PLANET
Networking & Communication

User's Manual

16-Port XGS-PON Managed OLT

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Revision

PLANET XGPL-16000 User's Manual
Model: XGPL-16000
Revision: 1.0 (July. 2025)
Part No: EM-XGPL-16000_v1.0

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1. Introduction

Thank you for purchasing PLANET XGS-PON OLT XGPL-16000. The description of this model is as follows:

Model	XGS-PON ports	10G SFP+ ports	100G/40G QSFP28 ports
XGPL-16000	16	8	2

1.1 Packet Contents

The box should contain the following items:

- XGS-PON OLT x 1
- Quick Installation Guide x 1
- Dust Cap (SFP) x 26
- RJ45 to DB9 Console Cable x 1
- Rack-mount Accessory Kit x 1
- AC Power Cord x 1

If any of these are missing or damaged, please contact your dealer immediately; if possible, retain the carton including the original packing material, and use them again to repack the product in case there is a need to return it to us for repair.

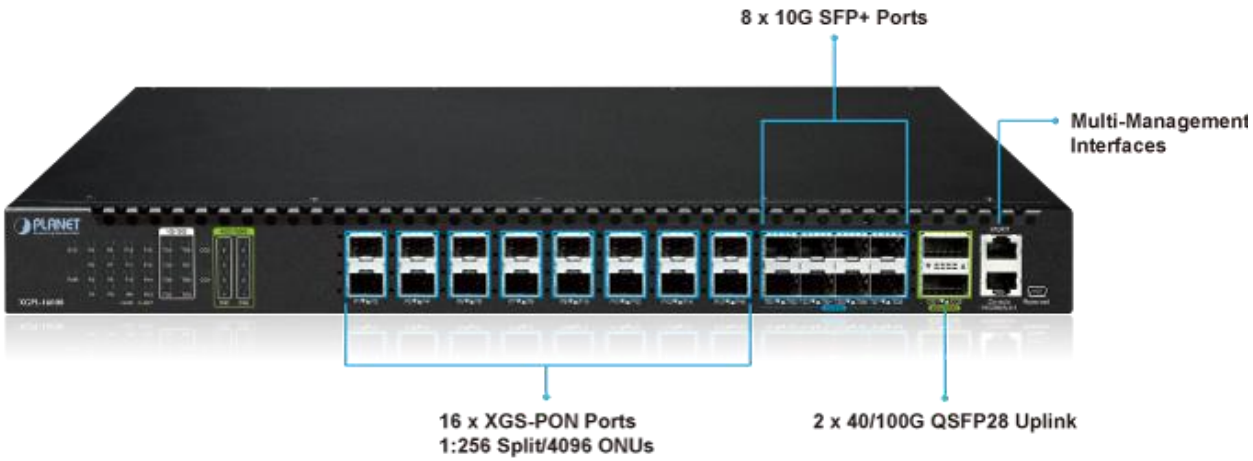
1.2 Product Description

High-Performance 16-Port XGS-PON OLT with 40G/100G Uplink Capability

PLANET XGPL-16000 is a high-density 16-Port XGS-PON Optical Line Terminal (OLT) designed for next-generation fiber broadband access networks. It integrates 16 XGS-PON ports, 8 10G SFP+ ports, and 2 40G/100G QSFP28 uplink ports, offering exceptional scalability and bandwidth aggregation for large-scale deployments.

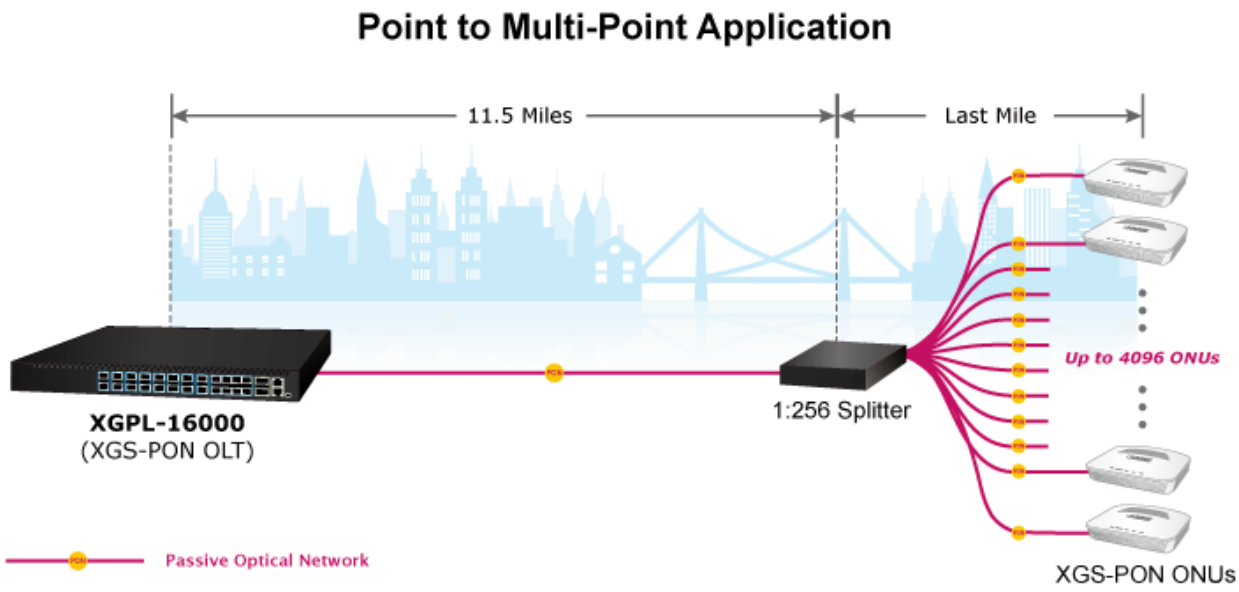
Key Features:

- 16 XGS-PON SFP slots with a 1:256 split ratio per port
- Two 40G/100G QSFP28 uplink interfaces for high-capacity backbone connectivity
- Eight 10G SFP+ ports for flexible service expansion or link redundancy
- Dual hot-swappable power supply (AC/DC/mixed) with front-to-back airflow
- Full L2/L3 features including VLAN, Q-in-Q, IGMP snooping, LACP, and RIP/OSPF
- Powerful QoS and SLA mechanisms with DBA per ONU
- CLI, SNMP, Telnet, and out-of-band management support



High-capacity Aggregation and Access

The XGPL-16000 supports a 1:256 split ratio per port, enabling access to up to 4096 ONUs in total. Each XGS-PON port provides symmetric 10Gbps downlink/uplink bandwidth, significantly outperforming legacy GPON systems. It supports N1/N2 XGS-PON transceivers and multiple GPON optical classes (B+/C+/C++/C+++/D+), making it backward compatible and deployment-flexible.



Strong Standards Compatibility

The XGPL-16000 is compliant with ITU-T G.9807/G.987/G.988 standards and adheres to China Telecom's GPON Technical Specification CTC 2.0. It also supports Ethernet-II, IEEE 802.1Q VLAN, Q-in-Q, and LACP, ensuring interoperability with a wide range of equipment and ONUs. The system supports Layer 2 multicast protocols, including IGMP snooping and MLD snooping, ensuring smooth IPTV and video-on-demand service delivery.

Powerful QoS and SLA Management

The device supports comprehensive QoS mechanisms, including IEEE 802.1p, CoS, WRR, SP, and FIFO queue scheduling, ensuring differentiated service levels for various traffic types. It also features DBA (Dynamic Bandwidth Allocation) and SLA (Service Level Agreement) functions per ONU, providing precise bandwidth control and carrier-grade traffic assurance.

Carrier-class Security and Reliability

The XGPL-16000 offers advanced security features, such as ACL (Access Control List), port isolation, broadcast storm suppression, and data encryption over PON interfaces. The system supports Type B and Type C optical path protection, abnormal ONU emission detection, and trunk fiber link protection, ensuring fault tolerance and minimal downtime in critical networks.

Modular, Redundant, and Eco-Friendly Design

The XGPL-16000 adopts a modular dual-power-slot design, supporting hot-swappable AC, DC, or mixed AC/DC power modules. The fan system uses a front-to-back airflow layout, optimized for rack-mounted deployments. It supports EMC level 3, operates under harsh temperature and humidity conditions, and provides low-noise and low-power operation to meet long-term deployment needs in data centers and equipment rooms.

Flexible and Efficient Management

The device offers multiple management interfaces, including CLI (console), Telnet, SNMP, and out-of-band Ethernet management. It supports TFTP remote software upgrade, debugging output, system logs, and batch ONU provisioning. With strong system maintainability and remote operation capabilities, it ensures simplified network operation and management (OAM).

1.3 How to Use This Manual

This User Manual is structured as follows:

Section 2, **Hardware Installation**

The section explains the functions of the Switch and how to physically install the XGS-PON OLT.

Section 3, Web-based Management

The section explains how to manage the XGS-PON OLT from Web UI.

Section 4, **Switch Operation**

The chapter explains how to do the switch operation of the XGS-PON OLT.

Appendix A

The section contains cable information of the XGS-PON OLT.

1.4 Product Features

- **XGS-PON Ports**
  - 16 XGS-PON OLT SFP slots, backward compatible with XG-PON and GPON transceivers
  - Up to 10Gbps symmetric downstream and upstream
  - Maximum transmission distance of up to 20km
  - Each PON port supports up to 256 ONT/HGU
  - Compliant with ITU-T G.9807, G.987 and G.988

- **Physical Ports**
  - Eight 10GBASE-SR/LR SFP+ slots
  - Two 40G/100G QSFP28 uplink slots
  - RJ45 to DB9 console interface for system setup and management
  - One 10/100BASE-TX out-of-band management port

- **OLT Management**
  - User-friendly CLI, Telnet, and SNMP management
  - 2 control interfaces:
    - Out-of-Band IP – via dedicated management port
    - In-Band IP – via SFP+ and QSFP28 uplinks
  - Supports ONT/HGU authentication to prevent unauthorized ONU access

- **ONU/HGU Management**
  - ONU/ONT port control
  - VLAN configuration per ONT
  - Supports DBA (Dynamic Bandwidth Allocation)
  - SLA (Service Level Agreement) per ONU

- **IP Routing Features**
  - Supports dynamic routing protocol: RIP and OSPF
  - IPv4 static routing
  - Routing interface provides per VLAN routing mode

- **Layer 2 Features**
  - Supports VLAN
    - IEEE 802.1Q tag-based VLAN
    - Provider Bridging (VLAN Q-in-Q, IEEE 802.1ad) supported
    - GVRP for dynamic VLAN management
  - Supports Link Aggregation
    - 802.3ad Link Aggregation Control Protocol (LACP)
    - Cisco ether-channel (static trunk)

- Supports Spanning Tree Protocol
  - STP, IEEE 802.1D (Classic Spanning Tree Protocol)
  - RSTP, IEEE 802.1w (Rapid Spanning Tree Protocol)
  - MSTP, IEEE 802.1s (Multiple Spanning Tree Protocol, spanning tree by VLAN)
- Port mirroring to monitor the incoming or outgoing traffic on a particular port (many to 1)
- Supports G.8032 ERPS (Ethernet Ring Protection Switching)
- Loop protection to avoid broadcast loops
- Link Layer Discovery Protocol (LLDP)

➢ **Quality of Service**

- Ingress shaper and egress rate limit per port
- 8 priority queues per port
  - IEEE 802.1p CoS
  - VLAN ID priority
  - DSCP/Precedence
- Policy-based QoS on ingress/egress

➢ **Multicast**

- Supports IPv4 IGMP snooping v1, v2 and v3
- Supports IPv6 MLD snooping v1 and v2
- Querier mode support
- MVR (Multicast VLAN Registration)

➢ **Security**

- Authentication
  - IEEE 802.1x port-based network access authentication
  - Built-in RADIUS client to cooperate with the RADIUS servers
  - RADIUS/TACACS+ users access authentication
- Access Control List
  - IP-based Access Control List (ACL)
  - MAC-based Access Control List (ACL)
  - Time-based ACL
- DHCP Snooping to filter distrusted DHCP messages
- Dynamic ARP Inspection discards ARP packets with invalid MAC address to IP address binding
- IP Source Guard prevents IP spoofing attacks

➢ **Management**

- IPv4 and IPv6 dual stack management
- Switch Management Interfaces
  - Console and Telnet Command Line Interface
  - HTTP web switch management
  - SNMP v1 and v2c switch management
  - SSHv2, SSLv3, TLSv1.0 and SNMP v3 secure access

- SNMP Management
  - Four RMON groups (history, statistics, alarms, and events)
  - SNMP trap for interface Link Up and Link Down notification
- Built-in Trivial File Transfer Protocol (TFTP) client
- BOOTP and DHCP for IP address assignment
- System Maintenance
  - Firmware upload/download via HTTP
  - Dual images
- DHCP Functions:
  - DHCP Relay
  - DHCP Option 82
  - DHCP Server
- User Privilege levels control
- Network Time Protocol (NTP) and SNTP
- Network Diagnostic
  - SFP-DDM (Digital Diagnostic Monitor)
  - ICMP remote IP ping
- Syslog remote alarm
- System Log

1.5 Product Specifications

Product	XGPL-16000
Hardware Specifications	
XGS-PON Ports	16, supporting Class B+/C+/C++/C+++/D+ XGS-PON/GPON transceivers
10GBASE-X SFP+ Slots	8, supporting 10GBASE-SR/LR SFP+ transceiver Backward compatible with 1GBASE-X SFP transceivers
100G QSFP28 Ports	2-port 100G QSFP28 Backward compatible with 40G QSFP+
Management Port	One 10/100BASE-TX RJ45 port
Console	One RJ45-to-RS232 serial port (115200, 8, N, 1)
RAM	2048MB
Flash Memory	4096MB
Dimensions (W x D x H)	442.5 x 280 x 44.6 mm
Weight	4,600g with single modular power supply
Power Consumption	120 watts/409.56BTU
Power Requirements - AC	100~240V AC, 1.5A max.
Power Requirements - DC	36~72V DC, 3A max.
Fan	4 Fans, Front-to-back airflow
Switching	
Switch Architecture	Store-and-forward
Switch Fabric	176Gbps
Address Table	128K
ARP Table	36K
ACL Table	Max. 3840 for IPv4 Max. 1920 for IPv6
Shared Data Buffer	2MB
Jumbo Frame	9KB
Flow Control	Back pressure for half duplex IEEE 802.3x pause frame for full duplex
XGS-PON Specifications	
Transmission Speed	Downstream: 10Gbps; Upstream: 10Gbps (XGS-PON) Downstream: 10Gbps; Upstream: 2.5Gbps (XG-PON) Downstream: 2.5Gbps; Upstream: 1.25Gbps (GPON)
Optical Split Ratio	Up to 256 per port
Transmission Distance	20km
PON Module Wavelength	XG(S)-PON: TX 1577nm / RX 1270nm GPON: TX 1490nm / RX 1310nm
PON Fiber Type	9/125um SMF (Single mode fiber optic)
Layer 3 Functions	
IP Interfaces	Up to 1K VLAN interfaces, shared by both IPv4 and IPv6
Routing Table	8K for IPv4 20K for IPv6
Routing Protocols	Static Routing RIP OSPF BGP IS-IS VRRP
Layer 2 Functions	
Port Configuration	Port disable/enable Flow control disable/enable Bandwidth control on each port Port loopback detect
Port Mirroring	TX/RX/Both Many to 1
VLAN	IEEE 802.1Q tag-based VLAN, up to 4K VLAN groups

	IEEE 802.1ad Q-in-Q VLAN stacking/tunneling Flexible Q-in-Q GVRP for VLAN management
Spanning Tree Protocol	IEEE 802.1D Spanning Tree Protocol (STP) IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) IEEE 802.1s Multiple Spanning Tree Protocol (MSTP)
Multicast	IPv4 IGMP v1/v2/v3 snooping IPv4 Querier mode support IGMP Filtering and IGMP Throttling IGMP Proxy reporting IGMP multicast forwarding
	IPv6 MLD v1/v2 snooping Multicast VLAN Register (MVR) Up to 3840 multicast groups
Link Aggregation	IEEE 802.3ad Ling Aggregation Control Protocol (LACP) Static trunk link aggregation Supports 64 groups with 16 ports per trunk group Up to 80Gbps bandwidth (full duplex mode) Load Balance Algorithm: - Source IP/destination IP/Source + destination IP - Source MAC/destination MAC/Source + destination MAC
Storm Control	Per 100pps 1-14880
Bandwidth Control	Supports rate limiting per ONU / per port At least 64Kbps stream Dynamic Bandwidth Allocation (DBA) on PON ports Supports SLA (Service Level Agreement)
QoS	PON interfaces: Dynamic Bandwidth Allocation (DBA) Service Level Agreement (SLA) Limiting the upstream/downstream rate based on each ONT/ONU/HGU
	8 priority queues on all switch ports Scheduling for priority queues - Weighted Round Robin (WRR) - Strict priority Traffic classification: - IEEE 802.1p CoS/DSCP/Precedence - VLAN ID - Policy-based ingress and egress QoS
Ring	ITU-T G.8032 ERPS Ring
Security Functions	
Access Control List	Supports Standard and Expanded ACL - IP-based ACL - MAC-based ACL - Time-based ACL ACL based on: - MAC Address - IPv4/IPv6 IP Address - Protocol-number - Sport/dport - ToS/Precedence Up to 1k entries
Security	Transmission data encryption on the PON interface MAC limitation MAC sticky Port isolation DHCP snooping Dynamic ARP inspection IP source guard
AAA	TACACS+ and IPv4/IPv6 over RADIUS
Network Access Control	IEEE 802.1x port-based network access control
Management Functions	
System Configuration	Console and Telnet

	Web browser SNMP v1, v2c
Secure Management Interfaces	SSHv2, SSLv3 Maximum 8 sessions for SSH and telnet connection
System Management	IPv4 and IPv6 dual stack management SNMP MIB and TRAP SNMP RMON 1, 2, 3, 9 four groups Firmware upgrade by HTTP/TFTP/FTP protocol through Ethernet network Configuration upload/download through HTTP/TFTP/FTP protocol Supports IEEE 802.1ab LLDP protocol NTP and SNTP client RADIUS authentication for IPv4/IPv6 login user name and password
Event Management	Remote syslog System log
SNMP MIBs	RFC 1213 MIB-II RFC 1215 Internet Engineering Task Force RFC 1271 RMON RFC 1354 IP-Forwarding MIB RFC 1493 Bridge MIB RFC 1643 Ether-like MIB RFC 1907 SNMPv2 RFC 2011 IP/ICMP MIB RFC 2012 TCP MIB RFC 2013 UDP MIB RFC 2096 IP forward MIB RFC 2233 if MIB RFC 2452 TCP6 MIB RFC 2454 UDP6 MIB RFC 2465 IPv6 MIB RFC 2466 ICMP6 MIB RFC 2573 SNMPv3 notification RFC 2574 SNMPv3 VACM RFC 2674 Bridge MIB Extensions
Standard Conformance	
Regulatory Compliance	CE, FCC, LVD
Standards Compliance	IEEE 802.3z Gigabit 1000BASE-SX/LX IEEE 802.3ae 10Gb/s Ethernet IEEE 802.3x flow control and back pressure IEEE 802.3ad port trunk with LACP IEEE 802.1D Spanning Tree Protocol IEEE 802.1w Rapid Spanning Tree Protocol IEEE 802.1s Multiple Spanning Tree Protocol IEEE 802.1p Class of Service IEEE 802.1Q VLAN tagging IEEE 802.1X port authentication network control IEEE 802.1ab LLDP RFC 768 UDP RFC 793 TFTP RFC 791 IP RFC 792 ICMP RFC 2068 HTTP RFC 1112 IGMP v1 RFC 2236 IGMP v2

	RFC 3376 IGMP v3 RFC 2710 MLD v1 RFC 3810 MLD v2 ITU-T G.9807.1 (XGS-PON) ITU-T G.987 (XG-PON) ITU-T G.988 (ONU Management and Control Interface)
Environments	
Operating	Temperature: 0 ~ 50 degrees C Relative Humidity: 5 ~ 90% (non-condensing)
Storage	Temperature: -10 ~ 70 degrees C Relative Humidity: 5 ~ 90% (non-condensing)

2. Hardware Installation

This section describes the hardware features and installation of the XGS-PON OLT on the desktop or rack mount. For easier management and control of the XGS-PON OLT, familiarize yourself with its display indicators and ports. Front panel illustrations in this chapter display the unit LED indicators. Before connecting any network device to the XGS-PON OLT, please read this chapter completely.

2.1 Hardware Description

2.1.1. OLT Front Panel

The front panel of the unit provides a simple interface monitoring the OLT. Figure 2-1 shows the front panel of the XGS-PON OLT.

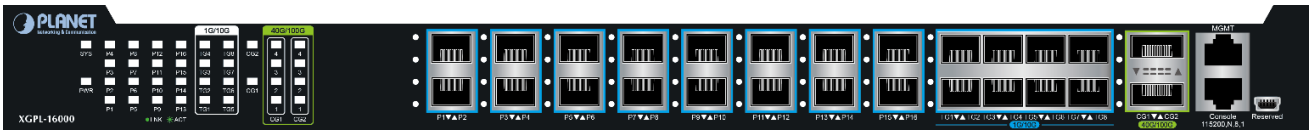


Figure 2-1 XGPL-16000 Front Panel

- **XGS-PON SFP+ Ports**

10GBASE-PR30 mini-GBC slot, SFP+ (Small Form Factor Pluggable) transceiver

Module: Up to 20 kilometers (single-mode fiber)

- **10G SFP+ Port**

10G BASE-SR/LR SFP+ Port, compatible with 1000BASE-SX/LX/BX SFP transceiver.

- **100G QSFP28 Uplink Ports**

QSFP28 port, compatible with 100GBASE-SR4/LR4 and 40GBASE-SR4/LR4

- **Management & Console Ports**

1 x 10/100/1000BASE-T RJ45 MGMT port

1 x RJ45 console port（for CLI configuration）

2.1.2. LED Indications

The front panel LEDs indicates instant status of port links, data activity and system power, and help to monitor and troubleshoot when needed. Figure 2-4 shows the LED indications of XGPL-16000.

XGPL-16000 LED Indication

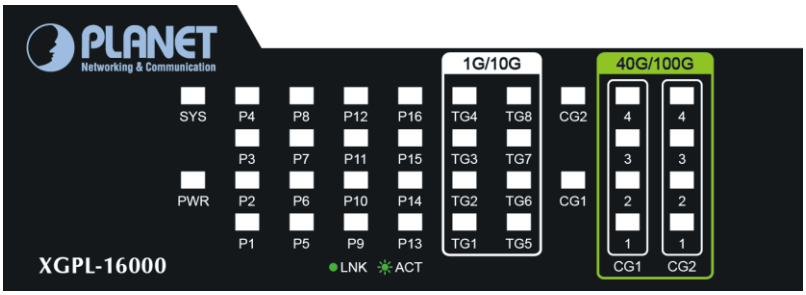


Figure 2-4 XGPL-16000 LED Panel

- **System**

LED	Color	Function	
SYS	Green	Flashing	System operating normally
		Off	System not powered on
PWR	Green	On	Power supply is normal
		Off	No Power
P1 – P16	Green	On	Link established
		Flashing	Data transmission
		Off	No connection
TG1 - TG8 (1/10G Ports)	Green	On	1G or 10G link established
		Flashing	Data transmission
		Off	No connection
CG1 - CG2 (40G/100G Ports)	Green	On	40G/100G link established
		Flashing	Data transmission
		Off	No connection
CG1 - CG2 (Breakout Ports 1-4)	Green	On	10G/25G breakout mode active
		Flashing	Data transmission
		Off	No connection

2.1.3. OLT Rear Panel

The rear panel of the XGS-PON OLT indicates an AC inlet power socket, which accepts input power from 100 to 240V AC, 50-60Hz. Figure 2-5 shows the rear panel of this XGS-PON OLT.

XGPL-16000 Rear Panel

Figure 2-5 Rear Panel of XGPL-16000

■ AC Power Receptacle

For compatibility with electric service in most areas of the world, the XGS-PON OLT's power supply automatically adjusts to line power in the range of 100-240V AC and 50/60 Hz.

Plug the female end of the power cord firmly into the receptacle on the rear panel of the XGS-PON OLT and the other end of the power cord into an electric outlet and then the power will be ready.

There is a power switch for AC power input use only, whereas DC power input has no power switch.

The device is a power-required device; if your networks should be active all the time, please consider using UPS (Uninterrupted Power Supply) for your device. It will prevent you from network data loss or network downtime.

In some areas, installing a surge suppression device may also help to protect your XGS-PON OLT from being damaged by unregulated surge or current to the switch or the power adapter.

2.2 Installing the OLT

This section describes how to install your XGS-PON OLT and make connections to the XGS-PON OLT. Please read the following topics and perform the procedures in the order being presented. To install your XGS-PON OLT on a shelf, simply complete the following steps.

2.2.1. Rack Mounting

To install the XGS-PON OLT in a 19-inch standard rack, please follow the instructions described below:

Step 1: Place the XGS-PON OLT on a hard flat surface, with the front panel positioned towards the front side.

Step 2: Attach the rack-mount bracket to each side of the XGS-PON OLT with supplied screws attached to the package. Figure 2-6 shows how to attach brackets to one side of the XGS-PON OLT.

Note

The following images are based on the GPL-8000. XGPL-16000 can be used in the same way

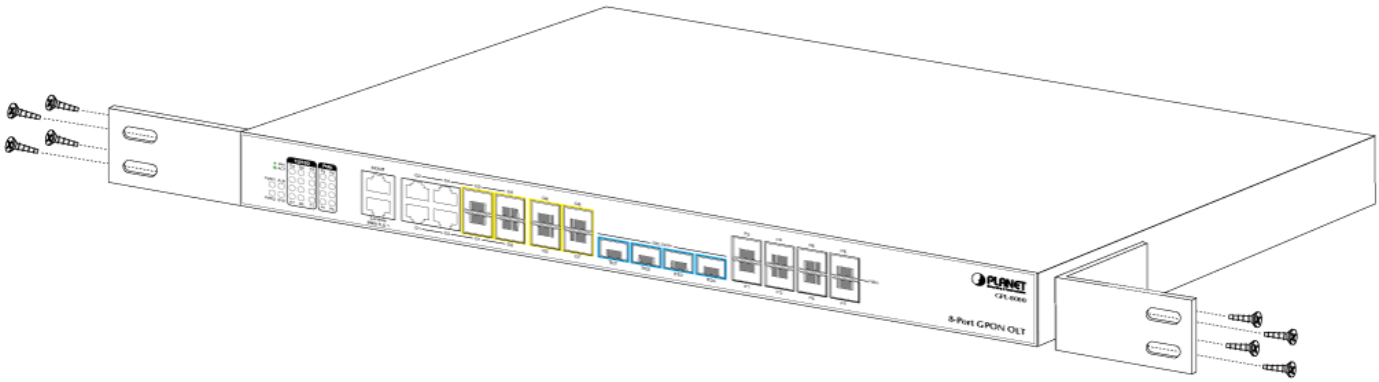


Figure 2-6 Attaching Brackets to the XGS-PON OLT.

You must use the screws supplied with the mounting brackets. Damage caused to the parts by using incorrect screws would invalidate the warranty.

Step 3: Secure the brackets tightly.

Step 4: Follow the same steps to attach the second bracket to the opposite side.

Step 5: After the brackets are attached to the XGS-PON OLT, use suitable screws to securely attach the brackets to the rack, as shown in Figure 2-7.

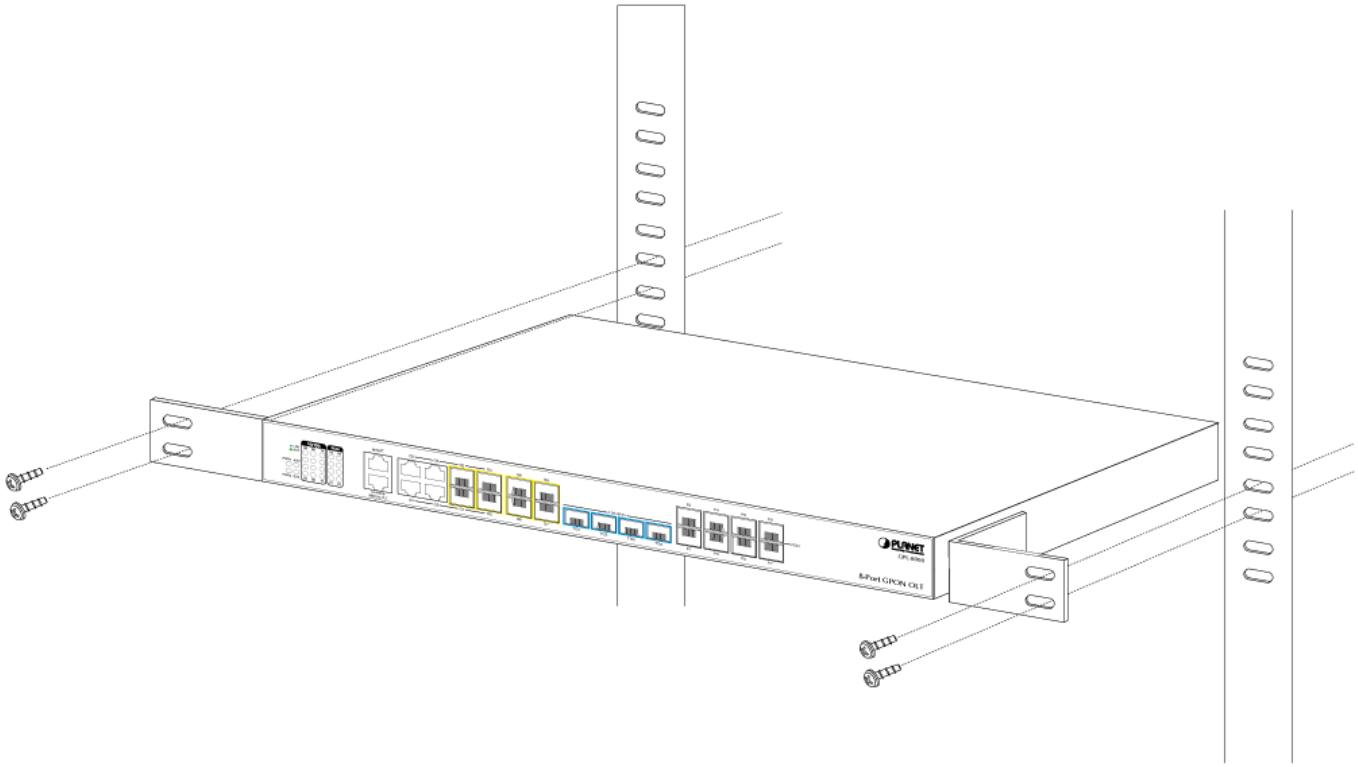


Figure 2-7 Mounting the XGS-PON OLT on a Rack

3. Web-based Management

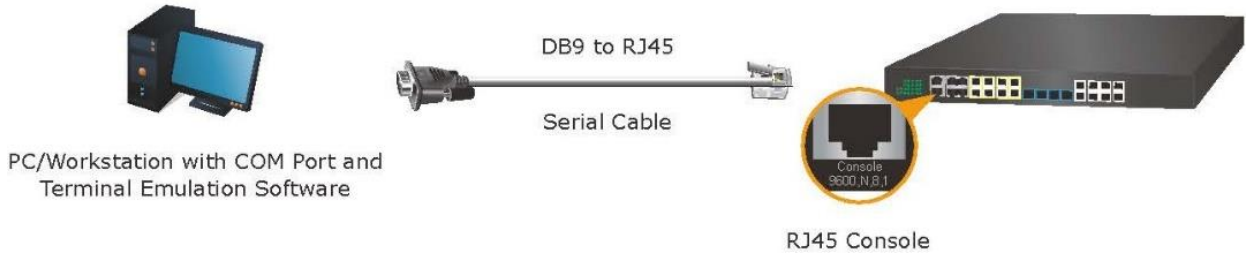
This section introduces the configuration and functions of the Web-based management.

3.1 About Web-based Management

The XGPL-16000 offers management features that allow users to manage the OLT from anywhere on the network through a standard browser such as Microsoft Edge. The Web-based Management supports **modern** browsers with HTML5 support. The XGPL-16000 can be configured through an Ethernet connection, making sure the manager PC must be set to the same IP subnet address with the OLT.

For example, the IP address of the XGS-PON OLT is configured with **192.168.1.1** on **Management Port**, then the manager PC should be set to **192.168.1.x** (where x is a number between 2 and 253, except 1 or 254), and the default subnet mask is 255.255.255.0.

If you have changed the default IP address of the OLT to 192.168.0.1 with subnet mask 255.255.255.0 via console, then the manager PC should be set to 192.168.0.x (where x is a number between 2 and 254) to do the relative configuration on manager PC.



3.2 Logging on to the Switch

Use Google Chrome or Edge Web browser. Enter the factory-default IP address to access the Web interface. The default IP of **Management port** is as follows:

http://192.168.1.1

When the following login screen appears, please enter the default username **"admin"** and password (or the username/password you have changed via console) to log in the main screen of OLT. The login screen in Figure 3-1-1 appears.

Figure 3-1 Login Screen

Default User name: **admin**
Default Password: **sw + the last 6 characters of the MAC ID in lowercase**

After entering the username and password, the main screen appears as Figure 3-2.

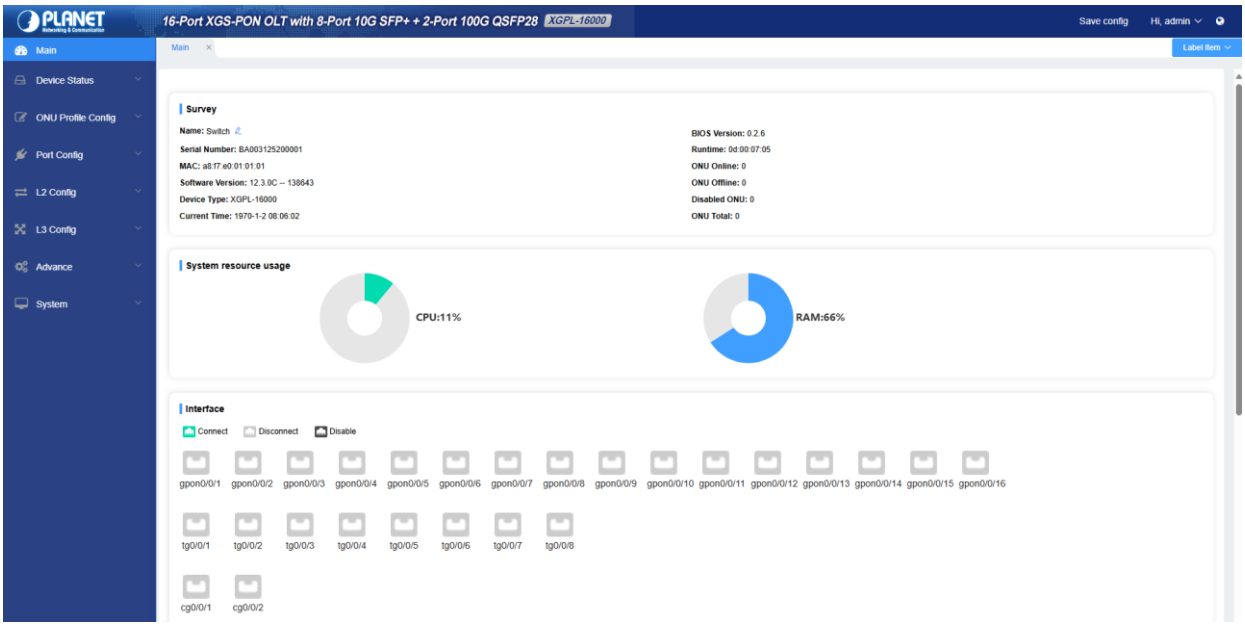


Figure 3-2 Web Main Page

The OLT menu on the left of the Web page lets you access all the commands and statistics the OLT provides.

Now, you can use the Web management interface to continue the OLT management or manage the ONU by Web interface. The OLT menu on the left of the web page lets you access all the commands and statistics the ONU provides.

Note

1. It is recommended to use Internet Explore 8.0 or above to access OLT.
2. The changed IP address takes effect immediately after clicking on the **Submit** button; you need to use the new IP address to access the Web interface.
3. For security reason, please change and memorize the new password after this first setup.

3.3 OLT Information

3.3.1. Device Information

This page shows the OLT information such as system name, serial number, hardware version, firmware version, MAC address and system time. The system name can be modified if need.

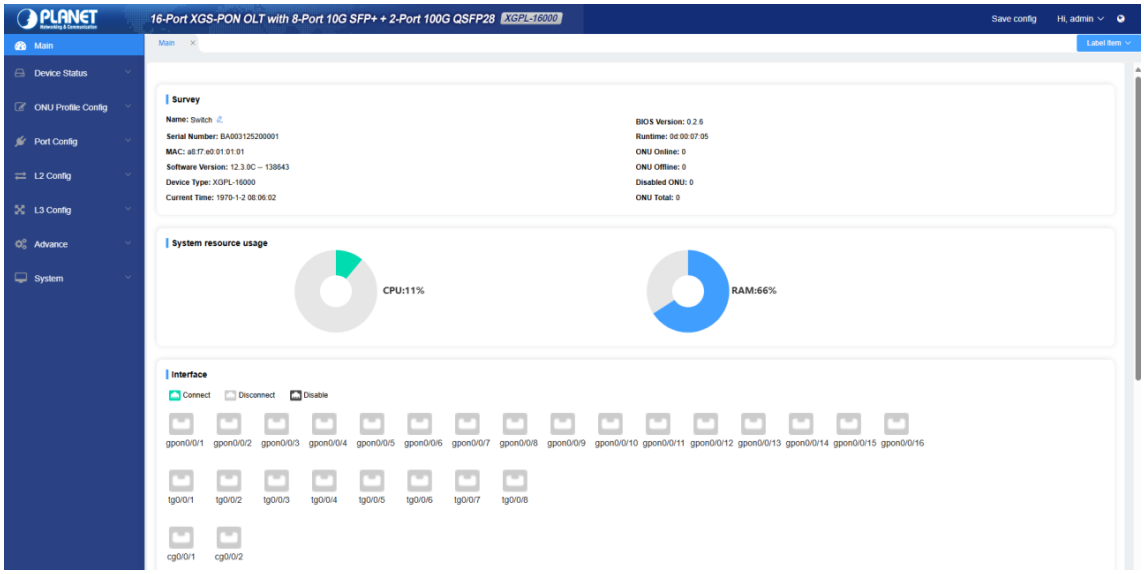


Figure 3-3 Web Main Page

3.3.2. Manage the Switch via SNMP Network Management Software

The followings are required by SNMP network management software to manage switches:

1) IP addresses are configured on the switch;
2) The IP address of the client host and that of the VLAN interface on the switch it subordinates to should be in the same segment;
3) If 2) is not met, the client should be able to reach an IP address of the switch through devices like routers;
4) SNMP should be enabled.

The host with SNMP network management software should be able to ping the IP address of the switch, so that when running, SNMP network management software will be able to find it and implement read/write operation on it. Details about how to manage switches via SNMP network management software will not be covered in this manual; please refer to “Simple Network Management software user manual”.

CLI Interface

The switch provides three management interfaces for users: CLI (Command Line Interface) interface, Web interfaceand Simple Network Management software. The command line interfaces for the switch can be classified into several modes. Each command mode enables you to configure different groupware. The command that can be used currently is up to the command mode where you are. You can enter the question mark in different command modes to obtain the available command list. Common command modes are listed in the following table:

Command Mode	Login Mode	Prompt	Exit Mode
System monitoring mode	Enter **Ctrl-p** after the power is on.	monitor#	Run **quit**.
User mode	Log in.	Switch>	Run **exit** or **quit**.
Management mode	Enter **enter** or **enable**in user mode.	Switch#	Run **exit** or **quit**.
Office configuration mode	Enter **config** in management mode.	Switch_config#	Run **exit** or **quit** or **Ctrl-z** to directly back to the management mode.
Port configuration mode	Enter the **interface** command in office configuration mode, such as **interface f0/1**.	Switch_config_f0/1#	Run **exit** or **quit** or **Ctrl-z** to directly back to the management mode.

Each command mode is unsuitable to subsets of some commands. If problem occurs when you enter commands, check the prompt and enter the question mark to obtain the available command list. Problem may occur when you run in incorrect command mode or you misspelled the command.
Pay attention to the changes of the interface prompt and the relative command mode in the following case:

Switch> enter
Password: <enter password>
Switch# config
Switch_config# interface f0/1
Switch_config_f0/1# quit
Switch_config# quit
Switch#

3.3.3. Help Function

Use the question mark (?) and the direction mark to help you enter commands:

- The currently available command list can be presented if you enter a question mark.

  OLT> ?

- The currently available commands starting with the known characters in the list can be displayed if you enter the known characters and then a question mark (without space).

  OLT> s?

- The parameter list of a command will be obtained if you enter the command, press "Space" and enter the question mark.

  OLT> show ?

- The previously entered commands can be presented if you press the “up” arrow key. If you continue press the “up” arrow key, more commands can be shown. If you press the “up” arrow key and then the “down” arrow key, the next command line following the current one can be presented.

3.3.4. Canceling a Command

To cancel a command or resume its default properties, add the keyword “no” before most commands. An example is given as follows:

no ip routing

3.3.5. Saving Configuration

You may need to save the configuration changes, so that you can recover the original configuration in case of system restarted or power cuts. You can use write command to save configuration in the Administration Mode or Global Configuration Mode.

4. Basic Configuration

4.1 System Management Configuration

4.1.1. File Management Configuration

4.1.2. Managing the file system

The filename in flash is no more than 20 characters and filenames are case insensitive.

4.1.3. Commands for the file system

The boldfaces in all commands are keywords. Others are parameters. The content in the square brakcet “[ ]” is optional.

Command	Description
format	Formats the file system and delete all data.
Differment [filename]	Displays files and directory names. The file name in the symbol “[]” means to display files starting with several letters. The file is displayed in the following format: Index numberfile name<FILE>lengthestablished time
delete filename	Deletes a file. The system will prompt if the file does not exist.
md dirname	Creates a directory.
rd dirname	Deletes a directory. The system will prompt if the directory is not existed.
more filename	Displays the content of a file. If the file content cannot be displayed by one page, it will be displayed by pages.
cd	Changes the path of the current file system.
pwd	Displays the current path.

4.1.4. Starting up from a file manually

monitor#boot flash <*local_filename*>
The previous command is to start a OLT software in the flash, which may contain multiple switch software.

- Parameter description

Parameter	Description
local_filename	A file name stored in the flash memory Users must enter the file name.

- Example

monitor#boot flash switch.bin

4.1.5. Updating software

User can use this command to download OLT system software locally or remotely to obtain version update or the custom-made function version (like data encryption and so on).
There are two ways of software update in monitor mode.

a) Through TFTP

monitor#copy tftpflash [ip_addr]

The previous commad is to copy file from the tftp server to the flash in the system. After you enter the command, the system will prompt you to enter the remote server name and the remote filename.

- Parameter description

Parameter	Description
ip_addr	IP address of the tftp server If there is no specified IP address, the system will prompt you to enter the IP address after the **copy** command is run.

- Example

The following example shows a **main.bin** file is read from the server, written into the switch and changed into the name **switch. Bin**.

monitor#copy tftp flash
Prompt: Source file name[]?main.bin
Prompt: Remote-server ip address[] ?192.168.20.1
Prompt: Destination file name [main.bin]?switch.bin
please wait ...
##
##
##
##
TFTP: successfully receive 3377 blocks ,1728902 bytes
monitor#

b) Through serial port communication protocol - zmodem

Use the **download** command to update software. Enter **download ?** to obtain help.
monitor#download c0 <*local_filename*>
This command is to copy the file to the flash of system through zmodem. The system will prompt you to enter the port rate after you enter the command.

- Parameter description

Parameter	Description
local_filename	Filename stored in the flash Users must enter the filename.

- Example

The terminal program can be **any terminal emulator such as Tera Term or PuTTY**.
Use the command:

monitor#download c0 switch.bin
Prompt: speed 115200
Then, modify the rate to 115200. After reconnection, select **send file** in the transfer menu of hyper terminal (terminal emulation). The **send file** dialog box appears as follows:

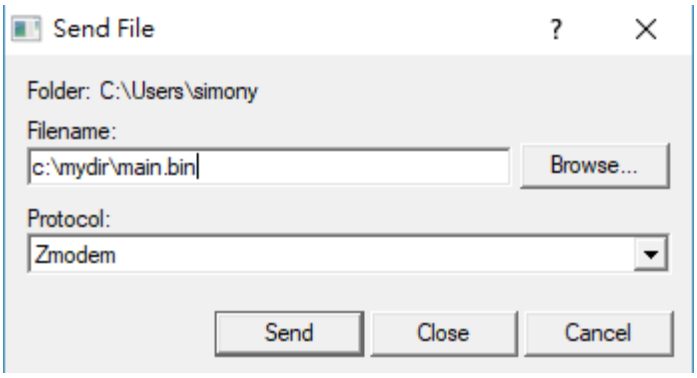


Figure 4-1 Send files

Enter the all-path of the switch software **main.bin** that our company provides in the filename input box, choose Zmodem as the protocol. Click **send** to send the file.
After the file is transferred, the following information appears:
ZMODEM: successfully receive 36 blocks ,18370 bytes
It indicates that the software update is completed

4.1.6. Updating configuration

The switch configuration is saved as a file, the filename is startup-config. You can use commands similar to software update to update the configuration.

a) Through TFTP

monitor#copy tftp flash startup-config

b) Through serial port communication protocol—zmodem.

monitor#download c0 startup-config

4.1.7. Using ftp to perform the update of software and configuration

config #copy ftpflash [ip_addr|option]

Use ftp to perform the update of software and configuration in formal program management. Use the **copy** command to download a file from ftp server to switch, also to upload a file from file system of the switch to ftp server. After you enter the command, the system will prompt you to enter the remote server name and remote filename.

copy{**ftp**: [[[//login-name: [login-password]@]location]/directory]/filename}|**flash**: filename>}{**flash**<: filename>|**ftp**: [[[//login-name: [login-password]@]location]/directory]/filename}<blksize><mode><type>

- Parameter description

Parameter	Description
login-nam	Username of the ftp server If there is no specified username, the system will prompt you to enter the username after the **copy** command is run.
login-password	Password of the ftp server If there is no specified password, the system will prompt you to enter the password after the **copy** command is run.
ip_addr	IP address of the ftp server If there is no specified IP address, the system will prompt you to enter the IP address after executing the **copy** command.
active	Means to connect the ftp server in active mode.
passive	Means to connect the ftp server in passive mode.
type	Set the data transmission mode (ascii or binary)

- Example

The following example shows a **main.bin** file is read from the server, written into the switch and changed into the name **switch. Bin**.

config#copy ftp flash
Prompt: ftp user name[anonymous]? login-nam
Prompt: ftp user password[anonymous]? login-password
Prompt: Source file name[]?main.bin
Prompt: Remote-server ip address[]?192.168.20.1
Prompt: Destination file name[main.bin]?switch.bin
or

```
config#copy ftp:  //login-nam:  login-password@192.168.20.1/main.bin flash:  switch.bin
#########################################################################
#########################################################################
FTP:  successfully receive 3377 blocks ,1728902 bytes
config#
```

1. When the ftp server is out of service, the wait time is long. If this problem is caused by the tcp timeout time (the default value is 75s), you can configure the global command **ip tcp synwait-time** to modify the tcp connection time. However, it is not recommended to use it.
2. When you use ftp in some networking conditions, the rate of data transmission might be relatively slow. You can properly adjust the size of the transmission block to obtain the best effect. The default size is 512 characters, which guarantee a relatively high operation rate in most of the networks.

4.1.8. Basic System Management Configuration

4.1.9. Configuring Ethernet IP address

monitor#ip address <*ip_addr*><*net_mask*>

This command is to configure the IPaddress of the Ethernet.,The default IP address is 192.168.1.1,and the network mask is255.255.255.0.

- Parameter description

Parameter	Description
ip_addr	IP address of the Ethernet
net_mask	Mask of the Ethernet

- Example

monitor#ip address 192.168.0.1 255.255.255.0

4.1.10. Configuring default route

monitor#ip route default <*ip_addr*>

This command is used to configure the default route. You can configure only one default route.

Parameter description

Parameter	Description
ip_addr	IP address of the gateway

- Example

monitor#ip route default 192.168.0.1

4.1.11. Using ping to test network connection state

monitor#ping <*ip_address*>

This command is to test network connection state.

- Parameter description

Parameter	Description
ip_address	Destination IP address

- Example

monitor#ping 192.168.20.100
PING 192.168.20.100: 56 data bytes
64 bytes from 192.168.20.100: icmp_seq=0. time=0. ms
64 bytes from 192.168.20.100: icmp_seq=1. time=0. ms
64 bytes from 192.168.20.100: icmp_seq=2. time=0. ms
64 bytes from 192.168.20.100: icmp_seq=3. time=0. ms
----192.168.20.100 PING Statistics----
4 packets transmitted, 4 packets received, 0% packet loss
round-trip (ms) min/avg/max = 0/0/0

4.1.12. HTTP Configuration

4.1.13. Configuring HTTP

- Enabling the http service
- Modifying the port number of the http service
- Configuring the access password of the http service
- Specifying the access control list for the http service

a) Enabling the http service

The http service is disabled by default.

The http service is enabled in the global configuration mode using the following command:

Command	Function
Ip http server	Enables the http service.

b) Modifying the port number of the http service

The number of the listen port for the http service is 80.

