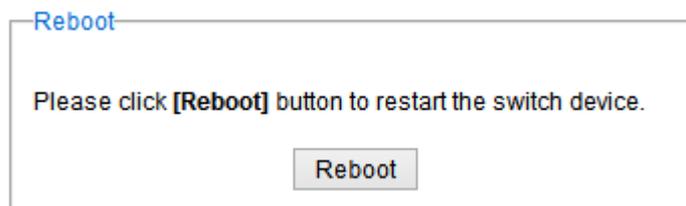


Figure 2.282 Reboot Webpage

3 Configuring with a Serial Console

A managed switch can also be configured by using a serial console. Note that a special serial console cable is required to connect to the console port on top of the EHG7XXX's chassis. Please contact Atop Technologies to obtain the cable, is needed. This method is similar to the web browser one. The options are the same, so users can take the same procedures as those examples in Chapter 2.

3.1 Serial Console Setup

After users install Tera Term, perform the following steps to access the serial console utility.

1. Start Tera Term. In **New Connection** window, select **serial** and appropriate port.

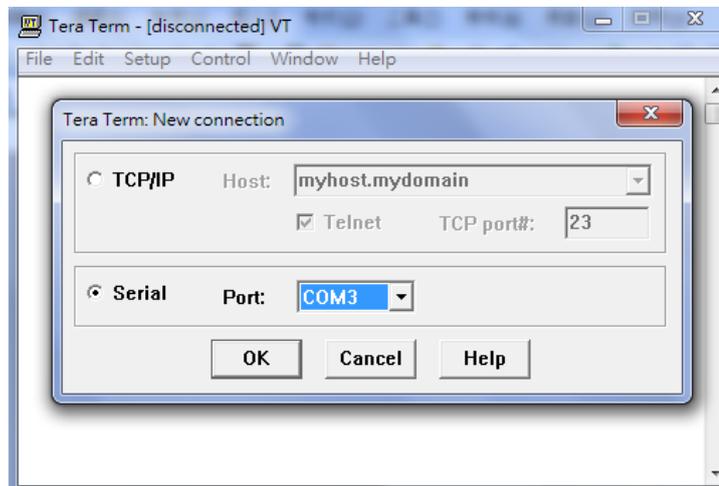


Figure 3.1 Setting of New Connection in Tera Term Program

2. Click **Setup** -> Choose **Serial Port**.

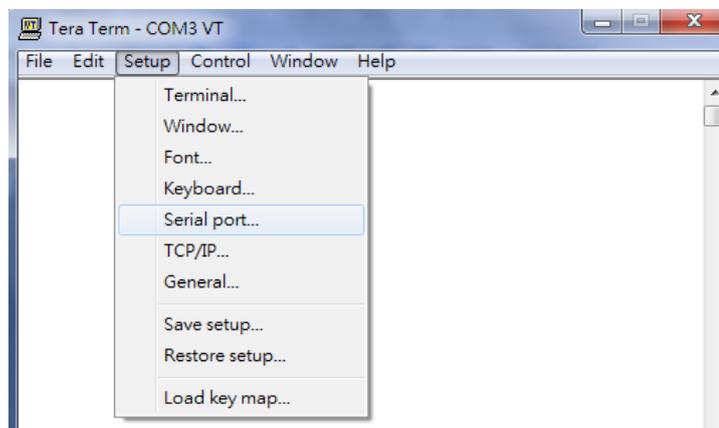


Figure 3.2 Setup Menu

3. The **Serial Port Setup** window pops up. Select an appropriate port for **Port**, **115200** for **Baud Rate**, **8 bits** for **Data**, **none** for **Parity**, and **1 bit** for **Stop**, as shown in Fig.3.3.

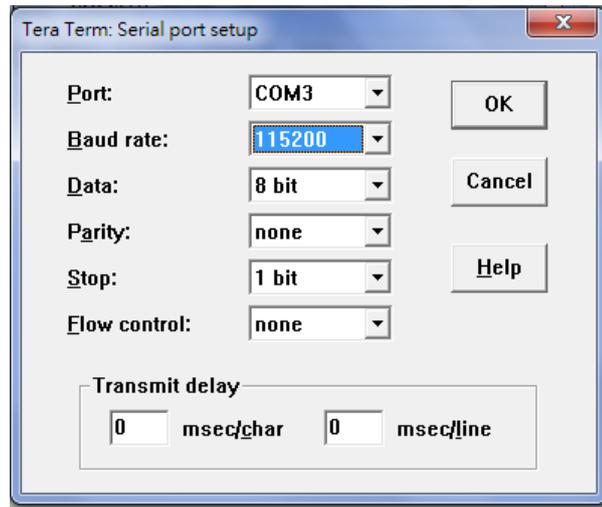


Figure 3.3 Setting for the Serial Port

4. After finishing settings and clicking **OK**, a **Command Line Interface (CLI)** will be brought up.

3.2 Command Line Interface Introduction

The Command Line Interface supports two types of privileges, which are operator and manager privileges. Users with operator privileges may only view the information, while those with manager privileges are allowed to view information and configure settings. Operator and manager privileges are initially entered without the need for passwords, but a user may be assigned with a password for both the operator and manager privileges. If passwords are assigned, then when the user attempts to enter CLI on the next time, they will need to enter the correct username and password.

If a user enters the password for the operator, then the prompt changes to indicate operator privilege. User is now in the “user” mode:

```
Switch>
```

If a user enters the password for the manager, then the prompt changes to indicate manager privilege. User is now in the “privileged” mode:

```
Switch#
```

If a user is in the user mode and wants to switch to the privileged mode, he/she may simply type in the command “**enable**” and then enter the correct username and password after the prompt:

```
Switch> enable  
Username: (enter username here)  
Password: (enter password here)  
Switch#
```

To enter the “configuration” mode, you need to be in the privileged mode, and then type in the command “**configure**”:

```
Switch# configure  
Switch(config)#
```

An illustration of the modes, related privileges and screen prompt is shown in Figure 3.4.

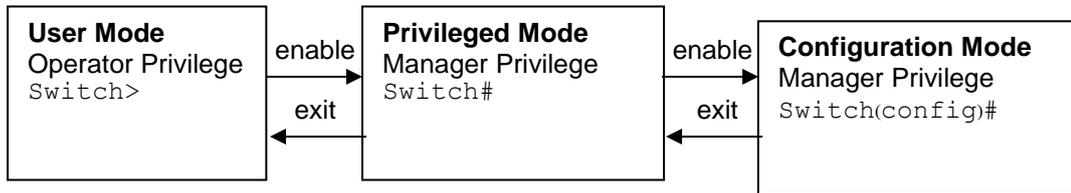


Figure 3.4 Modes, privileges and prompts

Users may enter “?” at any command mode and the CLI will return possible commands at that point, along with some description of the keywords:

```

Switch(config)# ip ?
Address      Set IP address and subnet mask
Default-gateway Set default gateway IP address
dns          Set DNS IP address
  
```

Users may use the <Tab> key to do keyword auto completion:

```

Switch(config)# syst <Tab>
Switch(config)# system
  
```

3.3 General Commands

The table below shows some useful commands that may be used anytime when using serial console.

Table 3.1 Command Descriptions

Commands	Descriptions
Enable	Turn on privileged mode
Disable	Turn off privileged mode
Configure	Enter configuration mode
?	List all available option.
Exit	Go back to the previous menu.
Help	Show any available helpful information
Logout	Log out of CLI
history <0~256>	Set the number of command to remember as history. Ex: history 5: memorize 5 previous commands.
No history	Disable command history
Show history	List last history commands
Hostname <string>	Set switch name
no hostname	Reset the switch name to factory default setting.
[no] password <manager operator all>	Set or remove username and password for manager or operator. The manager’s username and password are also used by the web user interface (web browser method of configuration).

3.4 Command Example

The serial console is another method to add/delete/change configuration, same as the web browser method. These two methods have similar functionalities. The picture below shows all the options on CLI. Two examples of making configurations: **Administration** and **Spanning Tree** using serial console method, which are shown in the following sub-sections, are the same as what are explained in Chapter 2. The only difference is that the web browser method is used in Chapter 2.



```
Tera Term - COM3 VT
File Edit Setup Control Window Help

alert          Alert information
boot           Reboot the switch
cos-mapping    CoS mapping information
clear          Clear values in destination protocol
copy           Copy configuration
disable        Turn off privileged mode command
dscp-mapping   DSCP mapping information
dhcp           DHCP information
dot1x          802.1x information
dipswitch      DIP Switch information
exit           Exit current mode and down to previous mode
erase          Erase configuration
erps           ERPS information
filter         Filter source MAC address information
garp           GARP information
gmrp           GMRP information
gvrp           GVRP information
help           Description of the interactive help system
history        Set the number of history commands
hostname       Set system's network name
ip             IP information
igmp           IGMP information
ia-ring        IA-Ring configuration
logout         Log out of the system
lldp           LLDP information
lACP           LACP information
mac-age-time   Enable MAC address age-out
mirror-port    Port monitoring information
mac-address-table MAC address table information
no             Negate a command or set its defaults
password       Password information
port           Port information
ping           Send ICMP ECHO_REQUEST to network hosts
qos            QoS information
radius-server  Radius server information
show           Show running system information
stormfilter    Storm filter on all kinds of traffic (Broadcast,Multicast,U
nitcast)
system         System information
snmp           Enable SNMP
systemtime     System time configuration
syslog         Syslog information
smtp           SMTP configuration
snmp           SNMP information
spanning-tree  Spanning Tree Protocol
timeout        Set the current CLI timeout setting
trunk          Trunking information
vlan           VLAN information
Switch(config)#
```

Figure 3.5 Example of Commands

3.4.1 Administration Setup using Serial Console

This section shows how users can find the administrative information and make changes using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

Table 3.2 Descriptions of Administrative Commands for Setting Up

Command	Description
<i>sntp</i> <IP-add> <before-utc after-utc> <0 ~ 24 hours>	Starts SNTP service
<i>[no] dhcp</i>	Enable or disable DHCP
<i>show dhcp</i>	Shows DHCP status
<i>ip address</i> <ip-addr> <ip-mask>	Set IP address and subnet mask
<i>ip default-gateway</i> <ip-addr>	Set the gateway IP address
<i>show ip</i>	Show IP address, subnet mask, and the default gateway
<i>Boot</i>	Use this command to reboot the switch
<i>Show running-config</i>	Display the running configurations of the switch.
<i>copy running-config startup-config</i>	Backup the switch configurations.
<i>erase startup-config</i>	Reset to default factory settings at the next boot time.
<i>Show arp</i>	Show the IP ARP translation table
<i>Ping ip-addr</i> <1~999>	Send ICMP Echo-Request to the network host. <1 ~ 999> specifies the number of repetitions.
<i>Exec</i>	Switch to shell mode. Shell mode may do shell command.