The port number of the http service is modified in global configuration mode using the following command:

Command	Function
Ip http port number	Modifies the port number of the http service.

c) Configuring the access passward of the http service

Http uses **enable** as the access password. You need to set the password **enable** if you want to perform authentication for http access. The password **enable** is set in global configuration mode using the following command:

Command	Function
Enable password {0|7} line	Sets the password **enable**.

d) Specifying the access control list for the http service

To control the host's access to http server, you can specify the access control list for http service. To specify an access control list, use the following command in global configuration mode:

Command	Function
ip http access-class STRING	Specifies an access control list for the http service.

4.1.14. Examples to http configuration

The following example uses default port (80) as the http service port, and the access address is limited to 192.168.20.0/24:

- ip acl configuration:

ip access-list standard http-acl

permit 192.168.20.0 255.255.255.0

- global configuration:

ip http access-class http-acl

ip http server

4.2 Terminal Configuration

4.2.1. VTY Configuration Introduction

The system uses the **line** command to configure terminal parameters. Through the command, you can configure the width and height that the terminal displays.

4.2.2. Configuration Task

The system has four types of lines: console, aid, asynchronous and virtual terminal. Different systems have different numbers of lines of these types. Refer to the following software and hardware configuration guide for the proper configuration.

Line Type	Interface	Description	Numbering
CON (CTY)	Console	To log in to the system for configuration.	0
VTY	Virtual and asynchronous	To connect Telnet, X.25 PAD, HTTP and Rlogin of synchronous ports (such as Ethernet and serial port) on the system	32 numbers starting from 1

4.2.3. Relationship between line and interface

a) Relationship between synchronous interface and VTY line

The virtual terminal line provides a synchronous interface to access to the system. When you connect to the system through VTY line, you actually connect to a virtual port on an interface. For each synchronous interface, there can be many virtual ports.

For example, if several Telnets are connecting to an interface (Ethernet or serial interface), you need to do the following steps for the VTY configuration:

(1) Log in to the line configuration mode.

(2) Configure the terminal parameters.

For VTY configuration, refer to Part 4.2.4 “VTY configuration example”.

4.2.4. Monitoring and Maintenance

Run **showline** to chek the VTY configuration.

4.2.5. Browsing Logs

By default, the system will export the logs to the console port. After the terminal monitor command is set on the telnet line, the logs will be exported to this line.

By default the logs will not be exported to the cache and cannot be browsed after you run show log. After you run logging buffer *size* to set the log cache, you can run show log to browse the log information.

4.2.6. VTY Configuration Example

It shows how to cancel the limit of the line number per screen for all VTYs without **more** prompt:

config#line vty 0 32

config_line#length 0

32 vty configuration timeout time

Switch_config#line vty 0 31

Switch_config_line#exec-timeout 10

Switch_config_line#exit

Switch_config#

4.3 Remote Monitoring

4.3.1. Configuring SNMP

4.3.2. Introduction

The SNMP system includes the following parts:

- SNMP management side (NMS)
- SNMP agent (AGENT)
- Management information base (MIB)

SNMP is a protocol working on the application layer. It provides the packet format between SNMP management side and agent.
SNMP management side can be part of the network management system (NMS, like CiscoWorks). Agent and MIB are stored on the system. You need to define the relationship between network management side and agent before configuring SNMP on the system.
SNMP agent contains MIB variables. SNMP management side can check or modify value of these variables. The management side can get the variable value from agent or stores the variable value to agent. The agent collects data from MIB. MIB is the database of device parameter and network data. The agent also can respond to the loading of the management side or the request to configure data. SNMP agent can send trap to the management side. Trap sends alarm information to NMS indicating a certain condition of the network. Trap can point out improper user authentication, restart, link layer state(enable or disable), close of TCP connection, lose of the connection to adjacent systems or other important events.

a) SNMP notification

When some special events occur, the system will send ‘inform’ to SNMP management side. For example, when the agent system detects an abnormal condition, it will send information to the management side.
SNMP notification can be treated as trap or inform request to send. Since the receiving side doesn’t send any reply when receiving a trap, this leads to the receiving side cannot be sure that the trap has been received. Therefore the trap is not reliable. In comparison, SNMP management side that receives “inform request” uses PDU that SNMP echoes as the reply for this information. If no “inform request” is received on the management side, no echo will be sent. If the receiving side doesn’t send any reply, then you can resend the “inform request”. Then notifications can reach their destination.
Since inform requests are more reliable, they consume more resources of the system and network. The trap will be discarded when it is sent. The “inform request” has to be stored in the memory until the echo is received or the request timeouts. In addition, the trap is sent only once, while the “inform request” can be resent for many times. Resending "inform request" adds to network communications and causes more load on network. Therefore, trap and inform request provide balance between reliability and resource. If SNMP management side needs receiving every notification, then the “inform request” can be used. If you give priority to the communication amount of the network and there is no need to receive every notification, then trap can be used.
This switch only supports trap, but we provide the extension for "inform request".

b) SNMP version

System of our company supports the following SNMP versions:

- SNMPv1---simple network management protocol, a complete Internet standard,which is defined in RFC1157.
- SNMPv2C--- Group-based Management framework of SNMPv2, Internet test protocol, which is defined in RFC1901.

Layer 3 switch of our company also supports the following SNMP:

- SNMPv3--- a simple network management protocol version 3, which is defined in RFC3410.

SNMPv1 uses group-based security format. Use IP address access control list and password to define the management side group that can access to agent MIB.

SNMPv3 provides secure access to devices by a combination of authenticating and encrypting packets over the network.

The security features provided in SNMPv3 are:

- Message integrity—Ensuring that a packet has not been tampered with in-transit.
- Authentication—Determining the message is from a valid source.
- Encryption—Scrambling the contents of a packet prevent it from being seen by an unauthorized source.

SNMPv3 provides for both security models and security levels. A security model is an authentication strategy that is set up for a user and the group in which the user resides. A security level is the permitted level of security within a security model. A combination of a security model and a security level will determine which security mechanism is employed when handling an SNMP packet. Three security models are available, that is, authentication and encryption, authentication and no encryption, no authentication.

You need to configure SNMP agent to the SNMP version that the management working station supports. The agent can communicate with many management sides.

c) Supported MIB

SNMP of our system supports all MIBII variables (which will be discussed in RFC 1213) and SNMP traps (which will be discussed in RFC 1215).

Our system provides its own MIB extension for each system.

4.3.3. SNMP Configuration Tasks

- Configuring SNMP view
- Creating or modifying the access control for SNMP community
- Configuring the contact method of system administrator and the system's location
- Defining the maximum length of SNMP agent data packet
- Monitoring SNMP state
- Configuring SNMP trap
- Configuring SNMP binding source address
- Configuring NMPv3 group
- Configuring NMPv3 user
- Configuring NMPv3 EngineID

a) Configuring SNMP view

The SNMP view is to regulate the access rights (include or exclude) for MIB. Use the following command to configure the SNMP view.

Command	Description
snmp-server view *nameoid*] [exclude | include]	Adds the subtree or table of OID-specified MIB to the name of the SNMP view, and specifies the access right of the object identifier in the name of the SNMB view. Exclude: decline to be accessed Include: allow to be accessed

The subsets that can be accessed in the SNMP view are the remaining objects that "include" MIB objects are divided by "exclude" objects. The objects that are not configured are not accessible by default.

After configuring the SNMP view, you can implement SNMP view to the configurtation of the SNMP group name, limiting the subsets of the objects that the group name can access.

b) Creating or modifying the access control for SNMP community

You can use the SNMP community character string to define the relationship between SNMP management side and agent. The community character string is similar to the password that enables the access system to log in to the agent. You can specify one or multiple properties releavant with the community character string. These properties are optional:

Allowing to use the community character string to obtain the access list of the IP address at the SNMP management side

Defining MIB views of all MIB object subsets that can access the specified community

Specifying the community with the right to read and write the accessible MIB objects

Configure the community character string in global configuration mode using the following command:

Command	Function
snmp-server community*string* [**view***view-name*] [**ro** | **rw**] [*word*]	Defines the group access character string.

You can configure one or multiple group character strings. Run **no snmp-server community** to remove the specified community character string.
For how to configure the community character string, refer to the part “SNMP Commands”.

c) Configuring the contact method of system administrator and the system’s location
SysContact and sysLocation are the management variables in the MIB’s system group, respectively defining the linkman’s identifer and actual location of the controlled node. These information can be accessed through **config.** files. You can use the following commands in global configuration mode.

Command	Function
snmp-server contact*text*	Sets the character string for the linkman of the node.
snmp-server location*text*	Sets the character string for the node location.

d) Defining the maximum length of SNMP agent data packet
When SNMP agent receives requests or sents respons, you can configure the maximum length of the data packet. Use the following command in global configuration mode:

Command	Function
snmp-server packetsize*byte-count*	Sets the maximum length of the data packet.

e) Monitoring SNMP state
You can run the following command in global configuration mode to monitor SNMP output/input statistics, including illegal community character string items, number of mistakes and request variables.

Command	Function
show snmp	Monitores the SNMP state.

f) Configuring SNMP trap
Use the following command to configure the system to send the SNMP traps (the second task is optional):

- Configuring the system to send trap

Run the following commands in global configuration mode to configure the system to send trap to a host.

Command	Function
snmp-server host host community-string[trap-type]	Specifies the receiver of the trap message.
snmp-server host*host* [traps|informs]{version {v1 | v2c | v3 {auth | noauth | priv } }}*community-string* [*trap-type*]	Specifies the receiver, version number and username of the trap message. Note: For the trap of SNMPv3, you must configure SNMP engine ID for the host before the host is configured to receive the trap message.

When the system is started, the SNMP agent will automatically run. All types of traps are activated. You can use the command snmp-server host to specify which host will receive which kind of trap.

Some traps need to be controlled through other commands. For example, if you want SNMP link traps to be sent when an interface is opened or closed, you need to run **snmp trap link-status** in interface configuration mode to activate link traps. To close these traps, run the **interface configuration** command snmp trap link-stat.

You have to configure the command **snmp-server host** for the host to receive the traps.

- Modifying the running parameter of the trap

As an optional item, it can specify the source interface where traps originate, queue length of message or value of resending interval for each host.

To modify the running parameters of traps, you can run the following optional commands in global configuration mode.

Command	Function
snmp-server trap-source *interface*	Specifies the source interface where traps originate and sets the source IP address for the message.
snmp-server queue-length *length*	Creates the queue length of the message for each host that has traps. Default value: 10
snmp-server trap-timeout*seconds*	Defines the frequency to resend traps in the resending queue. Default value: 30 seconds

g) Configuring the SNMP binding source address

Run the following command in the global configuration mode to set the source address for the SNMP message.

Command	Function
snmp source-addr *ipaddress*	Sets the source address for the SNMP message.

h) Configuring SNMPv3 group

Run the following command to configure a group.

Command	Function
snmp-server group [*groupname* {**v1** | **v2c** |**v3** [**auth** | **noauth** | **priv**]}][**read***readview*][**write***writeview*] [**notify***notifyview*] [**access***access-list*]	Configures a SNMPv3 group. You can only read all items in the subtree of the Internet by default.

i) Configuring SNMPv3 user

You can run the following command to configure a local user. When an administrator logs in to a device, he has to user the username and password that are configured on the device. The security level of a user must be higher than or equals to that of the group which the user belongs to. Otherwise, the user cannot pass authentication.

Command	Function
snmp-server user username groupname {v1 | v2c | v3 [encrypted] [auth {md5 | sha} *auth-password* **]} [access** *access-list***]**	Configures a local SNMPv3 user.

You can run the following command to configure a remote user. When a device requires to send traps to a remote control station, a remote user has to be configured if the control station performs ID authentication. Username and password of the remote user must be the same as those on the control station. Otherwise, the control station cannot receive traps.

Command	Function
snmp-server user username groupname remote *ip-address* **[udp-port** *port***] {v1 | v2c | v3 [encrypted] [auth {md5 | sha}** *auth-password* **]} [access** *access-list***]**	Configures a remote SNMPv3 user. Note: A remote SNMP engine ID must be configured for the control station of the IP address before a remote user is configured.

j) Configuring SNMPv3 Engine ID

The SNMP Engine ID is to identify an SNMP engine. Traditional SNMP manager and agent are part of the SNMP engine in the SNMPv3 frame.

Command	Function
snmp-server engineID remote *ip-address* **[udp-port** *port-number***]** *engineid-string*	Configures a remote SNMP engine.

4.3.4. Configuration example

a) Example 1

snmp-server community public RO

snmp-server community private RW

snmp-server host 192.168.10.2 public

The above example shows:

- how to set the community string **public** that can only read all MIB variables.
- how to set the community string **private** that can read and write all MIB variables.

You can use the community string **public** to read MIB variables in the system. You can also use the community string **private** to read MIB variables and write writable MIB variables in the system.

The above command specifies the community string **public** to send traps to 192.168.10.2 when a system requires to send traps. For example, when a port of a system is in the **down** state, the system will send a **linkdown** trap information to 192.168.10.2.

b) Example 2

snmp-server engineID remote 90.0.0.3 80000523015a000003

snmp-server group getter v3 auth

snmp-server group setter v3 priv write v-write

snmp-server user get-user getter v3 auth sha 12345678

snmp-server user set-user setter v3 encrypted auth md5 12345678

snmp-server user notifier getter remote 90.0.0.3 v3 auth md5 abcdefghi

snmp-server host 90.0.0.3 informs version v3 auth notifier

snmp-server view v-write internet included

The above example shows how to use SNMPv3 to manage devices. Group getter can browse device information, while group setter can set devices. User get-user belongs to group getter while user set-user belongs to group setter.

For user **get-**user, its security level is **authenticate but not encrypt**, its password is **12345678**, and it uses the sha arithmetic to summarize the password.

For user **set-**user, its security level is **authenticate and encrypt**, its password is **12345678**, and it uses the md5 arithmetic to summarize the password.

When key events occur at a device, use username **notifier** to send **inform** messages to host 90.0.0.3 of the administrator.

4.3.5. RMON Configuration

4.3.6. RMON configuration task

RMON configuration tasks include:

- Configuring the rMon alarm function for the switch
- Configuring the rMon event function for the switch
- Configuring the rMon statistics function for the switch
- Configuring the rMon history function for the switch
- Displaying the rMon configuration of the switch

a) Configuring rMon alarm for switch

You can configure the rMon alarm function through the command line or SNMP NMS. If you configure through SNMP NMS, you need to configure the SNMP of the switch. After the alarm function is configured, the device can monitor some statistic value in the system. The following table shows how to set the rMon alarm function:

Command	Function
configure	Enter the global configuration mode.
rmon alarm index variable*interval* {**absolute** | **delta**} **rising-threshold***value* [*eventnumber*] **falling-threshold***value* [*eventnumber*] [**owner***string*]	Add a rMon alarm item. **index** is the index of the alarm item. Its effective range is from 1 to 65535. **variable** is the object in the monitored MIB. It must be an effective MIB object in the system. Only obejects in the Integer, Counter, Gauge or TimeTicks type can be detected. **interval** is the time section for sampling. Its unit is second. Its effective value is from 1 to 4294967295. **absolute** is used to directly monitor the value of MIB object. **delta** is used to monitor the value change of the MIB objects between two sampling. **value** is the threshold value when an alarm is generated. **eventnumber** is the index of an event that is generated when a threshold is reached. **eventnumber** is optional. **owner string** is to describe the information about the alarm.
exit	Enter the management mode again.
write	Save the configuration.

After a rMon alarm item is configured, the device will obtain the value of variable-specified oid after an interval. The obtained value will be compared with the previous value according to the alrm type (absolute or delta). If the obtained value is bigger than the previous value and surpasses the threshold value specified by **rising-threshold**, an event whose index is **eventnumber** (If the value of **eventnumber** is 0 or the event whose index is **eventnumber** does not exist in the event table, the event will not occur). If the variable-specified oid cannot be obtained, the state of the alarm item in this line is set to **invalid**. If you run **rmon alarm** many times to configure alarm items with the same index, only the last configuration is effective. You can run **no rmon alarm index** to cancel alarm items whose indexes are **index**.

b) Configuring rMon event for switch

The steps to configure the rMon event are shown in the following table:

Step	Command	Purpose
1.	**configure**	Enter the global configuration mode.
2.	**rmon event index**[**description***string*] [**log**] [**owner***string*] [**trap** community]	Add an rMon event item. **index** means the index of the event item. Its effective range is from 1 to 65535. **description** means the information about the event. **log** means to add a piece of information to the log table when a event is triggered. **trap** means a trap message is generated when the event is triggered. **community** means the name of a community. **owner string** is to describe the information about the alarm.
3.	**exit**	Enter the management mode again.
4.	**write**	Save the configuration.

After a rMon event is configured, you must set the domain **eventLastTimeSent** of the rMon event item to **sysUpTime** when a rMon alarm is triggered. If the **log** attribute is set to the rMon event, a message is added to the log table. If the **trap** attribute is set to the rMon event, a trap message is sent out in name of community. If you run **rmon event** many times to configure event items with the same index, only the last configuration is effective. You can run **no rmon event index** to cancel event items whose indexes are **index**.

c) Configuring rMon statistics for switch

The rMon statistics group is used to monitor the statistics information on every port of the device. The steps to configure the rMon statistics are as follows:

Step	Command	Purpose
1.	**configure**	Enter the global configuration mode.
2.	**interface iftype ifid**	Enter the port mode. **iftype** means the type of the port. **ifid** means the ID of the interface.
3.	**rmon collection stat index** [**owner***string*]	Enable the statistics function on the port. **index** means the index of the statistics. **owner string** is to describe the information about the statistics.
4.	**exit**	Enter the global office mode.
5.	**exit**	Enter the management mode again.
6.	**write**	Save the configuration.

If you run **rmon collection stat** many times to configure statistics items with the same index, only the last configuration is effective. You can run **no rmon collection stats index** to cancel statistics items whose indexes are **index**.

d) Configuring rMon history for switch

The rMon history group is used to collect statistics information of different time sections on a port in a device. The rMon statistics function is configured as follows:

Step	Command	Purpose
1.	configure	Enter the global configuration command.
2.	interface iftype ifid	Enter the port mode. **iftype** means the type of the port. **ifid** means the ID of the interface.
3.	rmon collection history index [buckets bucket-number] [interval second] [owner owner-name]	Enable the history function on the port. **index** means the index of the history item. Among all data collected by history item, the latest **bucket-number** items need to be saved. You can browse the history item of the Ethernet to abtain these statistics values. The default value is 50 items. **second** means the interval to abtain the statistics data every other time. The default value is 1800 seconds. **owner string** is used to describe some information about the history item.
4.	exit	Enter the global office mode again.
5.	exit	Enter the management mode again.
6.	write	Save the configuration.

After a rMon history item is added, the device will obtain statistics values from the specified port every **second** seconds. The statistics value will be added to the history item as a piece of information. If you run **rmon collection history index** many times to configure history items with the same index, only the last configuration is effective. You can run **no rmon history index** to cancel history items whose indexes are **index**.

Too many system sources will be occupied; in the case. the value of **bucket-number** is too big or the value of **interval second** is too small.

e) Displaying rMon configuration of switch

Run **show** to display the rMon configuration of the switch.

Command	Purpose
show rmon [alarm] [event] [statistics] [history]	Displays the rmon configuration information. alarm means to display the configuration of the alarm item. event means to show the configuration of the event item and to show the items that are generated by the occurance of events and are contained in the log table. statistics means to display the configuration of the statistics item and statistics values that the device collects from the port. history means to display the configuration of the history item and statistics values that the device collects in the latest specified intervals from the port.

4.3.7. Configuring PDP

4.3.8. Introduction

PDP is a two-layer protocol specially used to detect network devices. PDP is used in Network Management Service (NMS) to detect all neighboring devices of an already known device. Using PDP enable you to learn the SNMP agent address and the types of neighboring devices. After neighboring devices are detected through PDP, the NMS can require neighboring devices through SNMP to obtain the network topology.

Our switches can detect neighboring devices through PDP, but cannot require neighboring devices through SNMP. Therefore, these switches have to be located at the verge of networks. Otherwise, the complete network topology cannot be obtained.

PDP on switches can be configured on all SANPs, such as Ethernet.

4.3.9. PDP configuration tasks

- Default PDP configuration of the switch
- Setting the PDP clock and information saving time
- Setting the PDP version
- Enabling the PDP on the switch
- Enabling the PDP on the port of the switch
- Monitoring and managing PDP

a) Default PDP configuration of the switch

Function	Default Setting
PDP global configuration state	Disabled
PDP port configuration state	Disabled
PDP clock (frequency for sending messages)	60 seconds
PDP information saving	180 seconds
PDP version	2

b) Setting the PDP clock and information saving time

Run the following commands in global configuration mode to set the frequency for PDP to send messages and the PDP information saving time:

Command	Purpose
pdp timer s*econds*	Sets the frequency for PDP to send messages.
pdp holdtime*seconds*	Sets the PDP information saving time.

c) Setting the PDP version

Run the following command in global configuration mode to set the PDP version:

Command	Purpose
pdp version {1|2}	Sets the PDP version.

d) Enabling PDP on the switch

PDP is not enabled in the default configuration. If you want to use PDP, run the following command in global configuration mode.

Command	Purpose
pdp run	Enables the PDP on the switch.

e) Enabling PDP on the port of the switch

PDP is not enabled in the default configuration. You can run the following command in interface configuration mode to enable PDP on the port after PDP is enabled on the switch.

Command	Purpose
pdp enable	Enables PDP on the port of the switch.

f) Monitoring and managing PDP

Run the following commands in management mode to monitor PDP:

Command	Purpose
show pdp traffic	Displays the number of PDP messages that the switch receives and sends.
show pdp neighbor [detail]	Displays neighboring devices that the switch detects through PDP.

4.3.10. PDP configuration examples

Example 1: Enabling PDP

config# pdp run

config# int f0/0

config_f0/0#pdp enable

Example 2: Setting the PDP clock and information saving time

config#**pdp timer** 30

config#**pdp holdtime** 90

Example 3: Setting the PDP version

config#pdp version 1

Example 4: Monitoring PDP information

config#show pdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge S - Switch, H - Host, I - IGMP, r - Repeater

Device ID Local IntrfceHoldtmeCapabilityPlatform Port ID

joeEth 0 133 4500 Eth 0

samEth 0 152 R AS5200 Eth 0

4.4 SSH Configuration commands

4.4.1.Introduction

4.4.2.SSH server

A scure and encrypted communication connection can be created between SSH client and the device through SSH server. The connection has telnet-like functions. SSH server supports the encryption algorithms including des, 3des and blowfish.

4.4.3.SSH client

SSH client is an application running under the ssh protocol. SSH client can provide authentication and encryption, so SSH client gurantees secure communication between communication devices or devices supporting SSH server even if these devices run in unsafe network conditions. SSH client supports the encryption algorithms including des, 3des and blowfish.

4.4.4.Function

SSH server and SSH client supports version 1.5. Both of them only support the shell application.

4.4.5.Configuration Tasks

4.4.6.Configuring the authentication method list

SSH server adopts the login authentication mode. SSH server uses the **default** authentication method list by default. Run the following command in global configuration command mode to configure the authentication method list:

Command	Purpose
Ip sshd auth_method STRING	Configures the authentication method list.

4.4.7.Configuring the access control list

To control the access to the device's SSH server, you need to configure the access control list for SSH server.
Run the following command in global configuration mode to configure the access control list:

Command	Purpose
Ip sshd access-class STRING	Configures the access control list.

4.4.8. Configuring the authentication timeout value

After a connection is established between client and server, server cuts off the connection if authentication cannot be approved within the set time.

Run the following command in global configuration mode to configure the configuration timeout value:

Command	Purpose
Ip sshd timeout <60-65535>	Configures the authentication timeout value.

4.4.9. Configuring the times of authentication retrying

If the times for failed authentications exeed the maximum times, SSH server will not allow you to retry authentication unless a new connction is established. The maximum times for retrying authentication is 3 by default.

Run the following command in global configuration mode to configure the maximum times for retrying authentication:

Command	Purpose
Ip sshd auth-retries <0-65535>	Configures the maximum times for retrying authentication.

4.4.10. Enabling SSH server

SSH server is disabled by default. When SSH server is enabled, the device will generate a rsa password pair, and then listen connection requests from the client. The process takes one or two minutes.

Run the following command in global configuration mode to enable SSH server:

Command	Purpose
Ip sshd enable	Enables SSH server. The digit of the password is 1024.

4.4.11. SSH server Configuration Example

The following configuration only allows the host whose IP address is 192.168.20.40 to access SSH server. The local user database is used to distinguish user ID.

4.4.12. Access control list

ip access-list standard ssh-acl

permit 192.168.20.40

4.4.13. Global configuration

aaa authentication login ssh-auth local

ip sshd auth-method ssh-auth

ip sshd access-class ssh-acl

ip sshd enable

5. Remote Monitoring

5.1 Remote Monitoring

5.1.1 SNMP Configuration

5.1.2 Overview

The SNMP system includes the following 3 parts:

- SNMP management server (NMS)
- SNMP agent (agent)
- MIB

SNMP is a protocol for the application layer.It provides the format for the packets which are transmitted between NMS and agent.
SNMP management server is a part of the network management system, such as CiscoWorks.
SNMP agent includes the MIB variable and the SNMP management server can be used to browse or change these variables' values.The management server can get the values from the agent or save these variables in the agent.The agent collects data from MIB.MIB is the database of equipment parameters and network data.

5.1.3 SNMP Notification

When a special event occurs, the system will send an inform to the SNMP management server.For example, when the agent system runs into a incorrect condition, it will send a message to the management server.
The SNMP notification can be sent as a trap or a inform request.Because the receiver receives a trap and does not send any response, the transmitter hence cannot confirm whether the trap is received. In this way, the trap is unreliable.Comparatively, the SNMP management server uses SNMP to respond PDU, which is acted as a response of this message.If the management server does not receive the inform request, it will not transmit a response.If the transmitter does not receives the response, it will transmit the inform request again.In this way, the inform has more chance to arrive the planned destination.

5.1.4 SNMP Tasks

- Configuring idle time value
- Configuring the time value of waiting for acknowledgement
- Configuring busy time value of remote end
- Configuring time value of Response
- Configuring the time of reject
- Configuring the redial times
- Configuring the size of window for resend
- Configuring the size of accumulated data packet
- Setting the acknowledgement time-delay
- Setting the maximum numbers of acknowledgement
- Showing LLC2 link information
- Debugging LLC2 link information

6. Security Configuration

6.1 AAAConfiguration

6.1.1 AAA Overview

Access control is the way to control access to the network and services. Authentication, authorization, and accounting (AAA) network security services provide the primary framework through which you set up access control on your router or access server.

6.1.1.1 AAA Security Service

AAA is an architectural framework for configuring a set of three independent security functions in a consistent manner. AAA provides a modular way of performing the following services:

• Authentication—Provides the method of identifying users, including login and password dialog, challenge and response, messaging support, and, depending on the security protocol you select, encryption.

Authentication is the way a user is identified prior to being allowed access to the network and network services. You configure AAA authentication by defining a named list of authentication methods, and then applying that list to various interfaces. The method list defines the types of authentication to be performed and the sequence in which they will be performed; it must be applied to a specific interface before any of the defined authentication methods will be performed. The only exception is the default method list (which is named "default"). The default method list is automatically applied to all interfaces if no other method list is defined. A defined method list overrides the default method list.

All authentication methods, except for local, line password, and enable authentication, must be defined through AAA. For information about configuring all authentication methods, including those implemented outside of the AAA security services, refer to the chapter "Configuring Authentication."

• Authorization—Provides the method for remote access control, including one-time authorization or authorization for each service, per-user account list and profile, user group support, and support of IP, IPX, ARA, and Telnet.

AAA authorization works by assembling a set of attributes that describe what the user is authorized to perform. These attributes are compared to the information contained in a database for a given user and the result is returned to AAA to determine the user's actual capabilities and restrictions. The database can be located locally on the access server or router or it can be hosted remotely on a RADIUS or TACACS+ security server. Remote security servers, such as RADIUS and TACACS+, authorize users for specific rights by associating attribute-value (AV) pairs, which define those rights with the appropriate user. All authorization methods must be defined through AAA.

As with authentication, you configure AAA authorization by defining a named list of authorization methods, and then applying that list to various interfaces. For information about configuring authorization using AAA, refer to the chapter "Configuring Authorization."

• Accounting—Provides the method for collecting and sending security server information used for billing, auditing, and reporting, such as user identities, start and stop times, executed commands (such as PPP), number of packets, and number of bytes.

Accounting enables you to track the services users are accessing as well as the amount of network resources they are consuming. When AAA accounting is activated, the network access server reports user activity to the RADIUS or TACACS+ security server (depending on which security method you have implemented) in the form of accounting records. Each accounting record is comprised of accounting AV pairs and is stored on the access control server. This data can then be analyzed for network management, client billing, and/or auditing. All accounting methods must be defined through AAA. As with authentication and authorization, you configure AAA accounting by defining a named list of accounting methods, and then applying that list to various interfaces. For information about configuring accounting using AAA, refer to the chapter "Configuring Accounting."

6.1.1.2 Benefits of Using AAA

AAA provides the following benefits:

- Increased flexibility and control of access configuration
- Scalability
- Standardized authentication methods, such as RADIUS, TACACS+, and Kerberos
- Multiple backup systems

6.1.1.3 AAA Principles

AAA is designed to enable you to dynamically configure the type of authentication and authorization you want on a per-line (per-user) or per-service (for example, IP, IPX, or VPDN) basis. You define the type of authentication and authorization you want by creating method lists, then applying those method lists to specific services or interfaces.

6.1.1.4 **Method Lists**

A method list is a sequential list that defines the authentication methods used to authenticate a user. Method lists enable you to designate one or more security protocols to be used for authentication, thus ensuring a backup system for authentication in case the initial method fails. Cisco IOS software uses the first method listed to authenticate users; if that method does not respond, Cisco IOS software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or the authentication method list is exhausted, in which case authentication fails.

The software attempts authentication with the next listed authentication method only when there is no response from the previous method. If authentication fails at any point in this cycle—meaning that the security server or local username database responds by denying the user access—the authentication process stops and no other authentication methods are attempted. The following figures shows a typical AAA network configuration that includes four security servers: R1 and R2 are RADIUS servers, and T1 and T2 are TACACS+ servers.

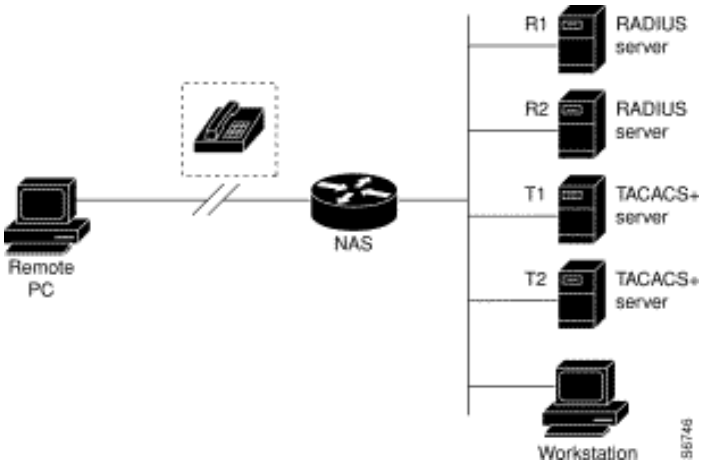


Figure 6-1 Typical AAA Network Configuration

Suppose the system administrator has defined a method list where R1 will be contacted first for authentication information, then R2, T1, T2, and finally the local username database on the access server itself. When a remote user attempts to dial in to the network, the network access server first queries R1 for authentication information. If R1 authenticates the user, it issues a PASS response to the network access server and the user is allowed to access the network. If R1 returns a FAIL response, the user is denied access and the session is terminated. If R1 does not respond, then the network access server processes that as an ERROR and queries R2 for authentication information. This pattern continues through the remaining designated methods until the user is either authenticated or rejected, or until the session is terminated. If all of the authentication methods return errors, the network access server will process the session as a failure, and the session will be terminated.

A FAIL response is significantly different from an ERROR. A FAIL means that the user has not met the criteria contained in the applicable authentication database to be successfully authenticated. Authentication ends with a FAIL response. An ERROR means that the security server has not responded to an authentication query. Because of this, no authentication has been attempted. Only when an ERROR is detected will AAA select the next authentication method defined in the authentication method list.

6.1.2 AAA Configuration Process

You must first decide what kind of security solution you want to implement. You need to assess the security risks in your particular network and decide on the appropriate means to prevent unauthorized entry and attack.

6.1.2.1 Overview of the AAA Configuration Process

Configuring AAA is relatively simple after you understand the basic process involved. To configure security on a Cisco router or access server using AAA, follow this process:

- If you decide to use a separate security server, configure security protocol parameters, such as RADIUS, TACACS+, or Kerberos.
- Define the method lists for authentication by using an AAA authentication command.
- Apply the method lists to a particular interface or line, if required.
- (Optional) Configure authorization using the AAA authorization command.
- (Optional) Configure accounting using the AAA accounting command.

6.1.3 AAA Authentication Configuration Task List

- Configuring Login Authentication Using AAA
- Configuring PPP Authentication Using AAA
- Enabling Password Protection at the Privileged Level
- Configuring Message Banners for AAA Authentication
- AAA authentication username-prompt
- AAA authentication password-prompt
- Establishing Username Authentication
- Enabling Password

6.1.4 AAA Authentication Configuration Task

To configure AAA authentication, perform the following configuration processes:

1. If you decide to use a separate security server, configure security protocol parameters, such as RADIUS, TACACS+, or Kerberos.
2. Define the method lists for authentication by using an AAA authentication command.
3. Apply the method lists to a particular interface or line, if required.

6.1.4.1 Configuring Login Authentication Using AAA

The AAA security services facilitate a variety of login authentication methods. Use the aaa authentication login command to enable AAA authentication no matter which of the supported login authentication methods you decide to use. With the aaa authentication login command, you create one or more lists of authentication methods that are tried at login. These lists are applied using the login authentication line configuration command.
To configure login authentication by using AAA, use the following commands beginning in global configuration mode:

Command	Purpose
aaa authentication login {default | *list-name*}*method1* [*method2...*]	Enables AAA globally.
line [console | vty] *line-number* [*ending-line-number*]	Enters line configuration mode for the lines to which you want to apply the authentication list.
login authentication {default | *list-name*}	Applies the authentication list to a line or set of lines.

The list-name is a character string used to name the list you are creating. The method argument refers to the actual method the authentication algorithm tries. The additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all methods return an error, specify none as the final method in the command line.

For example, to specify that authentication should succeed even if (in this example) the TACACS+ server returns an error, enter the following command:
aaa authentication login default group radius

Because the none keyword enables any user to log in for authentication, it should be used only as a backup method of authentication.

The following table lists the supported login authentication methods.:

Keyword	description
enable	Uses the enable password for authentication.
group *name*	Uses named server group for authentication.
group radius	Uses the list of all RADIUS servers for authentication.
line	Uses the line password for authentication.
local	Uses the local username database for authentication.
local-case	Uses case-sensitive local username authentication.
none	Uses no authentication.

(1) Login Authentication Using Enable Password

Use the aaa authentication login command with the enable method keyword to specify the enable password as the login authentication method. For example, to specify the enable password as the method of user authentication at login when no other method list has been defined, enter the following command:

aaa authentication login default enable

(2) Login Authentication Using Line Password

Use the aaa authentication login command with the line method keyword to specify the line password as the login authentication method. For example, to specify the line password as the method of user authentication at login when no other method list has been defined, enter the following command:

aaa authentication login default line

Before you can use a line password as the login authentication method, you need to define a line password.

(3) Login Authentication Using Local Password

Use the aaa authentication login command with the local method keyword to specify that the Cisco router or access server will use the local username database for authentication. For example, to specify the local username database as the method of user authentication at login when no other method list has been defined, enter the following command:

aaa authentication login default local

For information about adding users into the local username database, refer to the section "Establishing Username Authentication" in this chapter.

(4) Login Authentication Using Group RADIUS

Use the aaa authentication login command with the group radius method to specify RADIUS as the login authentication method. For example, to specify RADIUS as the method of user authentication at login when no other method list has been defined, enter the following command:

aaa authentication login default group radius

Before you can use RADIUS as the login authentication method, you need to enable communication with the RADIUS security server. For more information about establishing communication with a RADIUS server, refer to the chapter "Configuring RADIUS."

6.1.4.2 Enabling Password Protection at the Privileged Level

Use the aaa authentication enable default command to create a series of authentication methods that are used to determine whether a user can access the privileged EXEC command level. You can specify up to four authentication methods. The additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all methods return an error, specify none as the final method in the command line.

Use the following command in global configuration mode:

Command	Purpose
aaa authentication enable default*method1* [*method2...*]	Enables user ID and password checking for users requesting privileged EXEC level.

The method argument refers to the actual list of methods the authentication algorithm tries, in the sequence entered. The following table lists the supported enable authentication methods.

Keyword	Description
enable	Uses the enable password for authentication.
group *group-name*	Uses a subset of RADIUS or TACACS+ servers for authentication as defined by the aaa group server radius or aaa group server tacacs+ command.
group radius	Uses the list of all RADIUS hosts for authentication.
line	Uses the line password for authentication.
none	Uses no authentication.

6.1.4.3 Configuring Message Banners for AAA Authentication

AAA supports the use of configurable, personalized login and failed-login banners. You can configure message banners that will be displayed when a user logs in to the system to be authenticated using AAA and when, for whatever reason, authentication fails.

6.1.4.4 Configuring a Login Banner

To configure a banner that will be displayed whenever a user logs in (replacing the default message for login), use the following commands in global configuration mode: :

Command	Purpose
aaa authentication banner*delimiter* *text-string delimiter*	Creates a personalized login banner.

6.1.4.5 **Configuring a Failed-Login Banner**

To configure a message that will be displayed whenever a user fails login (replacing the default message for failed login), use the following commands in global configuration mode:

Command	Purpose
aaa authentication fail-message*delimiter text-string delimiter*	Creates a message to be displayed when a user fails login.

6.1.4.6 **Instruction**

To create a login banner, you need to configure a delimiting character, which notifies the system that the following text string is to be displayed as the banner, and then the text string itself. The delimiting character is repeated at the end of the text string to signify the end of the banner. The delimiting character can be any single character in the extended ASCII character set, but once defined as the delimiter, that character cannot be used in the text string making up the banner.

6.1.4.7 **AAA authentication username-prompt**

To change the text displayed when users are prompted to enter a username, use the aaa authentication username-prompt command in global configuration mode. To return to the default username prompt text, use the no form of this command. username:

The aaa authentication username-prompt command does not change any dialog that is supplied by a remote TACACS+ server. Use the following command to configure in global configuration mode:

Command	Purpose
aaa authentication username-prompt *text-string*	String of text that will be displayed when the user is prompted to enter an username.

6.1.4.8 **AAA authentication password-prompt**

To change the text displayed when users are prompted for a password, use the aaa authentication password-prompt command in global configuration mode. To return to the default password prompt text, use the no form of this command. password:

The aaa authentication password-prompt command does not change any dialog that is supplied by a remote TACACS+ server. Use the following command to configure in global configuration mode:

Command	Purpose
aaa authentication password-prompt*text-string*	String of text that will be displayed when the user is prompted to enter a password.

6.1.4.9 Establishing Username Authentication

You can create a username-based authentication system, which is useful in the following situations:

- To provide a TACACS-like username and encrypted password-authentication system for networks that cannot support TACACS
- To provide special-case logins: for example, access list verification, no password verification, autocommand execution at login, and "no escape" situations

To establish username authentication, use the following commands in global configuration mode as needed for your system configuration:

Use the no form of this command to delete a username.

username*name* {**nopassword** | **password***password* | **passwordencryption-type***encrypted-password*}

username*name* [**autocommand***command*]

username*name* [**callback-dialstring***telephone-number*]

username*name* [**callback-rotary***rotary-group-number*]

username*name* [**callback-line** [**tty** | **aux**] *line-number* [*ending-line-number*]]

username*name* [**noescape**] [**nohangup**]

username*name* [**privilege***level*]

username*name* [**user-maxlinks***number*]

no username *name*

6.1.4.10 Enabling password

To set a local password to control access to various privilege levels, use the enable password command in global configuration mode. To remove the password requirement, use the no form of this command.

enable password { [***encryption-type***] *encrypted-password*} [**level** *level*]

no enable password [**level** *level*]

6.1.5 AAA Authentication Configuration Example

6.1.5.1 RADIUS Authentication Example

This section provides one sample configuration using RADIUS.

The following example shows how to configure the switch to authenticate and authorize using RADIUS:

```
aaa authentication login radius-login group radius local
aaa authorization network radius-network radius
line vty
login authentication radius-login
```

The lines in this sample RADIUS authentication and authorization configuration are defined as follows: :

- The aaa authentication login radius-login radius local command configures the router to use RADIUS for authentication at the login prompt. If RADIUS returns an error, the user is authenticated using the local database.
- The aaa authentication ppp radius-ppp radius command configures the software to use PPP authentication using CHAP or PAP if the user has not already logged in. If the EXEC facility has authenticated the user, PPP authentication is not performed.
- The aaa authorization network radius-network radius command command queries RADIUS for network authorization, address assignment, and other access lists.
- The login authentication radius-login command enables the radius-login method list for line 3.

6.1.6 AAA Authorization Configuration Task List

- Configuring EXEC Authorization using AAA

6.1.7 AAA Authorization Configuration Task

To configure AAA authorization, perform the following configuration processes:

(1) If you decide to use a separate security server, configure security protocol parameters, such as RADIUS, TACACS+, or Kerberos.

(2) Define the method lists for authorization by using an AAA authorization command.

(3) Apply the method lists to a particular interface or line, if required.

6.1.7.1 **Configuring EXEC Authorization Using AAA**

Use the aaa authorization command to enable authorization

Use aaa authorization exec command to run authorization to determine if the user is allowed to run an EXEC shell. This facility might return user profile information such as autocommand information.

Use line configuration command login authorization to apply these lists. Use the following command in global configuration mode:

Command	Purpose
aaa authorization exec {default | *list-name*}*method1* [*method2...*]	Establishes global authorization list.
line [console | vty] *line-number* [*ending-line-number*]	Enters the line configuration mode for the lines to which you want to apply the authorization method list.
login authorization {default | *list-name*}	Applies the authorization list to a line or set of lines(in line configuration mode).

The keyword list-name is the character string used to name the list of authorization methods.

The keyword method specifies the actual method during authorization process. Method lists enable you to designate one or more security protocols to be used for authorization, thus ensuring a backup system in case the initial method fails. The system uses the first method listed to authorize users for specific network services; if that method fails to respond, the system selects the next method listed in the method list. This process continues until there is successful communication with a listed authorization method, or all methods defined are exhausted. If all specified methods fail to respond, and you still want the system to enter the EXEC shell, you should specify none as the last authorization method in command line.

Use default parameter to establish a default list, and the default list will apply to all interfaces automatically. For example, use the following command to specify radius as the default authorization method for exec:

aaa authorization exec default group radius

If no method list is defined, the local authorization service will be unavailable and the authorization is allowed to pass.

The following table lists the currently supported EXEC authorization mode:

Keyword	Description
group *WORD*	Uses a named server group for authorization.
group radius	Uses radius authorization.
local	Uses the local database for authorization.
if-authenticated	Allows the user to access the requested function if the user is authenticated.
none	No authorization is performed.

6.1.8 AAA Authorization Example

EXEC local authorization example

```
aaa authentication login default local
aaa authorization exec default local
!
username exec1 password 0 abc privilege 15
username exec2 password 0 abc privilege 10
username exec3 nopassword
username exec4 password 0 abc user-maxlinks 10
username exec5 password 0 abc autocommand telnet 172.16.20.1
!
```

The lines in this sample RADIUS authorization configuration are defined as follows: :

- The aaa authentication login default local command defines the default method list of login authentication. This method list applies to all login authentication servers automatically.
- The aaa authorization exec default local command defines default method list of exec authorization. The method list automatically applies to all users that need to enter exec shell.
- Username is exec1，login password is abc，EXEC privileged level is 15(the highest level)，that is, when user exec1 whose privileged level is 15 logs in exec shell, all commands can be checked and performed.
- Username is exec2，login password is abc，EXEC privileged level is 10，that is, when user exec2 whose privileged level is 10 logs in EXEC shell, commands with privileged level less than 10 can be checked and performed.
- Username is exec3，no password is needed for login.
- Username is exec4，login password is abc，the maximum links of the user is 10.
- Username is exec5，login password is abc, user performs telnet 172.16.20.1 immediately when logging in exec shell.

6.1.9 AAA Accounting Configuration Task List

- Configuring Connection Accounting using AAA
- Configuring Network Accounting using AAA

6.1.10 AA Accounting Configuration Task

To configure AAA accounting, perform the following configuration processes:

(1) If you decide to use a separate security server, configure security protocol parameters, such as RADIUS, TACACS+, or Kerberos.

(2) Define the method lists for accounting by using an AAA accounting command.

(3) Apply the method lists to a particular interface or line, if required.

6.1.10.1 Configuring Accounting Connection Using AAA

Use the **aaa accounting** command to enable AAA accounting.

To create a method list to provide accounting information about all outbound connections made from the network access server, use the aaa accounting connection command.

Command	Purpose
aaa accounting connection {default | *list-name*} {start-stop | stop-only | none} group *groupname*	Establishes global accounting list.

The keyword list-name is used to name any character string of the establishing list. The keyword method specifies the actual method adopted during accounting process.

The following table lists currently supported connection accounting methods:

Keyword	Description
group *WORD*	Enables named server group for accounting.
group radius	Enables radius accounting.
none	Disables accounting services for the specified line or interface.
stop-only	Sends a "stop" record accounting notice at the end of the requested user process.
start-stop	RADIUS or TACACS+ sends a "start" accounting notice at the beginning of the requested process and a "stop" accounting notice at the end of the process.

6.1.10.2 Configuring Network Accounting Using AAA

Use the aaa accounting command to enable AAA accounting.

To create a method list to provide accounting information for SLIP, PPP, NCPs, and ARAP sessions, use the aaa accounting network command in global configuration mode.

Command	Purpose
aaa accounting network {default | *list-name*} {start-stop | stop-only | none} group *groupname*	Enables global accounting list.

The keyword list-name is used to name any character string of the establishing list. The keyword method specifies the actual method adopted during accounting process.

The following table lists currently supported network accounting methods:

Keyword	Description
group *WORD*	Enables named server group for accounting.
group radius	Enables radius accounting.
none	Disables accounting services for the specified line or interface.
stop-only	Sends a "stop" record accounting notice at the end of the requested user process.
start-stop	RADIUS or TACACS+ sends a "start" accounting notice at the beginning of the requested process and a "stop" accounting notice at the end of the process.

6.1.10.3 AAA Accounting Update

To enable periodic interim accounting records to be sent to the accounting server, use the aaa accounting update command in global configuration mode. To disable interim accounting updates, use the no form of this command.

Command	Purpose
aaa accounting update [newinfo] [periodic*number*]	Enables AAA accounting update.

If the newinfo keyword is used, interim accounting records will be sent to the accounting server every time there is new accounting information to report. An example of this would be when IP Control Protocol (IPCP) completes IP address negotiation with the remote peer. The interim accounting record will include the negotiated IP address used by the remote peer.

When used with the periodic keyword, interim accounting records are sent periodically as defined by the argument number. The interim accounting record contains all of the accounting information recorded for that user up to the time the accounting record is sent.

When using both the newinfo and periodic keywords, interim accounting records are sent to the accounting server every time there is new accounting information to report, and accounting records are sent to the accounting server periodically as defined by the argument number. For example, if you configure the aaa accounting update newinfo periodic number command, all users currently logged in will continue to generate periodic interim accounting records while new users will generate accounting records based on the newinfo algorithm.

6.1.10.4 AAA accounting suppress null-username

To prevent the AAA system from sending accounting records for users whose username string is NULL, use the aaa accounting suppress null-username command in global configuration mode. To allow sending records for users with a NULL username, use the no form of this command.

- aaa accounting suppress null-username

6.2 Configuring RADIUS

This chapter describes the Remote Authentication Dial-In User Service (RADIUS) security system, defines its operation, and identifies appropriate and inappropriate network environments for using RADIUS technology. The "RADIUS Configuration Task List" section describes how to configure RADIUS with the authentication, authorization, and accounting (AAA) command set.

6.2.1 Introduction

6.2.1.1 RADIUS Introduction

RADIUS is a distributed client/server system that secures networks against unauthorized access. In the implementation, RADIUS clients run on switches and send authentication requests to a central RADIUS server that contains all user authentication and network service access information.
RADIUS has been implemented in a variety of network environments that require high levels of security while maintaining network access for remote users.
Use RADIUS in the following network environments that require access security: :

- Networks with multiple-vendor access servers, each supporting RADIUS. For example, access servers from several vendors use a single RADIUS server-based security database. In an IP-based network with multiple vendors' access servers, dial-in users are authenticated through a RADIUS server that has been customized to work with the Kerberos security system.
- Networks in which a user must only access a single service. Using RADIUS, you can control user access to a single host, to a single utility such as Telnet, or to a single protocol such as Point-to-Point Protocol (PPP). For example, when a user logs in, RADIUS identifies this user as having authorization to run PPP using IP address 10.2.3.4 and the defined access list is started.
- Networks that require resource accounting. You can use RADIUS accounting independent of RADIUS authentication or authorization. The RADIUS accounting functions allow data to be sent at the start and end of services, indicating the amount of resources (such as time, packets, bytes, and so on) used during the session. An Internet service provider (ISP) might use a freeware-based version of RADIUS access control and accounting software to meet special security and billing needs.

RADIUS is not suitable in the following network security situations:

- Multiprotocol access environments. RADIUS does not support the following protocols:
- AppleTalk Remote Access (ARA)
- NetBIOS Frame Control Protocol (NBFCP)
- NetWare Asynchronous Services Interface (NASI)
- X.25 PAD connections
- Switch-to-switch situations. RADIUS does not provide two-way authentication.
- Networks using a variety of services. RADIUS generally binds a user to one service model.

6.2.1.2 **RADIUS Operation**

When a user attempts to log in and authenticate to an access server using RADIUS, the following steps occur:

(1) The user is prompted for and enters a username and password.

(2) The username and encrypted password are sent over the network to theRADIUS server.

(3) The user receives one of the following responses from the RADIUS server:

a. ACCEPT—the user is authenticated.

b. REJECT—the user is not authenticated and is prompted to reenter the username and password, or access is denied.

c. CHALLENGE—a challenge is issued by the RADIUS server. The challenge collects additional data from the user.

d. CHANGE PASSWORD—a request is issued by the RADIUS server, asking the user to select a new password.

The ACCEPT or REJECT response is bundled with additional data that is used for EXEC or network authorization. You must first complete RADIUS authentication before using RADIUS authorization. The additional data included with the ACCEPT or REJECT packets consists of the following:

Services that the user can access, including Telnet, rlogin, or local-area transport (LAT) connections, and PPP, Serial Line Internet Protocol (SLIP), or EXEC services.

Connection parameters,include the host or client IP address, access list, and user timeouts.

6.2.2 RADIUS Configuration Task List

To configure RADIUS on your switch or access server, you must perform the following tasks:

- Use the aaa authentication global configuration command to define method lists for RADIUS authentication. For more information about using the aaa authentication command, refer to the "Configuring Authentication" chapter.
- Use line and interface commands to enable the defined method lists to be used. For more information, refer to the "Configuring Authentication" chapter.
- The following configuration tasks are optional:
- You may use the aaa authorization global command to authorize specific user functions. For more information about using the aaa authorization command, refer to the chapter "Configuring Authorization."
- You may use the aaa accounting command to enable accounting for RADIUS connections. For more information about using the aaa accounting command, refer to the chapter "Configuring Accounting."

6.2.3 RADIUS Configuration Task List

- Configuring Switch to RADIUS Server Communication
- Configuring Switch to Use Vendor-Specific RADIUS Attributes
- Specifying RADIUS Authentication
- Specifying RADIUS Authorization
- Specifying RADIUS Accounting

6.2.4 RADIUS Configuration Task

6.2.4.1 Configuring Switch to RADIUS Server Communication

The RADIUS host is normally a multiuser system running RADIUS server software from Livingston, Merit, Microsoft, or another software provider.
A RADIUS server and a Cisco router use a shared secret text string to encrypt passwords and exchange responses.
To configure RADIUS to use the AAA security commands, you must specify the host running the RADIUS server daemon and a secret text (key) string that it shares with the router.
To configure per-server RADIUS server communication, use the following command in global configuration mode:

Command	Purpose
radius-server host*ip-address* [auth-port*port-number*][acct-port*portnumber*]	Specifies the IP address or host name of the remote RADIUS server host and assign authentication and accounting destination port numbers.
radius-server key*string*	Specifies the shared secret text string used between the router and a RADIUS server.

To configure global communication settings between the router and a RADIUS server, use the following radius-server commands in global configuration mode:

Command	Purpose
radius-server retransmit*retries*	Specifies how many times the switch transmits each RADIUS request to the server before giving up (the default is 2).
radius-server timeout *seconds*	Specifies for how many seconds a switch waits for a reply to a RADIUS request before retransmitting the request.
radius-server deadtime *minutes*	Specifies for how many minutes a RADIUS server that is not responding to authentication requests is passed over by requests for RADIUS authentication.

6.2.4.2 Configuring Switch to Use Vendor-Specific RADIUS Attributes

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific information between the network access server and the RADIUS server by using the vendor-specific attribute (attribute 26).
Vendor-specific attributes (VSAs) allow vendors to support their own extended attributes not suitable for general use. For more information about vendor-IDs and VSAs, refer to RFC 2138, Remote Authentication Dial-In User Service (RADIUS). To configure the network access server to recognize and use VSAs, use the following command in global configuration mode:

Command	Purpose
radius-servervsa send [authentication]	Enables the network access server to recognize and use VSAs as defined by RADIUS IETF attribute 26.

6.2.4.3 Specifying RADIUS Authentication

After you have identified the RADIUS server and defined the RADIUS authentication key, you must define method lists for RADIUS authentication. Because RADIUS authentication is facilitated through AAA, you must enter the aaa authentication command, specifying RADIUS as the authentication method. For more information, refer to the chapter "Configuring Authentication."

6.2.4.4 Specifying RADIUS Authorization

AAA authorization lets you set parameters that restrict a user's access to the network. Authorization using RADIUS provides one method for remote access control, including one-time authorization or authorization for each service, per-user account list and profile, user group support, and support of IP, IPX, ARA, and Telnet. Because RADIUS authorization is facilitated through AAA, you must issue the aaa authorization command, specifying RADIUS as the authorization method. For more information, refer to the chapter "Configuring Authorization."

6.2.4.5 Specifying RADIUS Accounting

The AAA accounting feature enables you to track the services users are accessing as well as the amount of network resources they are consuming. Because RADIUS accounting is facilitated through AAA, you must issue the aaa accounting command, specifying RADIUS as the accounting method. For more information, refer to the chapter "Configuring Accounting."

6.2.5 RADIUS Configuration Examples

6.2.5.1 RADIUS Authentication and Authorization Example

The following example shows how to configure the router to authenticate and authorize using RADIUS:

```
aaa authentication login use-radius group radius local
```

The lines in this sample RADIUS authentication and authorization configuration are defined as follows: :

aaa authentication login use-radius radius local configures the router to use RADIUS for authentication at the login prompt. If RADIUS returns an error, the user is authenticated using the local database. In this example, use-radius is the name of the method list, which specifies RADIUS and then local authentication.

RADIUS Authentication, Authorization, and Accounting Example

The following example shows a general configuration using RADIUS with the AAA command set: :

```
radius-server host 1.2.3.4
radius-server key myRaDiUSpassWoRd
username root password AlongPassword
aaa authentication login admins radius local
line vty 1 16
login authentication admins
```

The lines in this example RADIUS authentication, authorization, and accounting configuration are defined as follows:

radius-server host command defines the IP address of the RADIUS server host. ;

radius-server key command defines the shared secret text string between the network access server and the RADIUS server host.

aaa authentication login admins group radius local command defines the authentication method list "dialins," which specifies that RADIUS authentication and then (if the RADIUS server does not respond) local authentication will be used on serial lines using PPP. ;

login authentication admins command applies the "admins" method list for login authentication.

6.2.5.2 RADIUS Application Example

The following example shows how to define the general configuration through the AAA command set:

```
radius-server host 1.2.3.4
radius-server key myRaDiUSpassWoRd
username root password AlongPassword
aaa authentication login admins radius local
line vty 1 16
login authentication admins
```

In the example above, each command line has its own meaning. See the following content:

The command **radius-server host** defines the IP address of the RADIUS server.

The command **radius-server key** defines the shared pin between the network access server and the RADIUS server.

The command **aaa authentication login admins radius local** defines the authentication method list **admins**, which first specifies RADIUS as the authentication method and then uses the local authentication if the RADIUS server does not respond.

The command login authentication admins specifies the method list admins as the login authentication method.

6.3 Web Authentication Configuration

The section describes the concept of Web authentication and configuration and usage of the Web authentication.

6.3.1 Overview

6.3.1.1 Web Authentication

The Web authentication of the switch is a connection control mode as PPPoE and 802.1x. When you use the Web authentication, the login and logout operations can be successfully performed through the interaction of the browser and the builtin portal server of the switch. During the operations of login and logout, no other client software need be installed.

1. Device role

The roles that the network devices take during the Web authentication are shown in Figure 6-2:

- **Client**: It is ausercomputer that accesses network through the switch. The user computer need be configured the network browser, the function of DHCP client and the function to originate DNS query.
- **DHCP server**: It is to distribute the IP address for users.
- **AAA server**: It is to save user right information and to charge users for their network access.
- **Switch**: It is a switch having Web authentication. It is to control the access right of users and works as an agent between users and AAA server.

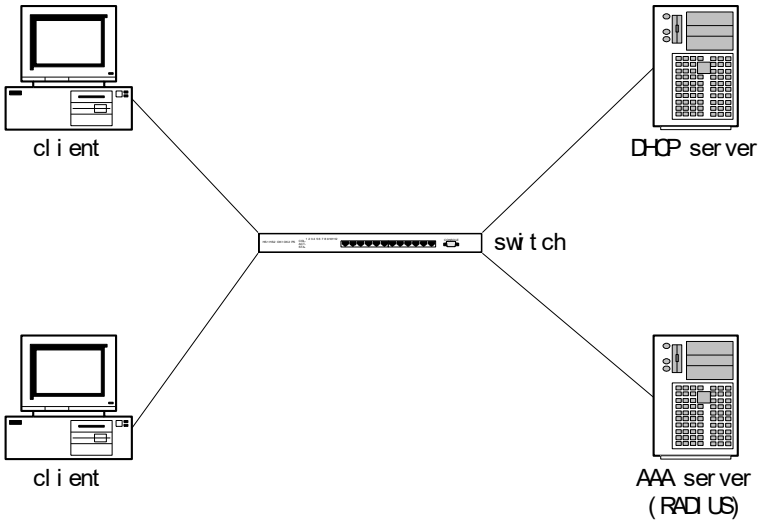


Figure 6-2Web authentication network

2. Authentication flow

According to different configuration strategies, the Web authentication flow of the switch may relate to protocols such as DHCP and DNS. Its typical flow is shown in Figure 3-2. The Web authentication flow generally contains the following steps:

(1) The DHCP server sends a DHCP confirmation request to a user through the switch after the user originates the process of DHCP address distribution. The switch then identifies and records the user.

(2) The user accesses any Website through the browser (Write down the domain name, not the IP address, in the host part of the **url** column in the browser), which activates the DNS request of the user computer.

(3) The DNS server returns the user a request response. The switch captures the request response message and changes the resolved address to the address of the built-in portal server in the switch.

(4) The DHCP confirmation process continues after the browser captures DNS resolution. The switch returns the corresponding authentication page according to different authentication methods after the switch receives the request.

(5) The user submits the authentication request; the switch authenticates the user through the AAA server after the switch receives information submitted by the user; if the authentication succeeds, the AAA server will be notified to start charging; the switch gives the user the network access right and returns the user a page that the authentication is successful; meanwhile, the switch also returns a **keep alive** page, which periodically sends the **user online** notification to the switch.

(6) The user sends the logout request to the switch through the browser. The switch then notifies the AAA server to stop charging, and withdraws the network access right from the user.

(7) In the period between successful user authentication and logout, the switch periodically detects the user online notification. If the notification is not received in the preset time, the switch considers that the user abnormally logs off, notifies the AAA server to stop charging and withdraws the network access right from the user.

The above steps may vary a little with configuration strategies and user's operations. For example, if user directly accesses the portal server of the switch before the authentication is approved, DNS-related processes will not be enabled.

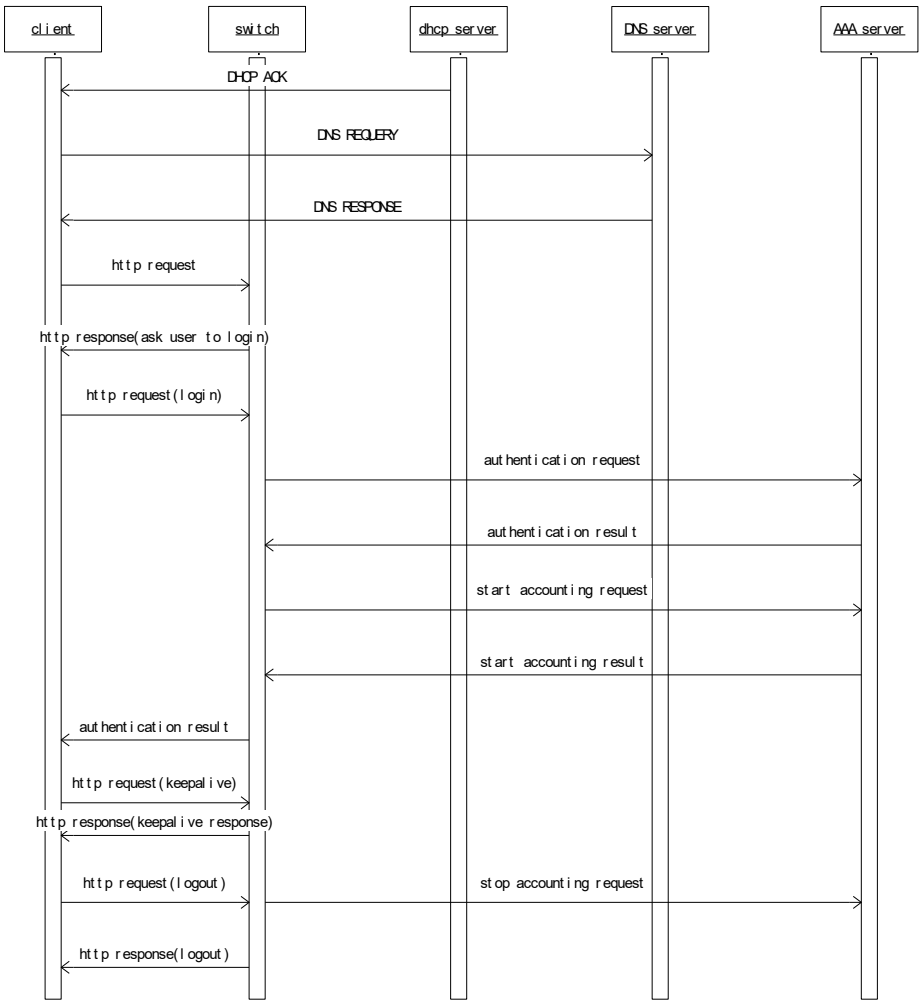


Figure 6-3 web authentication flow

6.3.1.2 **Planning Web Authentication**

1. Planning the authentication mode

Two authentication modes are provided to control user's access:

Username/password authentication mode: In this mode, the switch identifies the user through the username and password, and notifies the AAA server to start charging according to username; user needs to enter the username and password through the browser.

VLAN ID authentication mode: In this mode, the switch identifies the user through the VLAN ID the user belongs to, and notifies the AAA server to start charging according to VLAN ID; user only requires to confirm corresponding operations on the Web page before accessing the network.

Different operation strategies adopt different authentication modes. The supported maximum number of users that simultaneously access the network varies with the authentication mode. For the username/password authentication mode, the switch supports simultaneously accessed users as many as its performance permits. For the VLAN ID authentication mode, the maximum number of simultaneously accessed users equals the number of VLAN that the switch supports.

2. Planning network topology

The switch takes the routing interface as a unit to set the authentication attribute. if the web authentication function is enabled on a routing interface, network accesses through the routing interface are all controlled by the web authentication. the dhcp server, dns server or aaa server should connect the switch through the interface with web authentication function disabled. figure 6-4 shows the relative typical network topology.

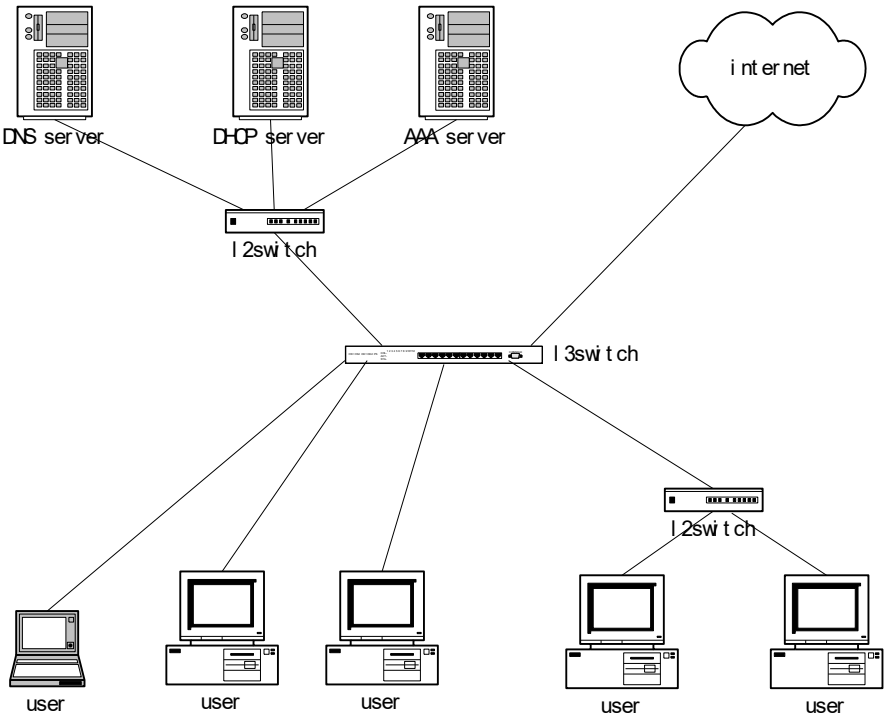


Figure 6-4 Typical network topology

6.3.2 Configuring Web Authentication

6.3.2.1 Global Configuration

1. Configuring the address of the portal server

Run the following command in global configuration mode to configure the address of the portal server:

Run…	To...
web-auth portal-server *A.B.C.D*	Configure the IP address of the portal server.

2. Configuring authentication duration

The parameter **authtime** determines the maximum time of user's authentication. If the authentication is not approved within the maximum time, the switch terminates the authentication procedure.

Run the following command in global configuration mode to configure the authentication duration (Unit: second):

Run...	To...
web-auth authtime <60-65535>	Configure the authentication duration.

3. Configuring the transmission period of the online notification

Through the online notification sent by the browser, the switch checks whether the user is online.

Run the following command in global configuration mode to configure the transmission period (unit: second):

Run...	To...
web-auth keep-alive<60-65535>	Configure the transmission period for the online notification.

4. Configuring the duration to detect the abnormal logout

When the switch does not receive the user online notification from the browser in the set duration, the switch considers that user logs out abnormally.

Run the following command in global configuration mode to configure the duration to detect the abnormal logout:

Run...	To...
web-auth holdtime <60-65535>	Configure the duration to detect user’s abnormal logout.

5. Configuring password for the VLAN ID authentication

When the authentication mode is set to VLAN ID, the switch takes **vlan n** as the user name, **n** representing the corresponding VLAN serial number. All user names use the same password.

Run the following command in global configuration mode to configure the password for the VLAN ID authentication:

Run...	To...
web-auth vlan-password <WORD>	Configure the password for the VLAN ID authentication.

6.3.2.2 Interface Configuration

1. Configuring authentication mode

The switch provides two authentication modes: username/password and VLAN ID.

Run the following command in interface configuration mode to configure the authentication mode:

Run...	To...
web-auth mode user | *vlan-id*	Configure the authentication mode.

2. Configuring authentication method list

Different authentication method lists can be applied on each interface. By default, the authentication method list named **default** is applied on each interface.

Run the following command in interface configuration mode to configure the authentication method list:

Run...	To...
web-auth authentication WORD	Configure the authentication method list.

3. Configuring the accounting method list

Different accounting method lists can be applied on each interface. By default, the accounting method list named **default** is applied on each interface.

Run the following command in interface configuration mode to configure the accounting method list:

Run...	To...
web-auth accounting WORD	Configure the accounting method list.

6.3.2.3 **Enabling Web Authentication**

If global configuration and interface configuration satisfy the requirements, you can enable the Web authentication on the designated routing switch.

Run the following command in interface configuration mode to enable the Web authentication:

Run...	To...
web-auth enable	Enable the Web authentication.

6.3.3 Monitoring and Maintaining Web Authentication

6.3.3.1 Checking the Global Configuration

Run the following command in privileged mode to check the global configuration:

Run...	To...
show web-auth	Check the global configuration.

6.3.3.2 Checking Interface Configuration

Run the following command in interface configuration mode to check the interface configuration:

Run...	To...
show web-auth interface [vlan | SuperVlan]	Check the interface configuration.

6.3.3.3 Checking User State

Run the following command in privileged mode to check the user state:

Run...	To...
show web-auth user	Check the user state.

6.3.3.4 Mandatorily Kicking Out Users

Run the following command in global configuration mode to mandatorily kick out a user.

Run...	To...
web-auth kick-out user-IP	Mandatorily kick out a user.

6.3.4 Web Authentication Configuration Example

Network topology

See Figure 6-5:

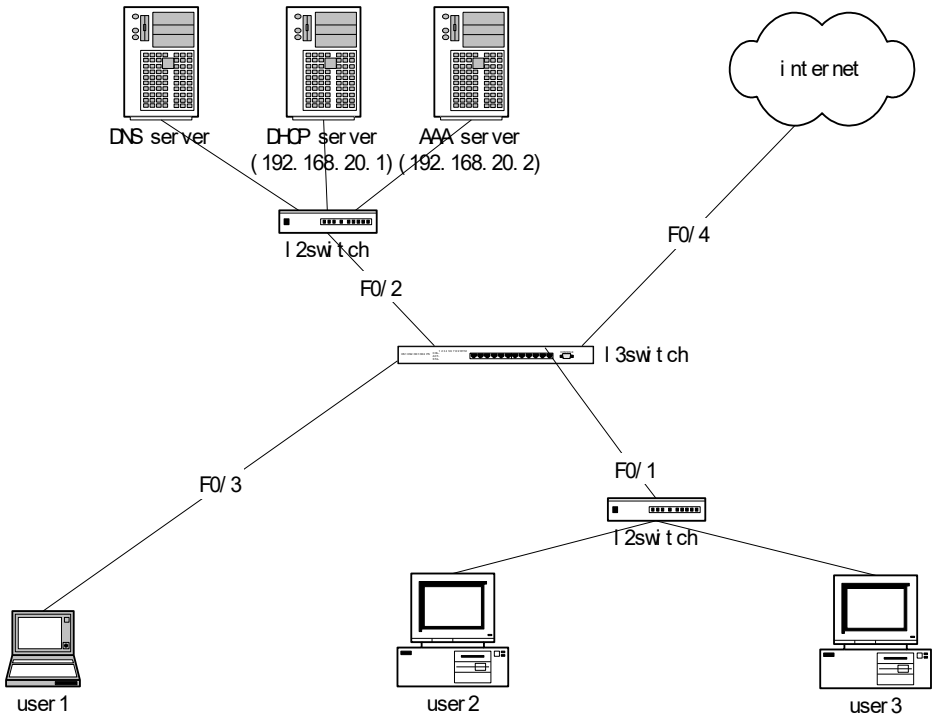


Figure 6-5 Network topology

Global configuration

```
aaa authentication login auth-weba radius
aaa accounting network acct-weba start-stop radius
!
radius-server host 192.168.20.2 auth-port 1812 acct-port 1813
radius-server key 405.10
!
ip dhcpd enable
ip http server
!
vlan 1-4
!
web-auth portal-server 192.168.20.41
web-auth holdtime 3600
web-auth authtime 600
web-auth keep-alive 180
```

Configuration of the layer-2 interface

```
interface FastEthernet0/1
 switchport pvid 1
!
interface FastEthernet0/2
 switchport pvid 2
!
interface FastEthernet0/3
 switchport pvid 3
!
interface FastEthernet0/4
 switchport pvid 4
```

Configuration of the routing interface

```
interface VLAN1
 no ip directed-broadcast
 ip helper-address 192.168.20.1
 web-auth accounting acct-weba
 web-auth authentication auth-weba
 web-auth mode vlan-id
 web-auth enable
!
interface VLAN2
 ip address 192.168.20.41 255.255.255.0
 no ip directed-broadcast
!
interface VLAN3
 no ip directed-broadcast
 ip helper-address 192.168.20.1
 web-auth accounting acct-weba
 web-auth authentication auth-weba
 web-auth mode user
 web-auth enable
!
interface VLAN4
 no ip directed-broadcast
!
```

7. Web Configuration

7.1 HTTP Switch Configuration

7.1.1 HTTP Configuration

Switch configuration can be conducted not only through command lines and SNMP but also through Web browser. The switches support the HTTP configuration, the abnormal packet timeout configuration, and so on.

7.1.1.1 Setting the HTTP Port

Generally, the HTTP port is port 80 by default, and users can access a switch by entering the IP address directly; however, switches also support users to change the service port and after the service port is changed you have to use the IP address and the changed port to access switches. For example, if you set the IP address and the service port to **192.168.1.3** and **1234** respectively, the HTTP access address should be changed to **http: // 192.168.1.3: 1234**. You'd better not use other common protocols' ports so that access collision should not happen. Because the ports used by a lot of protocols are hard to remember, you'd better use port IDs following port 1024.

Command	Purpose
ip http port { *portNumber* }	Sets the HTTP port.

7.1.1.2 Enabling the HTTP Service

Switches support to control the HTTP access. Only when the HTTP service is enabled can HTTP exchange happen between switch and PC and, when the HTTP service is closed, HTTP exchange stops.

Command	Purpose
ip http server	Enables the HTTP service.
ip http {*timeout*}	Configures the timeout time of HTTP abnormal packets.

7.1.1.3 Setting the HTTP Access Mode

You can access a switch through two access modes: HTTP access and HTTPS access, and you can use the following command to set the access mode to **HTTP**.

Command	Purpose
ip http http-access enable	Sets the HTTP access mode.

7.1.1.4 Setting the Maximum Number of VLAN Entries on Web Page

A switch supports at most 4094 VLANs and in most cases Web only displays parts of VLANs, that is, those VLANs users want to see. You can use the following command to set the maximum number of VLANs. The default maximum number of VLANs is 100.

Command	Purpose
ip http web max-vlan { *max-vlan* }	Sets the maximum number of VLAN entries displayed in a web page.

7.1.1.5 Setting the Maximum Number of Multicast Entries Displayed on a Web Page

A switch supports at most 100 multicast entries. You can run the following command to set the maximum number of multicast entries and Web then shows these multicast entries. The default maximum number of multicast entries is 15.

Command	Purpose
ip http web igmp-groups { *igmp-groups* }	Sets the maximum number of multicast entries displayed in a web page.

7.1.2 HTTPS Configuration

In order to improve the security of communications, switches support not only the HTTP protocol but also the HTTPS protocol. HTTPS is a security-purposed HTTP channel and it is added to the SSL layer under HTTP.

7.1.2.1 Setting the HTTP Access Mode

You can run the following command to set the access mode to **HTTPS**.

Command	Purpose
ip http ssl-access enable	Sets the HTTPS access mode.

7.1.2.2 It is used to set the HTTPS port.

As the HTTP port, HTTPS has its default service port, port 443, and you also can run the following command to change its service port. It is recommended to use those ports following port 1024 so as to avoid collision with other protocols' ports.

Parameter	Remarks
ip http secure-port {*portNumber*}	Sets the HTTPS port.

7.2 Configuration Preparation

7.2.1 Accessing the Switch through HTTP

When accessing the switch through Web, please make sure that the applied browser complies with the following requirements:

- HTML of version 4.0
- HTTP of version 1.1
- JavaScript™ of version 1.5

What's more, please ensure that the main program file, running on a switch, supports Web access and your computer has already connected the network in which the switch is located.

7.2.1.1 Initially Accessing the Switch

When the switch is initially used, you can use the Web access without any extra settings:

1. Modify the IP address of the network adapter and subnet mask of your computer to **192.168.1.x** and **255.255.255.0** respectively.
2. Open the Web browser and enter **192.168.1.1**in the address bar. It is noted that **192.168.1.1**is the default management address of the switch.
3. If the Internet Explorer browser is used, you can see the dialog box in figure 1. Both the original username and the password are “admin”, which is capital sensitive.

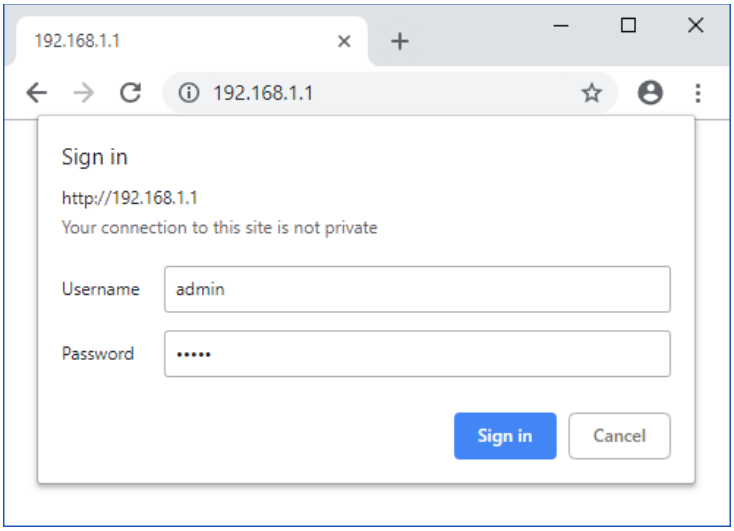


Figure 7-1: ID checkup of WEB login

4. After successful authentication, the systematic information about the switch will appear on the IE browser.

7.2.1.2 Upgrading to the Web-Supported Version

If your switch is upgraded to the Web-supported version during its operation and the switch has already stored its configuration files, the Web visit cannot be directly applied on the switch. Perform the following steps one by one to enable the Web visit on the switch:

1. Connect the console port of the switch with the accessory cable, or telnet to the management address of the switch through the computer.
2. Enter the global configuration mode of the switch through the command line, the DOS prompt of which is similar to “Switch_config#”.
3. If the management address of the switch is not configured, please create the VLAN interface and configure the IP address.
4. Enter the **ip http server** command in global configuration mode and start the Web service.
5. Run **username** to set the username and password of the switch. For how to use this command, refer to the “Security Configuration” section in the user manual.
6. After the above-mentioned steps are performed, you can enter the address of the switch in the Web browser to access the switch.
7. Enter **write** to store the current configuration to the configuration file.

7.2.2 Accessing a Switch through Secure Links

The data between the WEB browser and the switch will not be encrypted if you access a switch through common HTTP. To encrypt these data, you can use the secure links, which are based on the secure sockets layer, to access the switch.

To do this, you should follow the following steps:

1. Connect the console port of the switch with the accessory cable, or telnet to the management address of the switch through the computer.
2. Enter the global configuration mode of the switch through the command line, the DOS prompt of which is similar to “Switch_config#”.
3. If the management address of the switch is not configured, please create the VLAN interface and configure the IP address.
4. Enter the **ip http server** command in global configuration mode and start the Web service.
5. Run **username** to set the username and password of the switch. For how to use this command, refer to the “Security Configuration” section in the user manual.
6. ６. Run **ip http ssl-access enable** to enable the secure link access of the switch.
7. Run **no ip http http-access enable** to forbid to access the switch through insecure links.
8. Enter **write** to store the current configuration to the configuration file.
9. Open the WEB browser on the PC that the switch connects, enter **https://192.168.1.1**on the address bar (**192.168.1.1** stands for the management IP address of the OLT) and then press the **Enter** key. Then the switch can be accessed through the secure links.

7.2.3 Introduction of Web Interface

The Web homepage appears after login, as shown in figure 7-2:

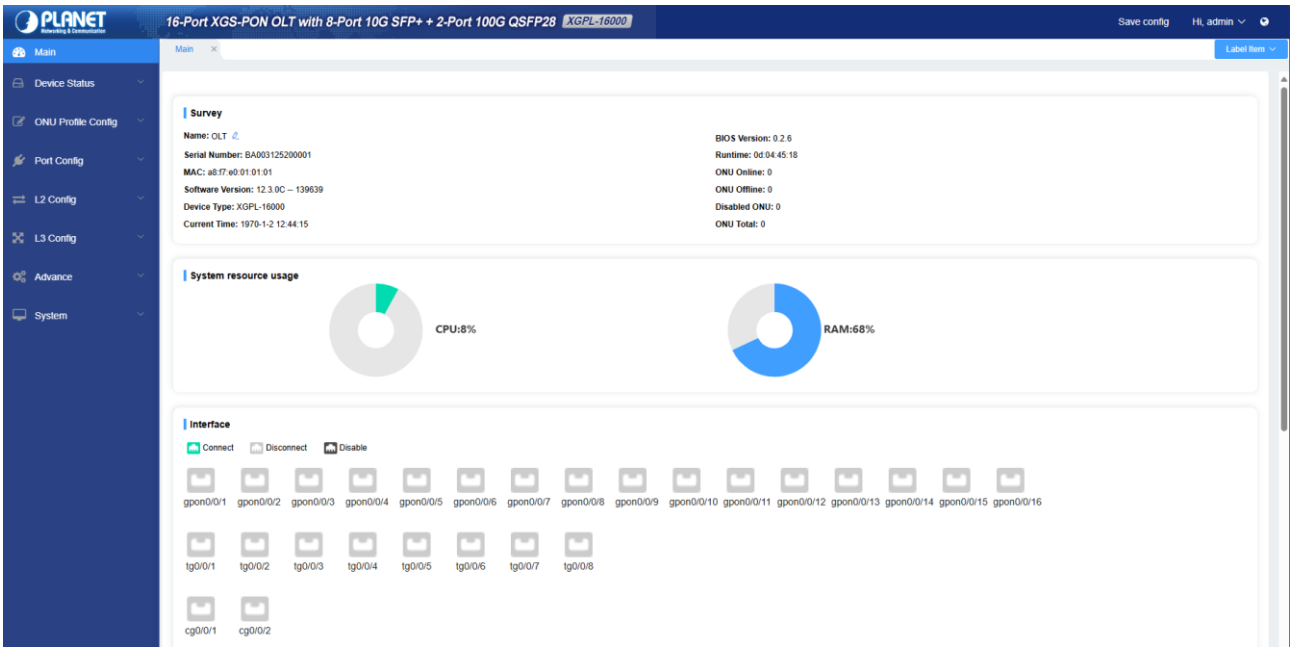


Figure 7-2: Web homepage

The whole homepage consists of the top control bar, the navigation bar, the configuration area and the bottom control bar.

7.2.3.1 Top Control Bar

Figure 7-3: Top control bar

Save All	Write the current settings to the configuration file of the device. It is equivalent to the execution of the **write** command. The configuration that is made through Web will not be promptly written to the configuration file after validation. If you click “Save All”, the unsaved configuration will be lost after rebooting.
Logout	Exit from the current login state. After you click "logout", you have to enter the username and the password again if you want to continue the Web function.

After you configure the device, the result of the previous step will appear on the left side of the top control bar. If error occurs, please check your configuration and retry it later.

7.2.3.2 **Navigation Bar**

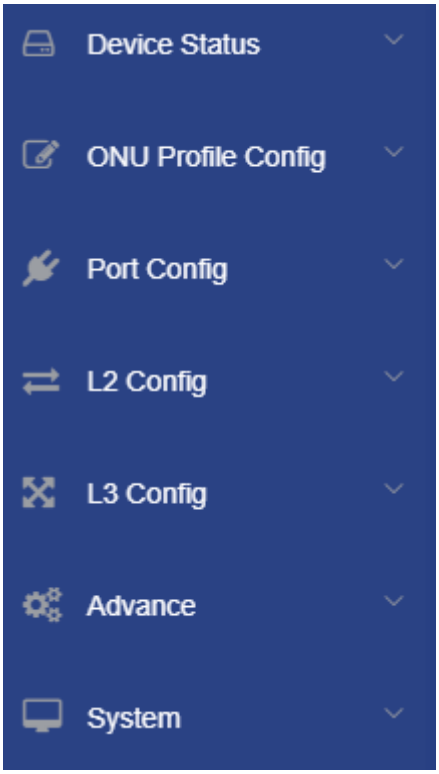


Figure 7-4 Navigation bar

The contents in the navigation bar are shown in a form of list and are classified according to types. By default, the list is located at “Runtime Info”. If a certain item need be configured, please click the group name and then the sub-item. For example, to browse the flux of the current port, you have to click “Interface State" and then “Interface Flow”.

Note

The limited user can only browse the state of the device and cannot modify the configuration of the device. If you log on to the Web with limited user’s permissions, only “Interface State” will appear.

7.2.3.3 Information Display Area

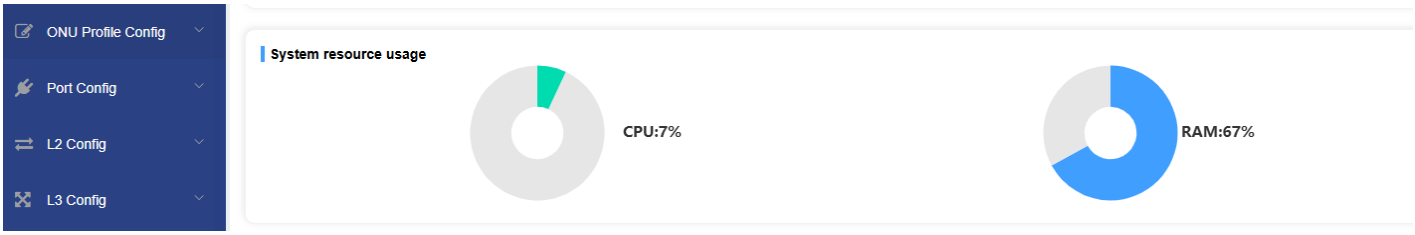


Figure 7-5 Configuration Area

The configuration display area shows the state and configuration of the device. The contents of this area can be modified by the clicking of the items in the navigation bar.

7.2.3.4 Configuration Area

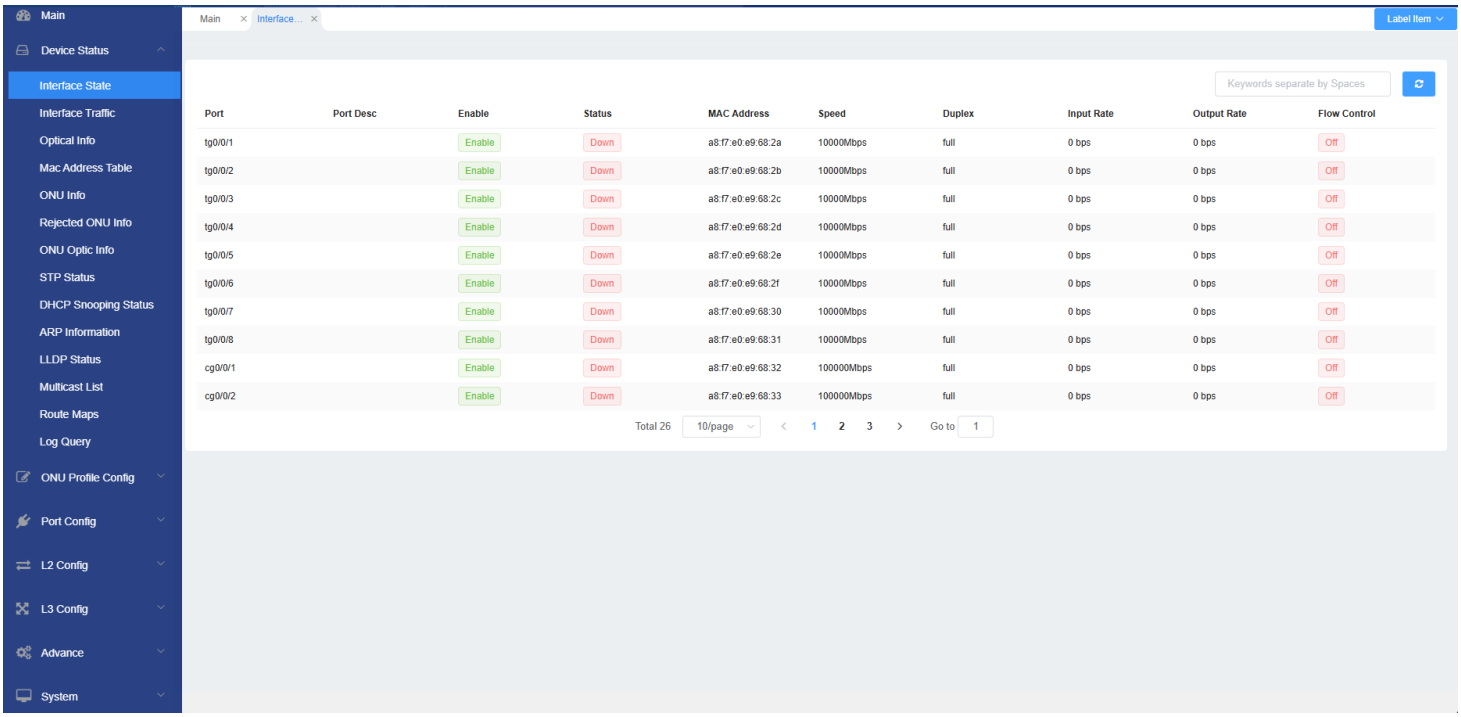
The configuration area is to show the content that is selected in the navigation area. The configuration area always contains one or more buttons, and their functions are listed in the following table:

Button	Function
Refresh	Refreshes the content displayed in the current configuration area.
Apply	Applies the modifications to the configuration to the device. The process of applying the configuration does not save the configuration to the device's configuration file, so click the "Save All" button in the top control bar.
Added	Create a new list entry. For example, create VLAN entries and users.
Delete	Deletes the list entry.
Back	Return to the previous configuration page.

7.3 Device Status

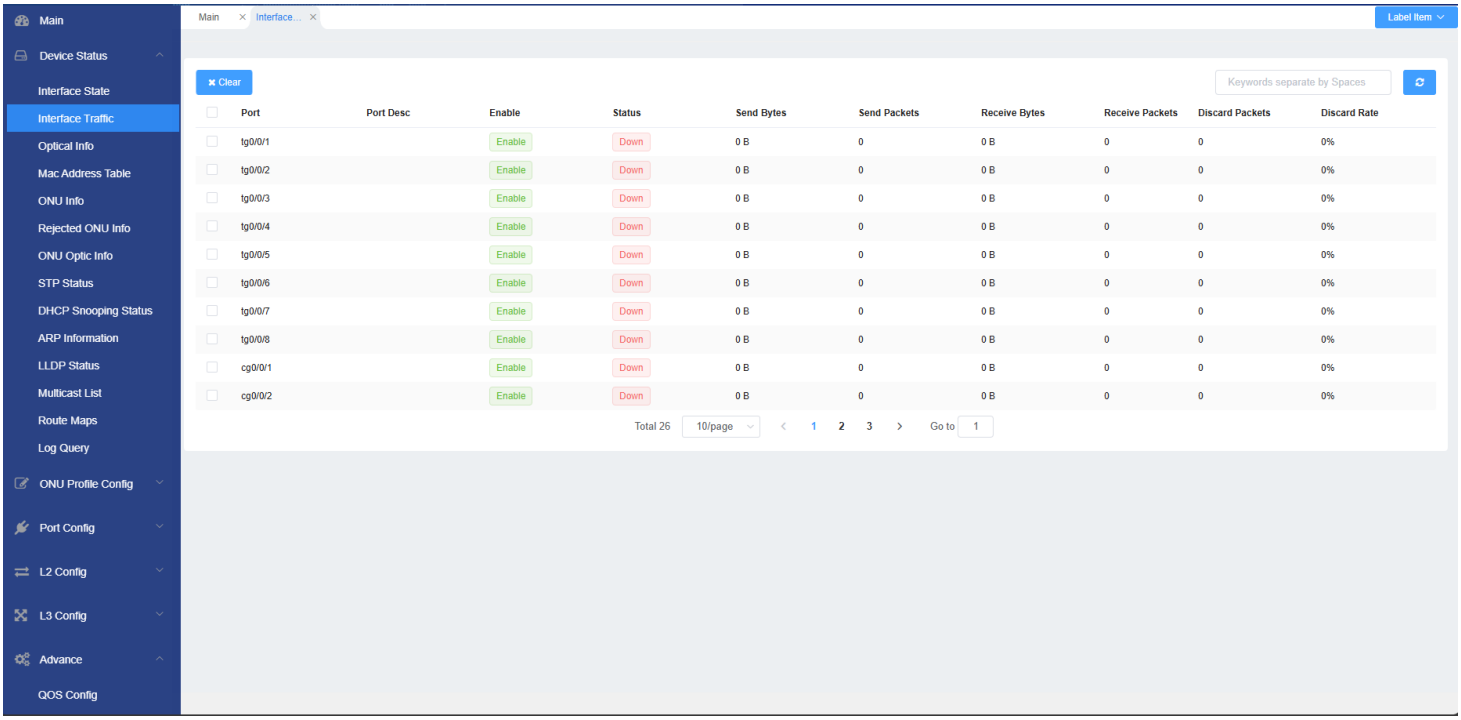
7.3.1 Interface State

In the navigation bar, click Device Status and interface state to enter the port status page.



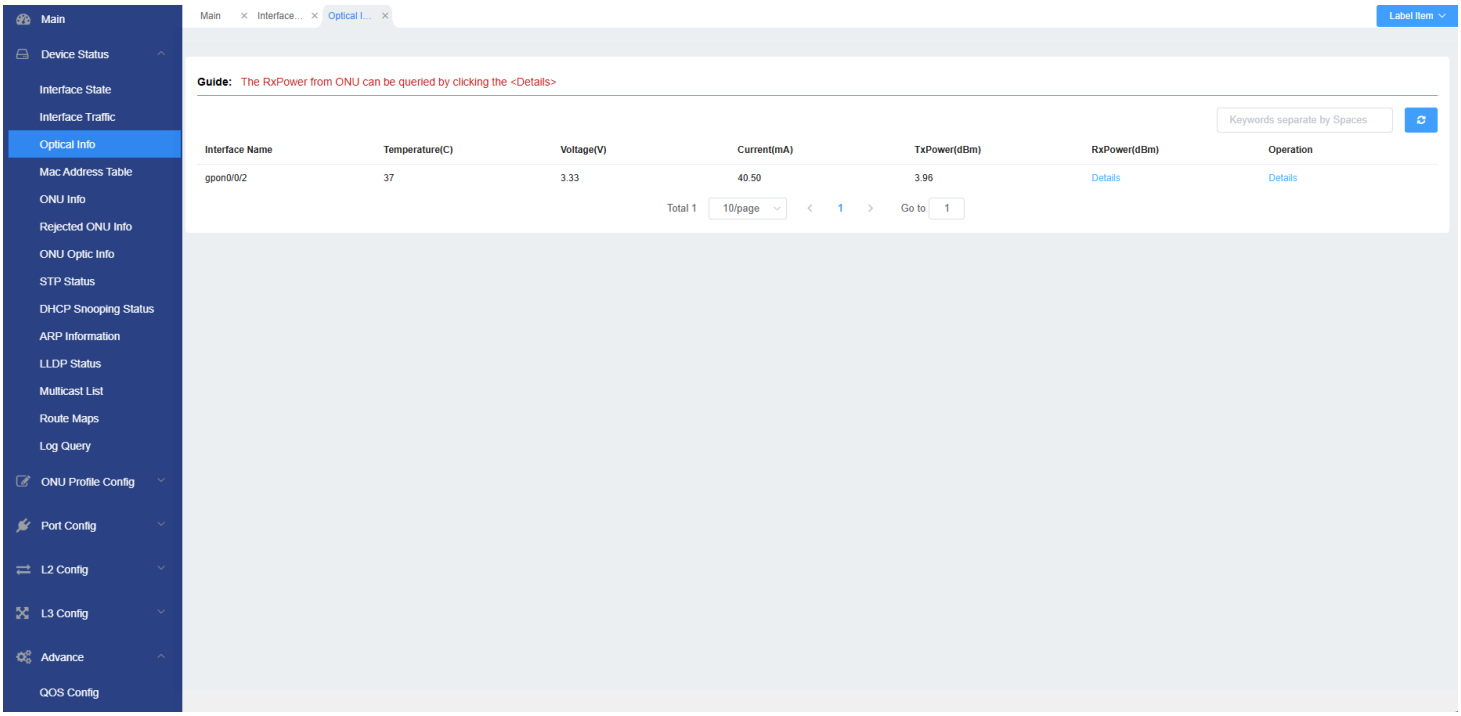
7.3.2 Interface Traffic

In the navigation bar, click Device Status and Interface Traffic to enter the Port Traffic page. Click "Clear" to clear the checked port traffic data



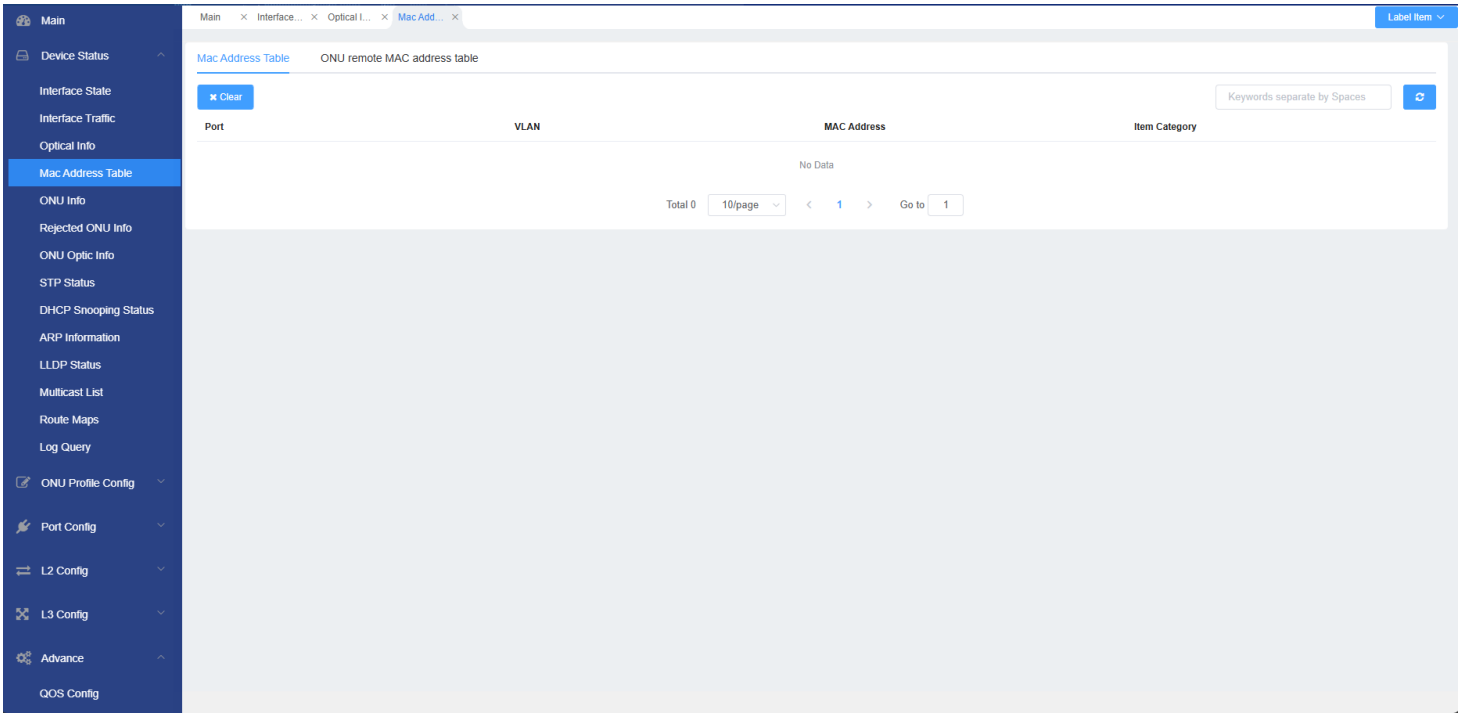
7.3.3 Optical Info

In the navigation bar, click Device Status and Optical Info to enter the GPON Optical Module Status page. Click "Detail" to enter the pop-up window to view the port and accept the power information.