3.4.2 Spanning Tree Setup using Serial Console

This section shows how users can see spanning tree information and make changes using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

Table 3.3 Descriptions of Commands for Setting up Spanning Tree

Command	Description
<i>[no] spanning-tree</i>	Enable/disable spanning-tree
<i>Spanning-tree forward-delay</i> <11~30>	Set the amount of forward delay in seconds. Ex: <i>spanning-tree forward-delay 20</i> : Set forward delay time to 20 seconds.
<i>Spanning-tree hello-time</i> <1~10>	Set hello time in seconds
<i>Spanning-tree maximum-age</i> <6~40>	Set the maximum age of the spanning tree in seconds
<i>Spanning-tree priority</i> <0~61440>	Set priority of the spanning tree bridge
<i>Spanning-tree port path-cost</i> <0 ~ 2E8><port #>	Set path cost for a specific port
<i>Spanning-tree port priority</i> <0 ~ 240><port #>	Set priority to a specific port
<i>Show spanning-tree</i>	Show spanning-tree information
<i>Show spanning-tree port</i> <port #>	Show port information
<i>[no] spanning-tree debug</i>	Enable or disable debugging of the spanning tree
<i>Spanning-tree protocol-version</i> <stp,retp>	Choose protocol version. A detailed description of stp/rstp can be found in section Spanning Tree of chapter 2
<i>[no] spanning-tree port mcheck</i> <port#>	Force the port to transmit RST BPDU.
<i>[no] spanning-tree port edge-port</i> <port #>	Set the port to be edge connection.
<i>[no] spanning-tree port non-stp</i> <port#>	Enable or disable spanning tree protocol on this port.
<i>[no] spanning-tree port point-to-point-mac</i> <auto true false> <port #>	Set the port to be point to point connection. Auto: Specify point to point link auto detection. True: Set the point to point link to true. False: Set the link to false.

3.4.3 VRRP Setup using Serial Console

This section shows how users can see VRRP (Virtual Router Redundancy Protocol) information and make changes using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

The following command line interface (CLI) can be used to configure Virtual Routers in the VRRP Setting.

Table 3.4 Descriptions of Commands for Setting up VRRP

Command	Description
Vrrp	Enable VRRP
no vrrp	Disable VRRP
vrrp add vrid <1-255> vlan <1-4096> state <MASTER BACKUP> preempt <0 1> priority <1-254> advt <1-255> auth <NONE PASS> [code <code>]	Add a new VRRP instance with vrrp-id, VLAN, state, preempt, priority, advertisement interval, and authentication details such as type (NONE PASS) and code (in case type is PASS).
no vrrp vrid <1-255>	Delete existing VRRP instance
no vrrp vrid all	Delete all existing VRRP instances
vrrp vrid <1-255> state <MASTER BACKUP>	Set the VRRP state for existing vrrp-id MASTER or BACKUP.
vrrp vrid <1-255> vif<AA:BB:CC:DD>	Set a Virtual IP to the existing vrrp-id
no vrrp vrid <1-255> vif <AA:BB:CC:DD>	Delete an existing virtual IP from existing vrrp-id
vrrp vrid <1-255> pre-empt	Enable a preemption mode for an existing vrrp-id
no vrrp vrid <1-255> pre-empt	Disable a preemption mode for an existing vrrp-id
vrrp vrid <1-255> priority <1-254>	Set the Priority 0-255 for an existing vrrp-id, 255 is the highest priority. 0 means master doesn't want to participate.
no vrrp <1-255> vrid priority	Set the Priority to default value (100) for an existing vrrp-id.
vrrp vrid <1-255> advt <1-255>	Set the VRRP packet Advertisement Interval timer
vrrp vrid <1-255> auth <NONE PASS> [pass-code]	Set the interface authentication type as NONE or PASS for an existing vrrp-id. If set it to PASS, enter pass-code.
show vrrp vrid [<1-255>]	Display the information of all existing virtual routers, if no vrid is entered. Otherwise, if vrid is entered, display the information of that virtual router.
show vrrp vrid <1-255> state	Display the state of existing vrrp-id
vrrp restart	Restart vrrp

Below is the screenshot for the CLI command "show vrrp vrid". In this example, three virtual routers are added to VRRP.

```

virtual router id: 53
  configured state: Backup
  running state: Unknown
  vlan: 1
  vlan ip address: 10.0.50.30/255.255.0.0
  priority: 150
  preempt: Disable
  advt interval: 10
  authentication type: No authentication
  virtual interface:
    10.0.50.252
    10.0.50.254

virtual router id: 54
  configured state: Backup
  running state: Unknown
  vlan: 1
  vlan ip address: 10.0.50.30/255.255.0.0
  priority: 100
  preempt: Disable
  advt interval: 10
  authentication type: Password auth code: check12
  virtual interface:
    10.0.50.56

virtual router id: 55
  configured state: Backup
  running state: Unknown
  vlan: 10
  vlan ip address: 192.168.10.1/255.255.0.0
  priority: 150
  preempt: Disable
  advt interval: 10
  authentication type: No authentication
  virtual interface:
    192.168.10.20
  
```

Figure 3.6 Example of Virtual Routers Configuration for VRRP

3.4.4 DHCP Server Setup using Serial Console

This section shows how users can see DHCP Server information and make changes using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

The following command line interface (CLI) can be used to configure VLANs in the DHCP Server's setting configuration.

Table 3.5 Descriptions of Commands for Setting up DHCP Server

Command	Description
<code>dhcp server vlan <1-4094></code>	Add VLAN interface of the DHCP server
<code>show dhcp server vlan [<1-4094>]</code>	Show configuration of DHCP server's VLAN
<code>dhcp server vlan <1-4094> leasetime <3200-7200></code>	Set lease time for each VLAN
<code>dhcp server vlan <1-4094> range <A.B.C.D> <A.B.C.D></code>	Add dynamic IP range for the DHCP server address pool
<code>dhcp server vlan <1-4094> dns <A.B.C.D> <P.Q.R.S></code>	Set domain name servers of a VLAN (0.0.0.0 if not used)

Command	Description
dhcp server vlan <1-4094> gateway <A.B.C.D> <P.Q.R.S>	Set gateways of a VLAN (0.0.0.0 if not used)
dhcp server vlan <1-4094> netbios-server <A.B.C.D> <P.Q.R.S>	Set netbios servers of a VLAN (0.0.0.0 if not used)
dhcp server vlan <1-4094> staticip <A.B.C.D> host <STRING_Y> mac <AA:BB:CC:DD:EE:FF>	Add static IP DHCP server address pool
no dhcp server vlan <1-4094> range <A.B.C.D>	Delete dynamic IP range from DHCP server address pool
no dhcp server vlan <1-4094> dns <A.B.C.D>	Delete domain name server from the DHCP server VLAN
no dhcp server vlan <1-4094> gateway <A.B.C.D>	Delete gateway from the DHCP server VLAN
no dhcp server vlan <1-4094> netbios-server <A.B.C.D>	Delete netbios server from the DHCP server VLAN
no dhcp server vlan <1-4094> staticip <A.B.C.D>	Delete static IP from the DHCP server VLAN
show dhcp server	Show running state of DHCP server
no dhcp server	Disable DHCP server
dhcp server	Enable DHCP server

Below is the screenshot for showing VLAN configurations in the DHCP server. In this example, three VLANs are added to the DHCP server.

```

EHG7508# configure
EHG7508(config)# show dhcp server vlan
vlan: 1, ip addr: 10.0.50.30
  domain server1: 0.0.0.0, domain server1: 0.0.0.0
  gateway1: 0.0.0.0, gateway2: 0.0.0.0
  netbios-server1: 0.0.0.0, netbios-server2: 0.0.0.0
  Dynamic ip address range(1)
    [0] 10.0.0.10 10.0.0.20
  Static ip address range(1)
    [0] 10.0.50.1 aa:bb:cc:ab:cd:ef
=====
vlan: 5, ip addr: 192.168.10.1
  domain server1: 192.168.10.0, domain server1: 192.168.1.0
  gateway1: 0.0.0.0, gateway2: 0.0.0.0
  netbios-server1: 0.0.0.0, netbios-server2: 0.0.0.0
  Dynamic ip address range(0)
  Static ip address range(0)
=====
vlan: 10, ip addr: 172.168.0.10
  domain server1: 0.0.0.0, domain server1: 0.0.0.0
  gateway1: 0.0.0.0, gateway2: 0.0.0.0
  netbios-server1: 0.0.0.0, netbios-server2: 0.0.0.0
  Dynamic ip address range(1)
    [0] 172.168.0.20 172.168.0.30
  Static ip address range(2)
    [0] 172.168.0.1 aa:bb:cc:dd:ee:ff
    [1] 172.168.10.10 aa:bb:cc:dd:ee:ff
=====
EHG7508(config)# █

```

Figure 3.7 Example of CLI for VLAN Configurations in DHCP Server

3.4.5 PIM SM Setup using Serial Console

This section shows how users can configure Protocol Independent Multicast Sparse Mode (PIM SM) using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

The following command line interface (CLI) can be used to configure PIM SM to support multicast routing.

Table 3.6 Descriptions of Commands for PIM SM Configuration

Command	Description
ip pim-sm	Enable PIM-SM
no ip pim-sm	Disable PIM-SM
ip pim-sm hello interval <30-18724>	Configure hello interval for PIM-SM
ip pim-sm spt-switchover no ip pim-sm spt-switchover	Configure Spanning Tree (SPT) type
ip pim-sm vid <1-4094> dr-priority <1-4294967294> route-distance <1-255> route-metric <1-1024>	Configure DR-Priority, Route-Distance and Route-Metric
ip pim-sm rp-priority <0-255> bsr-priority <0-255>	Configure RP priority and BSR priority
ip pim-sm election <static bootstrap>	Configure PIM-SM election type as either static or bootstrap
ip pim-sm rp-candidate vid <vlan-id> group <A.B.C.D/M>	Configure RP candidate group IP addresses
ip pim-sm rp-address <A.B.C.D> group <A.B.C.D/M>	Configure Static RP address and group address
Static-routing add <name> <Dest. IP> <mask> <Gateway IP>	Add static routing
show ip pim-sm	Display PIM Sparse Mode Configuration
show ip pim-sm bsr	Display PIM Sparse Mode BSR
show ip pim-sm rp-address	Display PIM Sparse Mode Static RP Address
show ip pim-sm neighbor	Display PIM Sparse Mode Neighbor Table
show ip pim-sm routing	Display PIM SM Multicast Routing Table
ip pim-sm restart	Restart PIM SM process
igmp-query-interval	Display IGMP's Query Interval
ip igmp join vid <vlan-id> group <group-address>	Send IGMP join message (*,G)
ip igmp leave vid <vlan-id> group <group-address>	Send IGMP leave message (*,G)

Below is a screenshot of a command line that shows a PIM Sparse Mode configuration.

```
EHG7508(config)# show ip pim-sm
-----
pim sparse mode configuration
-----
hello interval           : 30
spt switch-over Method  : enabled
rendezvous-point election : static
rendezvous-point static address: 10.0.50.30   group - 224.0.0.0/4   group - 239.0.0.0/8

pim sparse mode Configuration for VID 1
-----
VLAN Interface ID [VID] : 1
VLAN Interface IP       : 10.0.50.30
Route Distance          : 101
Route Metric            : 1024
DR Priority              : 1
-----
EHG7508(config)#
```

Figure 3.8 Example of PIM SM Configuration

3.4.6 PIM SSM Setup using Serial Console

This section shows how users can configure Protocol Independent Multicast Source Specific Mode (PIM SSM) using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

The following command line interface (CLI) can be used to configure PIM SSM to support multicast routing.