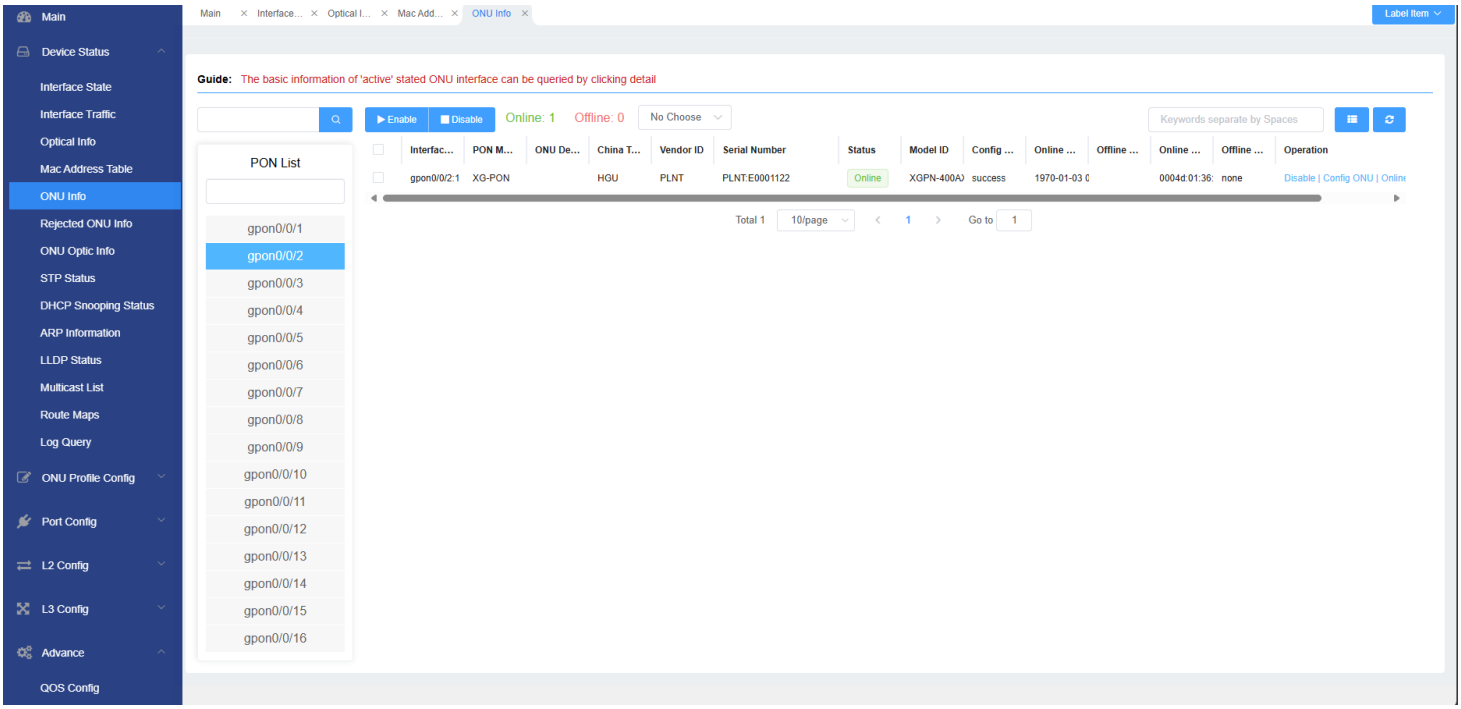
7.3.4 MAC Address Table

In the navigation bar, click Device Status and MAC Address Table to enter the MAC address table page.



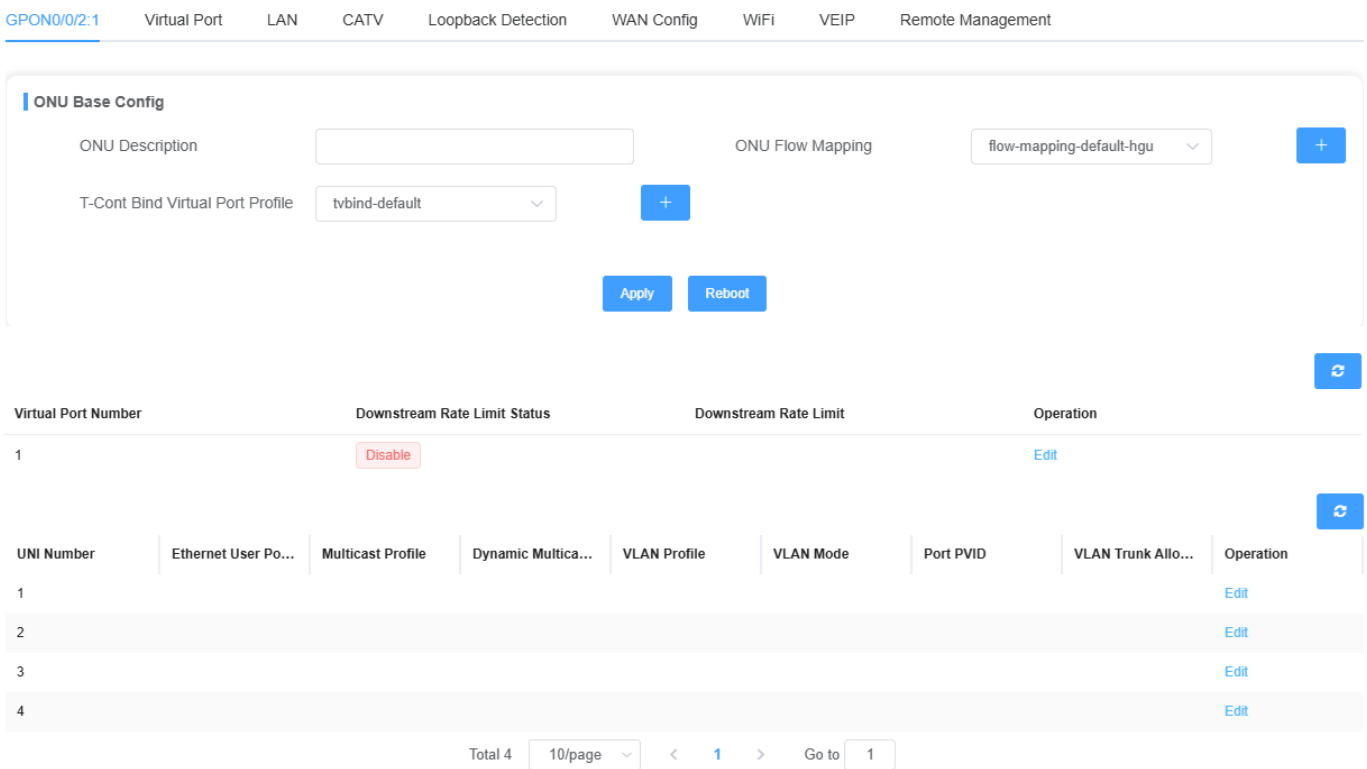
7.3.5 ONU Info

In the navigation bar, click Device Status and ONU Info to enter the ONU Port Status page. Based on the selected PON port, the list of PON ports is displayed.

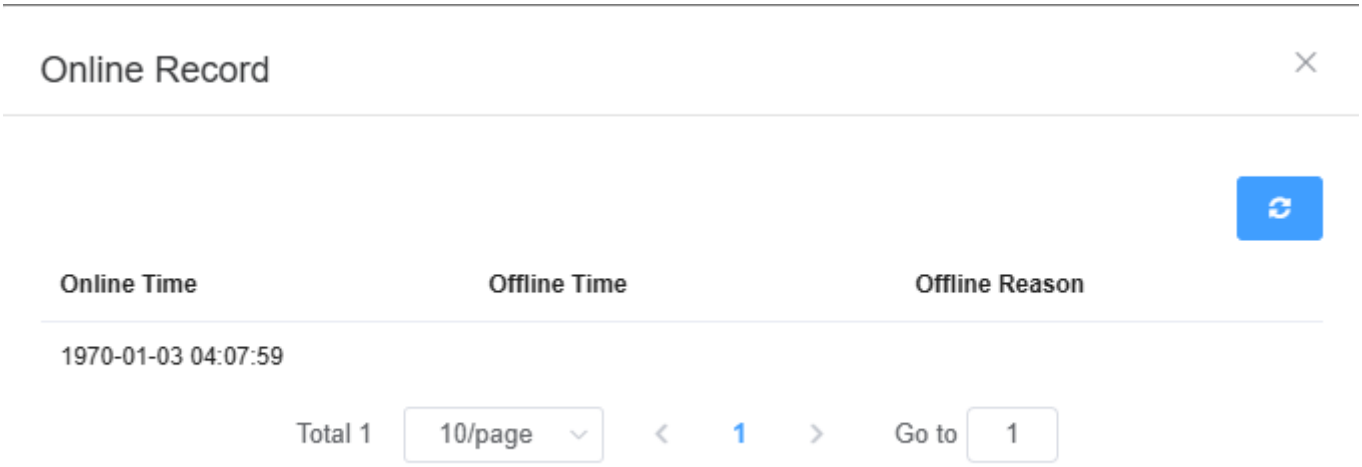


Click “Enable” to enable PON port.

Click "Configure ONU" to enter the ONU configuration interface, which contains a total of 4 modules that can be configured: basic configuration, CATV configuration, Loopback Detection configuration, and WiFi configuration (configuration items for interface configurations that are not compatible with WiFi functions are not displayed by default).



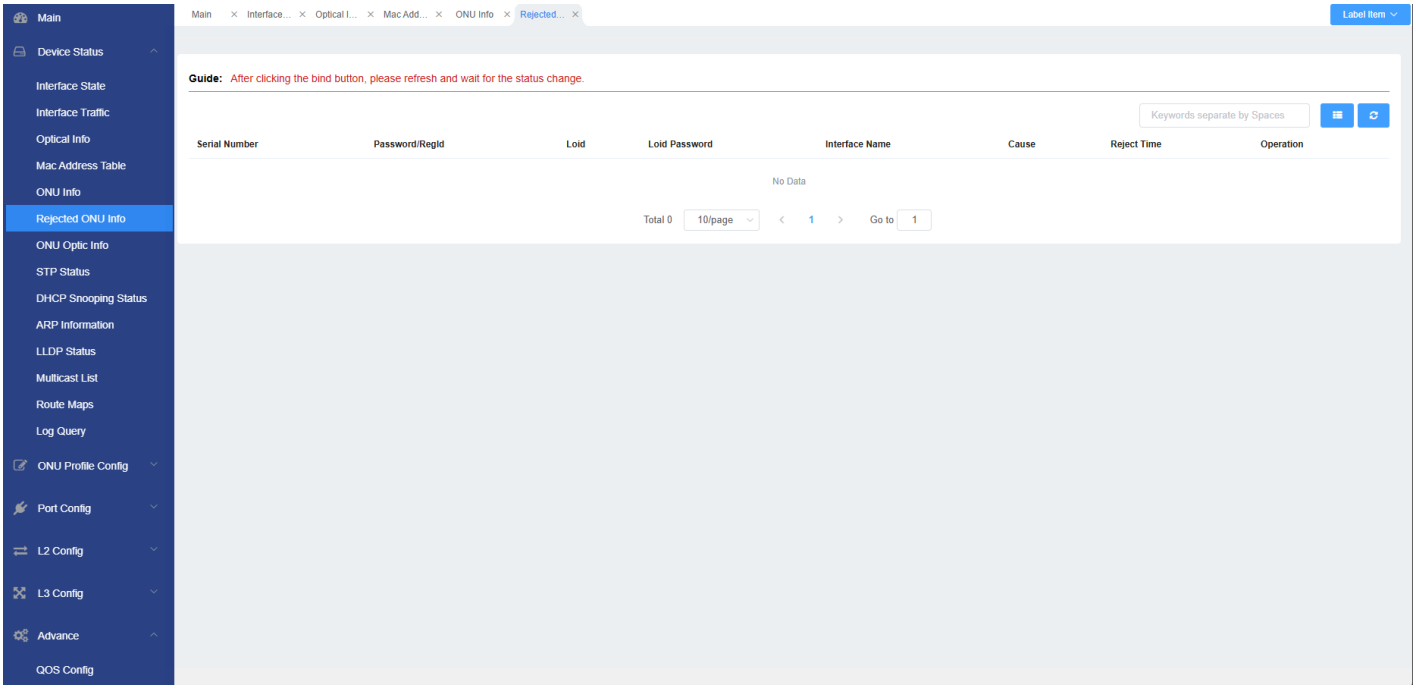
Click "Online Record" to display the online record information of the PON.



7.3.6 Rejected ONU Info

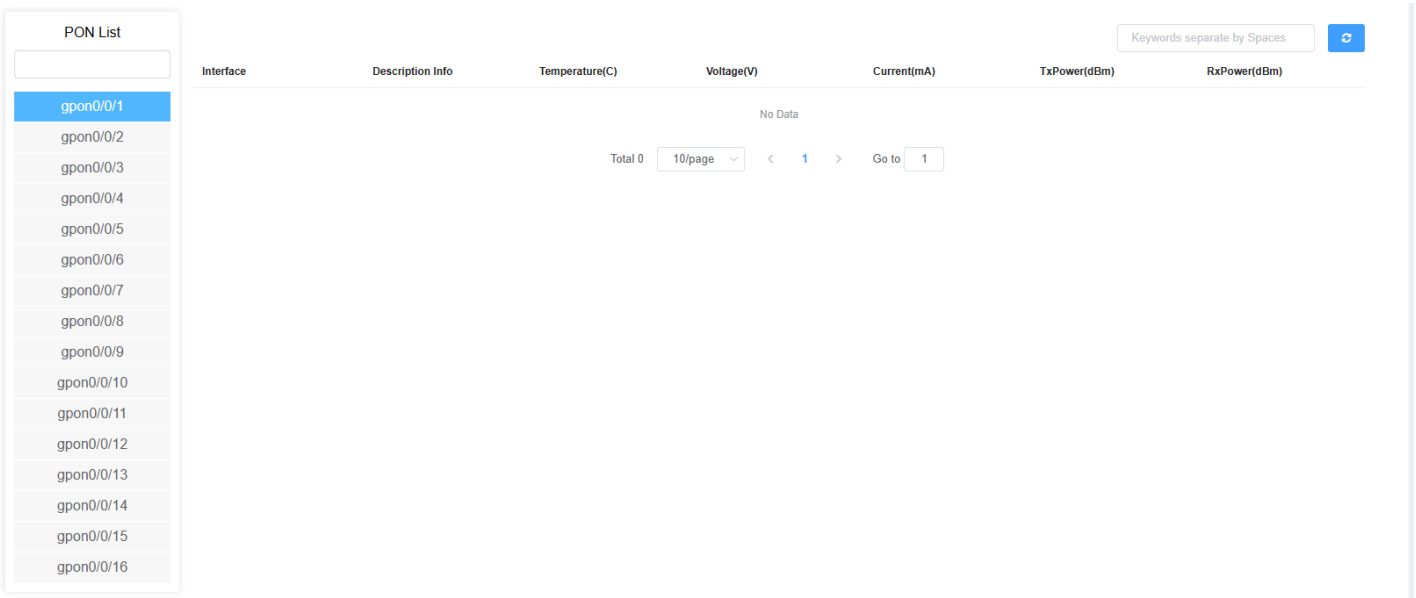
In the navigation bar, click Device Status and Rejected ONU Info to go to the ONU Information page for Rejected Registration.

Click "Bind" to bind the password of the port or the function of Loid.



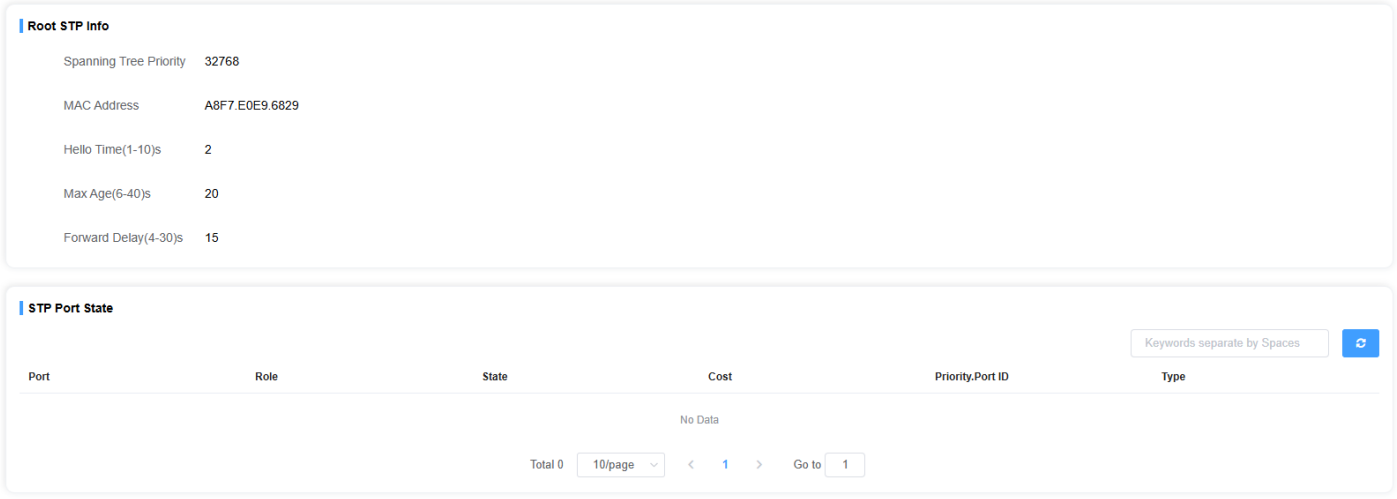
7.3.7 ONU Optic Info

In the navigation bar, click ONU Optic Info to check the ONU Optic information under different PON ports.



7.3.8 STP Status

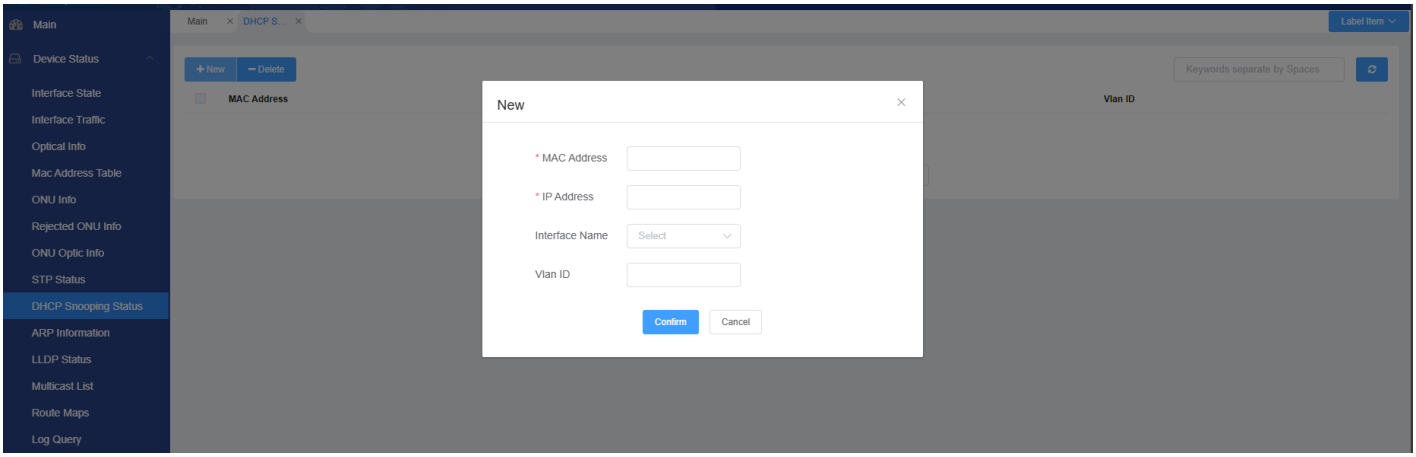
In the navigation bar, click STP Status to show the current STP status.



7.3.9 DHCP Snooping Status

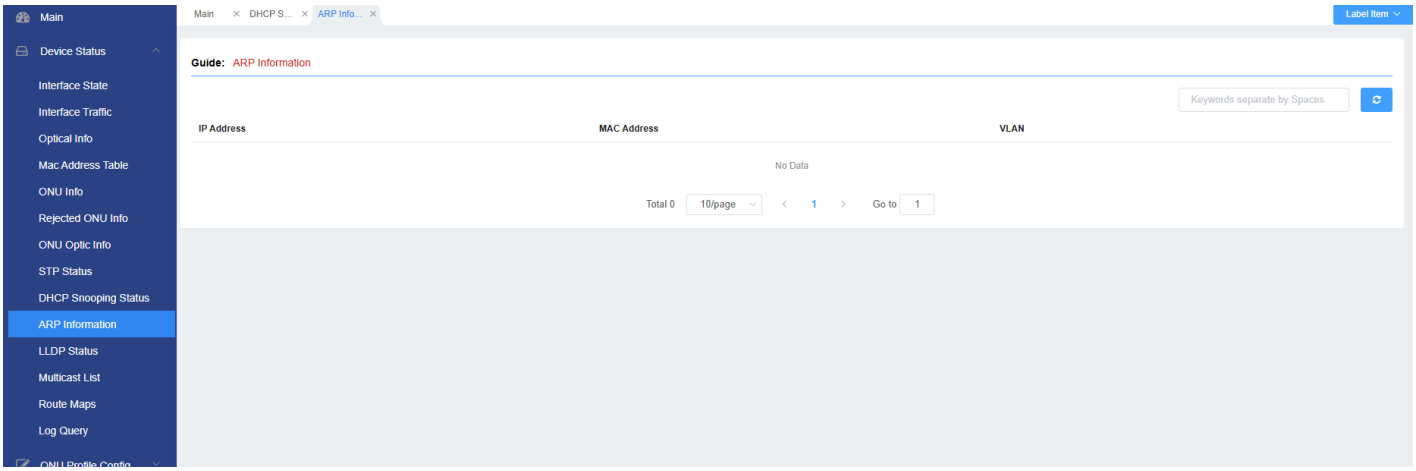
In the navigation bar, click DHCP Snooping Status to show the DHCP Snooping Status.

Click “New” or “Delect” can add or delete the items.



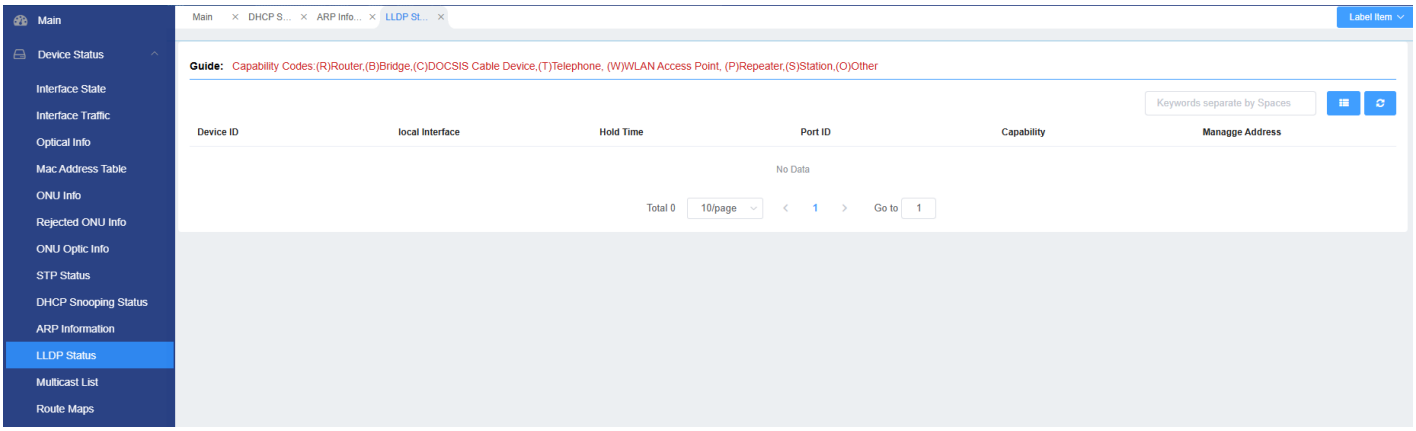
7.3.10 ARP Information

In the navigation bar, click ARP Information to show the ARP information.



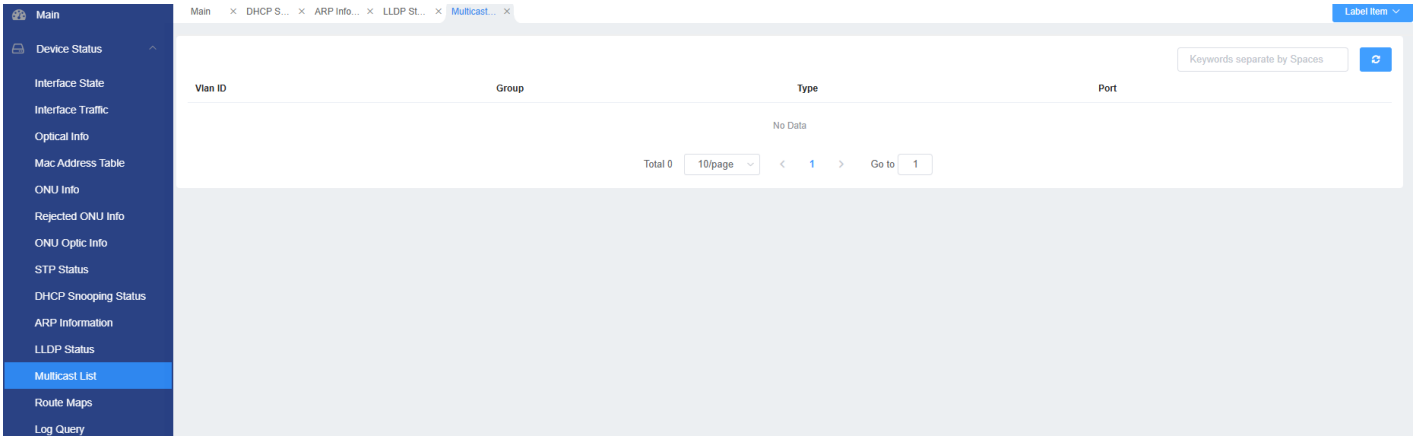
7.3.11 LLDP Status

In the navigation bar, click LLDP Status to show all the LLDP Information in this page.



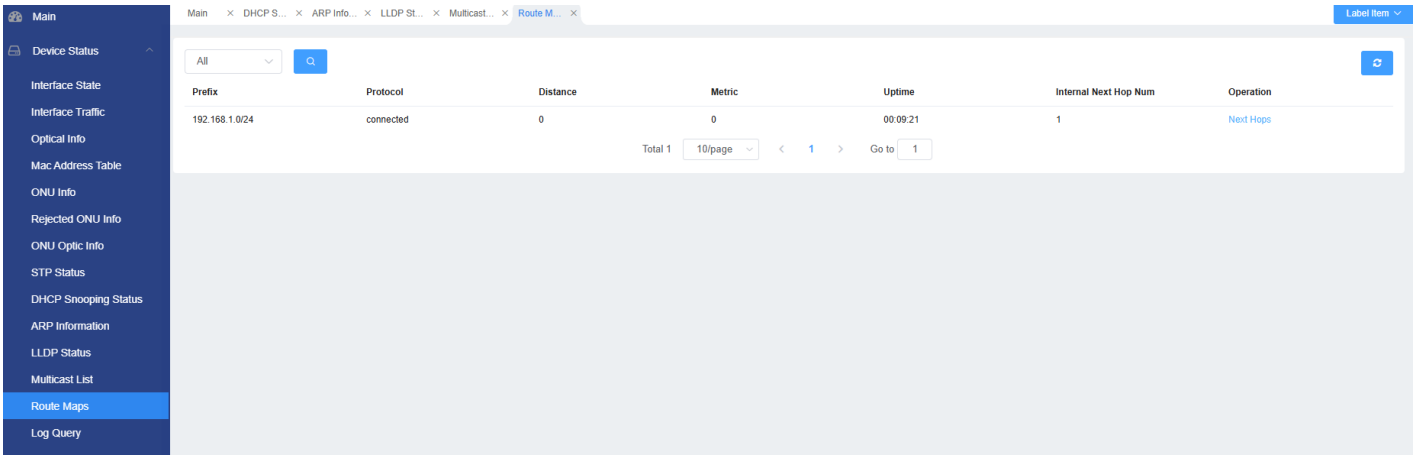
7.3.12 Multicast List

In the navigation bar, click Multicast List to check the layer 2 multicast group.



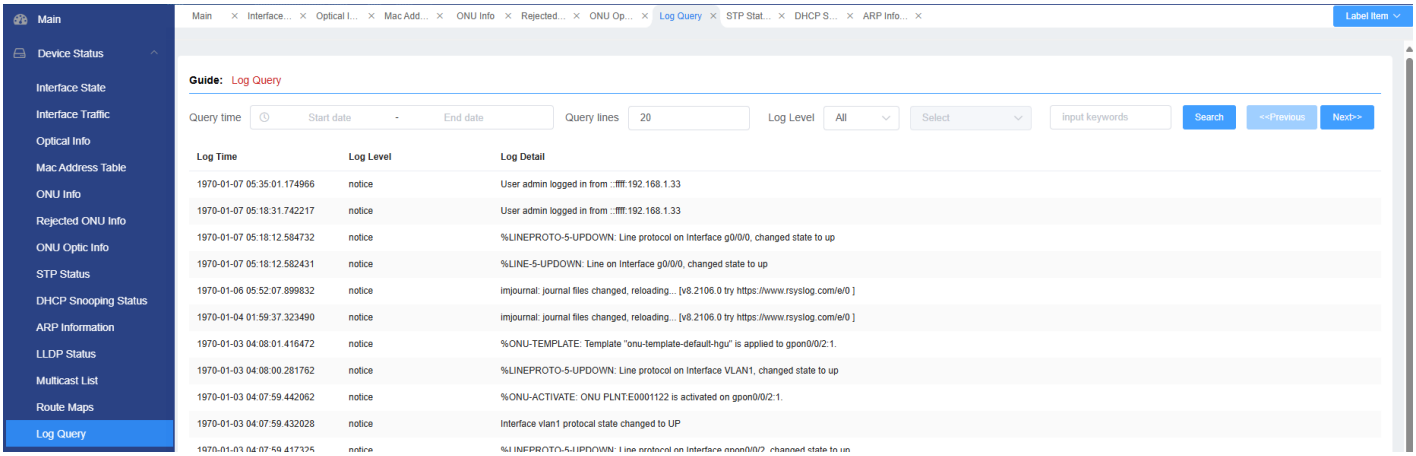
7.3.13 Route Maps

In the navigation bar, click Route Maps to see the routing information.



7.3.14 Log Query

In the navigation bar, click Device Status and then Log Query to enter the log query page.

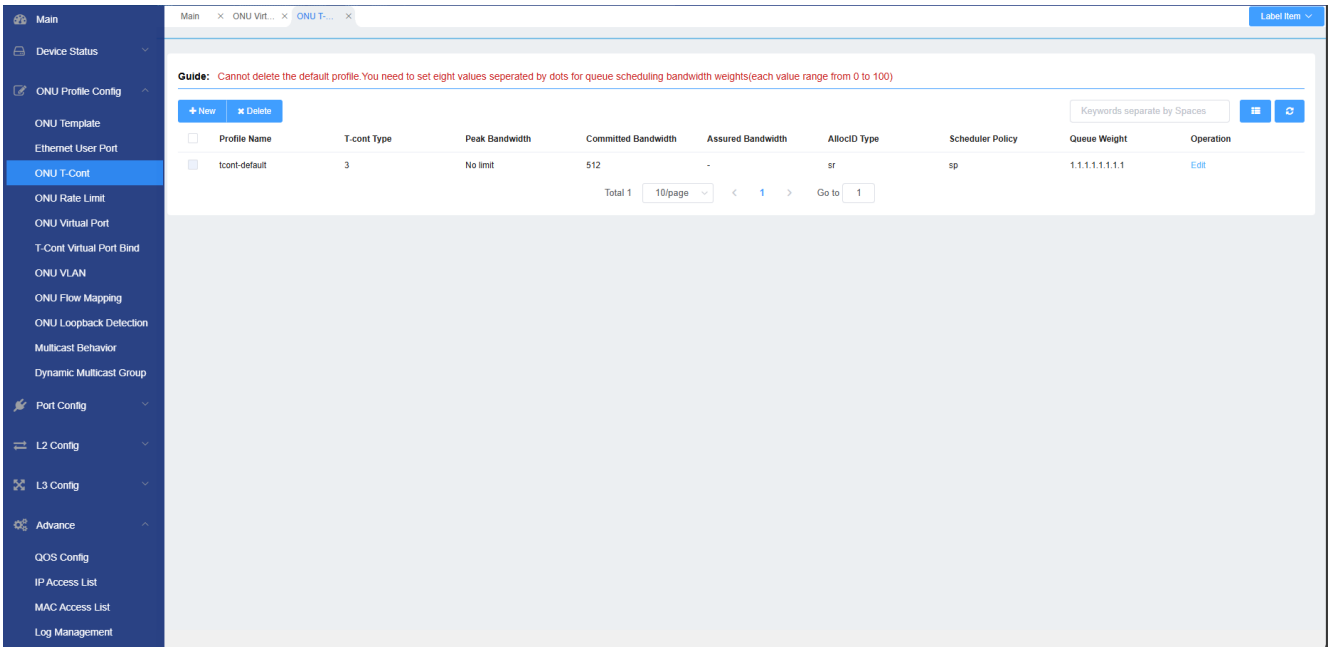


7.4 ONU Template Configuration

7.4.1 ONU T-Cont

In the navigation bar, click ONU Template Configuration and ONU T-Cont to enter the ONU T-Cont template configuration page.

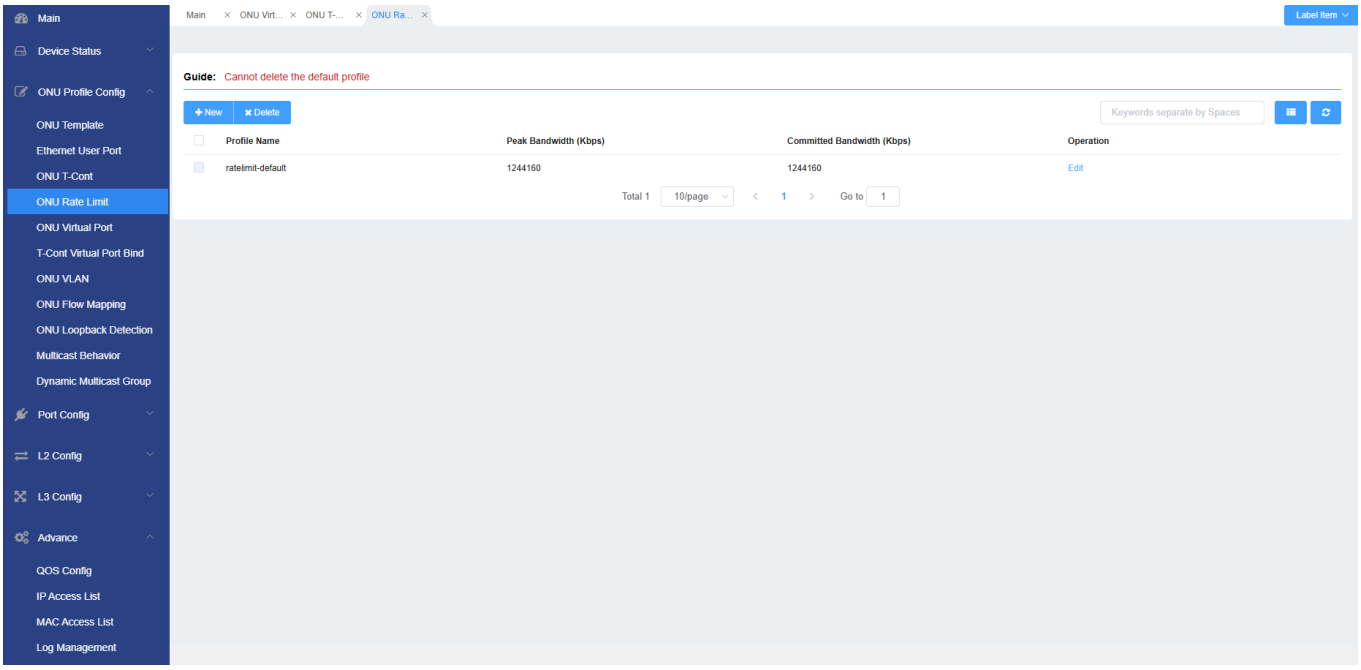
Click "Add", "Delete", and “Edit” to add, delete, and edit the T-Cont template data accordingly.



7.4.2 ONU Rate Limit

In the navigation bar, click ONU Profile Configuration, and then click ONU Rate Limiting to go to the ONU Rate Limit Profile Configuration page.

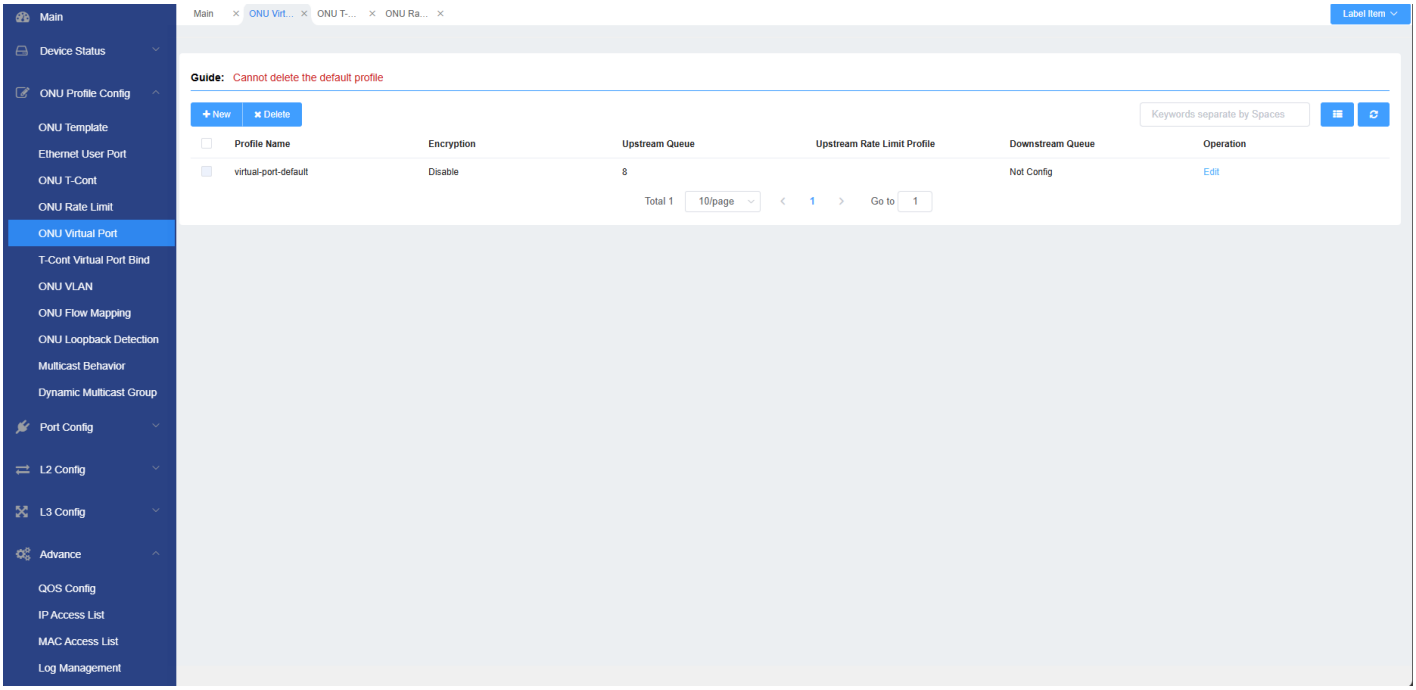
Click "Add", "Delete", and “Edit” to add, delete, and edit the ONU rate limit template data accordingly.



7.4.3 ONU Virtual Port

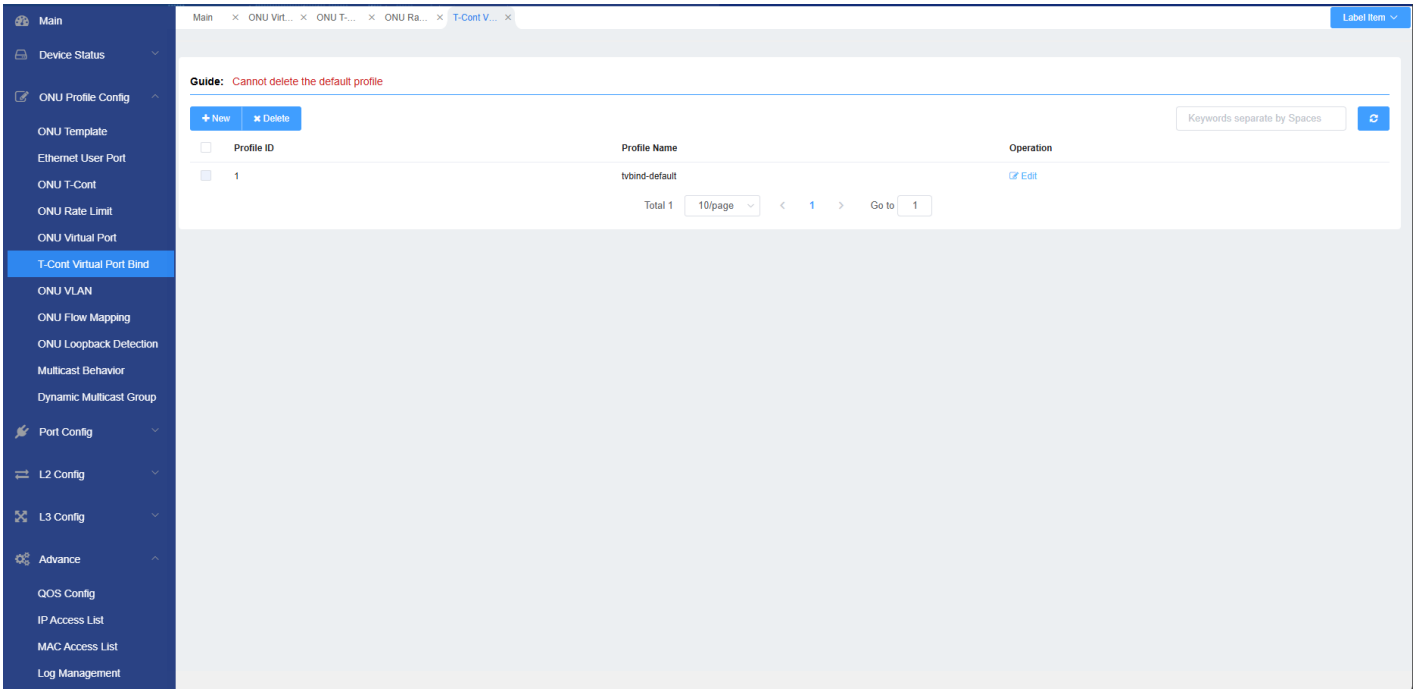
In the navigation bar, click ONU Template Configuration, and then click ONU Virtual Port to enter the ONU Virtual Port Template Configuration page.

Click "Add", "Delete", and “Edit” to add, delete, and edit the ONU virtual port template data accordingly.

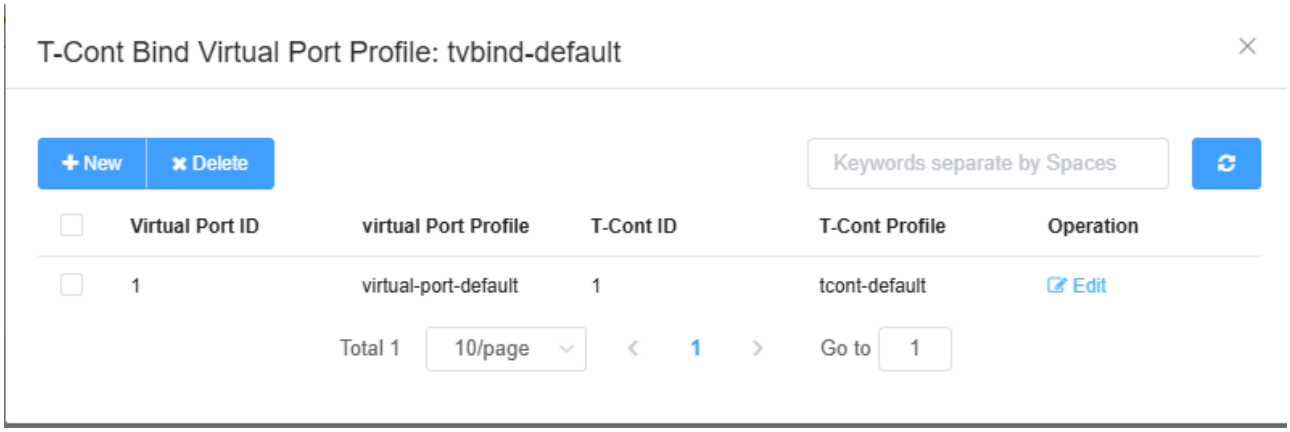


7.4.4 T-Cont and Virtual Port Binding

In the navigation bar, click ONU Template Configuration, and then click T-Cont and Virtual Port Binding. Click "Add" to add a template name. Click "Delete" to delete the corresponding template data.

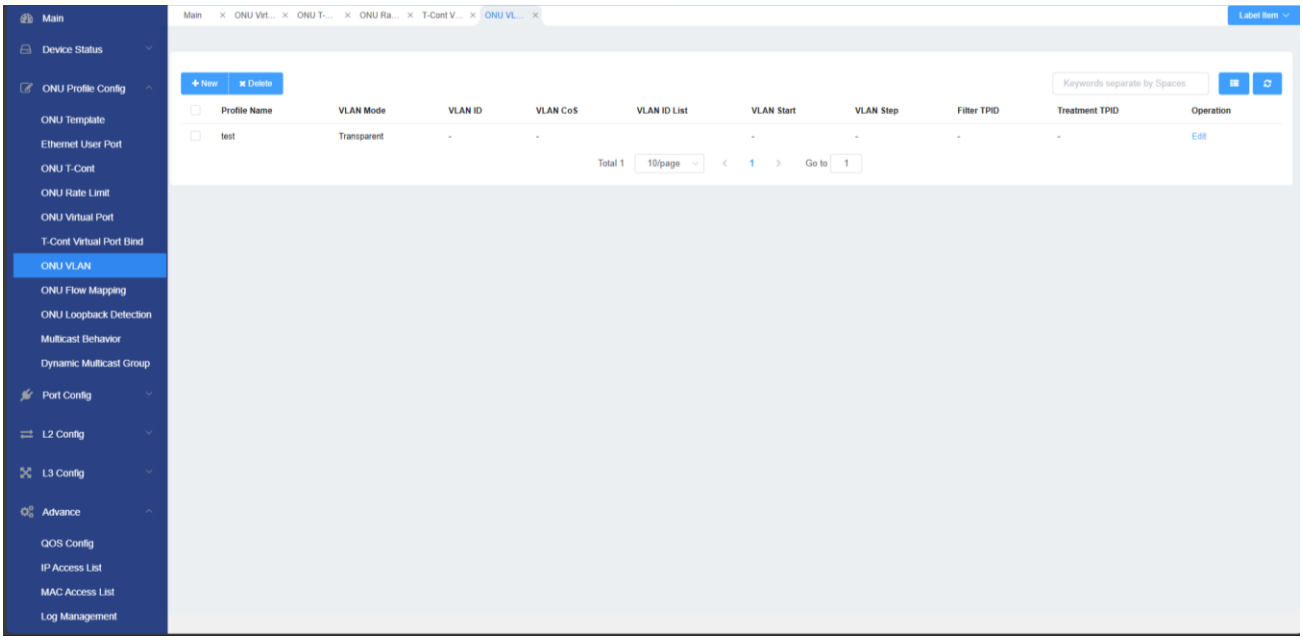


Click "Edit" to configure the binding between the template and the virtual port in the pop-up window.



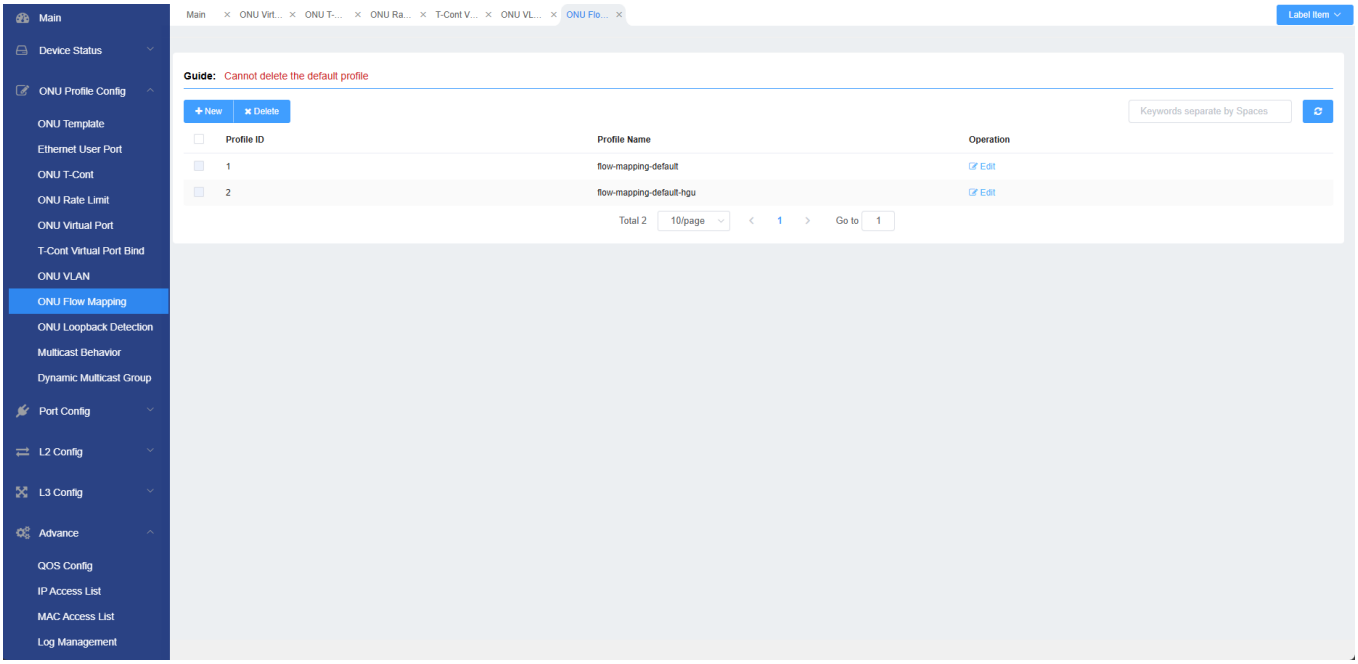
7.4.5 Configuring ONU VLAN

In the navigation bar, click ONU Profile Configuration, and then ONU VLAN Configuration. Click Add, Delete, and Modify to add, delete, and edit the ONU VLAN profile data.

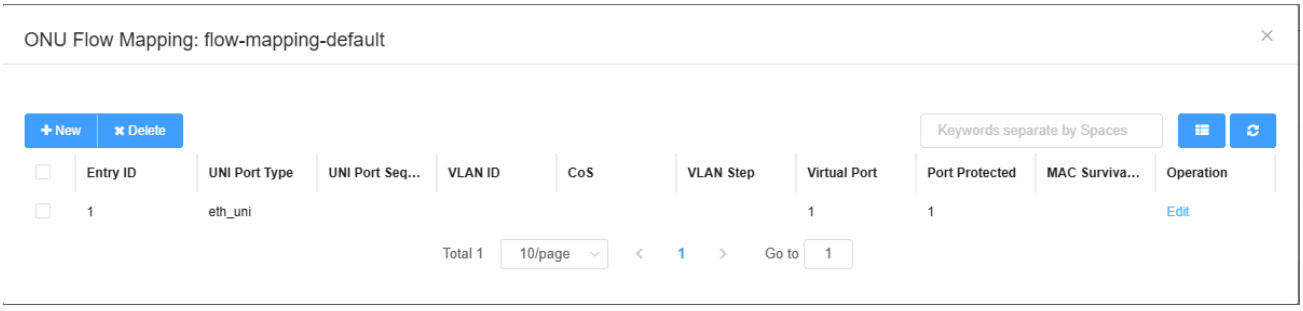


7.4.6 ONU Traffic Mapping

In the navigation bar, click ONU Profile Configuration, and then ONU Traffic Mapping. Click "Add" to add a template name. Click "Delete" to delete the corresponding template data.

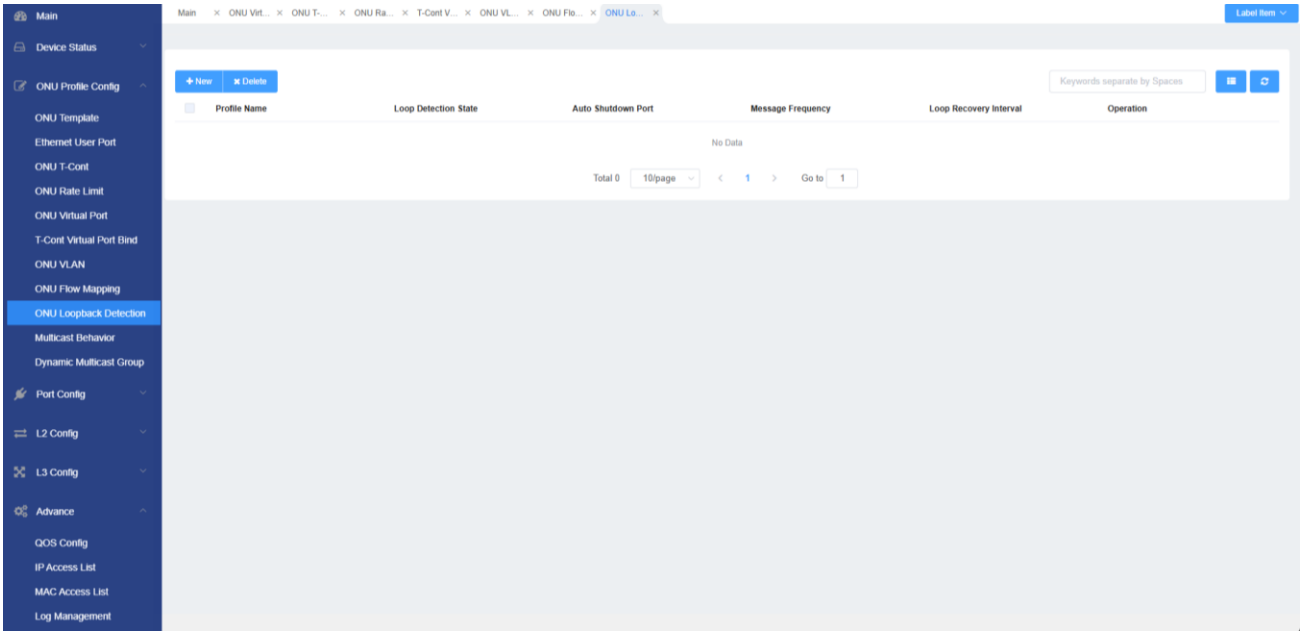


Click “Edit” to configure the mapping between the corresponding traffic templates in the pop-up window.



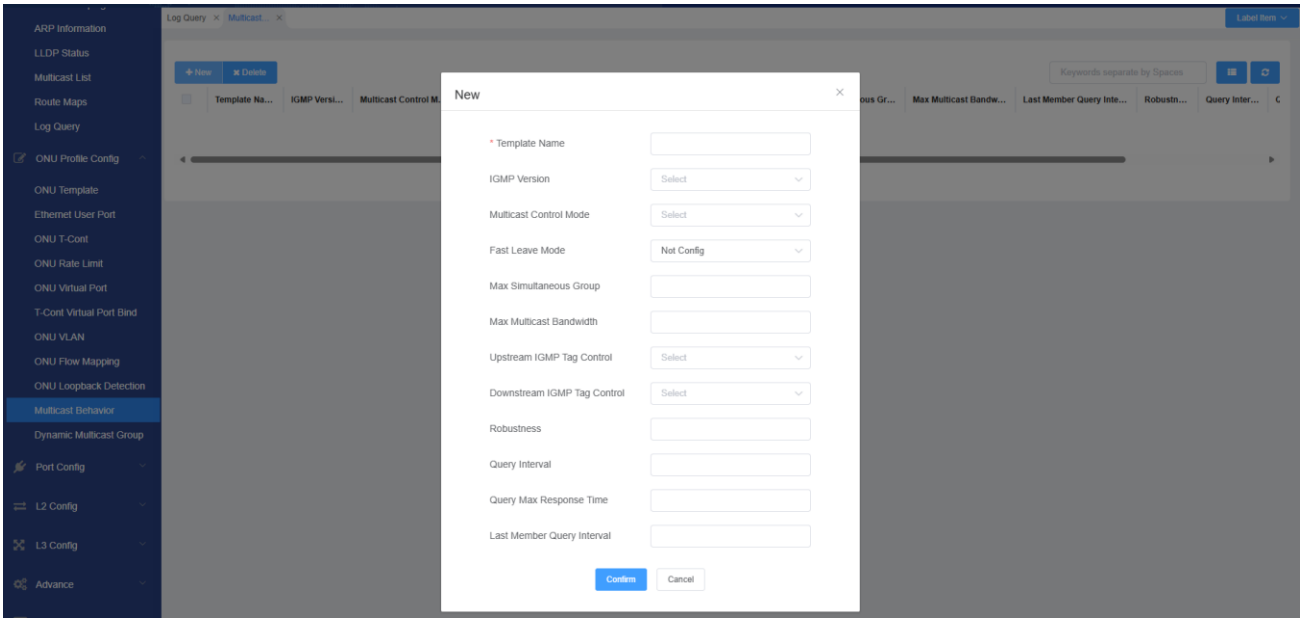
7.4.7 Port Loopback Detection

In the navigation bar, click ONU Template Configuration, and then click ONU Port Loopback Detection. Click "Add", "Delete", and “Edit” to add, delete, and edit the ONU port loopback detection template data accordingly.



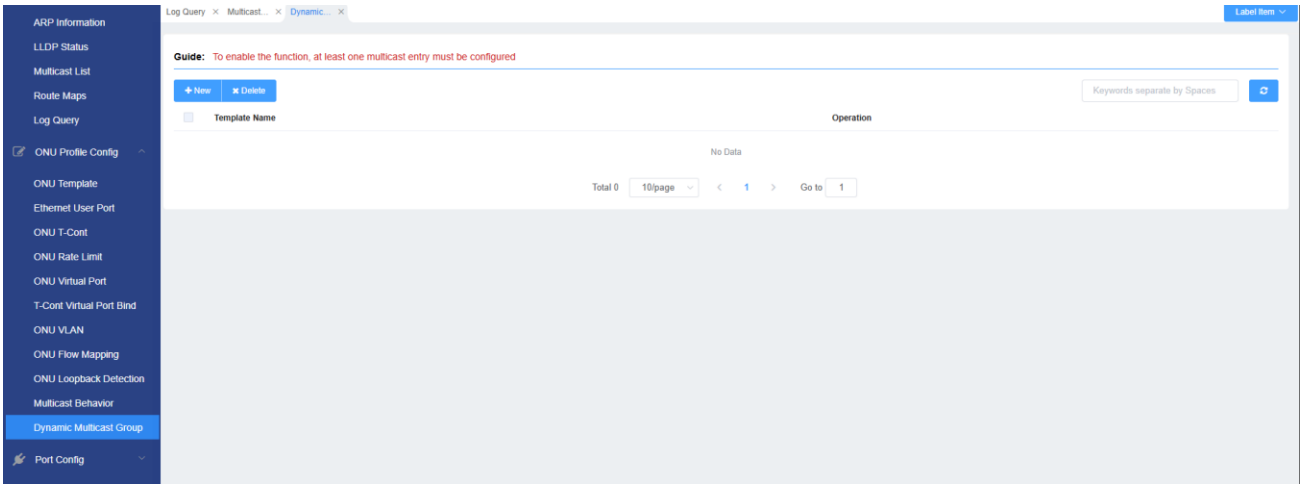
7.4.8 Multicast Behavior

In the navigation bar, click ONU Profile Config, and then Multicast Behavior. Click "Add" to add a Multicast Template. Click "Delete" to delete the corresponding template data.



7.4.9 Dynamic Multicast Group

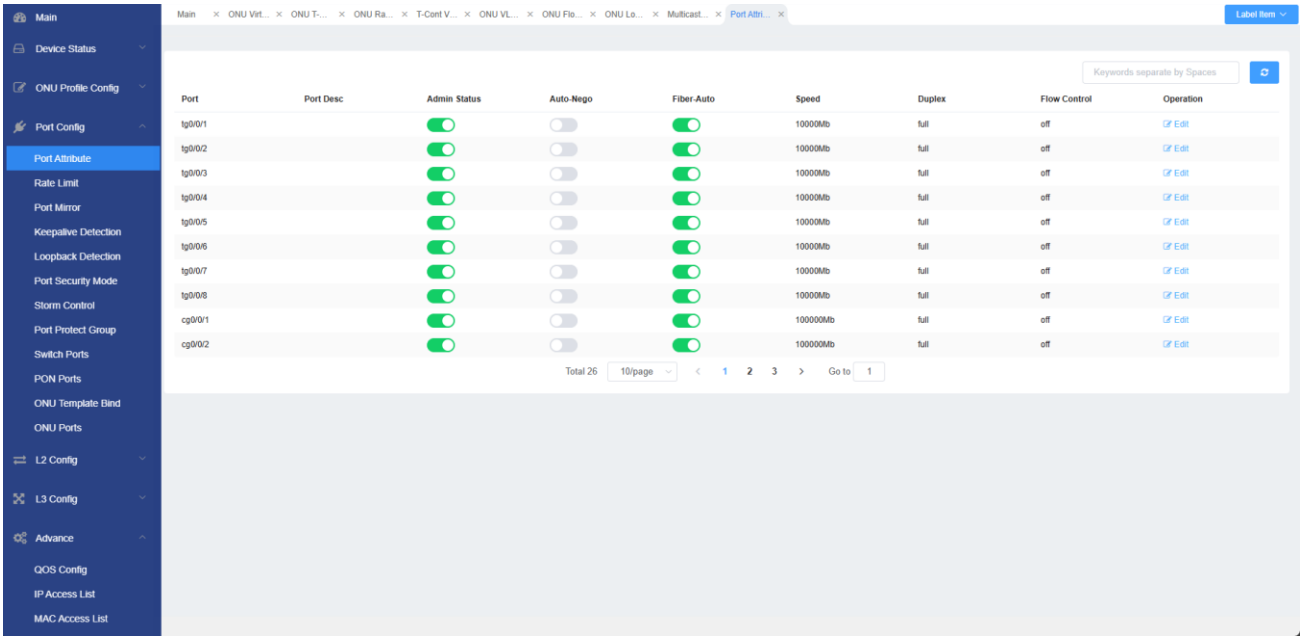
In the navigation bar, click ONU Profile Config, and then Multicast Dynamic Group, Click "Add" to add a Multicast Template. Click "Delete" to delete the corresponding template data.



7.5 Physical Port Configuration

7.5.1 Port Attribute Configuration

In the navigation bar, click Physical Port Configuration and Port Attribute Configuration to open the configuration page, as shown in the following figure.



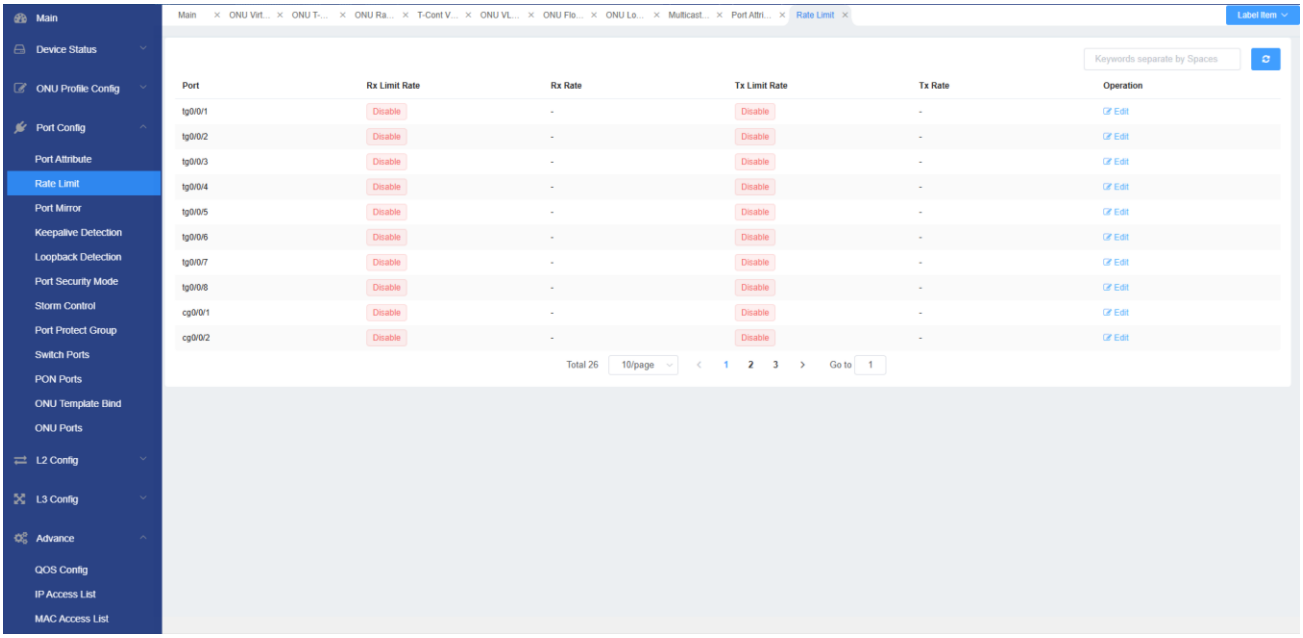
On the main page, you can directly modify the enabling status of the port and the auto-negotiation switch. If you need to modify the rate, duplex mode, and flow control status, you can click the “Edit” option of the corresponding port to modify it. The modifications for the rate and duplex mode of a port can only be done when the “adaptive state” is disabled.

Note:

Modifying the port rate or duplex mode may cause the port link state to be switched and affect network communication.

7.5.2 Port Rate Limit

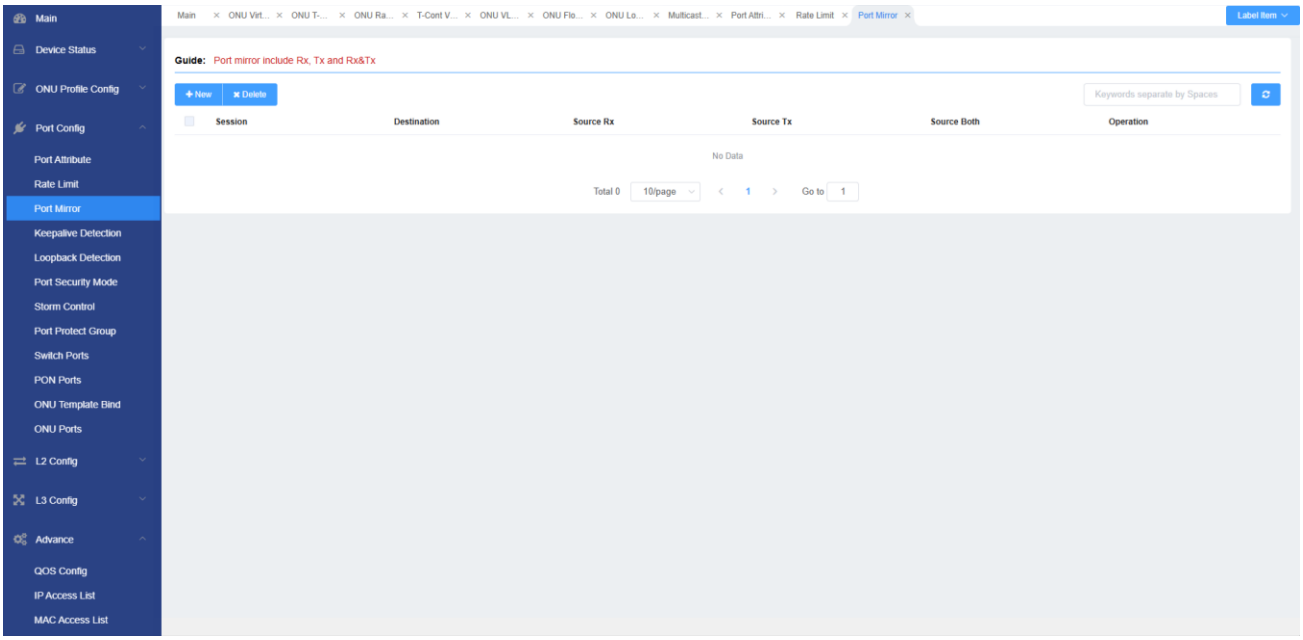
In the navigation bar, click Physical Port Configuration and Port Rate Limit to open the configuration page as shown in the following figure.



This page can be used to set the receive and send rate limits for ports. By default, all ports are not rate-limited. The receive and transmit rates can be configured as a percentage or in a specified unit of the switch.

7.5.3 Port Mirroring

In the navigation bar, click Physical Port Configuration and then Port Mirroring to go to the image configuration page.

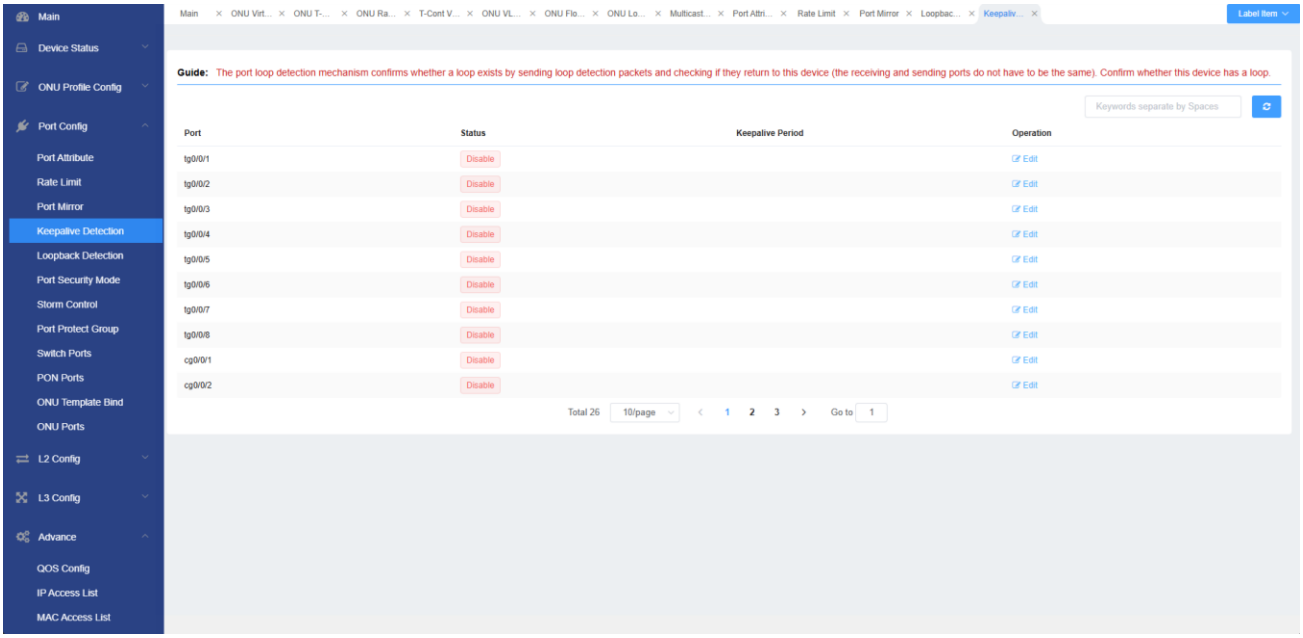


Click Add to add a port image, in which Session is required.

Click Modify to modify the corresponding port image.

7.5.4 Keepalive Detection

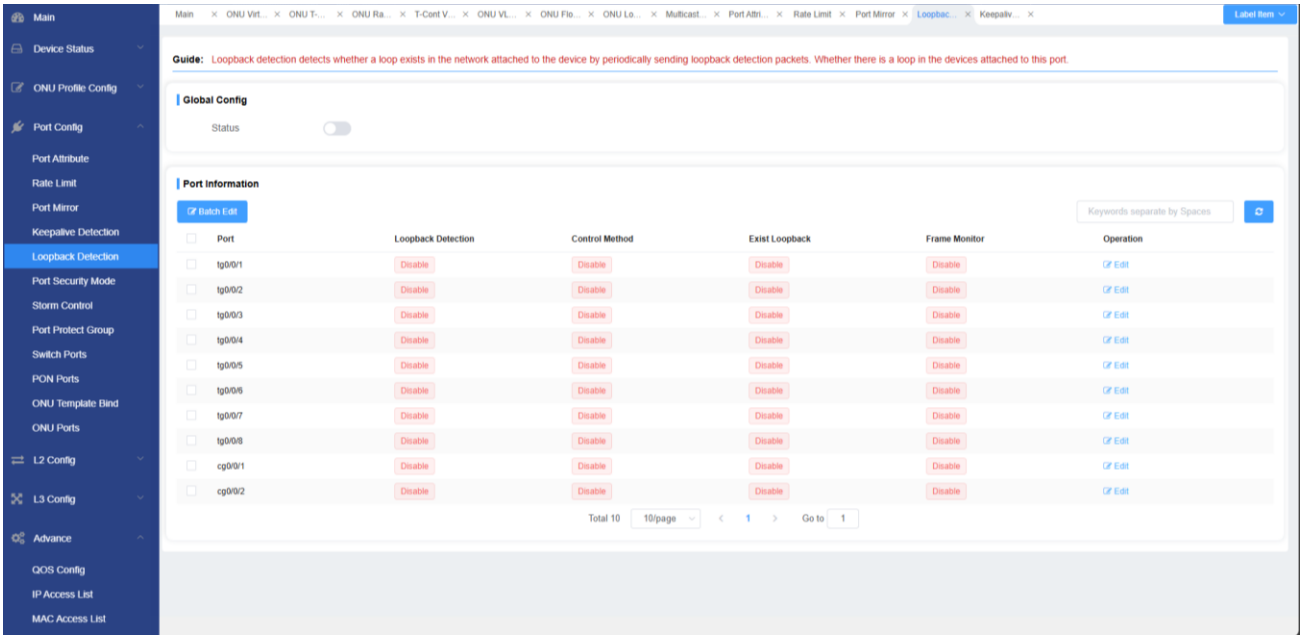
In the navigation bar, click Physical Port Configuration and then Port Loop Detection.



On the Port Loopback Detection page, you can configure the keepalive period used for detecting port loops.

7.5.5 Looback Detection Configuration

In the navigation bar, click Physical Port Configuration, and then click Loop Detection Configuration to enter the Loop Detection Configuration page.

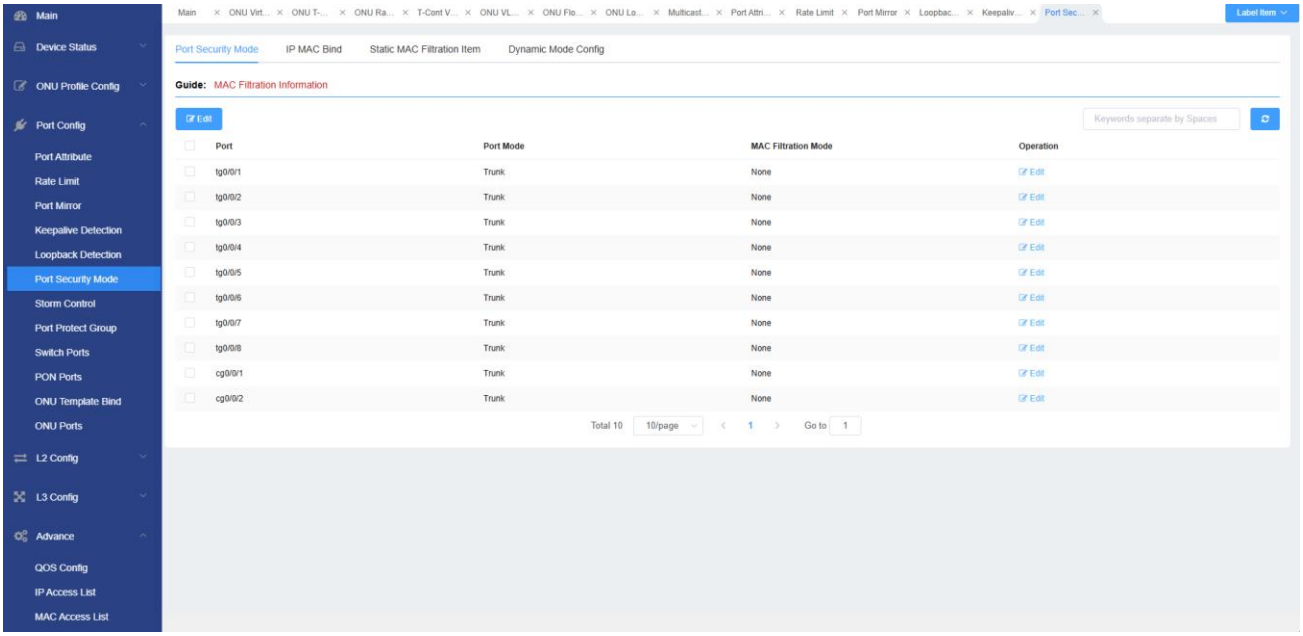


On the Loopback Detection Configuration page, you can configure whether loopback monitoring is enabled. You can also click “Edit” to modify whether the corresponding port enables loopback monitoring, control mode, presence loopback, and frame monitoring.

7.5.6 Port Security Mode

7.5.6.1 Port Security Mode

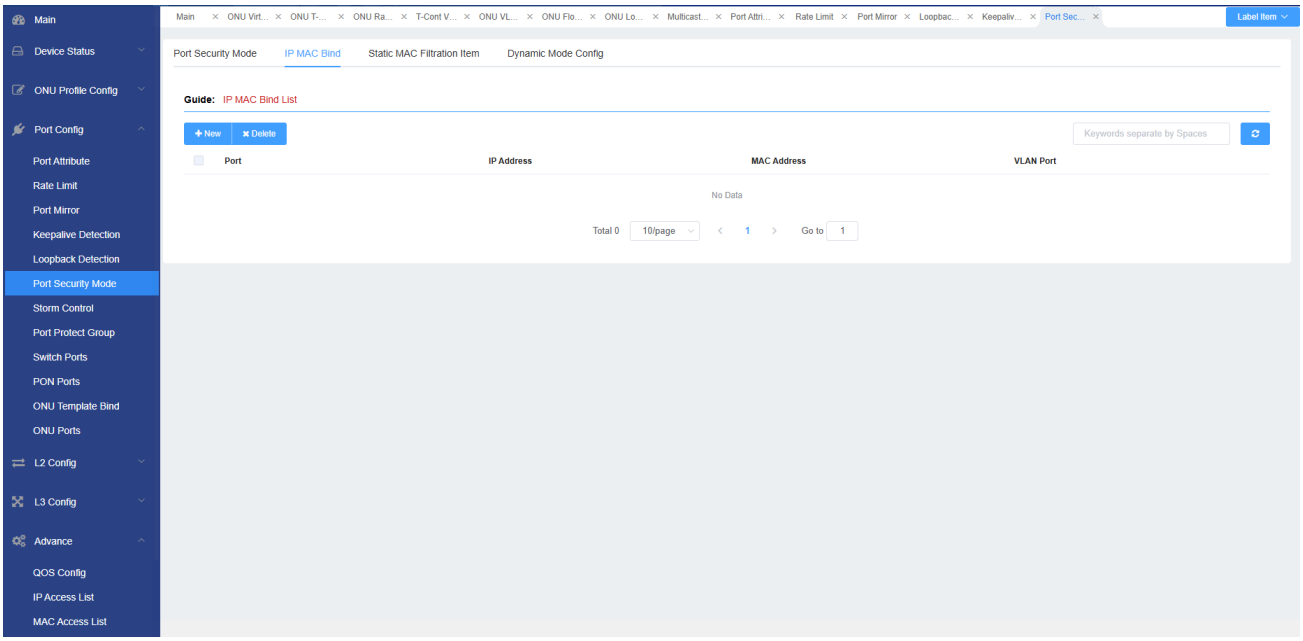
In the navigation bar, click Physical Port Configuration, then Port Security Mode, and then click Port Security Mode on the top of the page to enter the port security mode configuration interface.



Click “Edit” to switch the MAC filtering mode.

7.5.6.2 IP MAC Binding

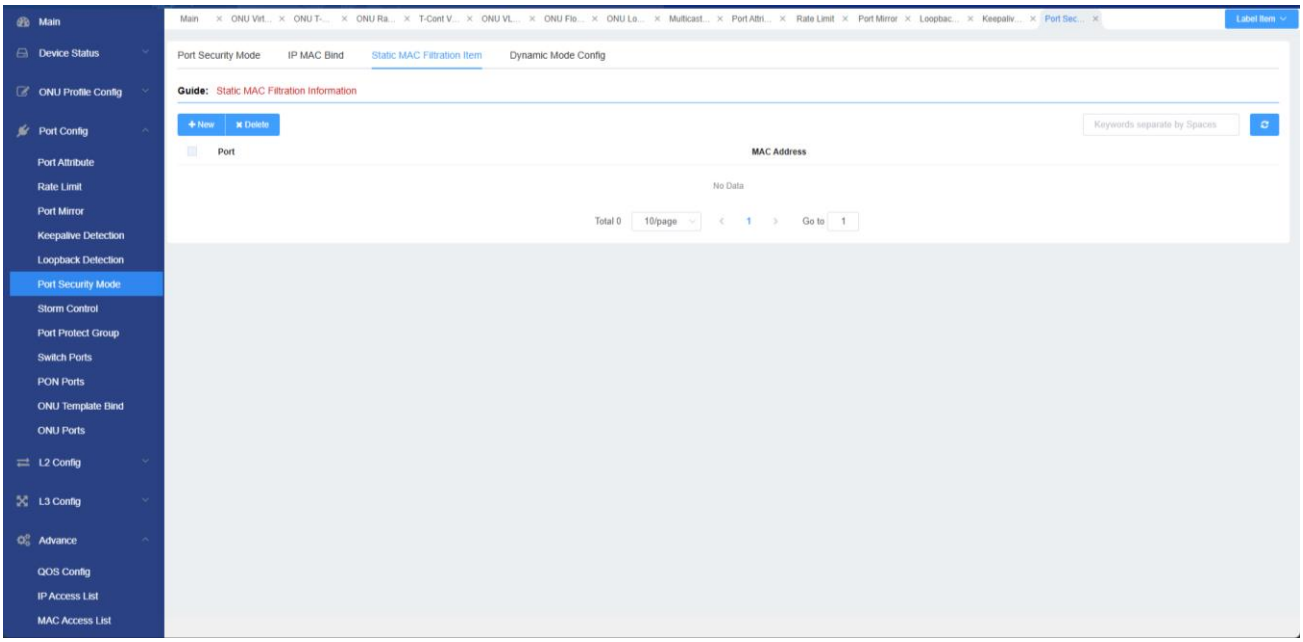
In the navigation bar, click "Physical Port Configuration", "Port Security Mode", and click "IP MAC Binding" at the top of the page to enter the IP MAC Bind interface.



Click "Add" to add the binding of the IP address, MAC address, and VLAN interface. Click “Edit” to modify the existing IP MAC binding information.

7.5.6.3 **Static MAC Filtering Entry**

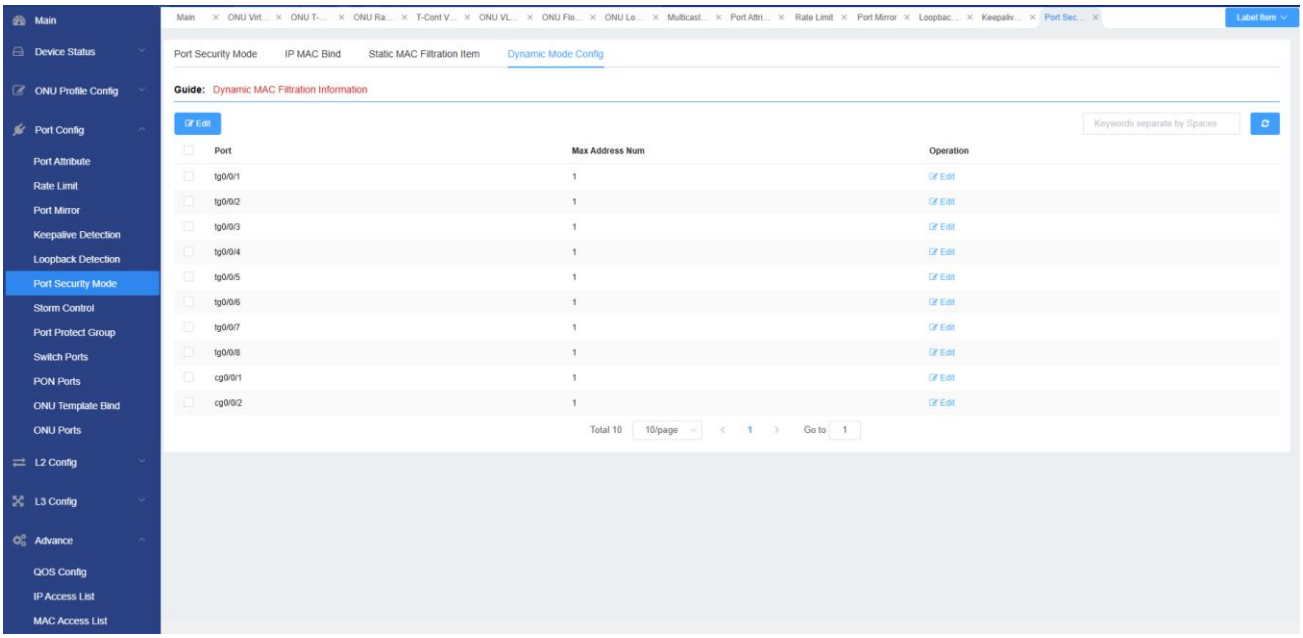
In the navigation bar, click "Physical Port Configuration", "Port Security Mode", and "Static MAC Filtering Entry" to the Static MAC Filtering Entry Configuration page.



Click "Add" to bind the source MAC address of each physical port, and limit the MAC address that allows or denies access to the port according to the set static MAC filter mode.

7.5.6.4 **Dynamic Mode Configuration**

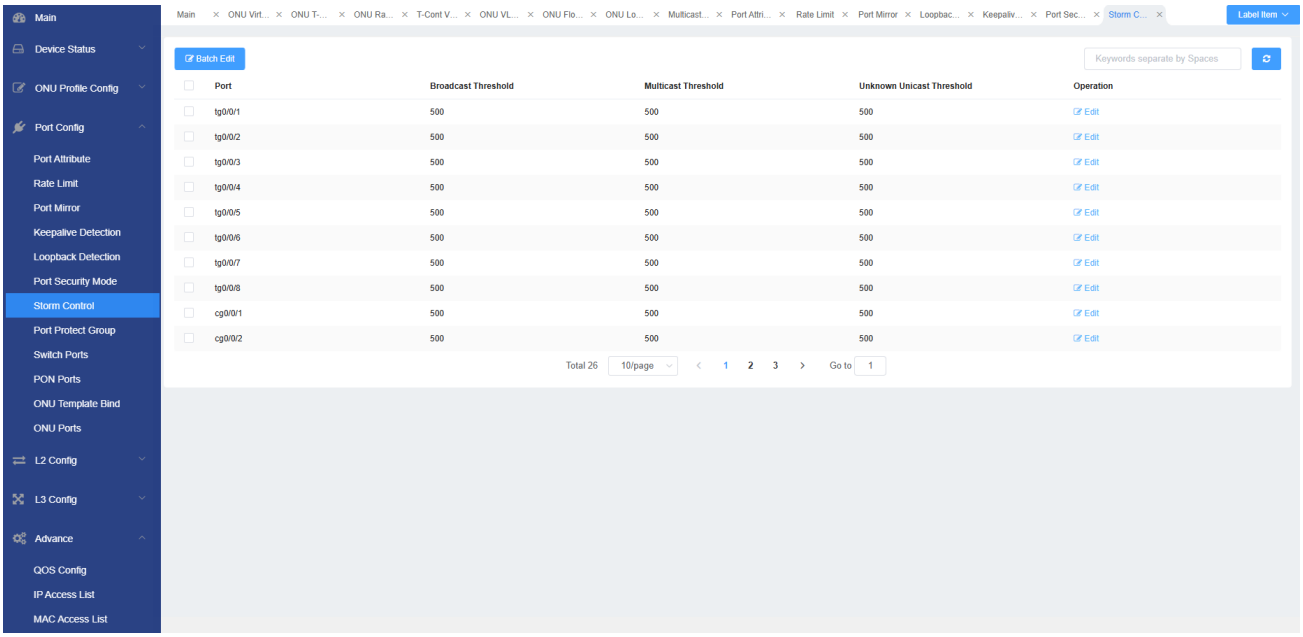
In the navigation bar, click Physical Port Configuration, Port Security Mode, and Dynamic Mode Configuration to enter the Dynamic Mode configuration page.



From this page, you can configure the maximum number of addresses that can be allowed. By default, the maximum number of addresses is 1.

7.5.7 Storm Control

In the navigation bar, click Physical Port Configuration, and then Storm Control to enter the broadcast storm control.

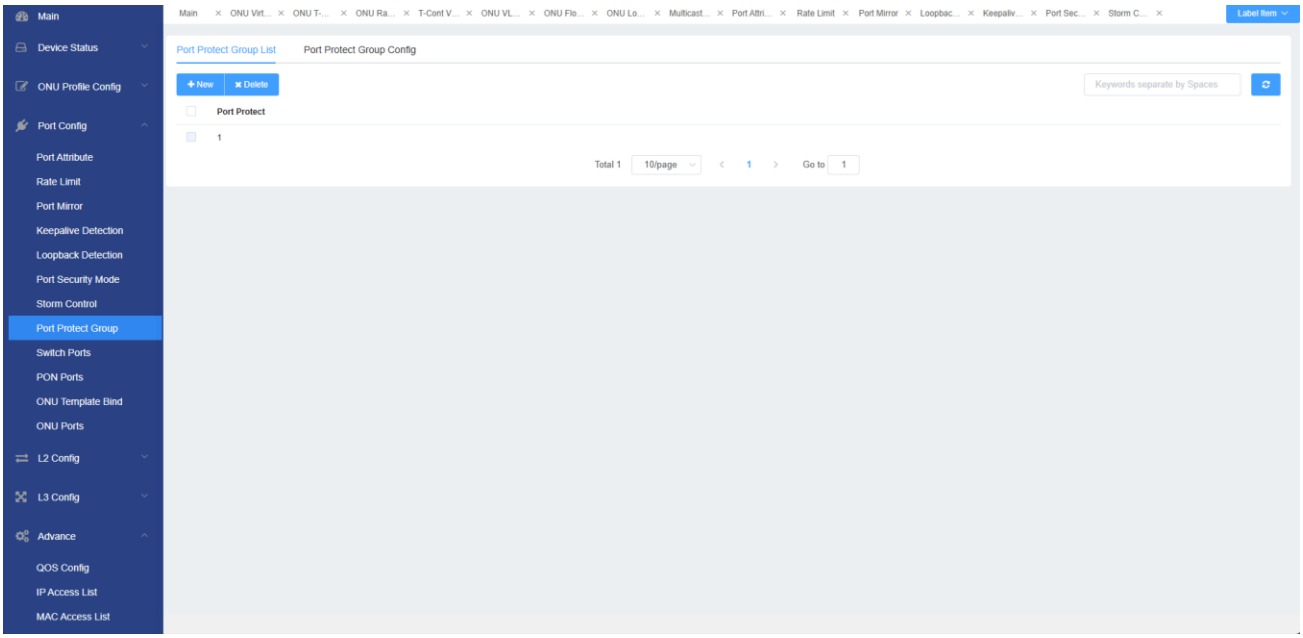


You can modify the broadcast status, multicast status, and unknown unicast status of the corresponding port by click Modify.

7.5.8 Port Protection Group Configuration

7.5.8.1 Port Protection Group List

In the navigation bar, click Physical Port Configuration, and then Port Protection Group Configuration to go to the Port Protection Group list page.

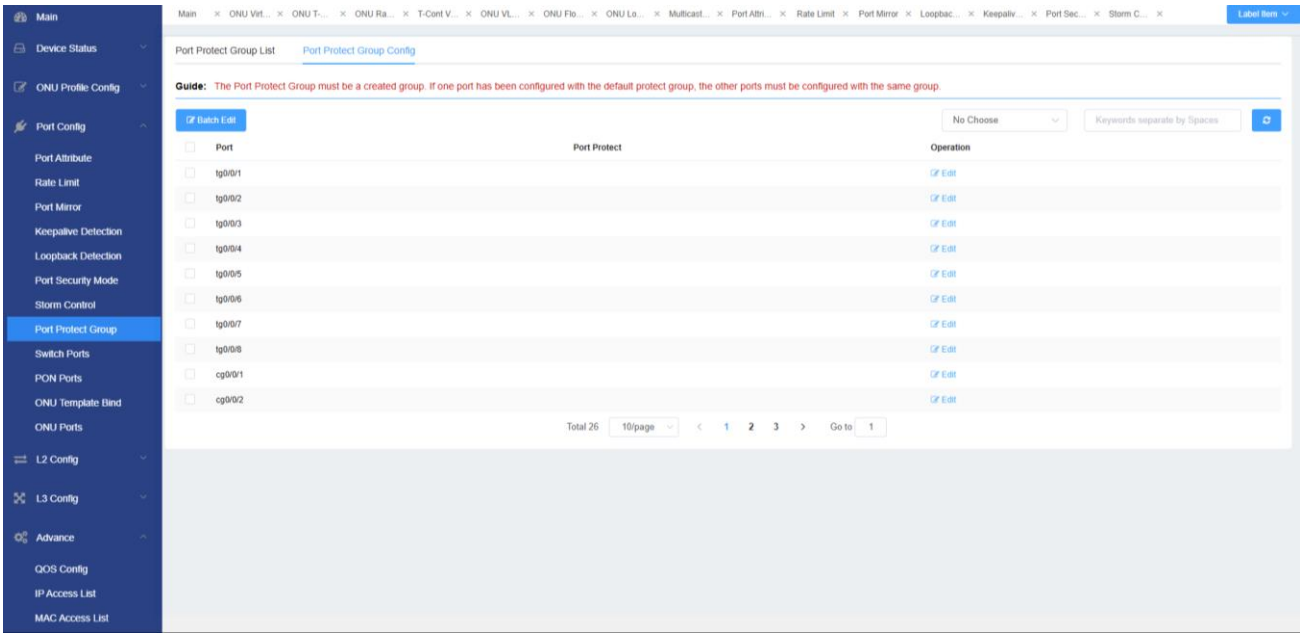


Click Add to create a port protection group.

You can delete a port protection group by selecting it.

7.5.8.2 **Configuring Protection Group Port**

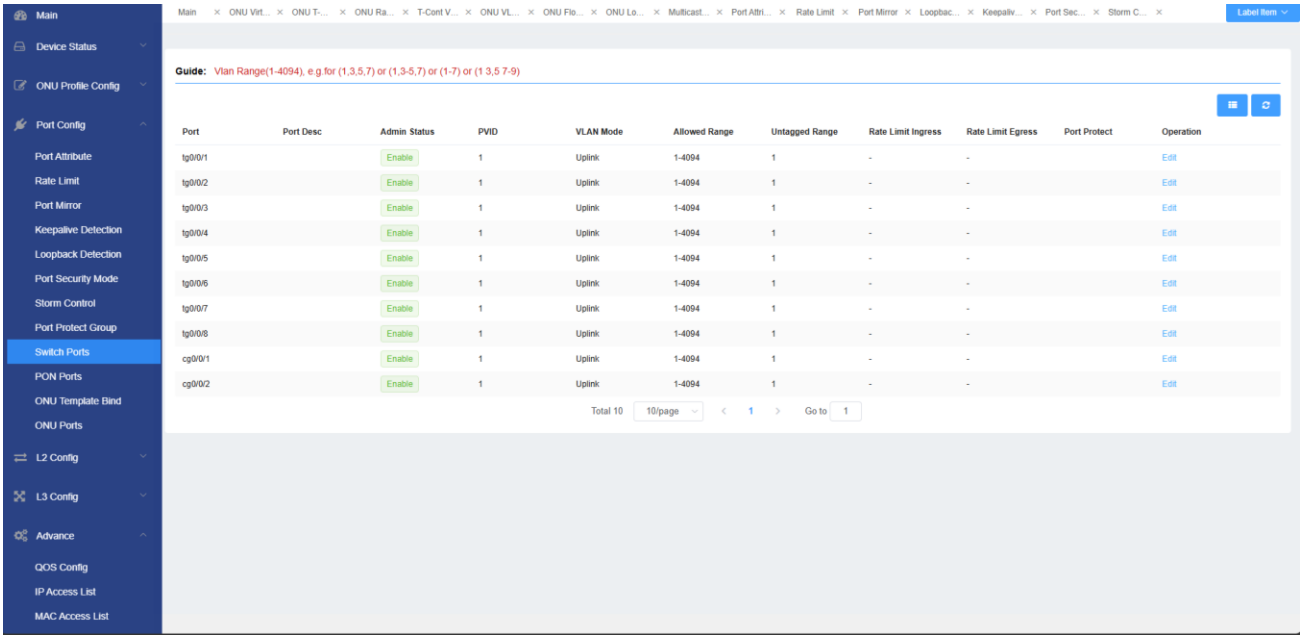
In the navigation bar, click Physical Port Configuration, Port Protection Group Configuration, and Port Protection Group Port Configuration.



The port protection group must be a created group, and if one port has a default protection group configured, only the remaining ports can be configured with the default protection group. Click Modify to modify the protection group of the port.