Table 3.7 Descriptions of Commands for PIM SSM Configuration

Command	Description
ip pim-ssm	Enable PIM-SSM
no ip pim-ssm	Disable PIM-SSM
ip pim-ssm hello interval <30-18724>	Configure hello interval for PIM-SSM
ip pim-ssm add-group <A.B.C.D/M>	Configure source group IP addresses
no ip pim-ssm group <A.B.C.D/M>	Delete source group IP addresses
show ip pim-ssm	Display PIM SSM configuration
show ip pim-ssm neighbor	Display PIM SSM Neighbor table
show ip pim-ssm routing	Display PIM SSM multicast routing table
ip pim-ssm restart	Restart PIM SSM
ip pim-ssm vid <1-4094> dr-priority <1-4294967294> route-distance <1-255> route-metric <1-1024>	Configure Designated Router (DR) Priority, Route-Distance and Route Metric
ip igmp join vid <vlan-id> group <group-address>	Send IGMP join message (*,G) for any source multicast
ip igmp join vid <vlan-id> group <group-address> source <source-address>	Send IGMP join message (S,G) for SSM
ip igmp leave vid <vlan-id> group <group-address>	Send IGMP leave message (*,G) for any source multicast
ip igmp leave vid <vlan-id> group <group-address> source <source-address>	Send IGMP leave message (S,G) for SSM

Below is a screenshot of a command line that shows a PIM Source Specific Mode configuration.

```
switch(config)# show ip pim-ssm
-----
pim ssm configuration
-----
      hello interval          : 30
pim ssm Configuration for VID 1
-----
      ULAN Interface ID [VID] : 1
      ULAN Interface IP       : 10.0.50.1
      DR Priority              : 1
-----
switch(config)#
```

Figure 3.9 Example of PIM Source Specific Mode Configuration

3.4.7 PIM DM Setup using Serial Console

This section shows how users can configure Protocol Independent Multicast Dense Mode (PIM DM) using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

The following command line interface (CLI) can be used to configure PIM DM to support multicast routing.

Table 3.8 Descriptions of Commands for PIM DM Configuration

Command	Description
ip pim-dm	Enable PIM-DM

Command	Description
no ip pim-dm	Disable PIM-DM
ip pim-dm vlan <1-4094> preference <1-255> metric <1-255>	Adding VLAN to PIM-DM
no ip pim-dm vlan <1-4094>	Delete VLAN from PIM-DM
ip pim-dm vlan <1-4094> preference <1-255>	Updating the preference ID for PIM-DM
ip pim-dm vlan <1-4094> metric <1-255>	Updating the metric for PIM-DM

3.4.8 BGP Setup using Serial Console

This section shows how users can inspect BGP information and make changes using commands. Detailed explanations of each technical term can be found in Chapter 2 of this manual.

The following command line interface (CLI) can be used to configure BGP feature of the switch.

Table 3.9 Descriptions of Commands for Setting up BGP Function

Command	Description
bgp bestpath as-path confed	This command specifies that the AS confederation path length must be used when it is available in the BGP best path decision process. Putting “no” in the front of the command to reset to the default, where the device ignores AS confederation path length in the BGP best path selection process.
bgp bestpath compare-routerid	By default, when comparing similar routes from peers, BGP does not consider the router ID of neighbors advertising the routes - BGP simply selects the first received route. Use this command to include router ID in the selection process. That is the similar routes are compared and the route with the lowest router ID is selected. Putting “no” in the front of the command to disable this feature and return the device to the default state, where the device ignores the router ID in the BGP best path selection process.
neighbor <neighborid> port<portnum>	Use this command to specify the TCP port to which packets are sent to on a BGP neighbor. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. <portnum>, ranging from 0 to 65535, specifies the TCP port number. Putting “no” in the front of the command to reset the port number back to the default value (TCP port 179).
neighbor <neighborid> weight <weight>	Use this command to set default weights for routes from this BGP or BGP4+ neighbor. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. <weight> ranging from 0 to 65535 specifies the weight that this command assigns to the route. Putting “no” in the front of the command to remove a weight assignment.
neighbor <neighborid> version <version>	Use this command to configure the device to accept only a particular BGP version. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. <version> {4} specifies the BGP version number. Use the no variant of this command to use the default BGP version (version 4).
Neighbor <neighborid> ebgp-multihop [<count>]	Use this command to accept and attempt BGP or BGP4+ connections to external peers on indirectly connected networks. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. <count> ranging from 1 to 255 is the maximum hop count set in the TTL field of the BGP packets. Use the no variant of this command to delete BGP connections to external peers on indirectly connected networks.

<p>Neighbor <ipaddress> interface <interface></p>	<p>Use this command to configure the interface name of a BGP4+ speaking neighbor. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. <interface> specifies the interface name of BGP neighbor, e.g. vlan2. Use the no variant of this command to disable this function.</p>
<p>show ip bgp filter- list<listname></p>	<p>Use this command to display routes conforming to the filter-list within an IPv4 environment. Use the show bgp ipv6 filter-list (BGP4+ only) command to display routes conforming to the filter-list within an IPv6 environment. <listname> specifies the regular-expression access list name.</p>
<p>neighbor <neighborid> distribute-list <access- list> {in out}</p>	<p>This command filters route updates from a particular BGP or BGP4+ neighbor using an access control list. <neighborid> The address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. <access-list> The access-list used to filter routes. The following types of access-lists: <WORD> The name of IP access-list. <1-199> The ID number of a standard IP access-list. <1300-2699> The ID number of an extended IP access-list. in Indicates that incoming advertised routes will be filtered. out Indicates that outgoing advertised routes will be filtered. The no variant of this command removes a previously configured BGP or BGP4+ distribute-list.</p>
<p>neighbor <peer-group> peer-group</p>	<p>Use this command to create a peer-group for BGP and BGP4+. <peer-group> Enter the name of the peer-group. Use the no variant of this command to disable this function.</p>
<p>neighbor <neighborid> send-community {both extended standard}</p>	<p>Use this command to specify that a community attribute should be sent to a BGP or BGP4+ neighbor. <neighborid> Specify the IPv4 address of the BGP neighbor, entered in the format A.B.C.D. both →Sends Standard and Extended Community attributes. Specifying this parameter with the no variant of this command results in no standard or extended community attributes being sent. extended→Sends Extended Community attributes. Specifying this parameter with the no variant of this command results in no extended community attributes being sent. standard →Sends Standard Community attributes. Specifying this parameter with the no variant of this command results in no standard community attributes being sent. Use the no variant of this command to remove the entry for the community attribute.</p>
<p>neighbor <neighborid> attribute-unchanged {as- path next-hop med}</p>	<p>Use this command to advertise unchanged BGP or BGP4+ attributes to the specified BGP or BGP4+ neighbor. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. as-path AS path attribute. next-hop Next hop attribute. med Multi Exit Discriminator.</p>
<p>neighbor <neighborid> capability orf prefix-list {both receive send}</p>	<p>Use this command to advertise ORF (Outbound Route Filters) capability to neighbors. Use this command to dynamically filter updates. The BGP speaker can advertise a prefix list with prefixes it wishes the peer to prune or filter from outgoing updates. <neighborid>--Specify the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. orf ---→ Advertises ORF capability to its neighbors.</p>

	<p>both-→Indicates that the local router can send ORF entries to its peer as well as receive ORF entries from its peer.</p> <p>receive-→Indicates that the local router is willing to receive ORF entries from its peer.</p> <p>Send-→Indicates that the local router is willing to send ORF entries to its peer.</p> <p>Use the no variant of this command to disable this function.</p>
<p>neighbor <neighborid> unsuppress-map <route- map-name></p>	<p>Use this command to selectively leak more specific routes to a particular BGP or BGP4+ neighbor. <neighborid> specifies the IPv4 address of the BGP neighbor, entered in the format A.B.C.D. <route-map-name> specifies the name of the route-map used to select routes to be unsuppressed. Use the no variant of this command to remove selectively leaked specific routes to a particular BGP or BGP4+ neighbor.</p>
<p>neighbor {<neighborid>} default-originate [route- map <routemap-name>]</p>	<p>Use this command to control the number of prefixes that can be received from a BGP or a BGP4+ neighbor. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. route-map→ If a route-map is specified, then the route table must contain at least one route that matches the permit criteria of the route map before the default route will be advertised to the specified neighbor. <routemap-name> is the route-map name. Use the no variant of this command to send no route as a default route.</p>
<p>neighbor <neighborid> capability route-refresh</p>	<p>Use this command to advertise route-refresh capability to the specified BGP and BGP4+ neighbors. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to disable this function.</p>
<p>neighbor <neighborid> dont-capability-negotiate</p>	<p>Use this command to disable capability negotiation for BGP and BGP4+. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to enable capability negotiation for BGP and BGP4+.</p>
<p>neighbor <neighborid> next-hop-self</p>	<p>Use this command to configure the BGP router as the next hop for a BGP speaking neighbor or peer group. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to Disable the BGP router as the next hop for a BGP speaking neighbor or peer group.</p>
<p>neighbor <neighborid> override-capability</p>	<p>Use this command to override a capability negotiation result for BGP. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to Delete a capability negotiation result for BGP.</p>
<p>neighbor <neighborid> passive</p>	<p>Use this command to configure the local BGP or BGP4+ router to be passive with regard to the specified BGP or BGP4+ neighbor. This has the effect that the BGP or BGP4+ router will not attempt to initiate connections to this BGP or BGP4+ neighbor but will accept incoming connection attempts from the BGP or BGP4+ neighbor. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to disable this function.</p>
<p>neighbor <neighborid> route-server-client</p>	<p>Use this command to specify the peer as route server client. <neighborid> specifies the address of an IPv4 BGP neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to delete route-server-client.</p>
<p>neighbor <neighborid> soft-reconfiguration inbound</p>	<p>Use this command to configure the device to start storing all updates from the BGP or BGP4+ neighbor, without any consideration of any inward route filtering policy that might be applied to the connection with this BGP or BGP4+ neighbor. <neighborid> specifies the address of an IPv4 BGP</p>

	neighbor, in dotted decimal notation A.B.C.D. Use the no variant of this command to disable this function for a BGP or BGP4+ neighbor.
bgp cluster-id <ip-address>	This command configures the cluster-id if the BGP cluster has more than one route reflector. A cluster includes one or more route reflectors and their clients. Usually, each cluster is identified by the router-id of its single route reflector. <ip-address>--A.B.C.D Route Reflector Cluster-id in IP address format. Use the no variant of this command removes the cluster ID.
set local-preference <pref-value>	This command changes the default local preference value. The local preference indicates the BGP local preference path attribute when there are multiple paths to the same destination. The path with the higher preference is chosen. <pref-value> ranging from 0 to 4294967295, configures local preference value. The default local preference value is 100. The no variant of this command reverts to the default setting.
bgp default local-preference <pref-value>	This command changes the default local preference value. <pref-value> ranging from 0 to 4294967295 configures default local preference value. The default local preference value is 100. The no variant of this command reverts to the default local preference value of 100.
distance <1-255> <ip-address/m> [<listname>]	This command sets the administrative distance for BGP and BGP4+ routes. The device uses this value to select between two or more routes to the same destination from two different routing protocols. Set the administrative distance for BGP routes in the Router Configuration mode, and for BGP4+ routes in IPv6 Address Family Configuration mode. <1-255> The administrative distance value you are setting for the route. <ip-address/m> The IP source prefix that you are changing the administrative distance for, entered in the form A.B.C.D/M. This is an IPv4 address in dotted decimal notation followed by a forward slash, and then the prefix length. <listname> The name of the access list to be applied to the administrative distance to selected routes. The no variant of this command sets the administrative distance for the route to the default for the route type.
set metric <metric value>	Use this command to add a metric set clause to a route map entry. <metric-value> ranging from 0 to 4294967295. The no variant of this command to delete a metric set clause to a route map entry.
bgp bestpath med {[confed] [missing-as-worst]}	This command controls how the Multi Exit Discriminator (MED) attribute comparison is performed. <i>Confed</i> → Compares MED among confederation paths. <i>missing-as-worst</i> → Treats missing MED as the least preferred one. Use the no variant of this command to prevent BGP from considering the MED attribute when comparing paths.
ip as-path access-list <listname> {deny permit} <reg-exp>	This command defines a BGP and BGP4+ Autonomous System (AS) path access list. The named AS path list is a filter based on regular expressions. If the regular expression matches the AS path in a BGP update message, then the permit or deny condition applies to that update. Use this command to define the BGP access list globally, then use neighbor configuration commands to apply the list to a particular neighbor. <listname> Specifies the name of the access list. <deny> Denies access to matching conditions. <permit> Permits access to matching conditions. <reg-exp> Specifies a regular expression to match the BGP AS paths ^ Caret Used to match the beginning of the input string. When used at the beginning of a string of characters, it negates a pattern match. \$ Dollar sign Used to match the end of the input string. . Period Used to match a single character (white spaces included).