7.5.9 Switch Port List

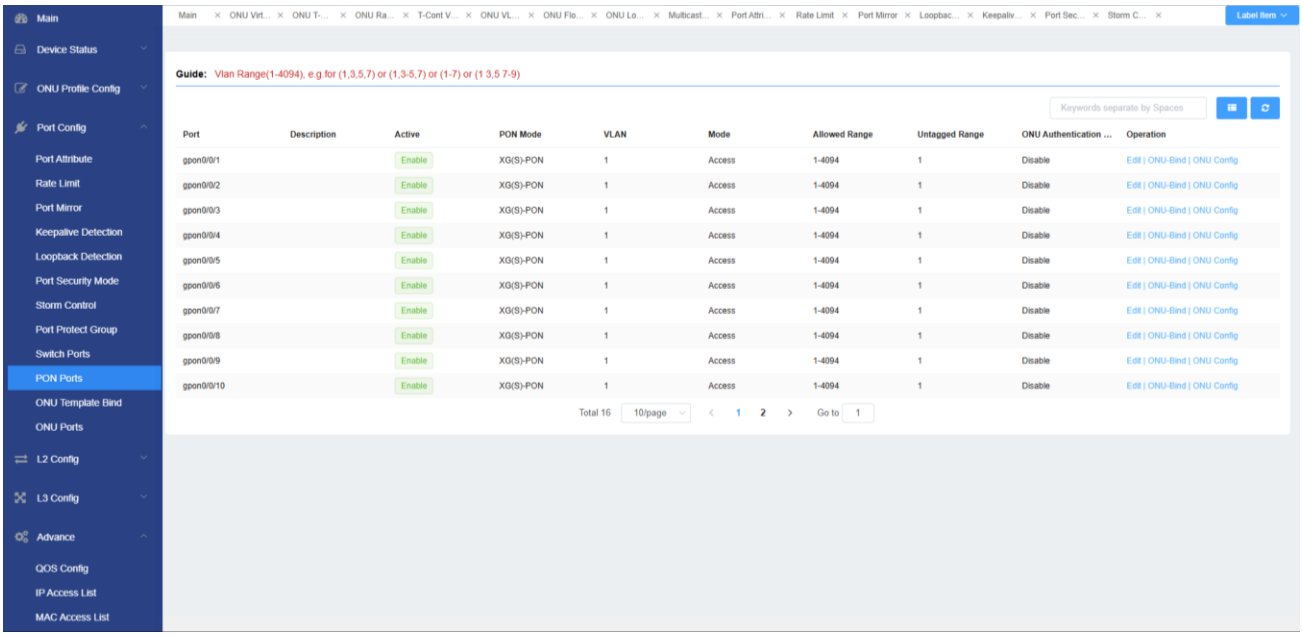
In the navigation bar, click Physical Port Configuration, and then click Switch Port List to go to the Switch Port List page.



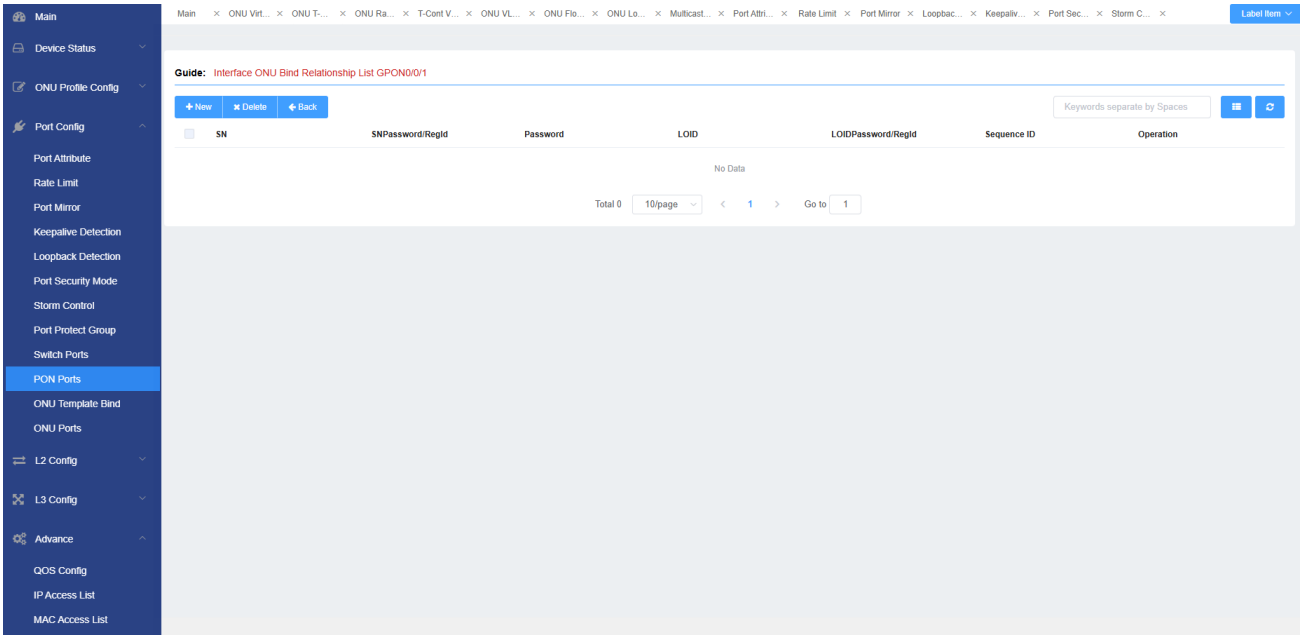
Click Modify to modify the port configuration items.

7.5.10 PON Ports

In the navigation bar, click Physical Port Configuration, and then PON ports to enter the PON list display page.



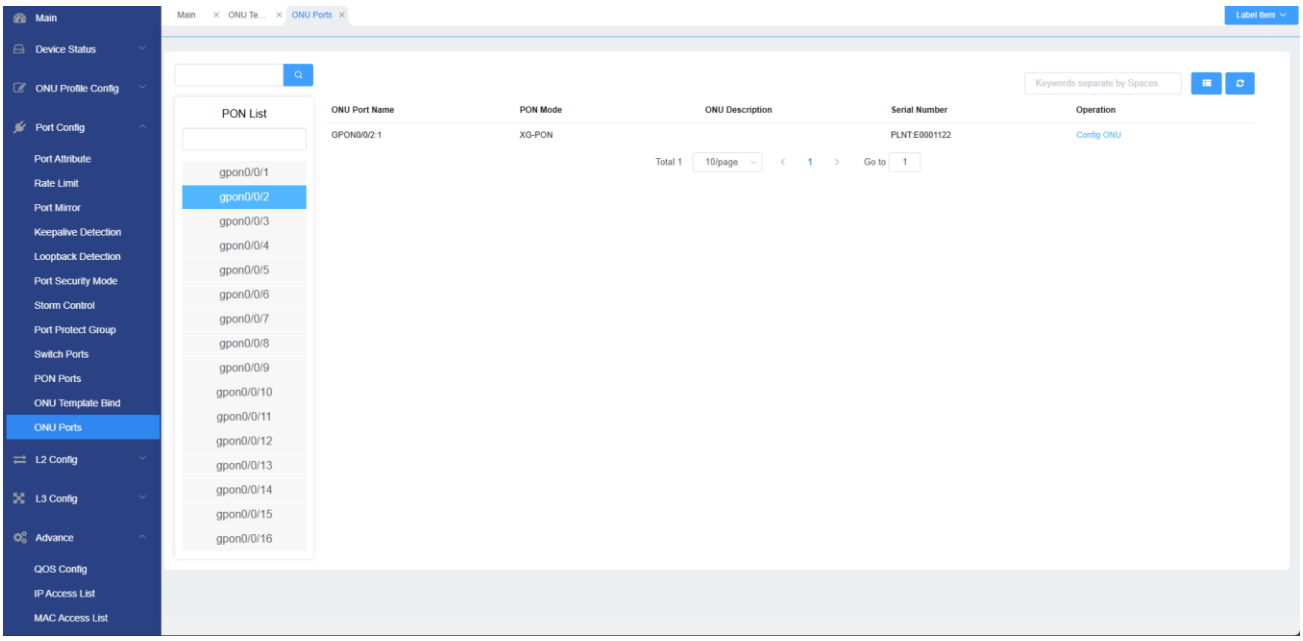
Click "Edit" to modify the configuration items of the corresponding PON port. Click "ONU-Bind" to enter the corresponding binding interface.



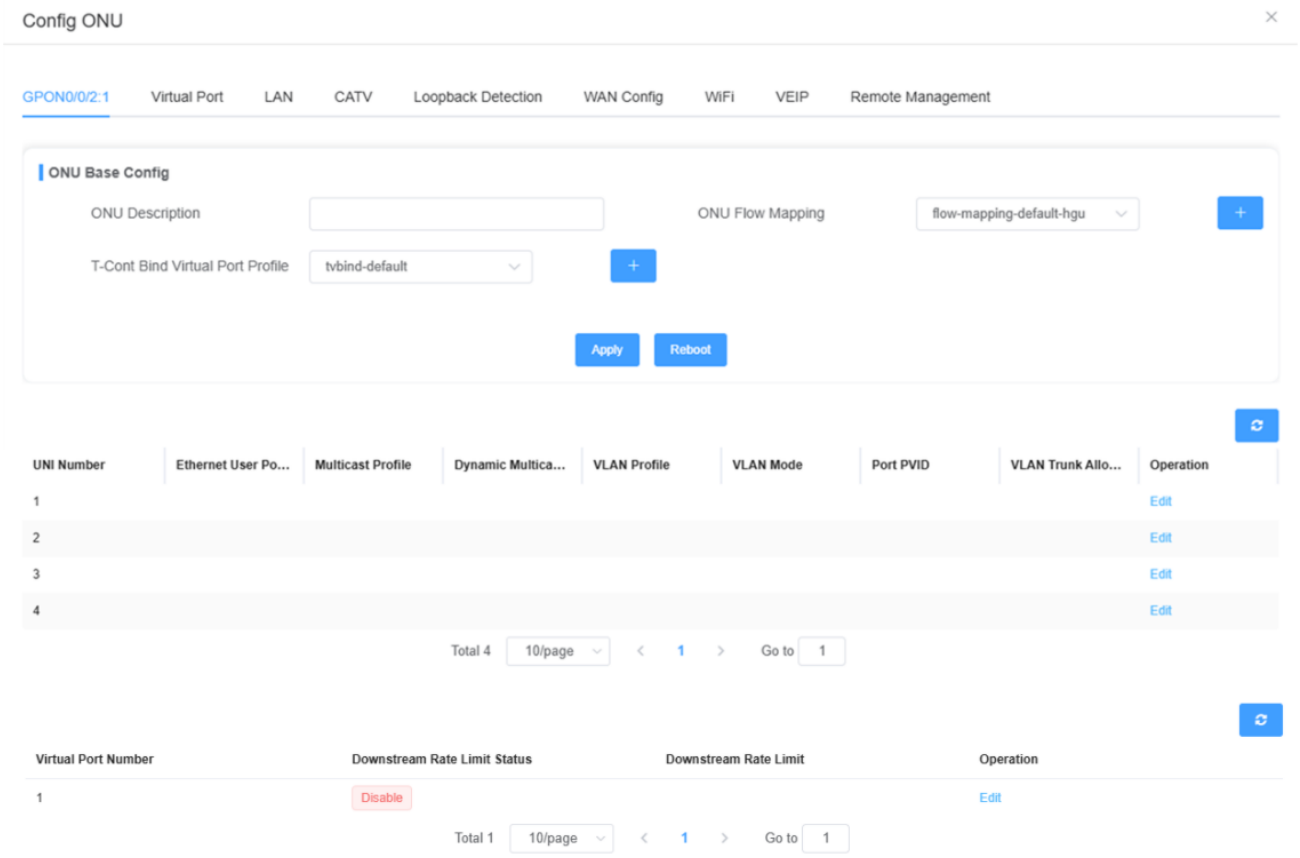
Click Add, Delete, or Modify to perform the corresponding operations on the data bound to the ONU. Click "Back" to return to the PON list configuration page.

7.5.11 ONU Port Configuration

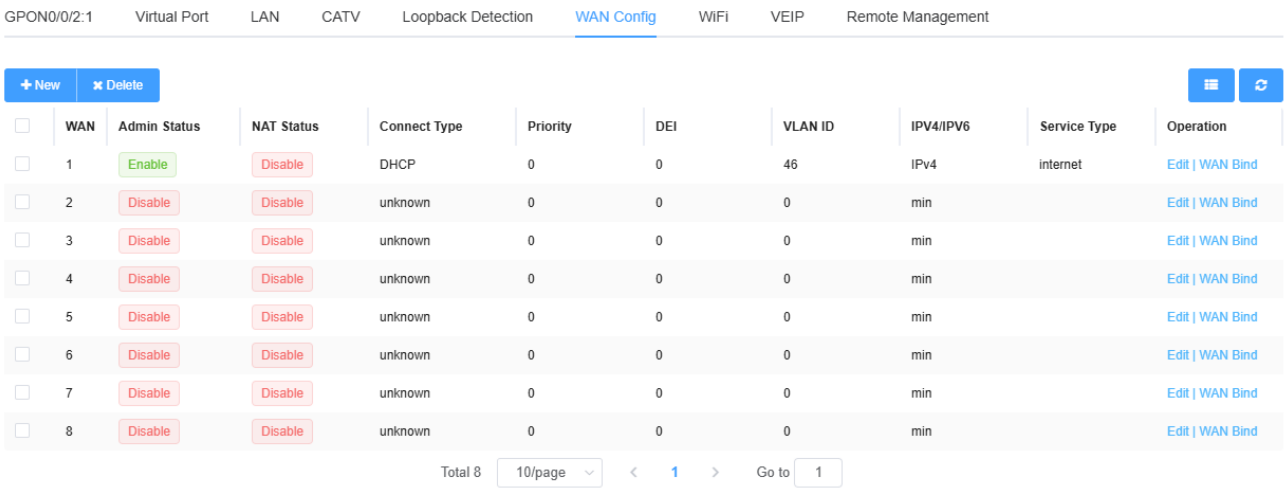
In the navigation bar, click Physical Port Configuration, and then ONU Port Configuration to go to the ONU Port Configuration page.



Click "Configure ONU" to enter the ONU configuration interface, which contains a total of 4 modules that can be configured: basic configuration, CATV configuration, Loopback Detection configuration, and WiFi configuration (configuration items for interface configurations that are not compatible with WiFi functions are not displayed by default).



Click "WAN Configuration" to enter the corresponding WAN configuration.



Note

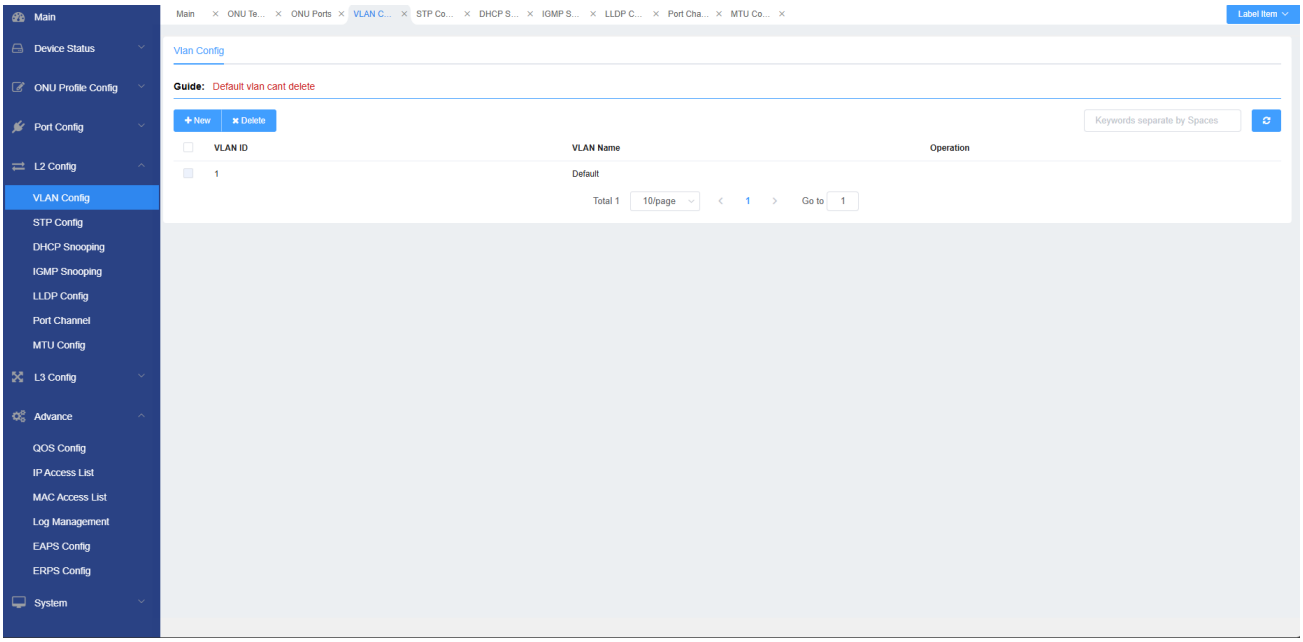
Since the WAN port configuration requires a large number of underlying functions to be configured, and it takes a long time for the WAN port to take effect, please be patient and try several times.

7.6 Layer-2 Configuration

7.6.1 VLAN Configuration

7.6.1.1 VLAN Configuration

In the navigation bar, click Layer-2 Configuration and VLAN Configuration to enter the VLAN list view.

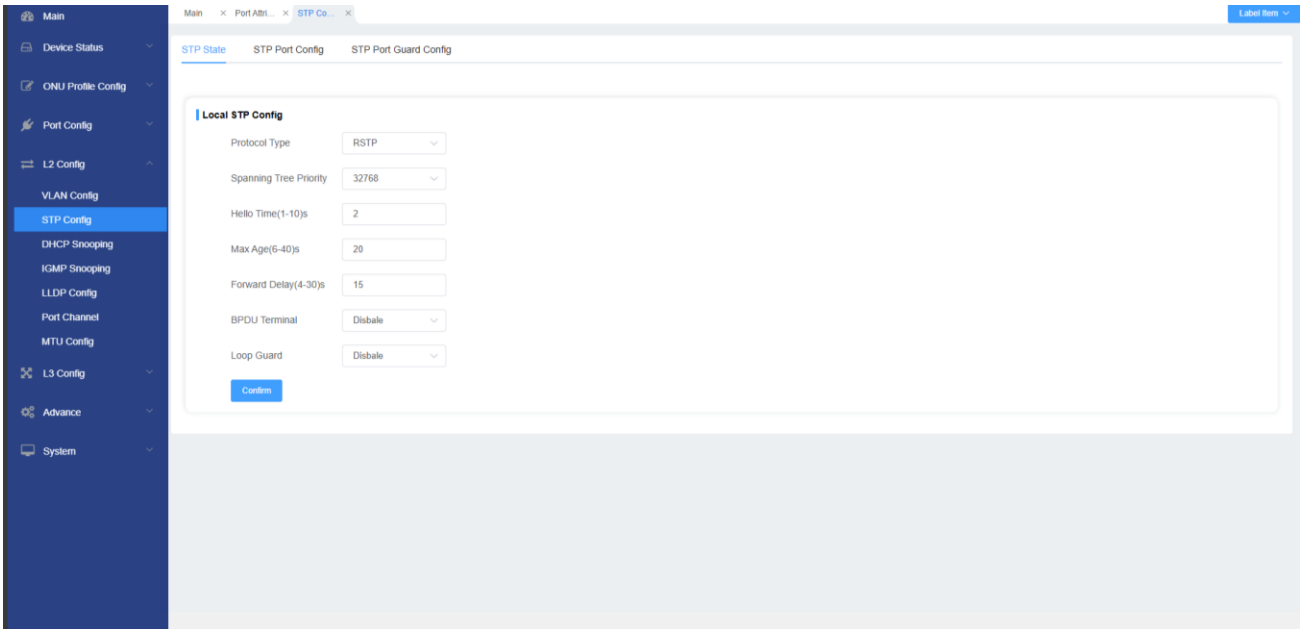


The VLAN list lists the VLAN entries that already exist in the current device in descending order. In the case of a large number of entries, find the VLAN of the desired configuration through functions such as page labels, "search", etc.
Click Add button to create a new VLAN. Select the checkbox of the current bar and click the "Delete" button to delete the selected VLAN.

7.6.2 STP Configuration

7.6.2.1 STP Status Information

In the navigation bar, click Layer-2 Configuration, and then STP Configuration to enter the STP status information and root bridge STP configuration display and local STP attribute configuration pages.



The STP configuration and STP port status of the root bridge are read-only.

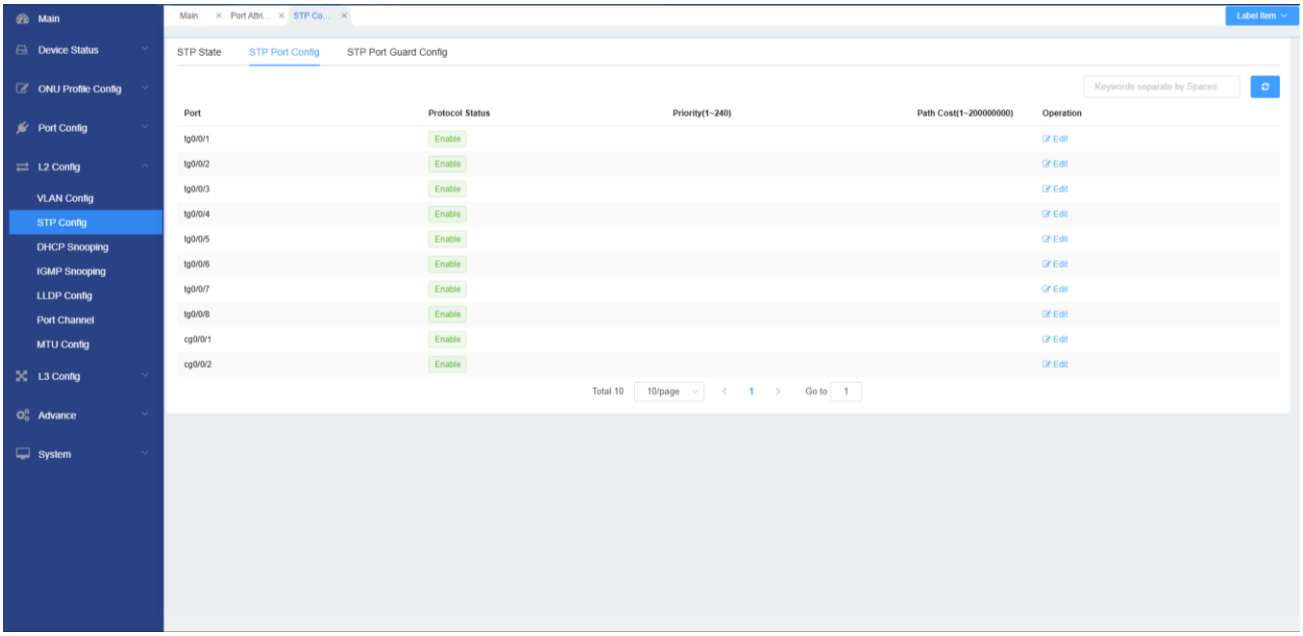
In the local STP configuration, you can use the drop-down list on the right of Protocol Type to change the current running spanning tree protocol mode, including RSTP and disable.

The priority and time parameters need to be configured separately for different modes.

Note: Changing the STP mode may cause network interruptions.

7.6.2.2 **STP Port Information Configuration**

Click the STP Port Information Configuration tab on the page to enter the STP port properties configuration page.

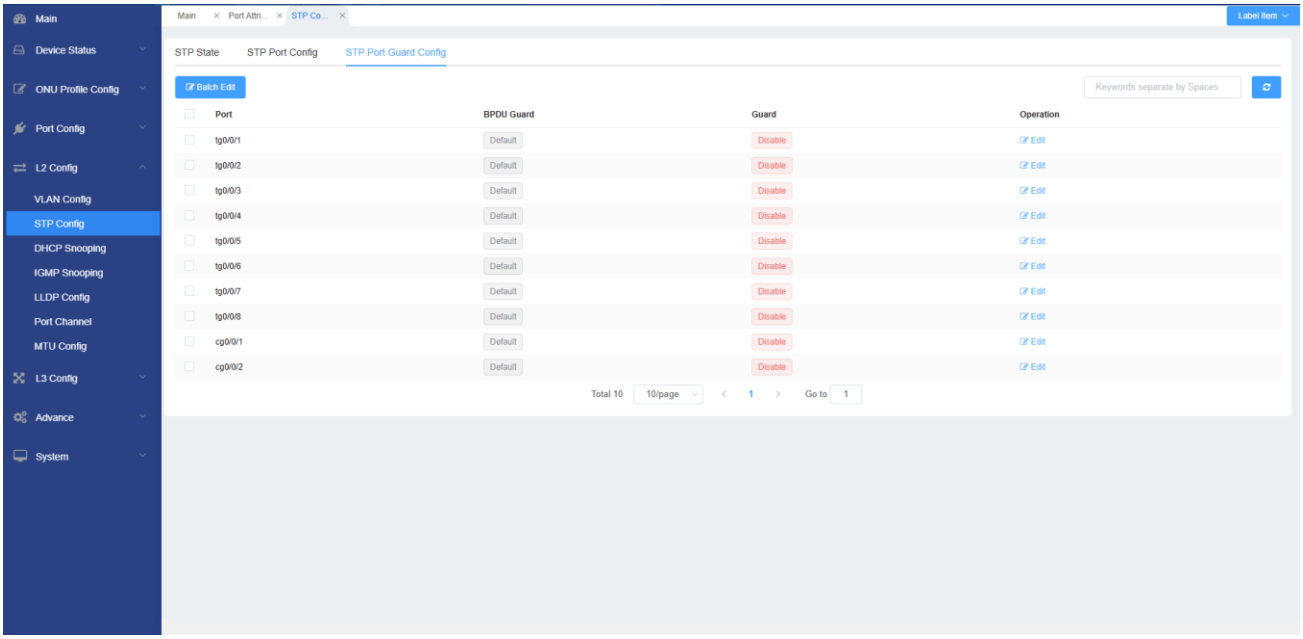


The configuration of port attributes is independent of the global STP mode. For example, if you configure the protocol status of a port to "Not Enabled" and then change the STP mode, the port will not participate in the protocol operation in the new mode.

The default value of the path cost of a port is 0, which means that the path cost is automatically calculated based on the rate of the port, if you need to modify the path cost, enter a value other than 0.

7.6.2.3 **STP Port Guard Configuration**

Click the STP Port Guard Configuration tab on the page to configure the STP port protection.

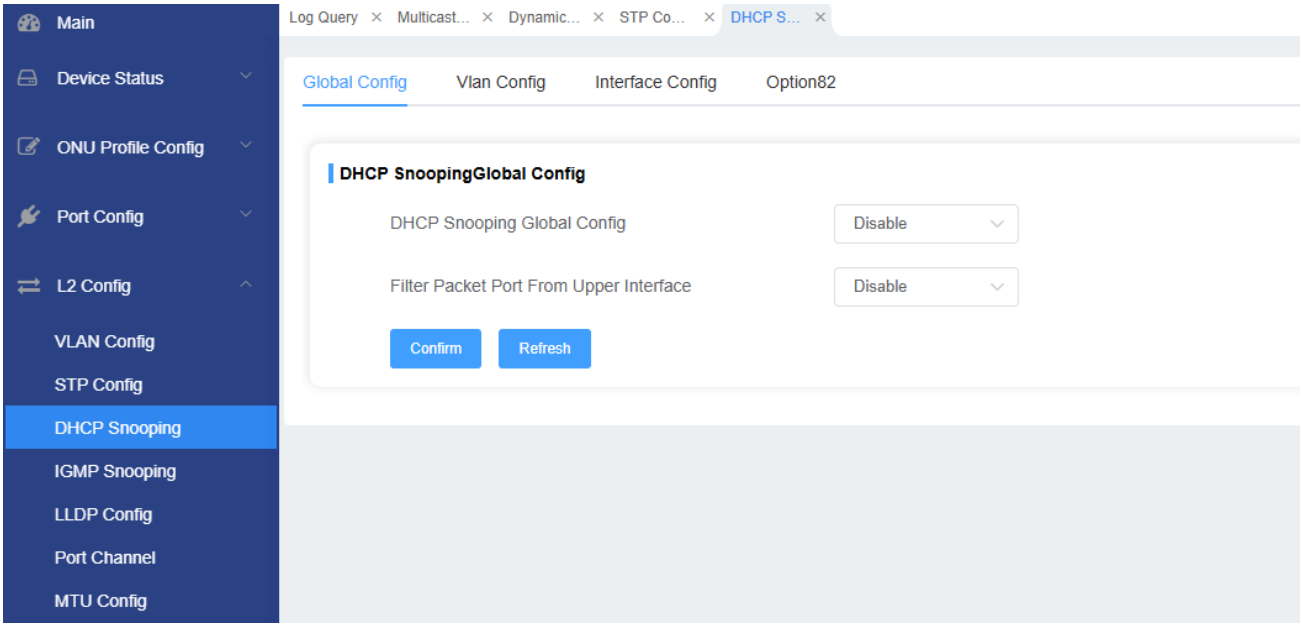


Click “Edit” to enter the corresponding port guard information modification interface.

7.6.3 DHCP Snooping

7.6.3.1 Global Configuration

In the navigation bar, click Layer-2 Configuration, and then DHCP Snooping.



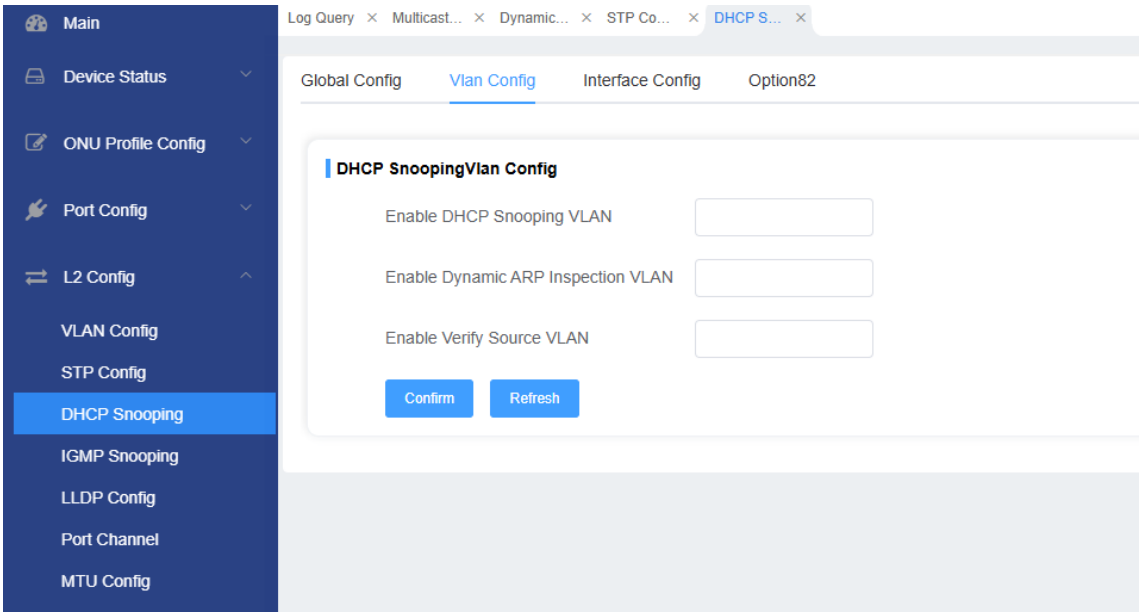
If the global DHCP snooping protocol is enabled, the switch listens to all DHCP packets and forms a binding relationship. If the client obtained the address from this switch before the command was configured, the switch cannot add the corresponding binding relationship. After the switch configuration is saved and restarted, the original interface binding relationship is lost, and the switch refuses to forward all IP packets after the IP source address monitoring function is enabled. After the TFTP server is configured for interface binding relationship backup, the binding relationship is backed up to the server through the TFTP protocol, and after the switch is restarted, the binding table is automatically downloaded from the TFTP server to ensure that the network works normally.

The name of the file that is saved on the TFTP server when you configure the backup interface binding relationship. In this way, different switches can back up their own interface binding tables to the same TFTP server.

The binding table of MAC address and IP address of the interface changes dynamically, and you need to check whether the binding is updated after a certain time interval, and if there is an update (add or delete binding entries), then re-back up. The default interval is 30 minutes.

7.6.3.2 **VLAN Attribute Configuration**

In the navigation bar, click Layer-2 Configuration, DHCP Snooping, and VLAN configuration to enter to the DHCP Snooping VLAN page.



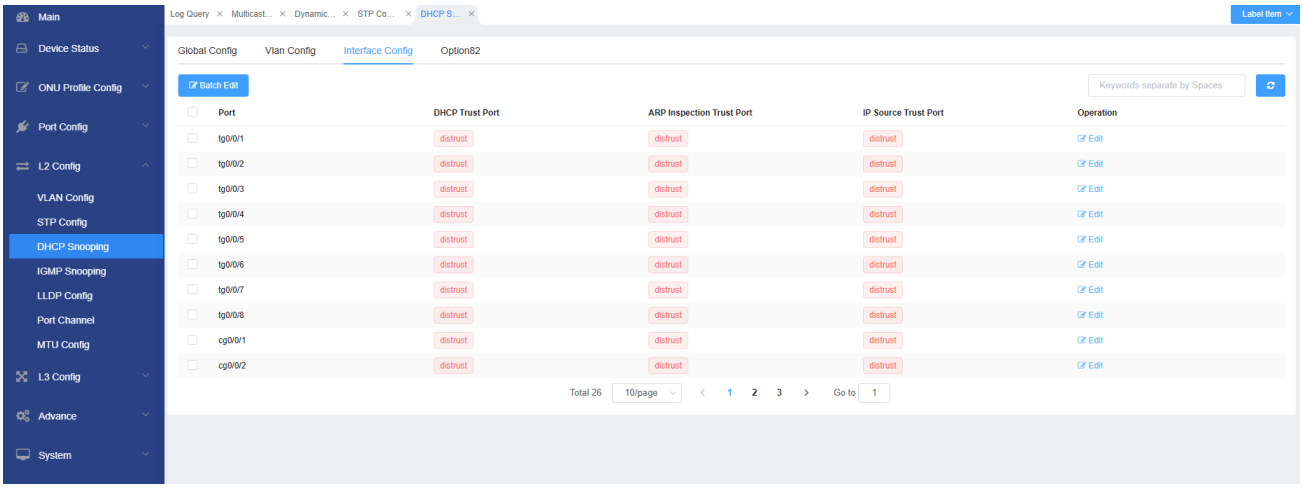
If DHCP Snooping is enabled on a VLAN, the DHCP packets received by all untrusted physical ports belonging to the entire VLAN are checked for validity. DHCP response packets received from untrusted physical ports in the VLAN are discarded to prevent users from illegally forging or mismisconfiguring the DHCP server from providing address allocation. If the sending MAC address of the DHCP request packet on an untrusted port does not match the hardware address field in the packet, the switch will also discard the DHCP DOS attack packet.

If the source MAC address and source IP address of an ARP packet received by the interface do not meet the binding relationship between the MAC address and IP address configured on the interface, the system rejects the processing of the packet. The binding relationship configured on the interface can be dynamically bound by DHCP or manually configured. If no MAC address and IP address binding are configured on the physical interface, the switch refuses to forward all ARP packets.

If the source MAC address and source IP address of an IP packet received by all physical ports belonging to the VLAN do not meet the binding relationship between the MAC address and IP address configured on the interface, the packet is rejected. The binding relationship configured on the interface can be dynamically bound to DHCP or manually configured. If no MAC address and IP address binding are configured on the physical interface, the switch refuses to forward all IP packets received by the interface.

7.6.3.3 **Port Attribute Configuration**

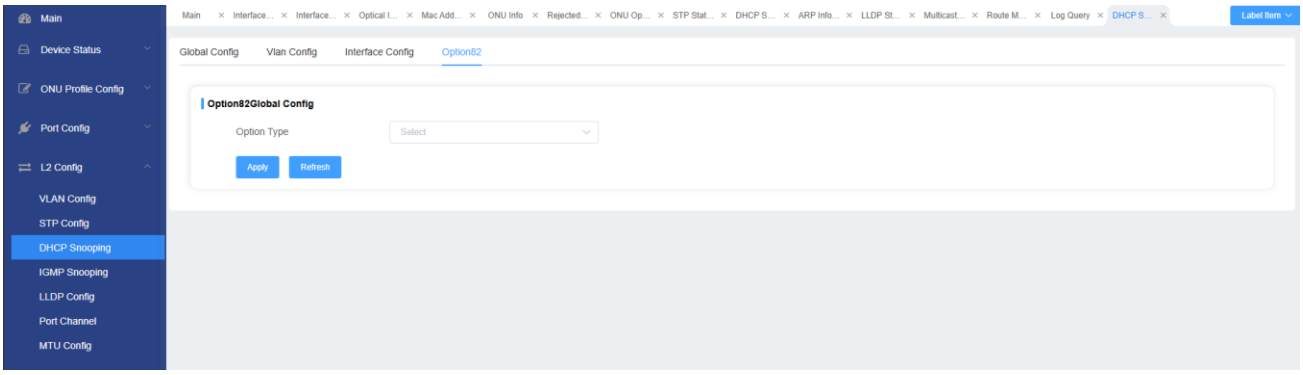
In the navigation bar, click Layer-2 Configuration, DHCP Snooping, and Port Configuration to enter the DHCP Snooping port attribute configuration page.



If an interface is configured as a DHCP trusted interface, DHCP packets received by the interface are not checked.
For ARP monitoring trust interfaces, the ARP monitoring function is not enabled. By default, the interface is untrusted.
For IP source address trust interfaces, the source address check function is not enabled.
Click "Modify" to enter the corresponding port modification interface for modification.

7.6.3.4 **Option82**

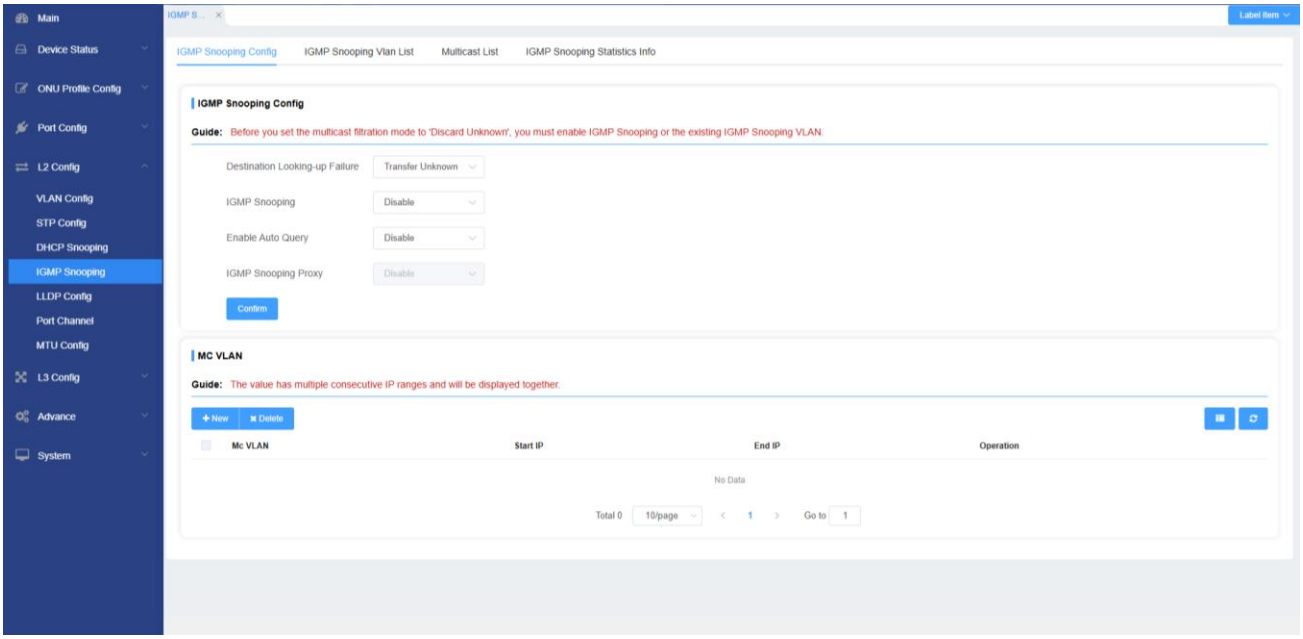
In the navigation bar, click Layer-2 Configuration, DHCP Snooping, and Option 82



7.6.4 IGMP-Snooping

7.6.4.1 IGMP-Snooping Configuration

In the navigation bar, click Layer-2 Configuration, and then IGMP Snooping.

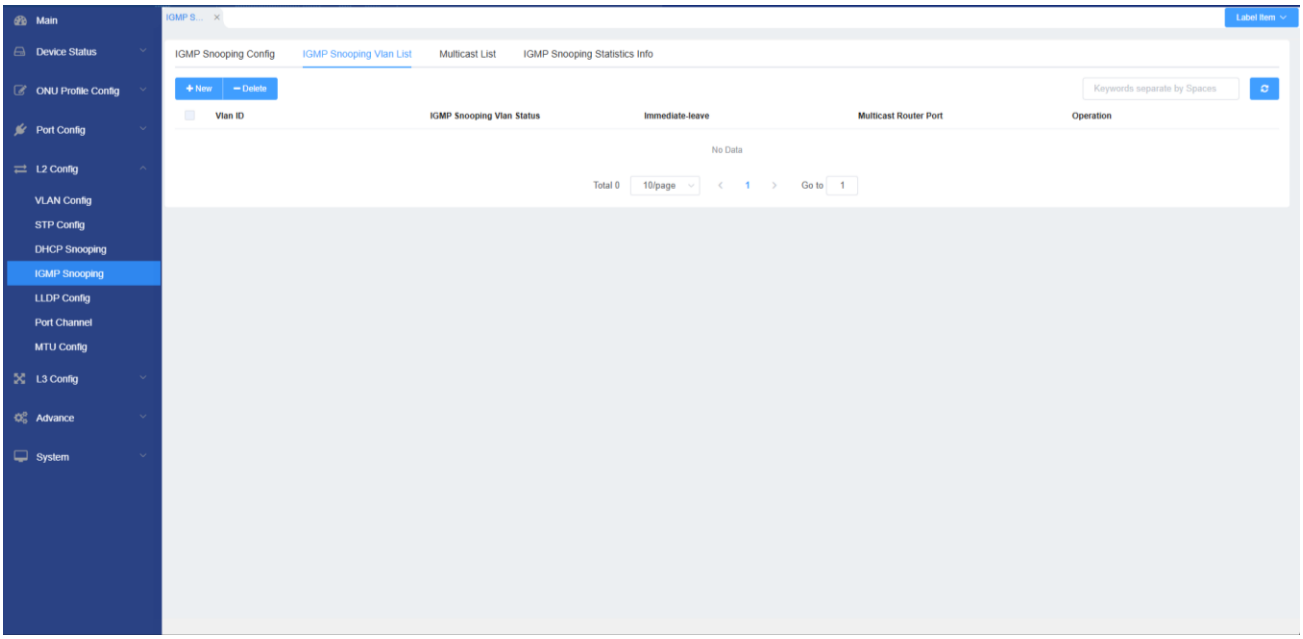


You can use this page to configure whether the switch forwards unknown multicast, enables IGMP-Snooping, and whether it acts as an IGMP Querier.

You can configure MC-VLAN commands on the MC VLAN list page.

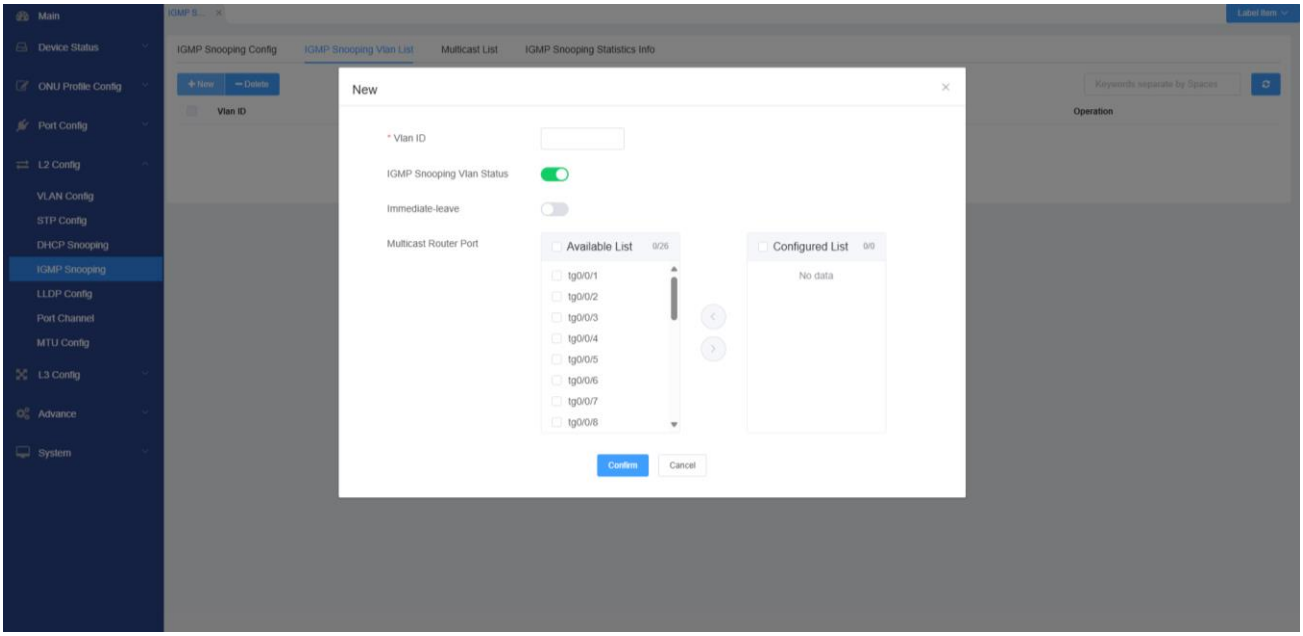
7.6.4.2 **VLAN List**

In the navigation bar, click Layer-2 Configuration, IGMP Snooping, IGMP Snooping VLAN List, and enter IGMP-Snooping VLAN list page.



Click add to add IGMP-Snooping Vlan Configuration.

Click delete to delete selected IGMP-Snooping VLAN . Click modify to modify the group port, operating status and Immediate-leave of IGMP-Snooping VLAN.

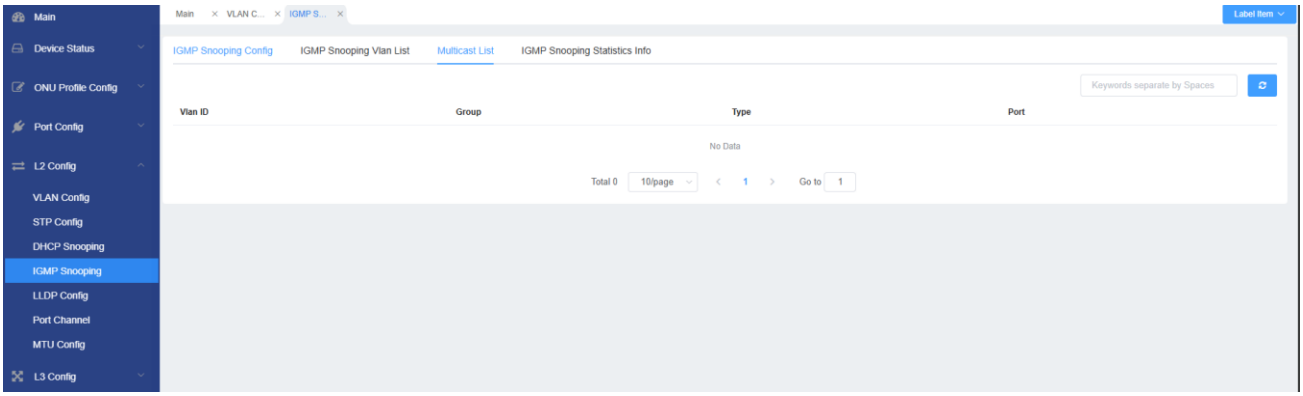


When creating IGMP-Snooping Vlan, VLAN ID can be modified; when modifying IGMP-Snooping Vlan, the VLAN ID cannot be modified.

Users can add and delete routing ports by ticking the ports in the list and then using the ">" and "<" buttons.