	<p>* Asterisk Used to match none or more sequences of a pattern. + Plus sign Used to match one or more sequences of a pattern. ? Question mark Used to match none or one occurrence of a pattern. _ Underscore Used to match spaces, commas, braces, parenthesis, or the beginning and end of an input string. [] Brackets Specifies a range of single-characters. - Hyphen Separates the end points of a range</p> <p>The no variant of this command disables the use of the access list.</p>
--	---

Below are the screenshot examples of BGP configurations listed in Table 3.9.

```
switch(config)#
switch(config)# bgp bestpath as-path confed
switch(config)#
switch(config)# show bgp bestpath as-path confed
bgp bestpath as-path confed
switch(config)#
switch(config)# no bgp bestpath as-path confed
switch(config)#
switch(config)# show bgp bestpath as-path confed
Disabled bgp bestpath as-path confed
```

Figure 3.10 Examples of CLI for Neighbor Bestpath AS-Path Confed Configuration in BGP

```
switch(config)#
switch(config)# bgp bestpath compare-routerid
switch(config)#
switch(config)# show bgp bestpath compare-routerid
bgp bestpath compare-routerid
switch(config)# no bgp bestpath compare-routerid
switch(config)#
switch(config)# show bgp bestpath compare-routerid
Disabled bgp bestpath compare-routerid
```

Figure 3.11 Examples of CLI for Neighbor Bestpath Compare-Routerid Configuration in BGP

```
switch(config)# bgp neighbor 10.0.50.4 port 65535
switch(config)#
switch(config)# show bgp neighbor port
neighbor 10.0.50.4 port 65535
switch(config)#
switch(config)#
switch(config)# no bgp neighbor 10.0.50.4 port 65535
switch(config)#
switch(config)# show bgp neighbor port
```

Figure 3.12 Examples of CLI for Neighbor Port Configuration in BGP

```
switch(config)#
switch(config)# bgp neighbor 10.0.50.5 weight 65535
switch(config)#
switch(config)# show bgp neighbor weight
neighbor 10.0.50.5 weight 65535
switch(config)#
switch(config)# no bgp neighbor 10.0.50.5 weight 65535
```

Figure 3.13 Examples of CLI for Neighbor Weight Configuration in BGP

```
switch(config)#
switch(config)# bgp neighbor 10.0.50.3 version 4
switch(config)#
switch(config)# show bgp neighbor version
neighbor 10.0.50.3 version 4
```

```
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.3 version 4  
switch(config)#  
switch(config)# show bgp neighbor version
```

Figure 3.14 Examples of CLI for Neighbor Version Configuration in BGP

```
switch(config)# bgp neighbor 10.0.50.4 ebgp-multihop 255  
switch(config)#  
switch(config)# show bgp neighbor ebgp-multihop  
neighbor 10.0.50.4 ebgp-multihop 255  
switch(config)# no bgp neighbor 10.0.50.2 ebgp-multihop 255  
switch(config)#  
switch(config)# show bgp neighbor ebgp-multihop
```

Figure 3.15 Examples of CLI for Neighbor EBGp-Multihop Configuration in BGP

```
switch(config)#  
switch(config)# bgp neighbor 10.0.50.5 interface vlan2  
switch(config)#  
switch(config)# show bgp neighbor interface  
neighbor 10.0.50.5 interface vlan2  
switch(config)#
```

```
switch(config)# no bgp neighbor 10.0.50.5 interface vlan2
switch(config)#
switch(config)# show bgp neighbor interface
switch(config)#
```

Figure 3.16 Examples of CLI for Neighbor Interface Configuration in BGP

```
switch(config)#
switch(config)# show ip bgp filter-list mylist
switch(config)# BGP: show ip bgp filter-list mylist
-----
bgpd> enable
bgpd# show ip bgp filter-list mylist
% mylist is not a valid AS-path access-list name
bgpd#
bgpd#
=====
switch(config)#
switch(config)#
```

Figure 3.17 Examples of CLI for Show Filter-List Configuration in BGP

```
switch(config)#
switch(config)# bgp neighbor 10.0.50.2 distribute-list mylist out
switch(config)#
switch(config)# show bgp neighbor distribute-list name
neighbor 10.0.50.2 distribute-list mylist out
switch(config)#
switch(config)# bgp neighbor 10.0.50.2 distribute-list 199 in
switch(config)#
switch(config)# show bgp neighbor distribute-list
neighbor 10.0.50.2 distribute-list 199 in
switch(config)# no bgp neighbor 10.0.50.2 distribute-list 199 in
switch(config)#
switch(config)# show bgp neighbor distribute-list
switch(config)#
switch(config)#
```

Figure 3.18 Examples of CLI for Neighbor Distribute-List Name Configurations in BGP

```
switch(config)#
switch(config)# bgp neighbor group1 peer-group
switch(config)#
switch(config)# show bgp neighbor peer-group
neighbor group1 peer-group
switch(config)# no bgp neighbor group1 peer-group
switch(config)#
switch(config)# show bgp neighbor peer-group
switch(config)#
```

Figure 3.19 Examples of CLI for Neighbor Peer-Group Configuration in BGP

```
switch(config)#
switch(config)# bgp neighbor 10.0.50.6 send-community extended
```

```
switch(config)#  
switch(config)# show bgp neighbor send-community  
neighbor 10.0.50.6 send-community extended  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.6 send-community extended  
switch(config)#  
switch(config)# show bgp neighbor send-community  
switch(config)#
```

Figure 3.20 Examples of CLI for Neighbor Send-Community Extended Configuration in BGP

```
switch(config)#  
switch(config)# bgp neighbor 10.0.50.4 attribute-unchanged as-path  
switch(config)# show bgp neighbor attribute-unchanged  
neighbor 10.0.50.4 attribute-unchanged as-path  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.4 attribute-unchanged as-path  
switch(config)#  
switch(config)# show bgp neighbor attribute-unchanged  
switch(config)#
```

Figure 3.21 Examples of CLI for Neighbor Attribute-Unchanged AS-Path Configuration in BGP

```
switch(config)#  
switch(config)# bgp neighbor 10.0.50.2 capability orf prefix-list send  
switch(config)# show bgp neighbor capability orf prefix-list  
neighbor 10.0.50.2 capability orf prefix-list send  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.2 capability orf prefix-list  
switch(config)#  
switch(config)# show bgp neighbor capability orf prefix-list  
switch(config)#
```

Figure 3.22 Examples of CLI for Neighbor Capability ORF Prefix-List Configuration in BGP

```
switch(config)#  
switch(config)#  
switch(config)# bgp neighbor 10.0.50.5 unsuppress-map mymap  
switch(config)#  
switch(config)# show bgp neighbor unsuppress-map  
neighbor 10.0.50.5 unsuppress-map mymap  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.5 unsuppress-map mymap  
switch(config)#  
switch(config)# show bgp neighbor unsuppress-map
```

Figure 3.23 Examples of CLI for Neighbor Unsuppress-Map Configuration in BGP

```
switch(config)# bgp neighbor 10.0.50.5 capability route-refresh  
switch(config)#  
switch(config)#  
switch(config)# show bgp neighbor capability route-refresh  
neighbor 10.0.50.5 capability route-refresh  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.5 capability route-refresh  
switch(config)#  
switch(config)# show bgp neighbor capability route-refresh
```

Figure 3.24 Examples of CLI for Neighbor Capability Route-Fresh Configuration in BGP

```
switch(config)# bgp neighbor 10.0.50.5 dont-capability-negotiate
```

```
switch(config)#  
switch(config)# show bgp neighbor dont-capability-negotiate  
neighbor 10.0.50.5 dont capability negotiate  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.5 dont-capability-negotiate  
switch(config)#  
switch(config)# show bgp neighbor dont-capability-negotiate
```

Figure 3.25 Examples of CLI for Neighbor Don't Capability Negotiate Configuration in BGP

```
switch(config)# bgp neighbor 10.0.50.2 next-hop-self  
switch(config)#  
switch(config)#  
switch(config)# show bgp neighbor next-hop-self  
neighbor 10.0.50.2 next-hop-self  
switch(config)# show bgp neighbor next-hop-self  
neighbor 10.0.50.2 next-hop-self  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.2 next-hop-self  
switch(config)#  
switch(config)# show bgp neighbor next-hop-self  
switch(config)#
```

Figure 3.26 Examples of CLI for Neighbor Next-Hop-Self Configuration in BGP

```
switch(config)#  
switch(config)# bgp neighbor 10.0.50.5 override-capability  
switch(config)#  
switch(config)# show bgp neighbor override-capability  
neighbor 10.0.50.5 override-capability  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.5 override-capability  
switch(config)#  
switch(config)# show bgp neighbor override-capability
```

Figure 3.27 Examples of CLI for Neighbor Override Capability Configuration in BGP

```
switch(config)#  
switch(config)# bgp neighbor 10.0.50.4 passive  
switch(config)#  
switch(config)# show bgp neighbor passive  
neighbor 10.0.50.4 passive  
switch(config)#  
switch(config)# show bgp neighbor passive  
neighbor 10.0.50.4 passive  
switch(config)#  
switch(config)# no bgp neighbor 10.0.50.4 passive  
switch(config)#  
switch(config)# show bgp neighbor passive
```

Figure 3.28 Examples of CLI for Neighbor Passive Configuration in BGP

```
switch(config)#  
switch(config)# bgp neighbor 10.0.50.6 route-server-client  
switch(config)#  
switch(config)# show bgp neighbor route-server-client  
neighbor 10.0.50.6 route-server-client  
switch(config)#
```

```
switch(config)# no bgp neighbor 10.0.50.6 route-server-client
switch(config)#
switch(config)# show bgp neighbor route-server-client
switch(config)#
switch(config)#
```