7.6.4.3 **Multicast Member List**

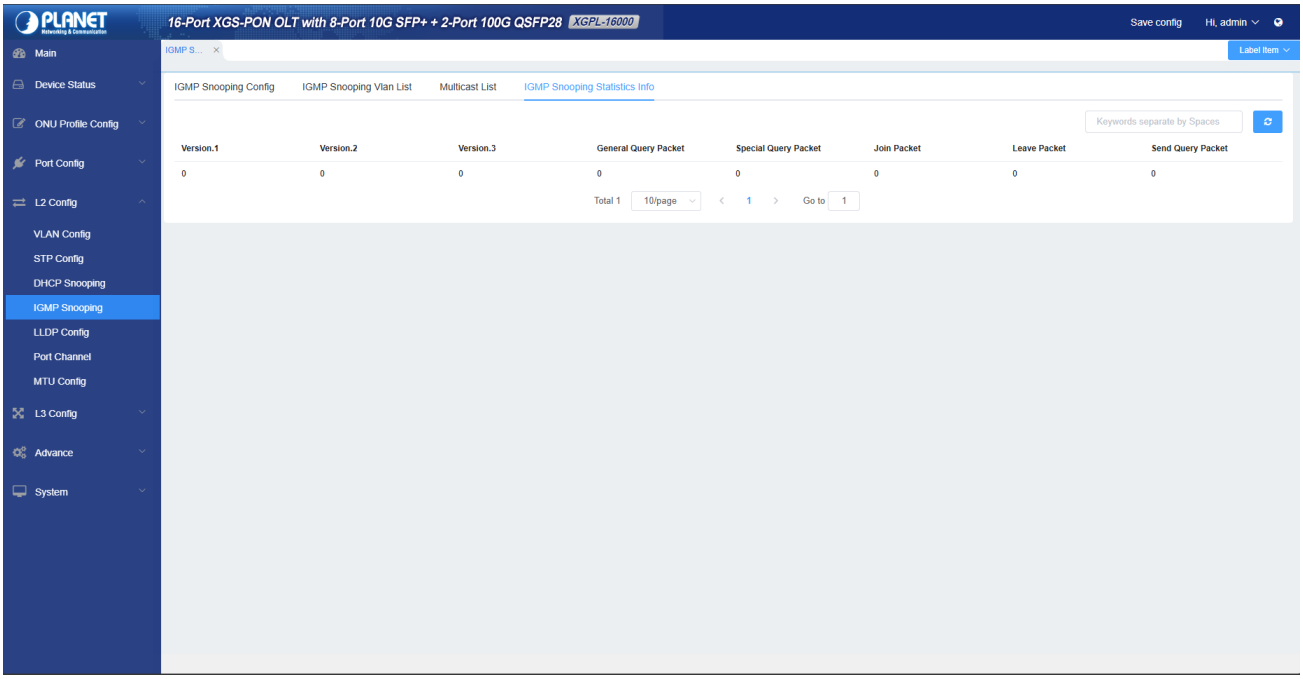
Click the Multicast Member List tab at the top of the page to enter the Multicast Member List page.



This page displays the IGMP-Snooping statistics, the multicast groups that exist in the current network, and the set of ports on which the members of each group are located. Click the "Refresh" button to refresh the contents of the list.

7.6.4.4 **Snooping Statistics Information**

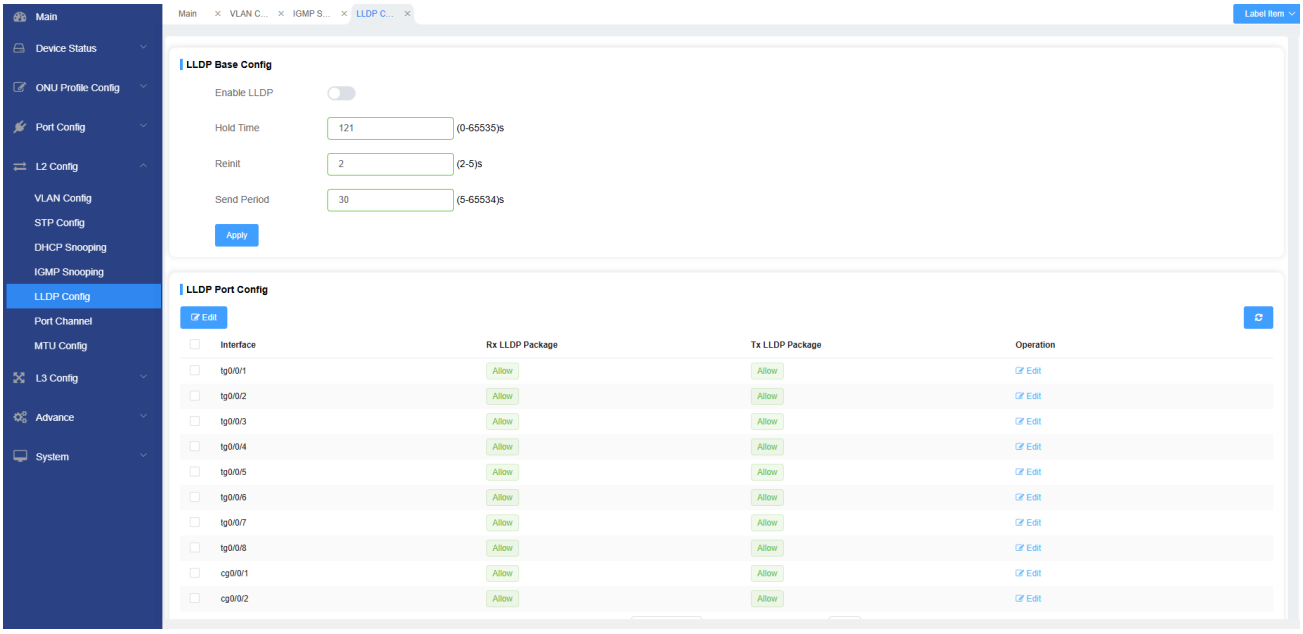
Click the IGMP Snooping Statistics tab at the top of the page to go to the IGMP Snooping Statistics page.



7.6.5 LLDP Config Configuration

In the navigation bar, click Layer 2 config, LLDP config to enter the LLDP configuration page.

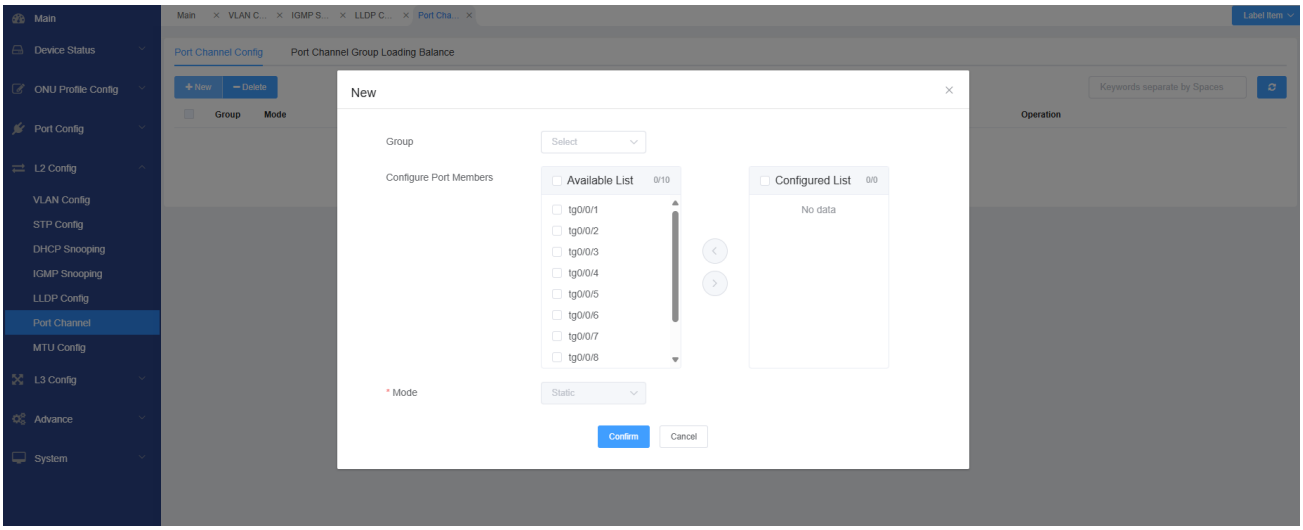
Click Enable LLDP to enable the LLDP feature. Hold time, Reinit,Send Period can set in this page.



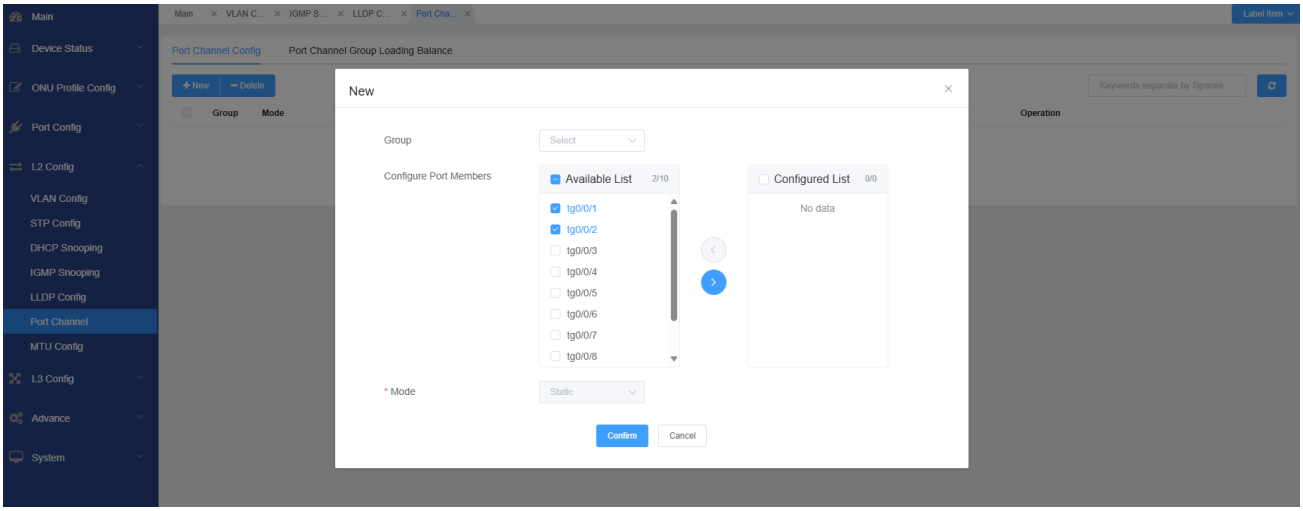
7.6.6 Port Channel

7.6.6.1 Port Channel Configuration

In the navigation bar, click Layer-2 Configuration and Port Channel to go to the aggregation configuration page.



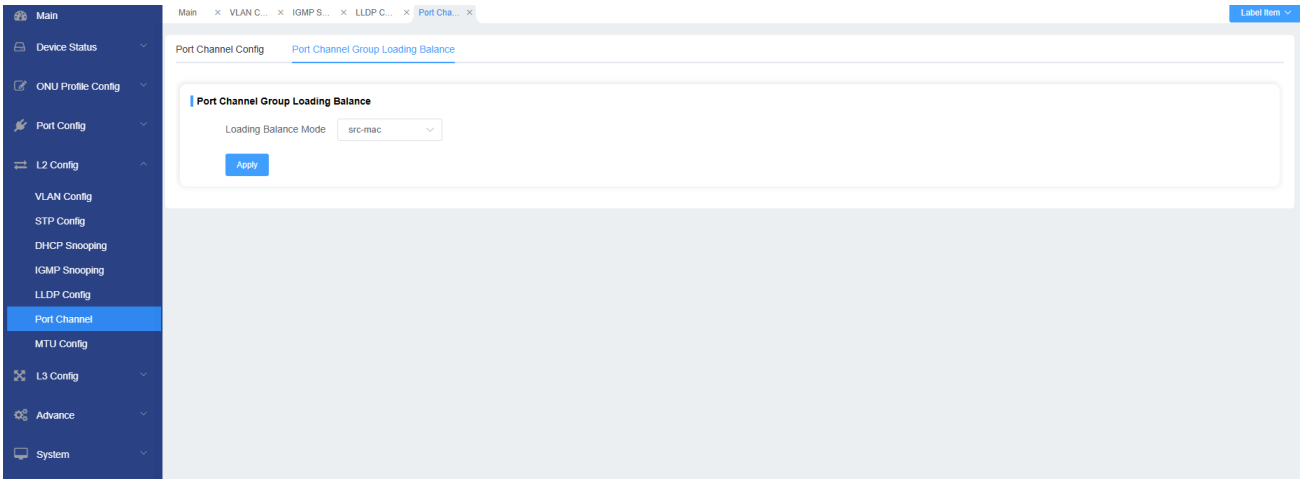
Click "Add" to create a new aggregation group, and you can configure up to 8 aggregation groups through the web, and each group can configure up to 128 physical ports to join the aggregation. Click Delete to delete the selected aggregation group, and click Modify to modify the member port and aggregation mode of the aggregation port.



When you create a new aggregation group, the aggregation group is optional, but when you modify the aggregation group, the aggregation group is not. When there are member ports on the aggregation port, the user can choose the aggregation modes Static, LACP Active, and LACP Passive. You can add and delete the member ports of the aggregation group by checking the ports in the list and then using the > and < buttons.

7.6.6.2 **Port Channel Group Loading Balance**

Some models of Link Aggregation Load Balancing support aggregation group-based load balancing mode configuration, and some do not, but you can set it in global configuration mode. By default, it is based on "src-mac" mode equalization.

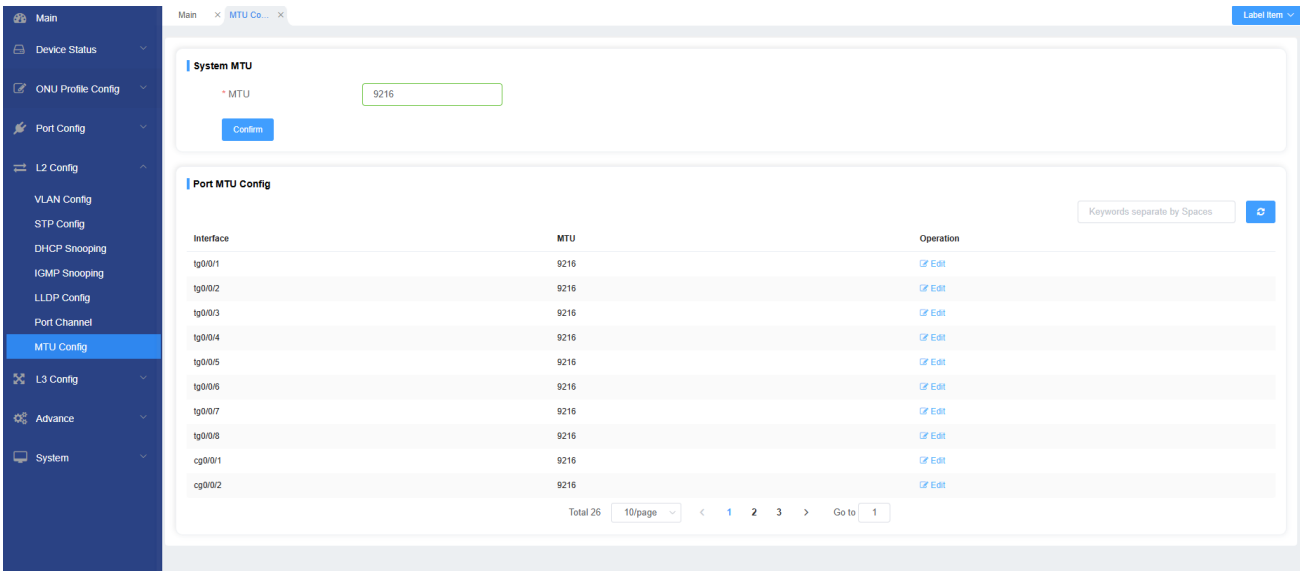


7.6.7 MTU Config

In the navigation bar, click Layer 2 config, MTU config to enter the MTU configuration page.

By default all the ports will use same MTU in global.

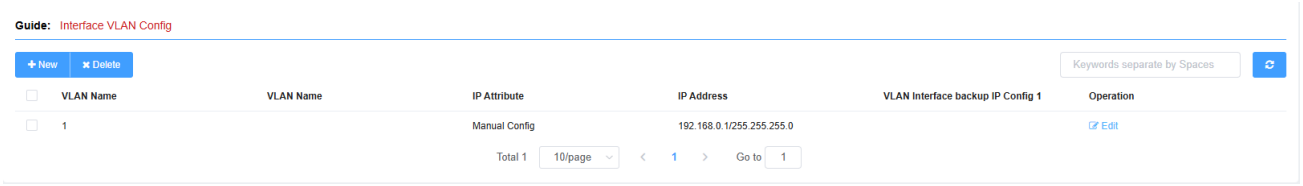
Click Edit in different port can set different MTU for different port.



7.7 Layer-3 Configuration

7.7.1 VLAN interface IP Configuration

In the navigation bar, click Layer-3 Configuration, VLAN Interface IP Configuration to enter the VLAN interface configuration page.

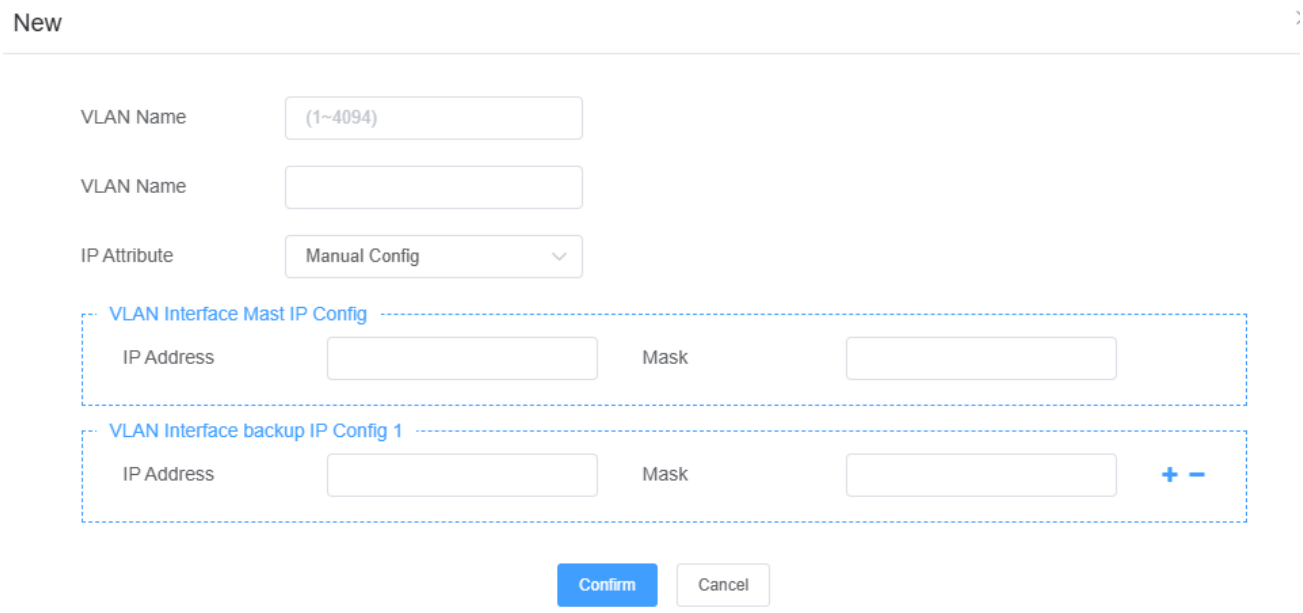


Click Add to add a VLAN interface configuration.

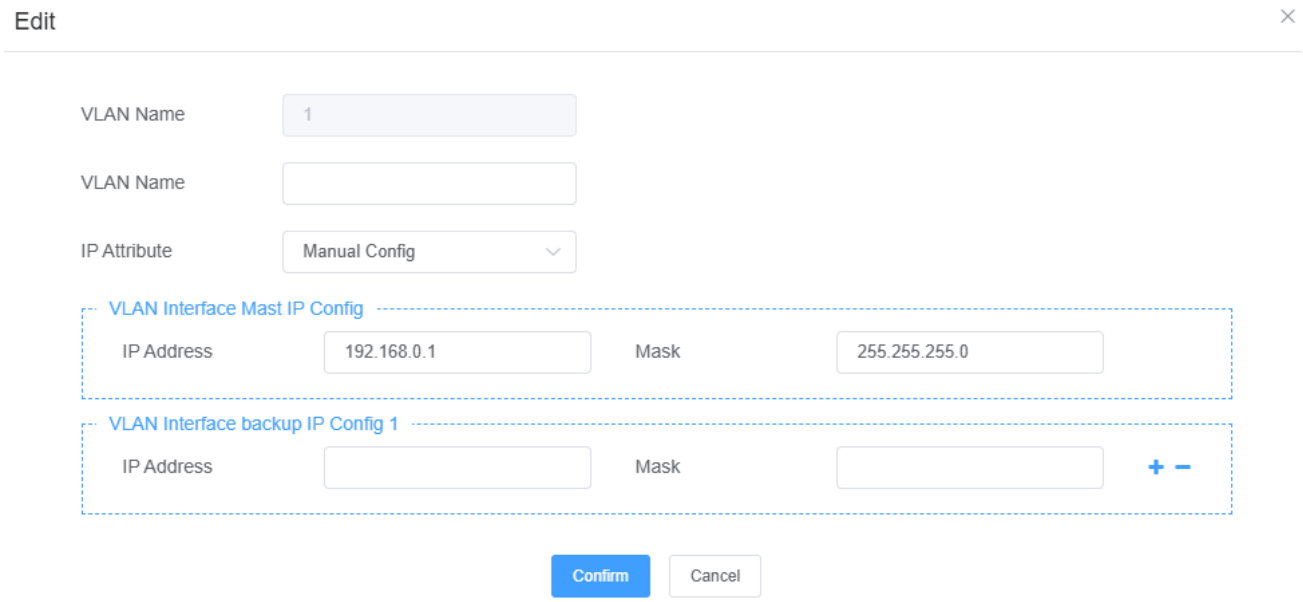
Click Delete to delete the VLAN interface.

Click “Edit” to go to the corresponding VLAN interface configuration page and set the corresponding settings.

Click "Add" to modify the VLAN interface name.



Click “Edit” . The VLAN interface name cannot be modified.

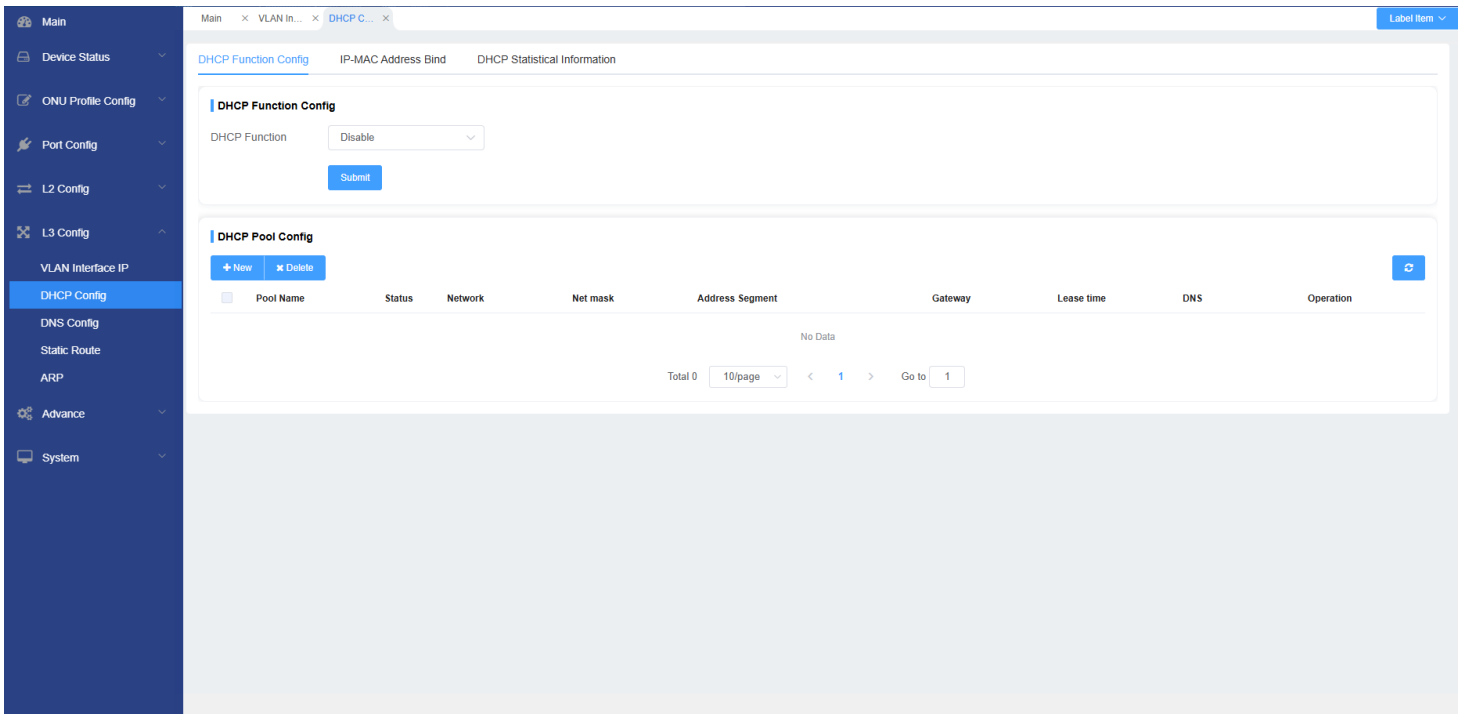


7.7.2 DHCP Configuration

7.7.2.1 DHCP Function Configuration

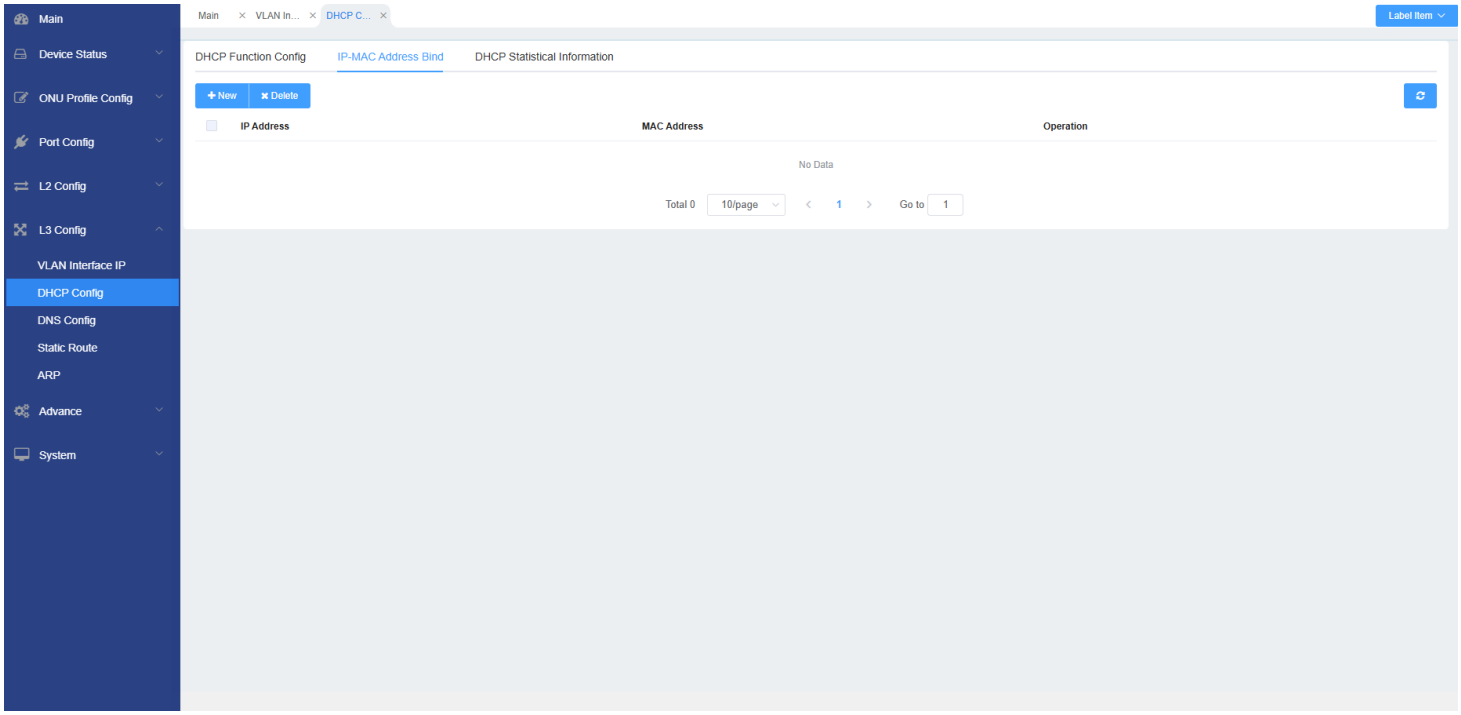
In the navigation bar, click "Layer-3 Configuration" and "DHCP Configuration" to enter the DHCP function configuration, where you can enable or disable the DHCP function globally.

Meanwhile, you can also add, delete, and modify address pools.



7.7.2.2 IP-MAC Address Binding

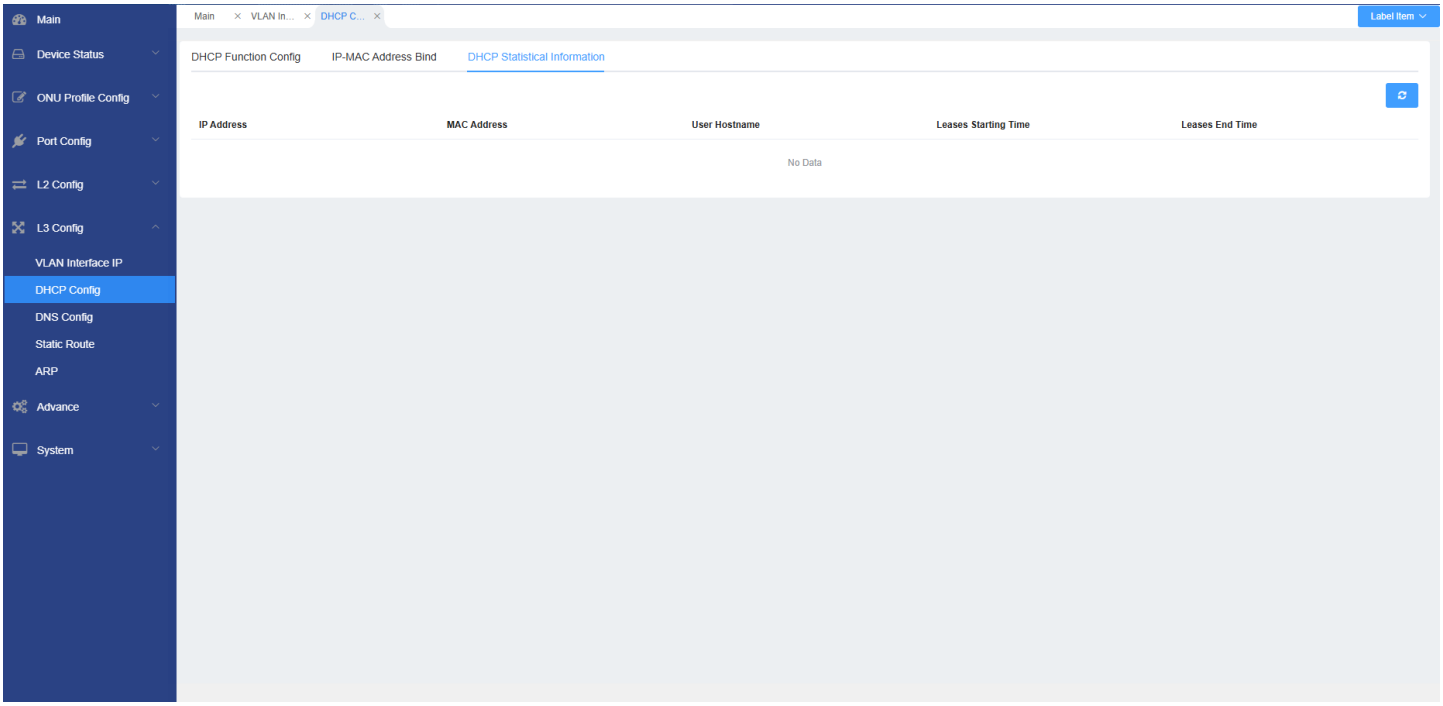
In the navigation bar, click "Layer-3 Configuration", "DHCP Configuration", and click IP-MAC address binding to enter the IP-MAC address binding interface.



On this page, you can add, delete, and modify the binding of IP-MAC addresses.

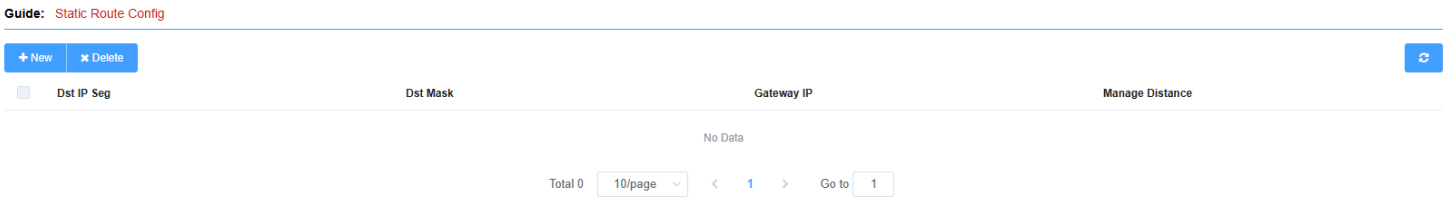
7.7.2.3 DHCP Statistics Information

In the navigation bar, click "Three-layer configuration", "DHCP configuration", and click DHCP statistics to enter the DHCP statistics display page. On this page, you can view DHCP-related statistics.



7.7.3 Static Routing Configuration

In the navigation bar, click Layer-3 Configuration and Static Route Configuration to enter the Static Route Configuration page.



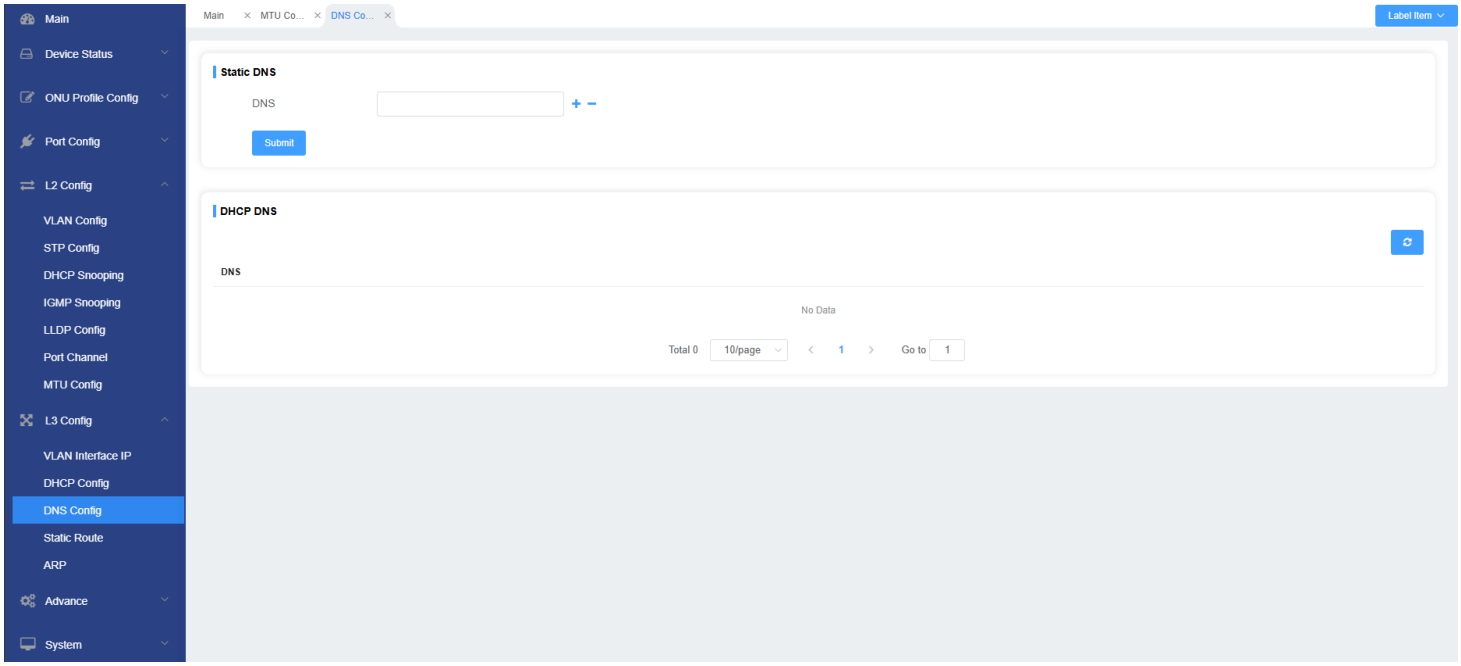
Click Create to add a static route entries.

Click Delete to delete the selected static route entries.

7.7.4 DNS Configuration

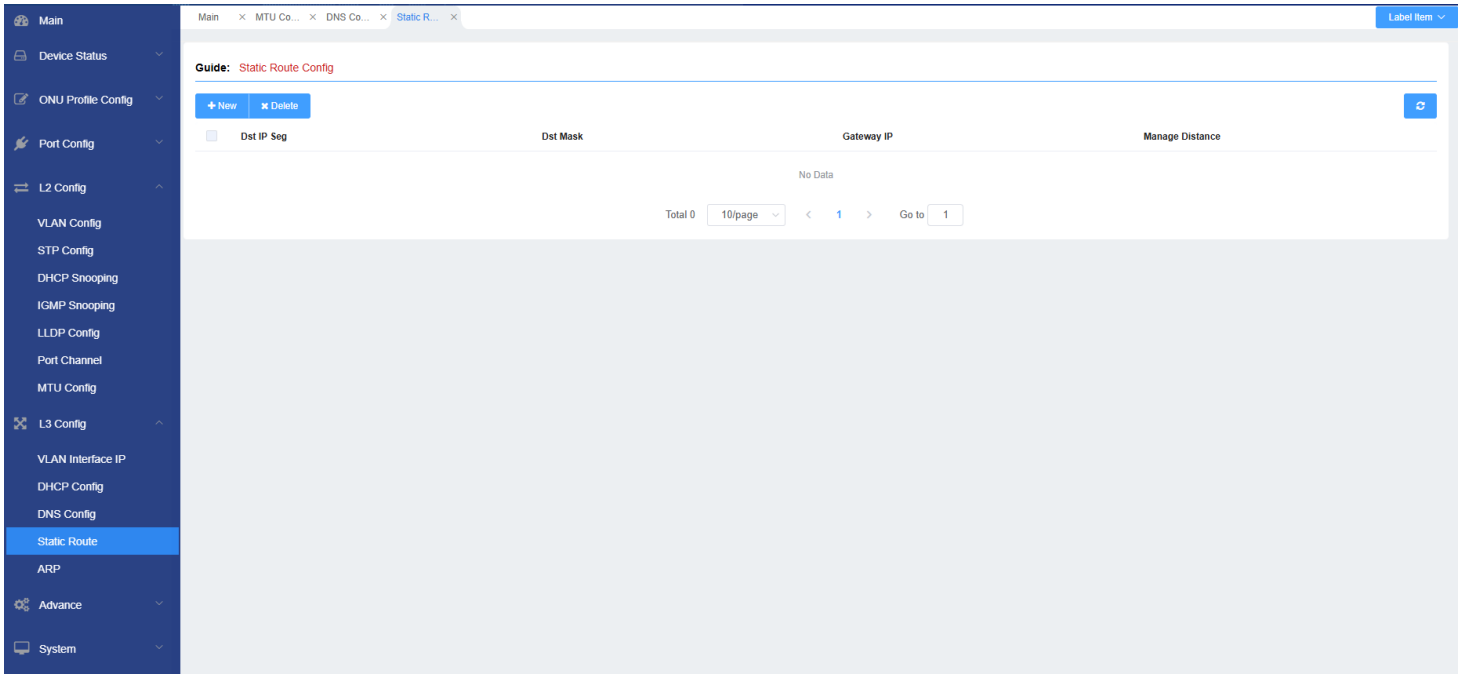
In the navigation bar, click Layer-3 Configuration and DNS Configuration to enter the DNS Configuration page.

Device can support multi-DNS config.



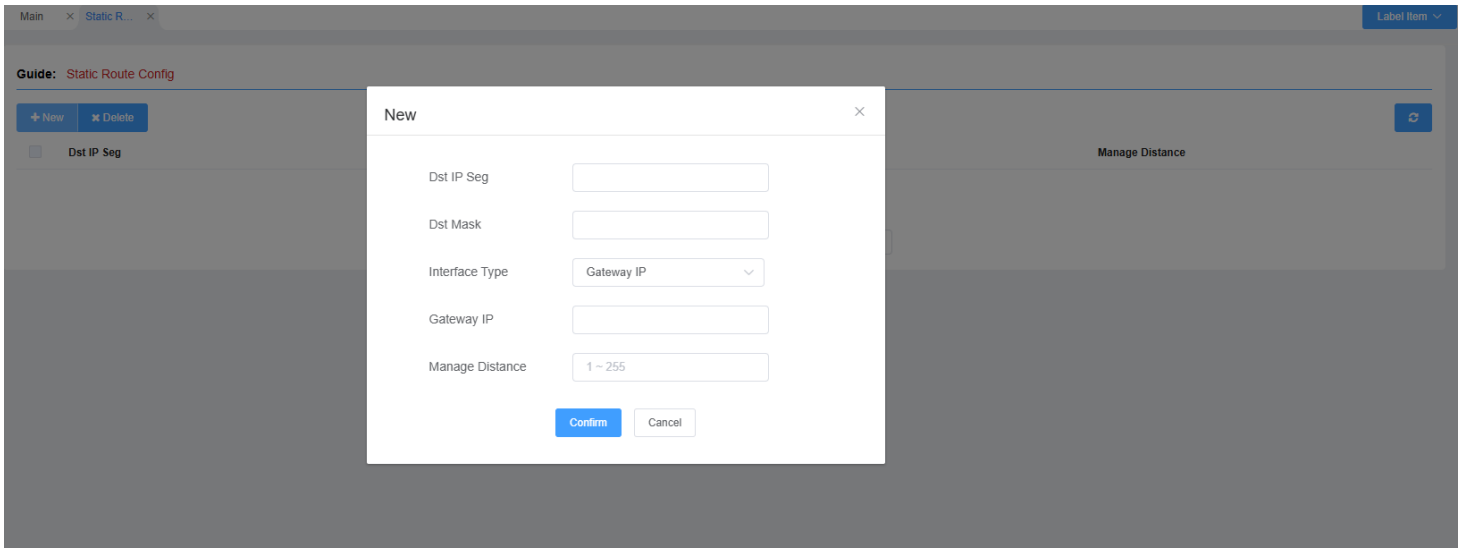
7.7.5 Static Routing Configuration

In the navigation bar, click Layer-3 Configuration and Static Route Configuration to enter the Static Route Configuration page.



Click Create to add a static route entries.

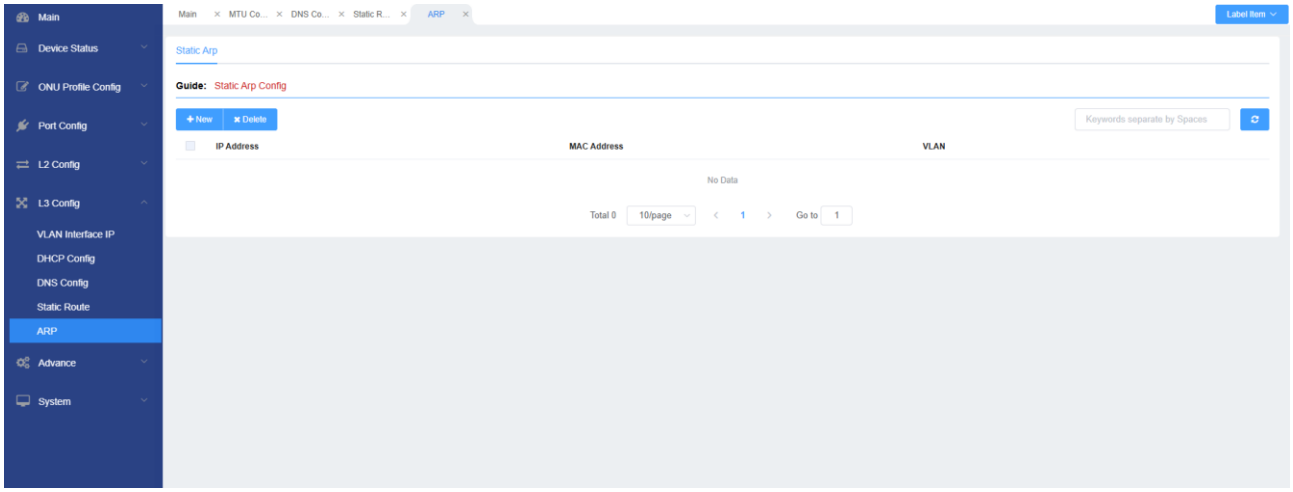
Click Delete to delete the selected static route entries



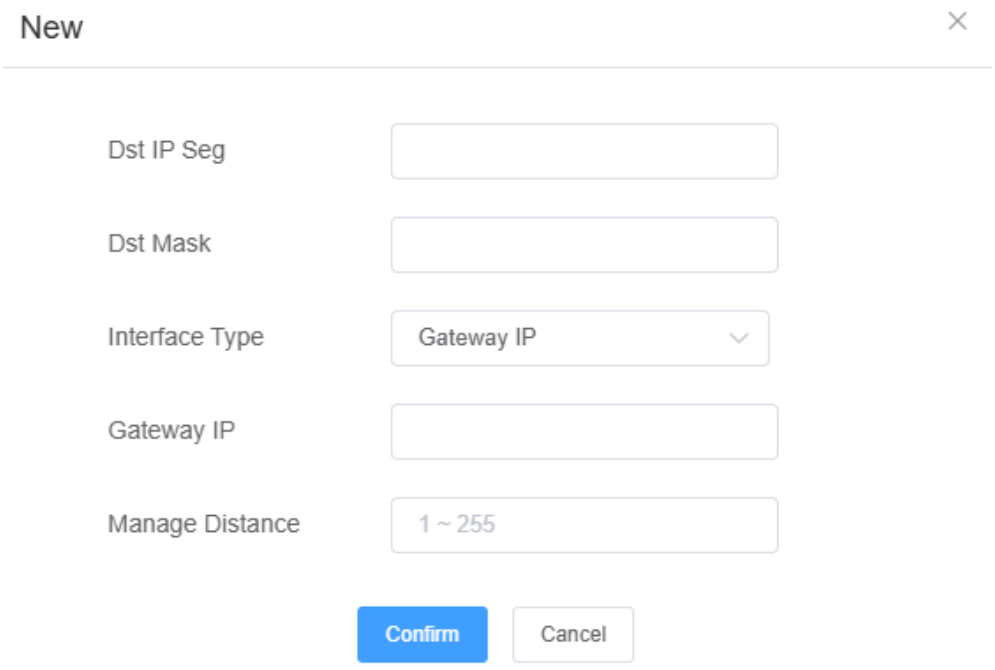
7.7.6 ARP Configuration

7.7.6.1 Static ARP

In the navigation bar, click Layer-3 Configuration and ARP Configuration to enter the static ARP configuration page.



Click Add to add an ARP entry, and you need to specify a VLAN interface when configuring an ARP entry. Click Delete to delete the selected ARP entries.

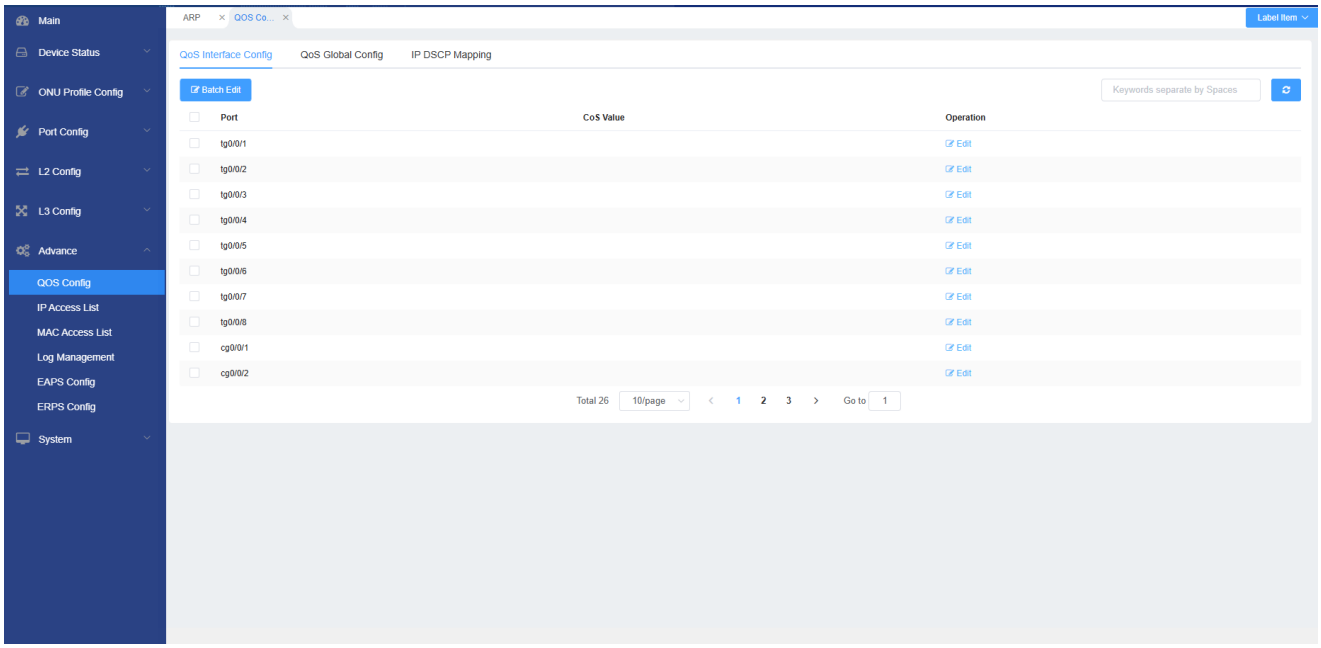


7.8 Advanced Device Configuration

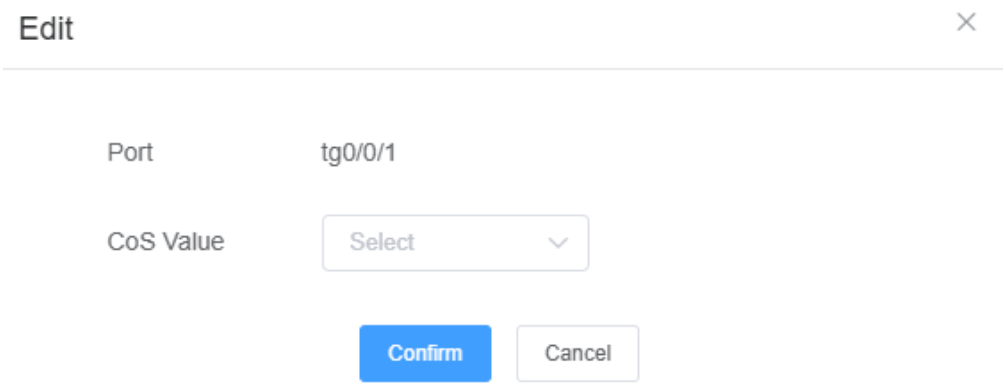
7.8.1 QoS Configuration

7.8.1.1 QoS Port Configuration

Click Advanced Configuration, QoS Configuration, and then click the QoS Interface Configuration tab at the top of the page to enter the QoS parameter configuration page of the interface.