Figure 3.29 Examples of CLI for Neighbor Route Server Client Configuration BGP

```
switch(config)#
switch(config)# show bgp neighbor soft-reconfiguration
neighbor 10.0.50.6 soft-reconfiguration inbound
switch(config)#
switch(config)# no bgp neighbor 10.0.50.6 soft-reconfiguration inbound
switch(config)#
switch(config)# show bgp neighbor soft-reconfiguration
switch(config)#
switch(config)#
switch(config)# bgp neighbor 10.0.50.6 soft-reconfiguration inbound
switch(config)#
switch(config)# show bgp neighbor soft-reconfiguration
neighbor 10.0.50.6 soft-reconfiguration inbound
```

Figure 3.30 Examples of CLI for Neighbor Soft-Reconfiguration Inbound Configuration in BGP

```
switch(config)#
switch(config)# bgp cluster-id 10.10.1.1
switch(config)#
switch(config)# show bgp cluster-id
bgp cluster-id 10.10.1.1
switch(config)#
switch(config)# no bgp cluster-id 10.10.1.1
switch(config)#
switch(config)# show bgp cluster-id
switch(config)#
switch(config)#
```

Figure 3.31 Examples of CLI for Cluster-ID Configuration in BGP

```
switch(config)#
switch(config)# bgp set local-preference 2345555
switch(config)#
switch(config)# show bgp set local-preference
set local-preference 2345555
switch(config)#
switch(config)# no bgp set local-preference 2345555
switch(config)#
switch(config)# show bgp set local-preference
switch(config)#
```

Figure 3.32 Examples of CLI for Set Local-Preference Configuraion in BGP

```
switch(config)#
switch(config)# bgp default local-preference 100
switch(config)#
switch(config)# show bgp default local-preference
bgp default local-preference 100
switch(config)#
```

```
switch(config)#
switch(config)# show bgp default local-preference
bgp default local-preference 100
switch(config)#
switch(config)# no bgp default local-preference 100
switch(config)#
switch(config)# show bgp default local-preference
switch(config)# █
```

Figure 3.33 Examples of CLI for Default Local Preference Configurations in BGP

```
switch(config)# bgp distance 1 1.1.1.1/12 atop
switch(config)#
switch(config)# show bgp distance access-list
distance 1 1.1.1.1/12 atop
switch(config)# no bgp distance 1 1.1.1.1/12 atop
switch(config)#
switch(config)# show bgp distance access-list
```

Figure 3.34 Examples of CLI for Distance Configuration in BGP

```
switch(config)#
switch(config)# bgp set metric 4294967295
switch(config)#
switch(config)# show bgp set metric
set metric 4294967295
switch(config)#
switch(config)# no bgp set metric 4294967295
switch(config)#
switch(config)# show bgp set metric
Disabled Metric
switch(config)# █
```

Figure 3.35 Examples of CLI for Set Metric Configuration in BGP

```
switch(config)#
switch(config)# bgp bestpath med missing-as-worst
switch(config)#
switch(config)# show bgp bestpath med
bgp bestpath med missing-as-worst
switch(config)# █

switch(config)# show bgp bestpath med
bgp bestpath med missing-as-worst
switch(config)#
switch(config)# no bgp bestpath med missing-as-worst
switch(config)#
switch(config)# show bgp bestpath med
switch(config)# █
```

Figure 3.36 Examples of CLI for Best Path Med Configuration in BGP

```
switch(config)#
switch(config)# bgp ip as-path access-list mylist permit ^
switch(config)#
switch(config)# show bgp ip as-path access-list
ip as-path access-list mylist permit ^
switch(config)#
switch(config)# no bgp ip as-path access-list mylist permit ^
switch(config)#
switch(config)# show bgp ip as-path access-list
switch(config)# █
```

Figure 3.37 Examples of CLI for IP AS-PATH Access List Configuration in BGP

4 Configuring with a Telnet Console

An alternative configuration method is the Telnet method and it is described in this chapter.

4.1 Telnet

Telnet is a remote terminal software to login to any remote telnet servers. It is typically installed in most of the operating systems. In order to use it, users open a command line terminal (e.g., cmd.exe for Windows Operating System).

4.2 Telnet Login

After the command line terminal is opened, type in "telnet 10.0.50.1" as shown in Figure 4.1. Note that telnet command needs to follow by IP address or domain name. In this example, the default IP address is 10.0.50.1. If users change the switch IP address, the IP address to log-in should be changed to match the new switch IP address.



Figure 4.1 Telnet Command

4.3 Command Line Interface for Telnet

After input the telnet command line, the switch's interface is displayed as shown in Figure 4.2.

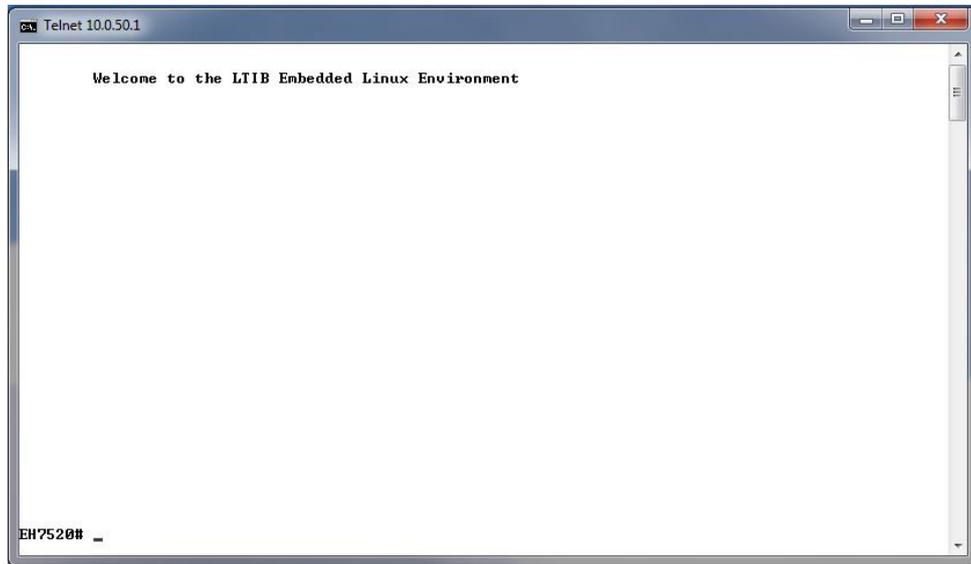


Figure 4.2 Log-in Screen using Telnet

Users will see the welcome screen to the switch interface. From Chapter 3, configuring through telnet is similar to configuring through the serial console. Users are automatically logged into the privileged mode. The configuration commands are also similar to the serial console methods. (Please refer to Chapter 3 for more information on configuration).

4.4 Commands in the Privileged Mode

When users do not know the commands to use for the command line configuration, users type in "?" and the commands are displayed on screen as shown in Figure 4.3.

```
EH7520#  
configure Configuration  
disable Turn off privileged mode command  
exit Exit current mode and down to previous mode  
help Description of the interactive help system  
history Set the number of history commands  
logout Log out of the system  
no Negate a command or set its defaults  
show Show running system information  
EH7520#
```

Figure 4.3 Commands in the Privileged Mode

4.5 Commands in the Configuration Mode

When users type in “?” in configuration mode, a long list of commands is displayed on screen as shown in

Figure 4.4. Table 4.1 shows all commands that can be used to configure the switch in the configuration mode.

```

Telnet 10.0.50.1
EH7520# configure
EH7520(config)#
alert                Alert information
boot                 Reboot the switch
cos-mapping          CoS mapping information
clear                Clear values in destination protocol
copy                 Copy configuration
cring                Compatible-Ring configuration
disable              Turn off privileged mode command
dscp-mapping         DSCP mapping information
dhcp                 DHCP information
dot1x                802.1x information
dipswitch            DIP Switch information
daylight-saving-time Daylight Saving Time
exit                 Exit current mode and down to previous mode
erase                Erase configuration
erps                 ERPS information
filter               Filter source MAC address information
garp                 GARP information
garp                 GARP information
garp                 GARP information
help                 Description of the interactive help system
history              Set the number of history commands
ip                   IP information
igmp                 IGMP information
ia-ring              iA-Ring configuration
logout               Log out of the system
lldp                 LLDP information
lACP                 LACP information
mac-age-time         Enable MAC address age-out
mirror-port          Port monitoring information
mac-address-table    MAC address table information
no                   Negate a command or set its defaults
password             Password information
port                 Port information
ping                 Send ICMP ECHO_REQUEST to network hosts
ptp                  PTP information
qos                  QoS information
radius-server        Radius server information
show                 Show running system information
stormfilter           Storm filter on all kinds of traffic (Broadcast,Multicast,Unitcast)
security              Static port security configuration
system               System information
snmp                  Enable SNMP
systemtime           System time configuration
syslog               Syslog information
smtp                 SMTP configuration
snmp                 SNMP information
spanning-tree        Spanning Tree Protocol
timeout              Set the current CLI timeout setting
trunk                 Trunking information
uring                U-Ring configuration
vlan                 VLAN information
EH7520(config)#
EH7520(config)#

```

Figure 4.4 Commands in the Configuration Mode

Table 4.1 Commands in the Configuration Mode

Commands	Descriptions
alert	Alert information
boot	Reboot the switch
cos-mapping	CoS mapping information
clear	Clear values in the destination protocol
copy	Copy configuration
cring	Compatible-Ring configuration
disable	Turn off the privileged mode command
dscp-mapping	DSCP mapping information
dhcp	DHCP information
dot1x	802.1x information
dipswitch	DIP Switch information
daylight-saving-time	Daylight Saving Time
exit	Exit the current mode and move to the previous mode

erase	Erase the configuration
erps	ERPS information
filter	Filter the information of the source MAC address
garp	GARP information
gvrp	GVRP information
help	Description of the interactive help system
history	Set the number of history commands
ip	IP information
igmp	IGMP information
ia-ring	iA-Ring configuration
logout	Log out of the system
lldp	LLDP information
lACP	LACP information
mac-age-time	Enable age-out time for the MAC address
mirror-port	The monitoring information of a Port
mac-address-table	Information of the MAC address table
no	Negate a command or set to its defaults
password	Password information
port	Port information
ping	Send ICMP ECHO_REQUEST to network hosts
ptp	PTP information
qos	QoS information
radius-server	Radius server information
show	Show information of the current running system
stormfilter	Storm filter on all kinds of traffic (Broadcast,Multicast,Unitcast)
security	Security configuration of a static port
system	System information
sntp	Enable SNTP
systemtime	Configuration of the system time
syslog	Syslog information
smtp	SMTP configuration
snmp	SNMP information
spanning-tree	Spanning Tree Protocol
timeout	Set the current CLI timeout
trunk	Trunking information
uring	U-Ring configuration
vlan	VLAN information

Note: Please see Chapter 3 for the details of switch configuration.

5 Device Management Utility

Atop also provides a software utility called **Device Management Utility** to assist the users in configuring the product. The Device Management Utility was formerly called Device View or Serial Manager. The latest Device Management Utility is version 5.20. This chapter will describe how to use the Device Management Utility with the EHG7XXX industrial managed switch. After installing the utility software on your PC. Please click on the Device Management Utility's icon to start the program. Figure 5.1 illustrates the GUI of the Device Management Utility.

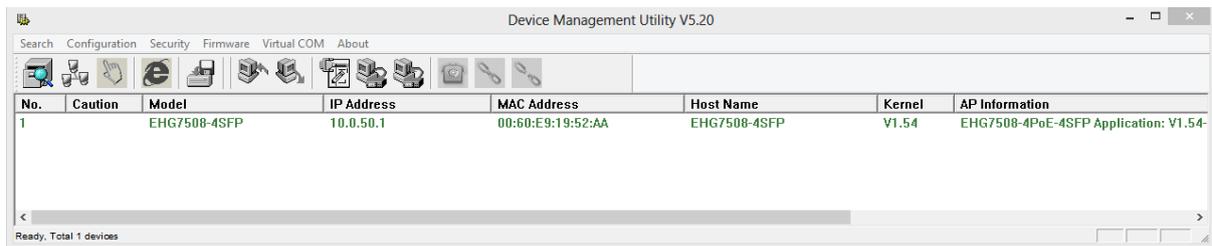


Figure 5.1 Device Management Utility

If the managed switch is on the same subnet as the PC that runs the Device Management Utility, the users should be able to find the switch on the list of the device as shown in Figure 5.1. If for some reason, it cannot be found, the user can click the first icon called **Rescan** on the icon bar to search for the device connected to the same subnet as the Device Management Utility. Depicts the Search icon.



Figure 5.2 Rescan (Search) Icon

To perform any task on the desired device, please click to select the entry of that particular device on the list inside the window of Device Management Utility. Typically, when the users double-click the entry, the Device Management Utility will connect to the switch and perform a login process.

It is strongly recommended the users to setup the administration password for the managed switch for network security purpose. If no administration password is set, the Device Management Utility will be able to login to and change any configuration on the device.

If the **Local Login Setting** was configured in Section 2.3.1, a login dialog will pop-up as shown in when the Device Management Utility try to select the **Config by Browser** menu under the **Configuration** pulldown menu or click on the fourth icon on the icon bar. The users then can enter the **User Name** and **Password** to verify the identity. Note that the User Name is typically set to "admin" and Password is "default" for convenient.

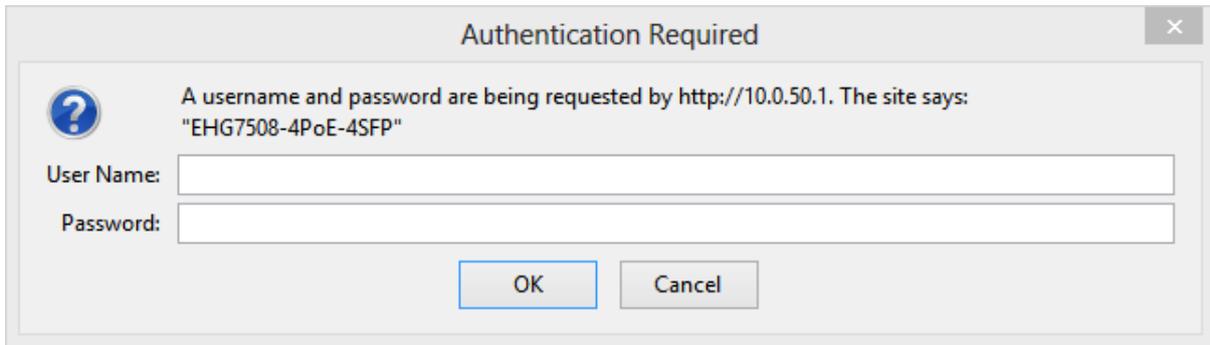


Figure 5.3 Authentication to Login to EHG7XXX switch

5.1 Network Setting

While the device is selected, the user can configure the network parameters by clicking on the Network icon, the second icon on the icon bar as depicted in Figure 5.4. Alternatively, the users can click on the pulldown menu **Configuration** and select **Network...** menu.



Figure 5.4 Network Configure Icon

The **Network Setting** dialog window will pop-up as shown in Figure 5.5. The users can enable the DHCP options by checking the box in front of **DHCP (Obtain an IP automatically)** option. This will allow the device to get its new IP address and other network parameters from a DHCP server from the network. Alternatively, the users can manually set the **IP address**, **Subnet mask**, **Gateway**, and **Host name**.

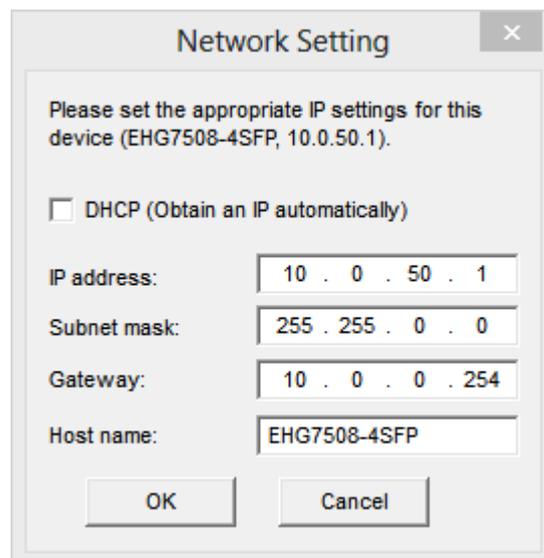


Figure 5.5 Network Setting Dialog

After clicking on the **OK** button, another dialog window will pop-up to ask for authorization in modification of this managed switch. The users are required to enter the correct **Password**. Note that the **User Name** is default as admin which cannot be changed. Then, click the **Authorize** button to allow the change of the network parameter.

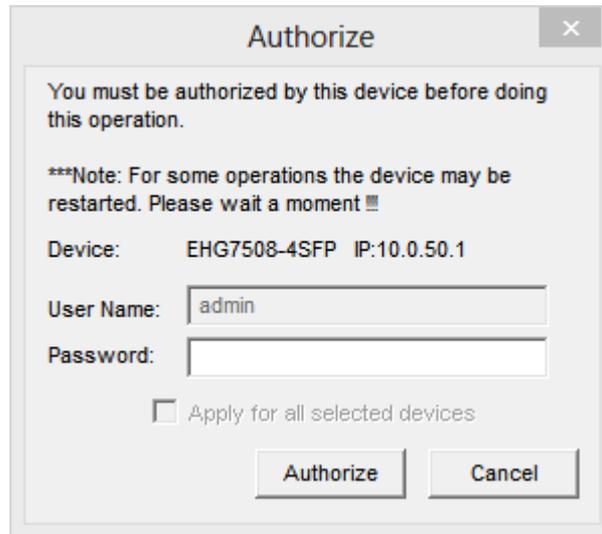


Figure 5.6 Administration Verification before Changing the Network Setting

A warning dialog will pop-up as shown in Figure 5.7 to inform the users that the device will restart after the network configuration was changed. Note that if the configurations were not changed, it may be because of the wrong user name, password, or IP configuration. The users should check these password settings or network settings of the product.

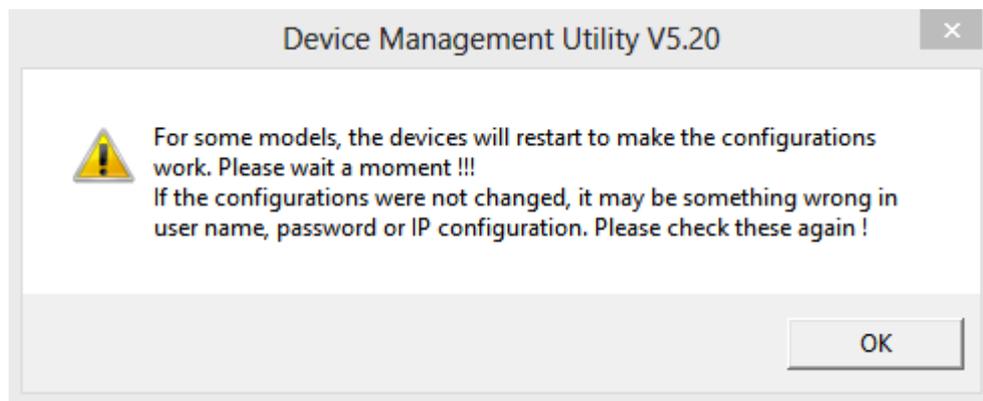


Figure 5.7 Warning Dialog before the Device Restart

If the IP address was changed, the users may need to search for the device again using the **Rescan** icon or the first icon on the icon bar.

5.2 Topology Diagram

Device management Utility comes with a visualization tool called **Topology Diagram** to automatically draw a network diagram. The users can select the **Topology Diagram** menu under the **Configuration** pulldown menu to start the visualization tool as shown in Figure 5.8. The current version of the Topology Diagram is 1.4.0. Note that the tools can display the device discovered by the Device Management Utility and draw a connection between devices in the network that can be reached by the Device Management Utility. Note that to be able to use the Topology Diagram, the switch's LLDP feature in Section 2.20.1 must be enabled.

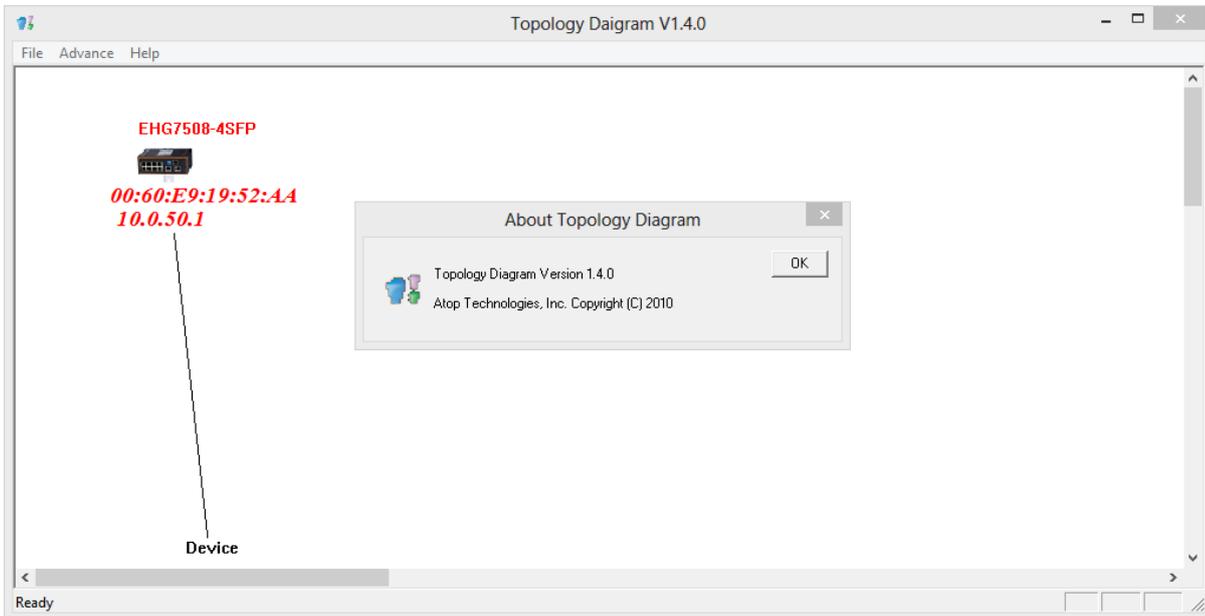


Figure 5.8 Topology Diagram

Additional information can also be display on the diagram which are the **Port** number and the **MAC address** of the device that is currently connecting to the EHG7XXX switch. Please select **Show Information** menu under the **File** pulldown menu. Figure 5.9 shows the result of additional information.

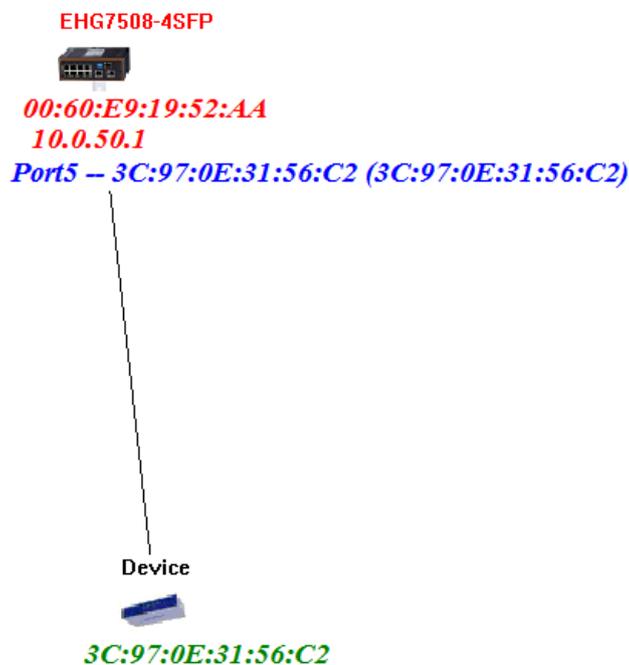


Figure 5.9 Show Information on Topology Diagram

Note that the Topology Diagram can be used to check the Ring Topology. The user can select the **RingCheck** menu from the **Advance** pulldown menu.

5.3 Firmware Update

The Device Management Utility can be used to update firmware of the switch. To perform this task, the users can click on the fifth icon on the icon bar as shown in Figure 5.10. Alternatively, the **Firmware Download...** menu under the **Firmware** pulldown menu can also perform this task.



Figure 5.10 Upgrade from Disk (Firmware Update) Icon

Figure 5.11 shows the dialog for Download Firmware from Disk. The window displays the current version of the firmware on the switch and provides the option to download either Kernel firmware or AP firmware to the switch. The users can choose a new and valid firmware (.dld extension) from the local PC and then clicking on the **Upgrade** button to perform the update.

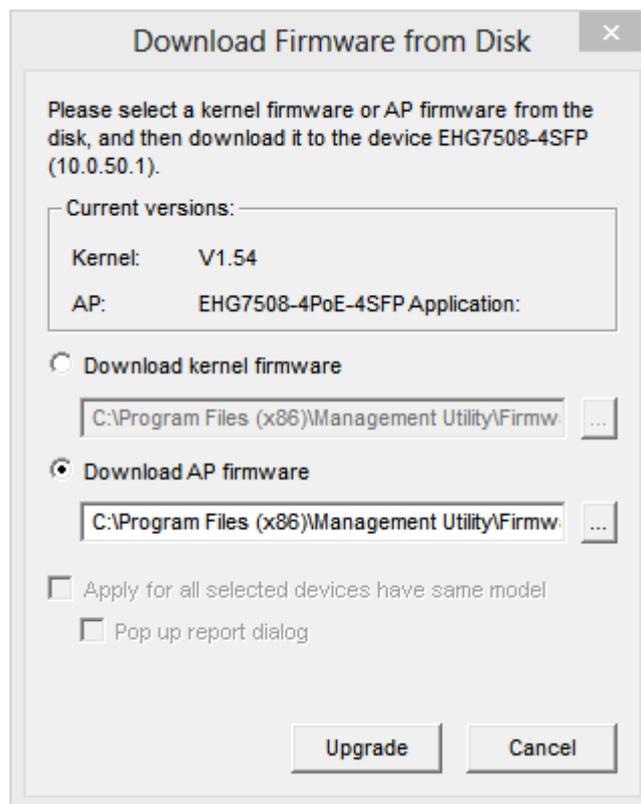


Figure 5.11 Dialog Window for Download Firmware from Disk

6 Glossary

Term	Description
802.1	A working group of IEEE standards dealing with Local Area Network.
802.1p	Provide mechanism for implementing Quality of Service (QoS) at the Media Access Control Level (MAC).
802.1x	IEEE standard for port- xbased Network-Access Control. It provides an authentication mechanism to devices wishing to attach to a LAN or WLAN
Broadcast	Broadcast packets to all stations of a local network.
Client	Device that use services provided by other participants in the network.
DES	Data Encryption Standard is a block cipher that uses shared secret encryption. It's based on a symmetric-key algorithm that uses a 56-bit key.
DHCP	Dynamic Host Configuration Protocol allows a computer to be configured automatically, eliminating the need for intervention by a network administrator. It also prevents two computers from being configured with the same IP address automatically. There are two versions of DHCP; one for IPv4 and one for IPv6.
DNS	Domain Name System is a hierarchical naming system built for any computers or resources connected to the Internet. It maps domain names into the numerical identifiers. For example, the domain name www.google.com is translated into the address 74.125.153.104.
EAP	Extensible Authentication Protocol is an authentication framework widely used by IEEE.
Ethernet	In star-formed physical transport medium, all stations can send data simultaneously. Collisions are detected and corrected through network protocols.
Gateway	Provide access to other network components on the OSI layer model. Packets which are not going to a local partner are sent to the gateway. The gateway takes care of communication with the remote network.
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol is used on IPv4 networks for establishing multicast group memberships.
IP	Internet Protocol
IPv4	Internet Protocol version 4 is the fourth revision of the Internet Protocol. Together with IPv6, it is the core of internet network. It uses 32-bit addresses, which means there are only 2 ³² possible unique addresses. Because of this limitation, an IPv4 addresses became scarce resource. This has stimulated the development of IPv6, which is still in its early stage of development.
LAN	Local Area Network is the network that connects devices in a limited geographical area such as company or computer lab.

MAC	Media Access Control is a sub-layer of the Data Link Layer specified in the OSI model. It provides addressing and channel access control mechanisms to allow network nodes to communicate within a LAN.
MAC Address	A unique identifier assigned to network interfaces for communications on a network segment. It is formed according to the rules of numbering name space managed by IEEE.
MD5	Message-Digest algorithm 5 is a widely used cryptographic which has a function with a 128-bit hash value.
Multicast	This type of transmission sends messages from one host to multiple hosts. Only those hosts that belong to a specific multicast group will receive the multicast. Also, networks that support multicast send only one copy of the information across the network until the delivery path that reaches group members diverges. At these diverges points, multicast packets will be copied and forwarded. This method can manage high volume of traffic with different destinations while using network bandwidth efficiently.
OSI Model	Open System Interconnection mode is a way of sub-dividing a communication system into smaller parts called layers. A layer is a collection of conceptually similar functions that provide services to the layer above it and receives services from the layer below it.
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service is an authentication and monitoring protocol on the application level for authentication, integrity protection and accounting for network access.
Server	Devices that provide services over the network.
SMTP	Simple Mail Transfer Protocol (SMTP) is an internet standard for email transmission across IP network.
SNMP	Simple Network Management Protocol is a protocol for managing devices on IP networks. It exposes management data in the form of variables on the managed systems, which describe the system configuration.

7 Modbus Memory Map

1. Read Registers (Support Function Code 3, 4).
2. Write Register (Support Function Code 6).
3. 1 Word = 2 Bytes.

Address	Data Type	Read/Write	Description
System Information			
0x0000 (0)	32 words	R	System Description = "Managed Switch EH7510" Word 0 Hi byte = 'M' Word 0 Lo byte = 'a' Word 1 Hi byte = 'n' Word 1 Lo byte = 'a' Word 2 Hi byte = 'g' Word 2 Lo byte = 'e' Word 3 Hi byte = 'd' Word 3 Lo byte = '' Word 4 Hi byte = 'S' Word 4 Lo byte = 'w' Word 5 Hi byte = 'i' Word 5 Lo byte = 't' Word 6 Hi byte = 'c' Word 6 Lo byte = 'h' Word 7 Hi byte = '' Word 7 Lo byte = 'E' Word 8 Hi byte = 'H' Word 8 Lo byte = '7' Word 9 Hi byte = '5' Word 9 Lo byte = '1' Word 10 Hi byte = '0' Word 10 Lo byte = '\0'
0x0020 (32)	1 word	R	Firmware Version = Ex: Version = 1.02 Word 0 Hi byte = 0x01 Word 0 Lo byte = 0x02
0x0021 (33)	3 words	R	Ethernet MAC Address Ex: MAC = 00-01-02-03-04-05 Word 0 Hi byte = 0x00 Word 0 Lo byte = 0x01 Word 1 Hi byte = 0x02 Word 1 Lo byte = 0x03 Word 2 Hi byte = 0x04 Word 2 Lo byte = 0x05
0x0024 (36)	1 word	R	Kernel Version Ex: Version = 1.03 Word 0 Hi byte = 0x01 Word 0 Lo byte = 0x03
Console Information			

0x0030 (48)	1 word	R	Baud Rate 0x0000: 4800 0x0001: 9600 0x0002: 14400 0x0003: 19200 0x0004: 28800 0x0005: 38400 0x0006: 57600 0x0007: 144000 0x0008: 115200
0x0031 (49)	1 word	R	Data Bits 0x0007: 7 0x0008: 8
0x0032 (50)	1 word	R	Parity 0x0000: None 0x0001: Odd 0x0002: Even
0x0033 (51)	1 word	R	Stop Bit 0x0001: 1 0x0002: 2
0x0034 (52)	1 word	R	Flow Control 0x0000: None
Power Information			
0x0040 (64)	1 word	R	Power Status Power 1 OK, Hi byte = 0x01 Power 1 Fail, Hi byte = 0x00 Power 2 OK, Low byte = 0x01 Power 2 Fail, Low byte = 0x00
IP Information			
0x0050 (80)	1 word	R	DHCP Status 0x0000: Disabled 0x0001: Enabled
0x0051 (81)	2 words	R	IP Address of switch Ex: IP = 192.168.1.1 Word 0 Hi byte = 0xC0 Word 0 Lo byte = 0xA8 Word 1 Hi byte = 0x01 Word 1 Lo byte = 0x01
0x0053 (83)	2 words	R	Subnet Mask of switch Ex: IP = 255.255.255.0 Word 0 Hi byte = 0xFF Word 0 Lo byte = 0xFF Word 1 Hi byte = 0xFF Word 1 Lo byte = 0x00
0x0055 (85)	2 words	R	Gateway Address of switch Ex: IP = 192.168.1.254 Word 0 Hi byte = 0xC0 Word 0 Lo byte = 0xA8 Word 1 Hi byte = 0x01 Word 1 Lo byte = 0xFE
0x0057 (87)	2 words	R	DNS1 of switch Ex: IP = 168.95.1.1

			Word 0 Hi byte = 0xA8 Word 0 Lo byte = 0x5F Word 1 Hi byte = 0x01 Word 1 Lo byte = 0x01
0x0059 (89)	2 words	R	DNS2 of switch Ex: IP = 168.95.1.1 Word 0 Hi byte = 0xA8 Word 0 Lo byte = 0x5F Word 1 Hi byte = 0x01 Word 1 Lo byte = 0x01
System Status Clear			
0x0100 (256)	1 word	W	Clear Port Statistics 0x0001: Do clear action
0x0101 (257)	1 word	W	Clear Relay Alarm 0x0001: Do clear action
0x0102 (258)	1 word	W	Clear All Warning Events 0x0001: Do clear action
Warning Events Information			
0x0200 (512)	64 words	R	1st Warning Event Information
0x0300 (768)	64 words	R	2st Warning Event Information
0x0400 (1024)	64 words	R	3st Warning Event Information
0x0500 (1280)	64 words	R	4st Warning Event Information
0x0600 (1536)	64 words	R	5st Warning Event Information
Port Status			
0x1000 (4096)	5 words	R	Port Status 0x0000: Disabled 0x0001: Enabled Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status
0x1020 (4128)	5 words	R	Port Negotiation Status, force = 0x00 Status, auto = 0x01 Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status
0x1040 (4160)	5 words	R	Port Speed Status, 10M = 0x01

			<p>Status, 100M = 0x02 Status, 1000M = 0x03 Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status</p>
0x1060 (4192)	5 words	R	<p>Port Duplex Status, half-duplex = 0x00 Status, full-duplex = 0x01 Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status</p>
0x1080 (4224)	5 words	R	<p>Port Flow Control Status, disabled = 0x00 Status, enabled = 0x01 Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status</p>
0x10A0 (4256)	5 words	R	<p>Port Link Status Status, down = 0x00 Status, up = 0x01 Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status</p>
0x1200 (4608)	20 words	R	<p>Port TX rate Ex. Port 1 runs at TX Rate (1024 Kbps = 0x400). Word 0 of Port 1 = 0x0000</p>

			<p>Word 1 of Port 1 = 0x0400 Word 0,1 = Port 1 TX Rate Word 2,3 = Port 2 TX Rate Word 4,5 = Port 3 TX Rate Word 6,7 = Port 4 TX Rate Word 8,9 = Port 5 TX Rate Word 10,11 = Port 6 TX Rate Word 12,13 = Port 7 TX Rate Word 14,15 = Port 8 TX Rate Word 16,17 = Port 9 TX Rate Word 18,19 = Port 10 TX Rate</p>
0x1280 (4736)	20 words	R	<p>Port RX rate Ex. Port 1 runs at RX Rate (1024 Kbps = 0x400). Word 0 of Port 1 = 0x0000 Word 1 of Port 1 = 0x0400 Word 0,1 = Port 1 RX Rate Word 2,3 = Port 2 RX Rate Word 4,5 = Port 3 RX Rate Word 6,7 = Port 4 RX Rate Word 8,9 = Port 5 RX Rate Word 10,11 = Port 6 RX Rate Word 12,13 = Port 7 RX Rate Word 14,15 = Port 8 RX Rate Word 16,17 = Port 9 RX Rate Word 18,19 = Port 10 RX Rate</p>
0x1300 (4864)	40 words	R	<p>Count of Good Packets of TX Ex. Port 1 gets 0x2EEEE1FFFF good packets of TX. Word 0 of Port 1 = 0x0000 Word 1 of Port 1 = 0x002E Word 2 of Port 1 = 0xEEE1 Word 3 of Port 1 = 0xFFFF Word 0,1,2,3 = Port 1 good packets Word 4,5,6,7 = Port 2 good packets Word 8,9,10,11 = Port 3 good packets Word 12,13,14,15 = Port 4 good packets Word 16,17,18,19 = Port 5 good packets Word 20,21,22,23 = Port 6 good packets Word 24,25,26,27 = Port 7 good packets Word 28,29,30,31 = Port 8 good packets Word 32,33,34,35 = Port 9 good packets Word 36,37,38,39 = Port 10 good packets</p>
0x1400 (5120)	40 words	R	<p>Count of Bad Packets of TX Ex. Port 1 gets 0x2EEEE1FFFF bad packets of TX. Word 0 of Port 1 = 0x0000 Word 1 of Port 1 = 0x002E Word 2 of Port 1 = 0xEEE1 Word 3 of Port 1 = 0xFFFF Word 0,1,2,3 = Port 1 good packets Word 4,5,6,7 = Port 2 good packets Word 8,9,10,11 = Port 3 good packets Word 12,13,14,15 = Port 4 good packets Word 16,17,18,19 = Port 5 good packets Word 20,21,22,23 = Port 6 good packets Word 24,25,26,27 = Port 7 good packets</p>

			Word 28,29,30,31 = Port 8 good packets Word 32,33,34,35 = Port 9 good packets Word 36,37,38,39 = Port 10 good packets
0x1500 (5376)	40 words	R	Count of Good Packets of RX Ex. Port 1 gets 0x2EEEE1FFFF good packets of RX. Word 0 of Port 1 = 0x0000 Word 1 of Port 1 = 0x002E Word 2 of Port 1 = 0xEEE1 Word 3 of Port 1 = 0xFFFF Word 0,1,2,3 = Port 1 good packets Word 4,5,6,7 = Port 2 good packets Word 8,9,10,11 = Port 3 good packets Word 12,13,14,15 = Port 4 good packets Word 16,17,18,19 = Port 5 good packets Word 20,21,22,23 = Port 6 good packets Word 24,25,26,27 = Port 7 good packets Word 28,29,30,31 = Port 8 good packets Word 32,33,34,35 = Port 9 good packets Word 36,37,38,39 = Port 10 good packets
0x1600 (5632)	40 words	R	Count of Bad Packets of RX Ex. Port 1 gets 0x2EEEE1FFFF bad packets of RX. Word 0 of Port 1 = 0x0000 Word 1 of Port 1 = 0x002E Word 2 of Port 1 = 0xEEE1 Word 3 of Port 1 = 0xFFFF Word 0,1,2,3 = Port 1 good packets Word 4,5,6,7 = Port 2 good packets Word 8,9,10,11 = Port 3 good packets Word 12,13,14,15 = Port 4 good packets Word 16,17,18,19 = Port 5 good packets Word 20,21,22,23 = Port 6 good packets Word 24,25,26,27 = Port 7 good packets Word 28,29,30,31 = Port 8 good packets Word 32,33,34,35 = Port 9 good packets Word 36,37,38,39 = Port 10 good packets
Redundancy Information			
0x2000 (8192)	1 word	R	Redundancy Protocol 0x0000: None 0x0001: STP 0x0002: RSTP 0x0004: ERPS 0x0008: iA-Ring 0x0010: Compatible-Ring
0x2100 (8448)	1 word	R	STP Root 0x0000: Not Root 0x0001: Root 0xFFFF: RSTP not enable
0x2101 (8449)	5 words	R	STP Port Status 0x00: Disabled

			<p>0x01: Listening 0x02: Learning 0x03: Forwarding 0x04: Blocking 0x05: Discarding 0xFF: RSTP Not Enable Word 0 Hi byte = Port 1 Status Word 0 Lo byte = Port 2 Status Word 1 Hi byte = Port 3 Status Word 1 Lo byte = Port 4 Status Word 2 Hi byte = Port 5 Status Word 2 Lo byte = Port 6 Status Word 3 Hi byte = Port 7 Status Word 3 Lo byte = Port 8 Status Word 4 Hi byte = Port 9 Status Word 4 Lo byte = Port 10 Status</p>
0x2200 (8704)	5 words	R	<p>ERPS R-APS VLAN ID of the ring Ex: 3st VLAN ID = 1, Word 2 = 0x0001 1~4094: ID Value range 0x0000: VLAN ID Not Setup Word 0 = 1st VLAN ID Word 1 = 2st VLAN ID Word 2 = 3st VLAN ID Word 3 = 4st VLAN ID Word 4 = 5st VLAN ID</p>
0x2230 (8752)	5 words	R	<p>ERPS West Port Ex: 3st West Port = Port 2, Word 2 = 0x0002 0x0001: Port 1 0x0002: Port 2 ... 0x000A: Port 10 0x000C: Trk1 0x000D: Trk2 0x000E: Trk3 0x000F: Virtual Channel 0x00FF: VLAN ID exist but no West Port be Selected 0xFFFF: ERPS Not Enable Word 0 = 1st VLAN ID West Port Word 1 = 2st VLAN ID West Port Word 2 = 3st VLAN ID West Port Word 3 = 4st VLAN ID West Port Word 4 = 5st VLAN ID West Port</p>
0x2240 (8768)	5 words	R	<p>ERPS East Port Ex: 3st West Port = Port 3, Word 2 = 0x0003 0x0001: Port 1 0x0002: Port 2 ... 0x000A: Port 10 0x000C: Trk1 0x000D: Trk2 0x000E: Trk3 0x000F: Virtual Channel 0x00FF: VLAN ID exist but no East Port be Selected 0xFFFF: ERPS Not Enable</p>

			Word 0 = 1st VLAN ID East Port Word 1 = 2st VLAN ID East Port Word 2 = 3st VLAN ID East Port Word 3 = 4st VLAN ID East Port Word 4 = 5st VLAN ID East Port
0x2250 (8784)	5 words	R	ERPS West Port Status Ex: 3st West Port Status = Forwarding, Word 2 = 0x0001 0x0001: Forwarding 0x0002: Blocking 0x0003: Signal Fail Blocking 0x000F: Virtual Channel 0x00FF: VLAN ID exist but no West Port be Selected 0xFFFF: ERPS Not Enable Word 0 = 1st VLAN ID West Port Status Word 1 = 2st VLAN ID West Port Status Word 2 = 3st VLAN ID West Port Status Word 3 = 4st VLAN ID West Port Status Word 4 = 5st VLAN ID West Port Status
0x2260 (8800)	5 words	R	ERPS East Port Status Ex: 3st East Port Status = Blocking, Word 2 = 0x0002 0x0001: Forwarding 0x0002: Blocking 0x0003: Signal Fail Blocking 0x000F: Virtual Channel 0x00FF: VLAN ID exist but no East Port be Selected 0xFFFF: ERPS Not Enable Word 0 = 1st VLAN ID East Port Status Word 1 = 2st VLAN ID East Port Status Word 2 = 3st VLAN ID East Port Status Word 3 = 4st VLAN ID East Port Status Word 4 = 5st VLAN ID East Port Status
0x2270 (8816)	5 words	R	ERPS Node State Ex: 3st Node State = Protection, Word 2 = 0x0002 0x0001: None 0x0002: Idle 0x0003: Protection 0xFFFF: ERPS Not Enable Word 0 = 1st VLAN ID Node State Word 1 = 2st VLAN ID Node State Word 2 = 3st VLAN ID Node State Word 3 = 4st VLAN ID Node State Word 4 = 5st VLAN ID Node State
0x2280 (8832)	5 word	R	ERPS RPL Owner 0x0000: Disabled 0x0001: Enabled
0x2300 (8960)	1 word	R	iA-Ring Master Status 0x0000: Disabled 0x0001: Enabled 0xFFFF: iA-Ring not enable
0x2301 (8961)	1 word	R	1st Ring Port Ex: 1st Ring Port = Port 2, Word 0 = 0x0002 0x0001: Port 1

			0x0002 : Port 2 ... 0x000A: Port 10 0xFFFF: iA-Ring not enable
0x2302 (8962)	1 word	R	2st Ring Port Ex: 2st Ring Port = Port 3, Word 0 = 0x0003 0x0001: Port 1 0x0002: Port 2 ... 0x000A: Port 10 0xFFFF: iA-Ring not enable



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