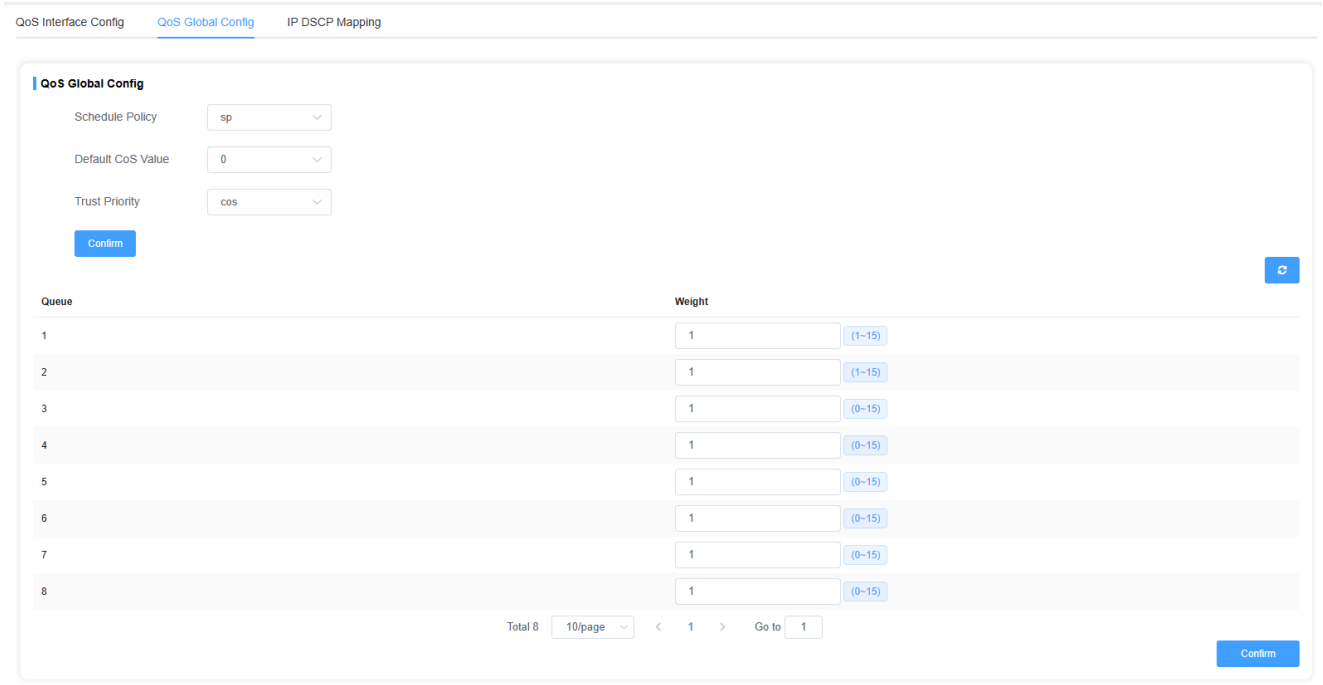


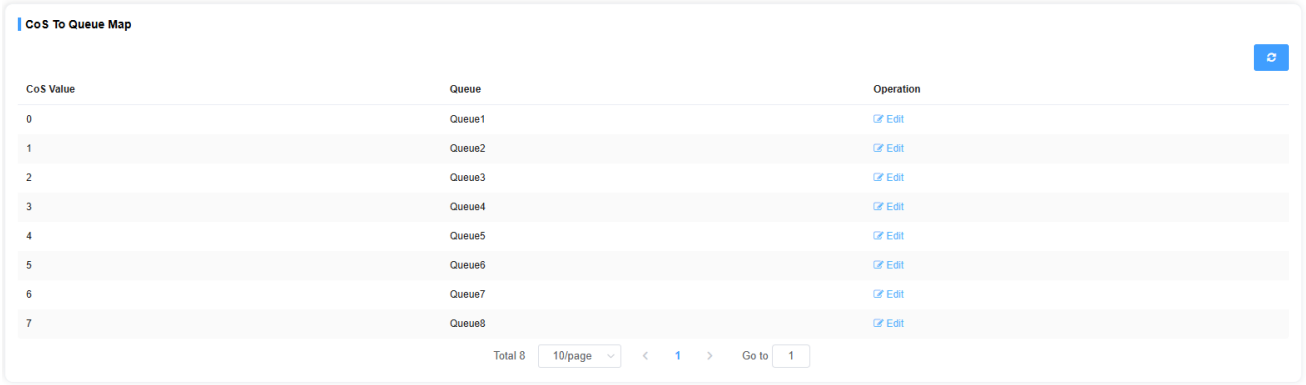
Click “Edit” to enter the CoS value modification page of the corresponding port, and set the CoS value of the port through the drop-down box below the port name. The default CoS of port is 0, which indicates the lowest priority. CoS7 is the highest priority.



7.8.1.2 QoS Global Configuration

Click Advanced Configuration, QoS Configuration, and then click the QoS Global Configuration tab at the top of the page to enter the global QoS parameter configuration page.



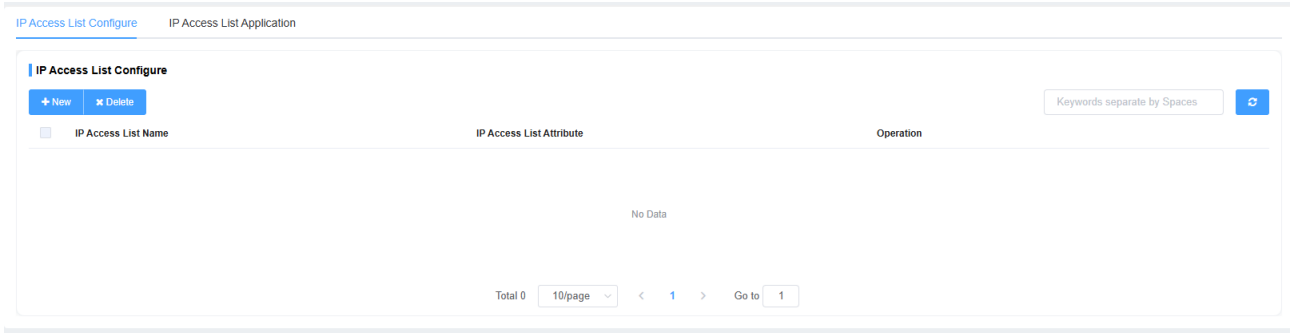


In the WRR priority queue scheduling mode, you can set the weight ratio of QoS queues, and there are a total of 8 queues, with queue 1 being the lowest priority and queue 8 being the highest priority.

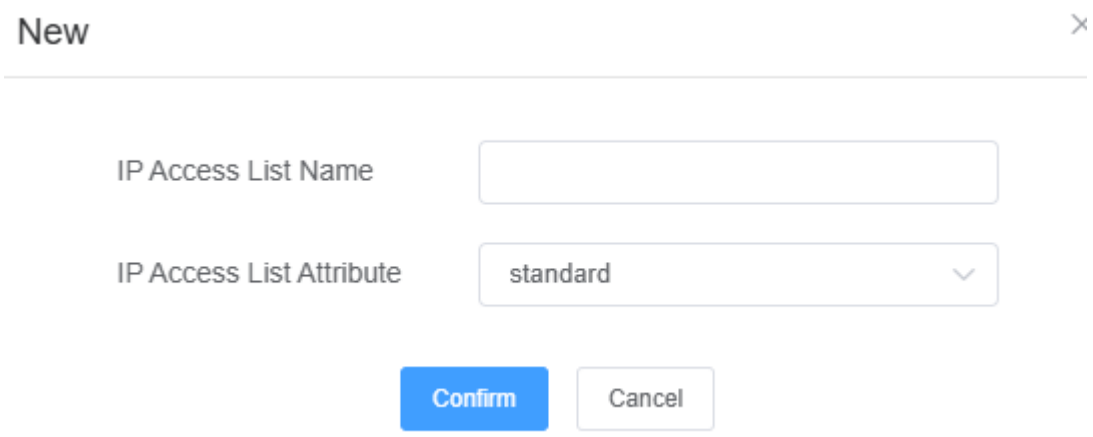
7.8.2 IP Access Control List

7.8.2.1 IP Access Control List Configuration

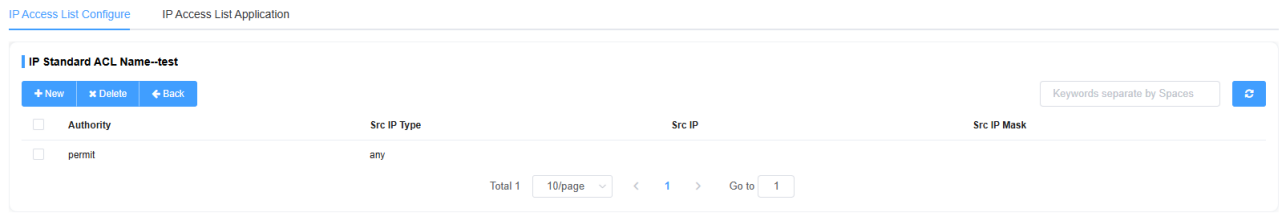
In the navigation bar, click Advanced Configuration, IP Access Control List, and then click IP Access Control List Configuration at the top of the page to enter the IP Access Control List configuration page.



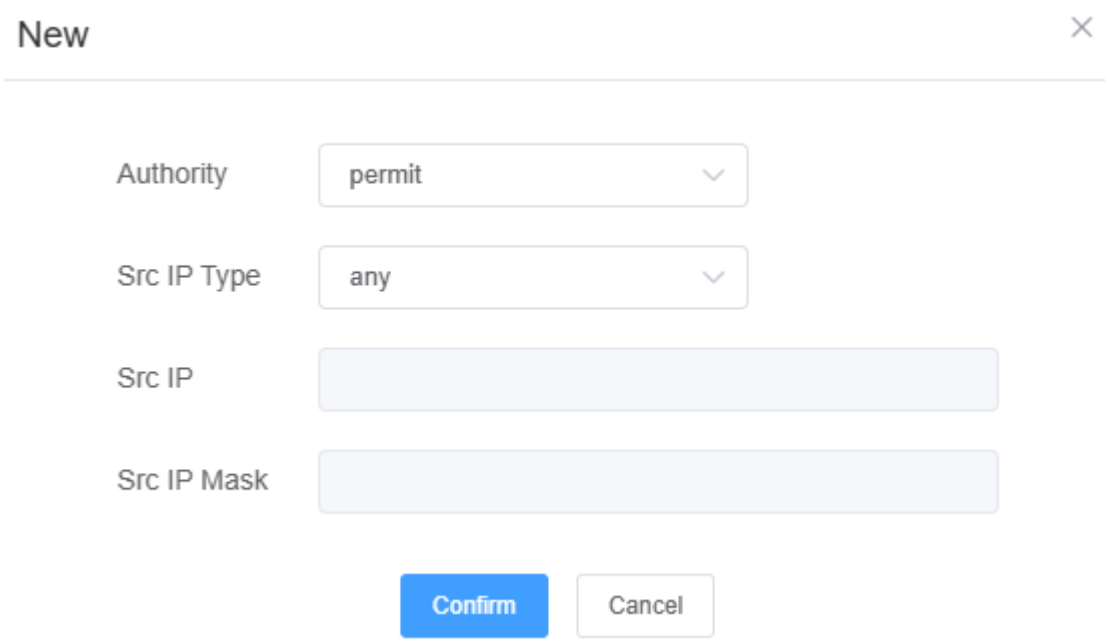
Click "Add" to add an IP access control list name. Click "Delete" to delete the access control list.



Click “Edit” to enter the corresponding IP access control list and set the corresponding rules. The access control list attribute is "standard".

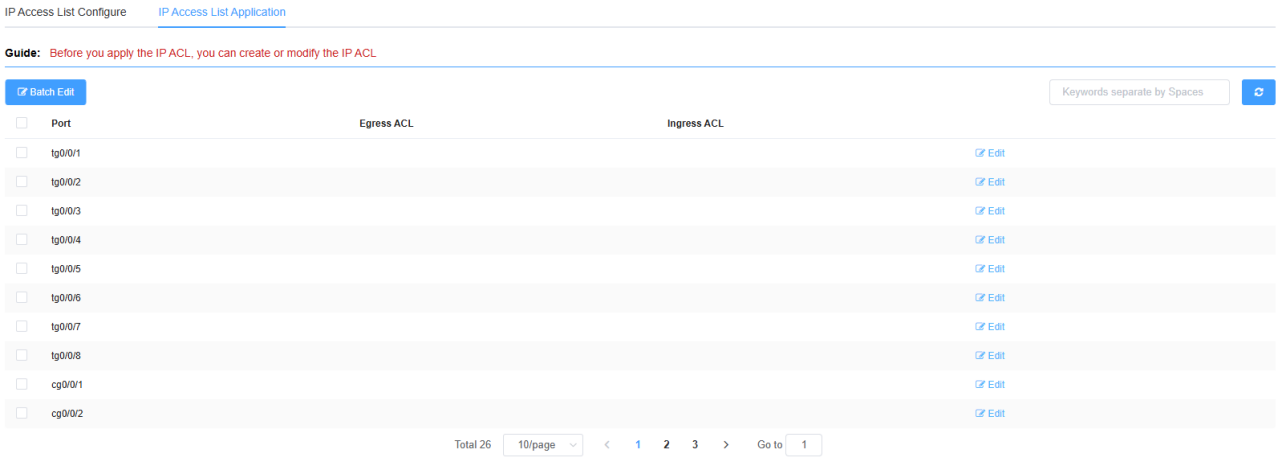


Click "Add" to add an IP access control list rule. Click "Delete" to delete the ACL rule.



7.8.2.2 IP Access Control List Application

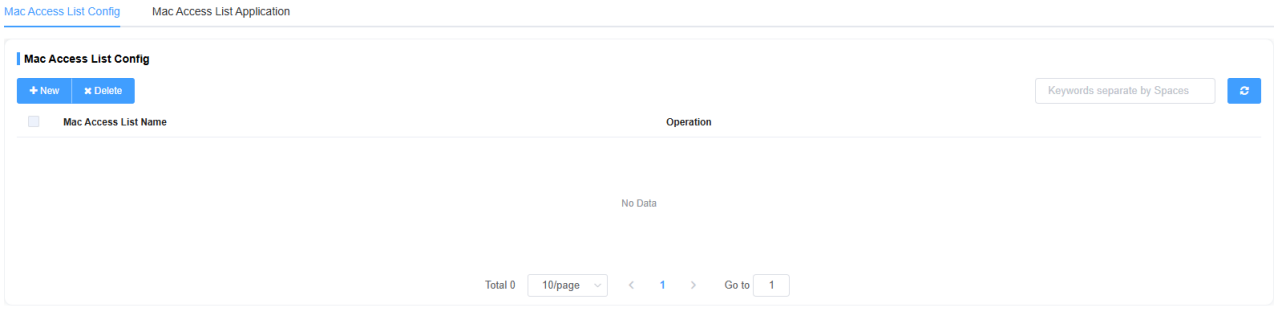
In the navigation bar, click Advanced Configuration, click IP Access Control List, and then click IP Access Control List Application at the top of the page to enter the IP Access Control List Application page.



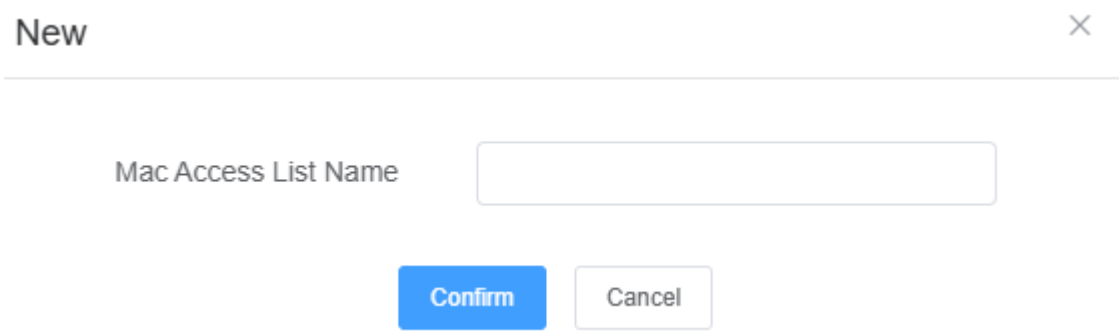
7.8.3 MAC Access Control List

7.8.3.1 MAC Access Control List Configuration

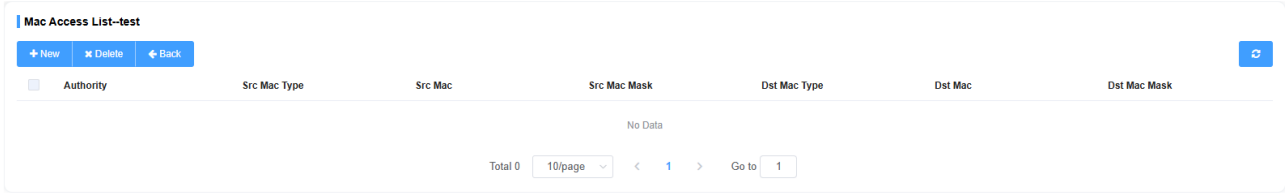
In the navigation bar, click Advanced Configuration, MAC Access Control List, and then click MAC Access Control List Configuration at the top of the page to enter the MAC Access Control List configuration page.



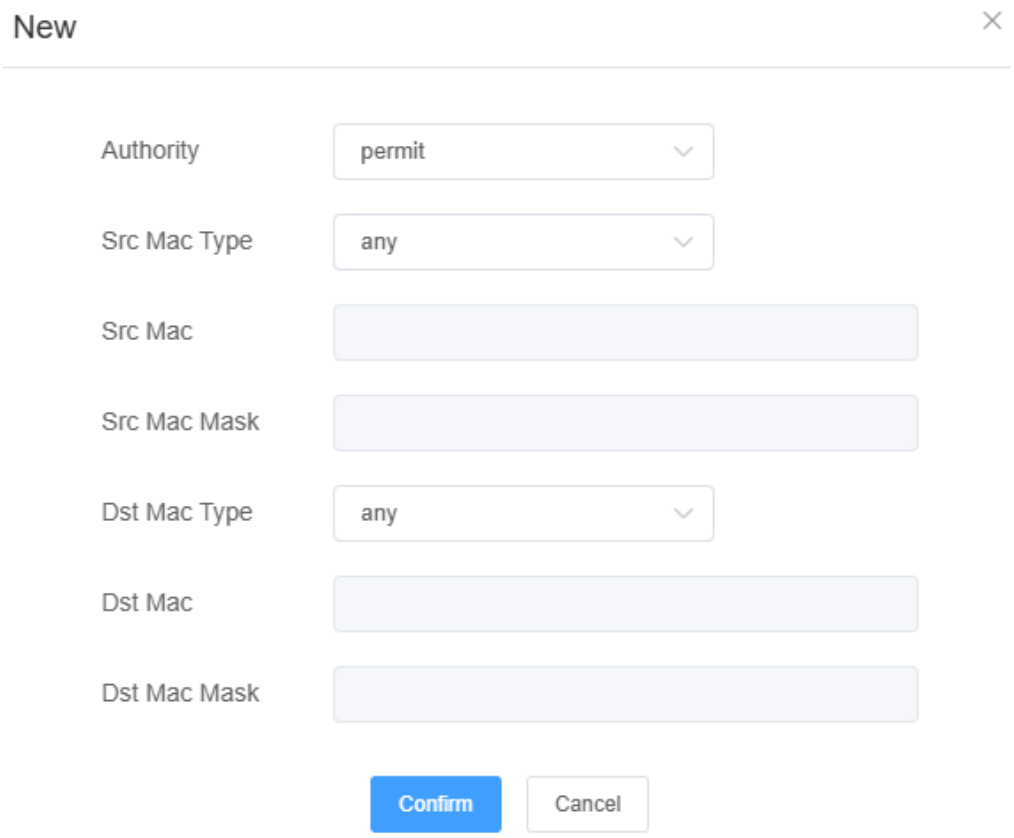
Click "Add" to add a MAC access control list name. Click "Delete" to delete the access control list.



Click “Edit” to enter the corresponding MAC access control list and set the corresponding rules.

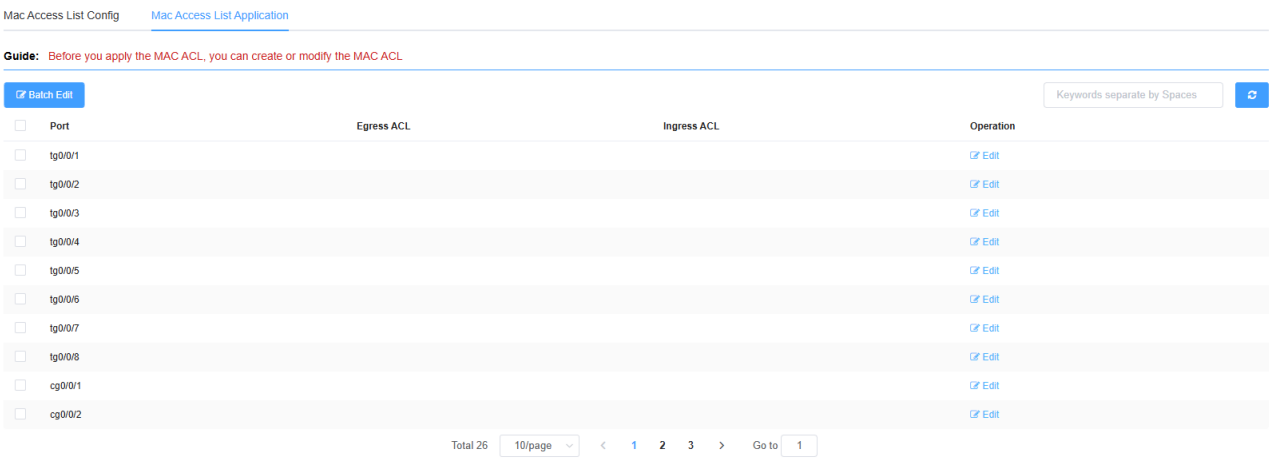


Click "Add" to add a MAC access control list rule. Click "Delete" to delete the ACL rule.



7.8.3.2 MAC Access Control List Application

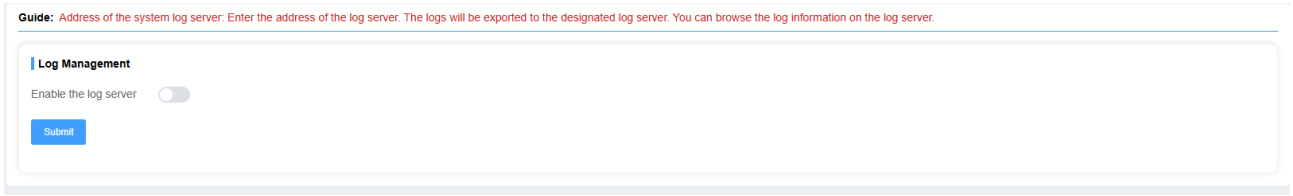
In the navigation bar, click "Advanced Device Configuration", "MAC Access Control List", and then click "MAC Access Control List Application" at the top of the page to enter the MAC Access Control List application page.



7.8.4 Log Management

In the navigation bar, click Advanced Device Configuration and then Log Management to enter the log management page.

You can configure the server address and port number to be sent to send logs to the specified log server.

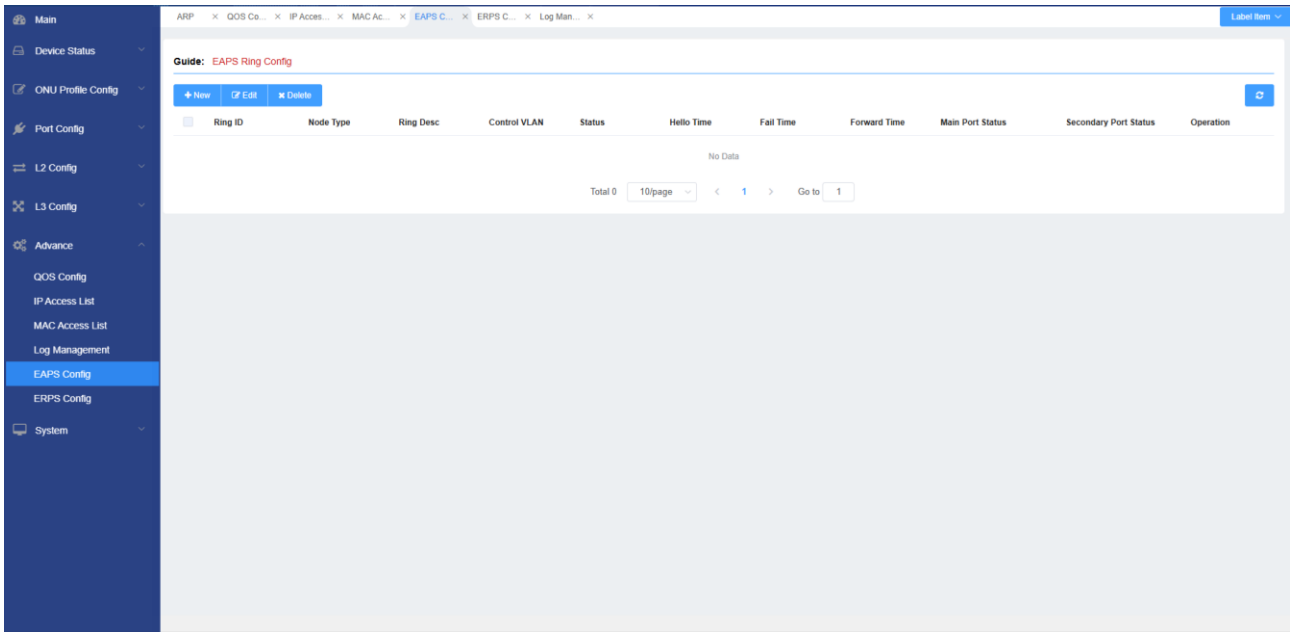


Note:

A maximum of 8 log server addresses can be configured.

7.8.5 EAPS Configuration

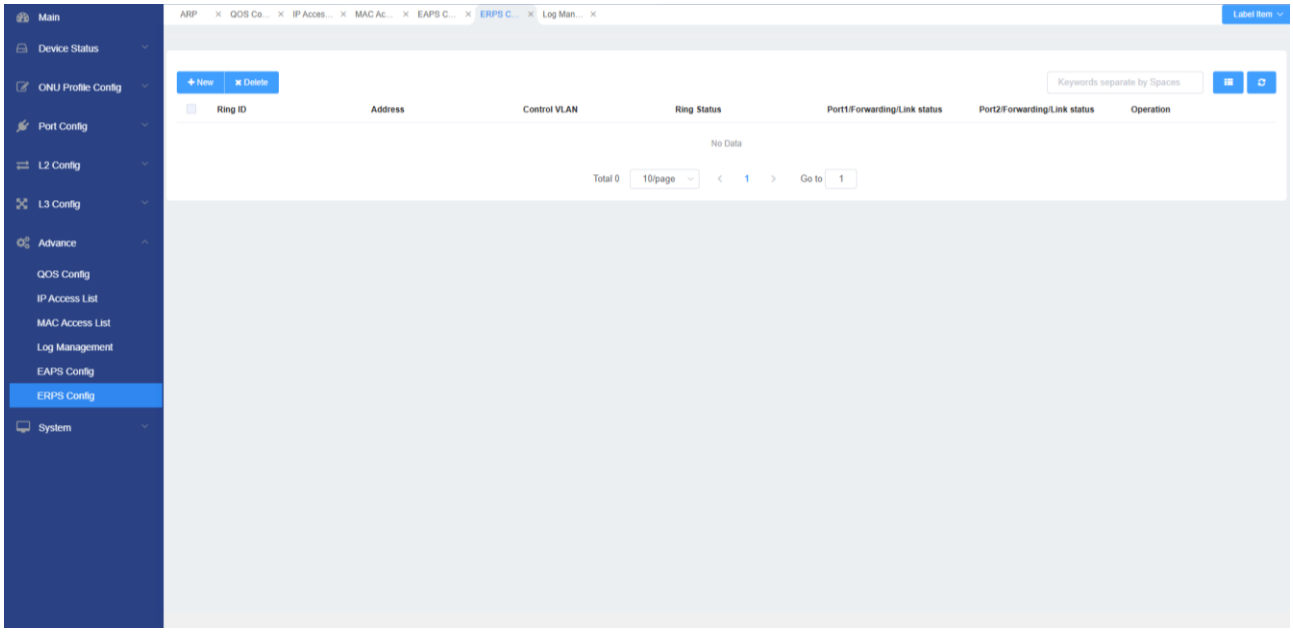
In the navigation bar, click Advanced Device Configuration, and then EAPS Configuration to enter the EAPS configuration page.



You can add, modify, and delete EAPS configurations based on the functions displayed on the page.

7.8.6 ERPS Configuration

In the navigation bar, click Advanced Device Configuration and ERP Configuration to enter the ERP configuration page.

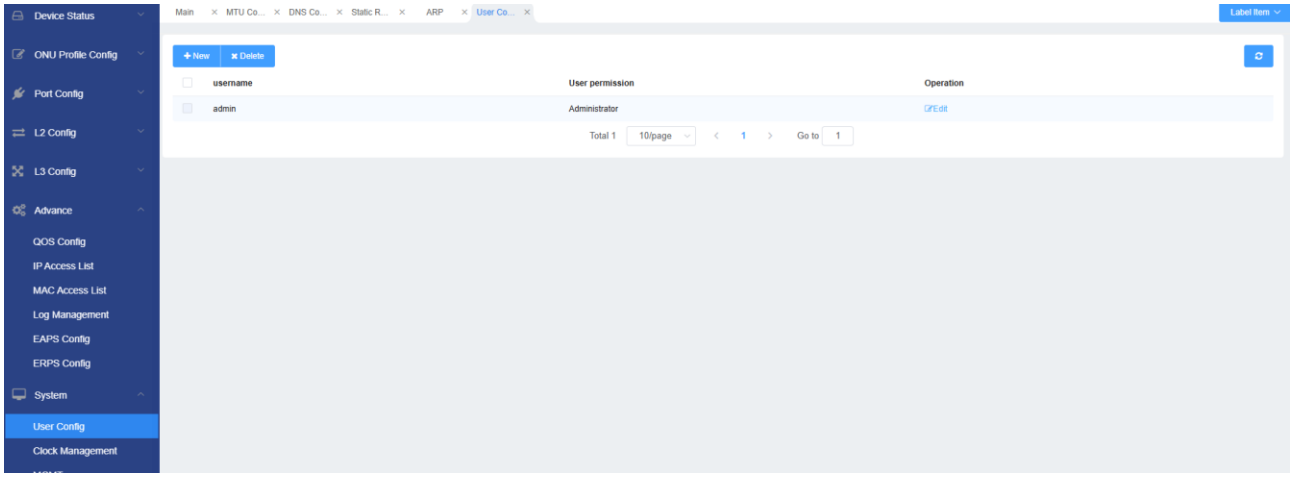


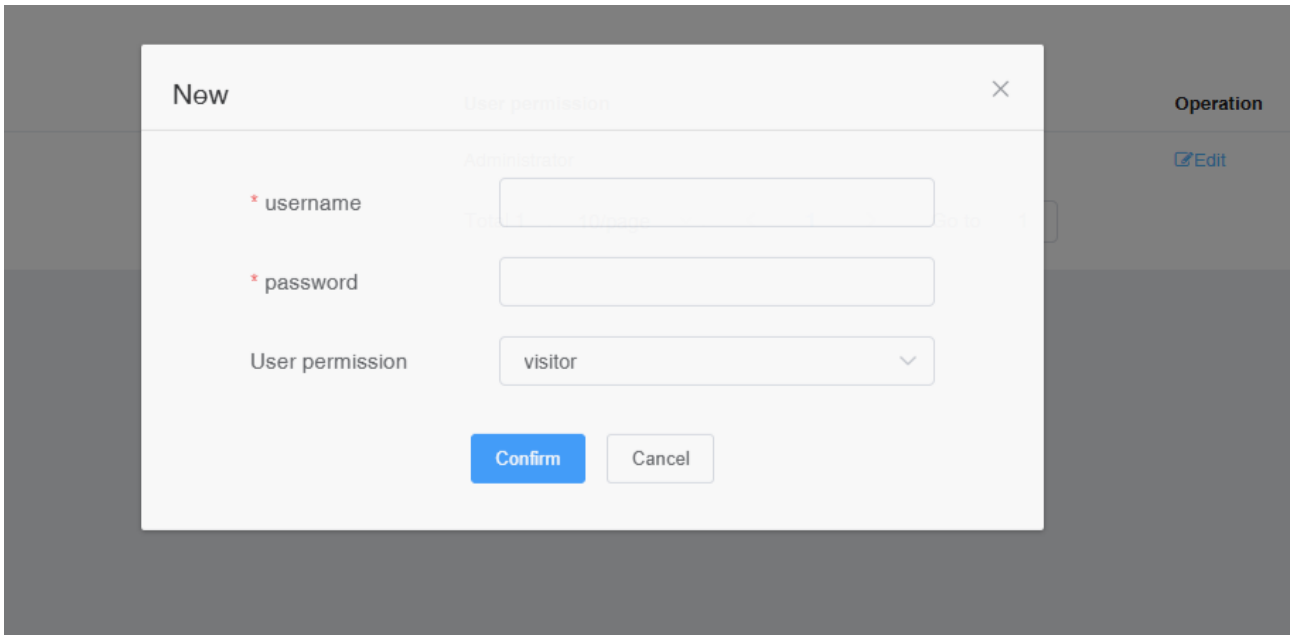
According to the functions displayed on the interface, the ERP configuration can be added, modified, and deleted accordingly.

7.9 System

7.9.1 User Config

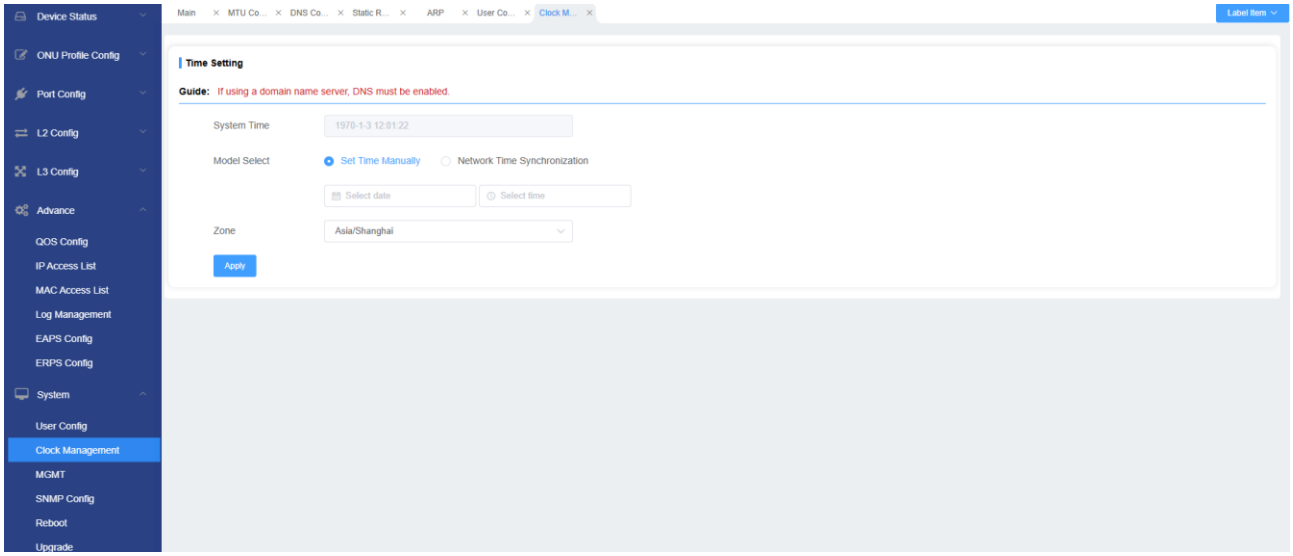
In the navigation bar, click System ，User Config to enter the user config page.





7.9.2 Clock Mangement

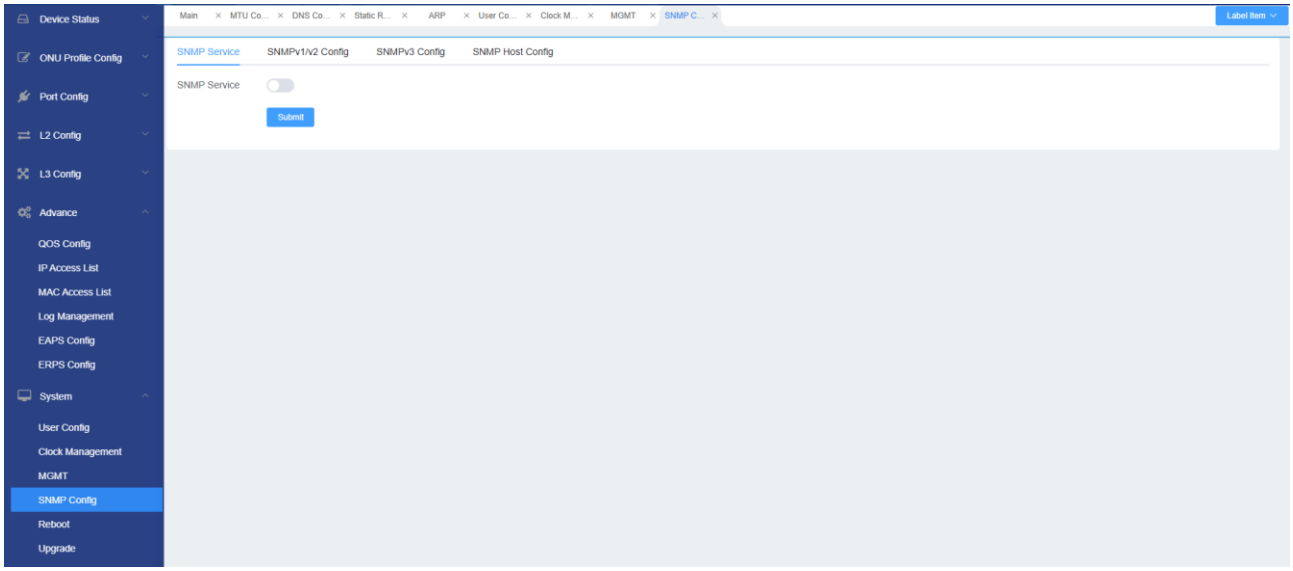
In the navigation bar, click System，Clock managment to enter the clock setting.

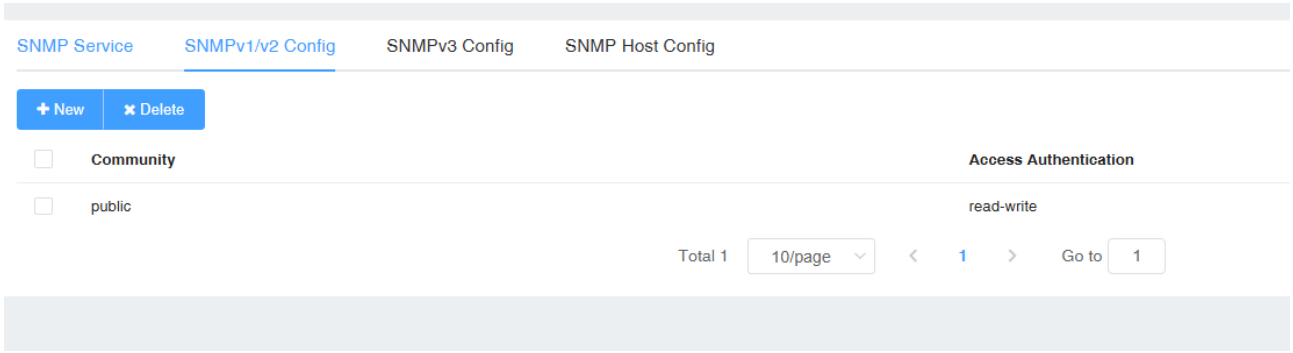


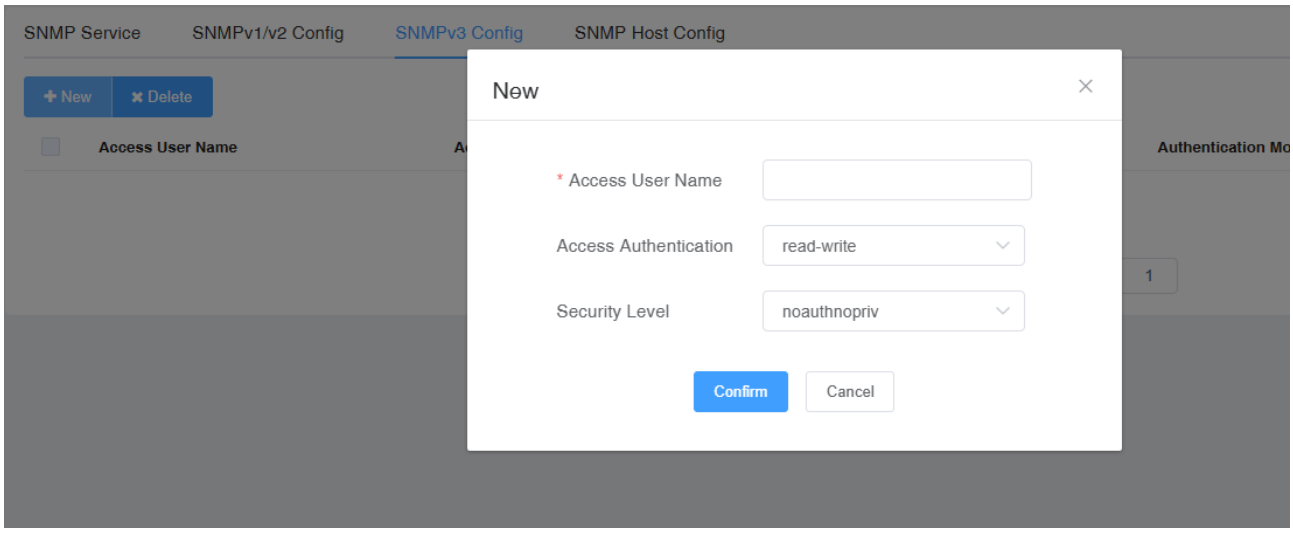
7.9.3 SNMP config

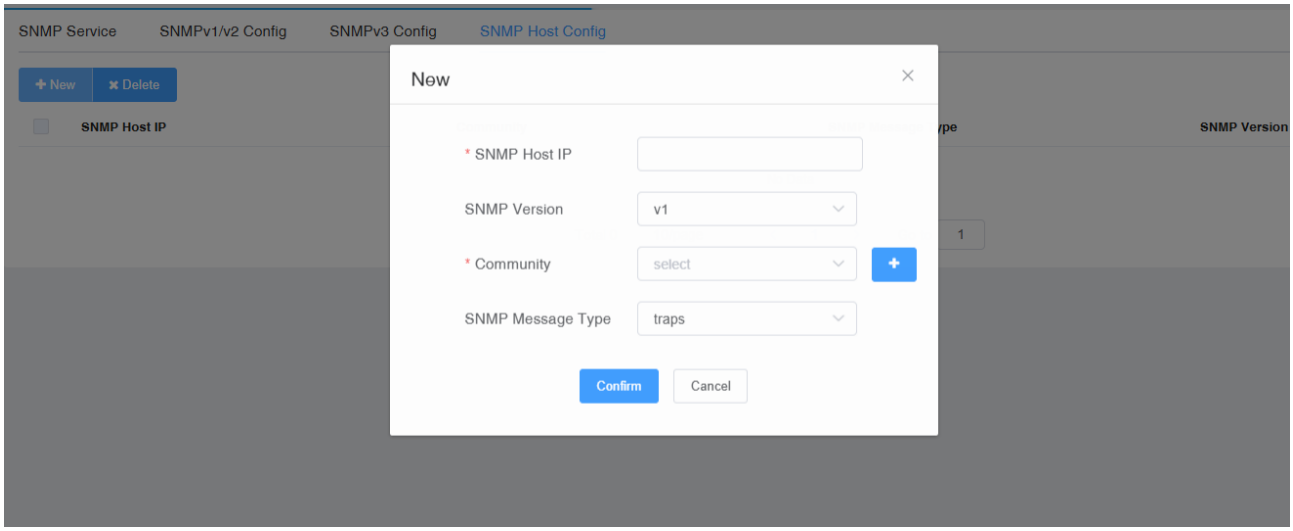
In the navigation bar, click System，snmp config to enter the snmp setting.

In this page can set snmp service/snmp community/snmpv1v2v3




SNMP Service
SNMPv1/v2 Config
SNMPv3 Config
SNMP Host Config
+ New
✖ Delete
Community
Access Authentication
public
read-write
Total 1
10/page
1
Go to
1

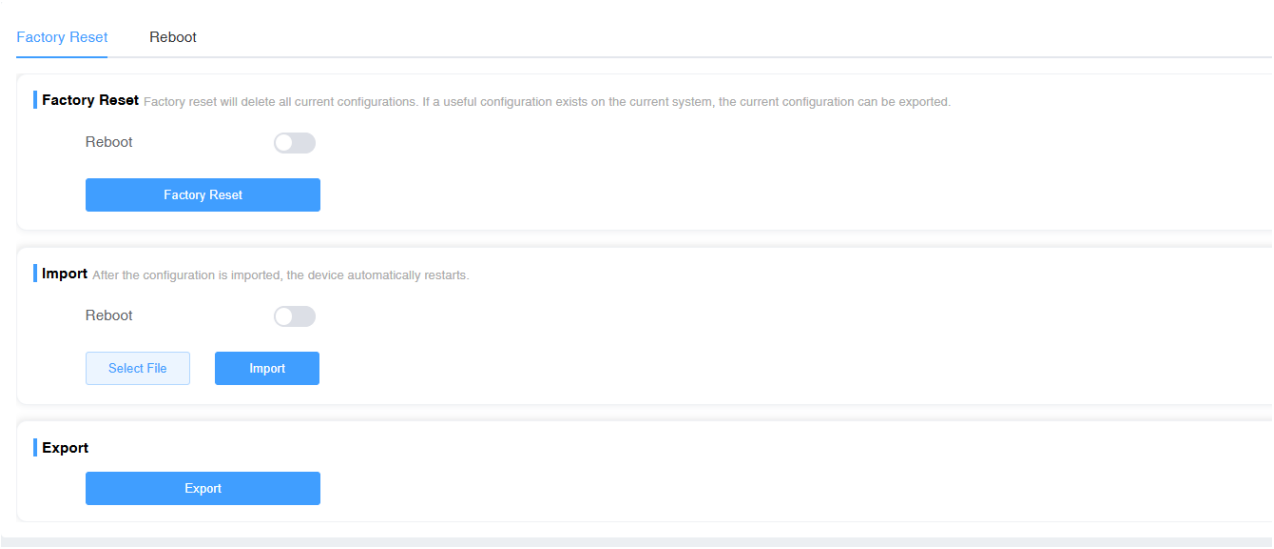

SNMP Service
SNMPv1/v2 Config
SNMPv3 Config
SNMP Host Config
+ New
✖ Delete
Access User Name
New
* Access User Name
Access Authentication
read-write
Security Level
noauthnopriv
Confirm
Cancel


SNMP Service
SNMPv1/v2 Config
SNMPv3 Config
SNMP Host Config
+ New
✖ Delete
SNMP Host IP
SNMP Version
New
* SNMP Host IP
SNMP Version
v1
* Community
select
SNMP Message Type
traps
Confirm
Cancel

7.9.4 System Reboot

7.9.4.1 Factory Reset

In the navigation bar, click "System", "System Restart", and then click the "Factory Reset" option above to enter the factory reset page.



Click "Factory Reset" to reboot the device and restore it to its initial state.

To import a configuration, you need to "Select File", select the correct configuration file, and then click "Import Configuration".

Click "Export Configuration" will back up the configuration file of the current device, and the file name is config.tar.xz.

Note：

The "Factory Reset" and "Import Configuration" operations need to restart the device to take effect, and it is recommended to select "Automatically restart the device after reset"

7.9.4.2 System Reboot

In the navigation bar, click "System" and "System Restart" to enter the restart device page.

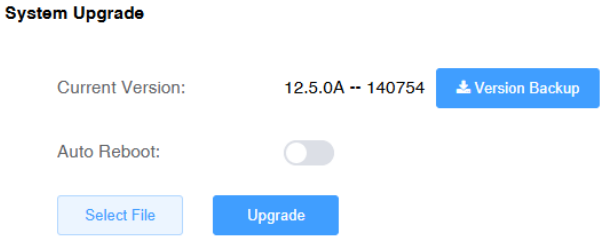
To restart your device, make sure your changes to the device configuration have been saved, and then click the "Restart Device" button.

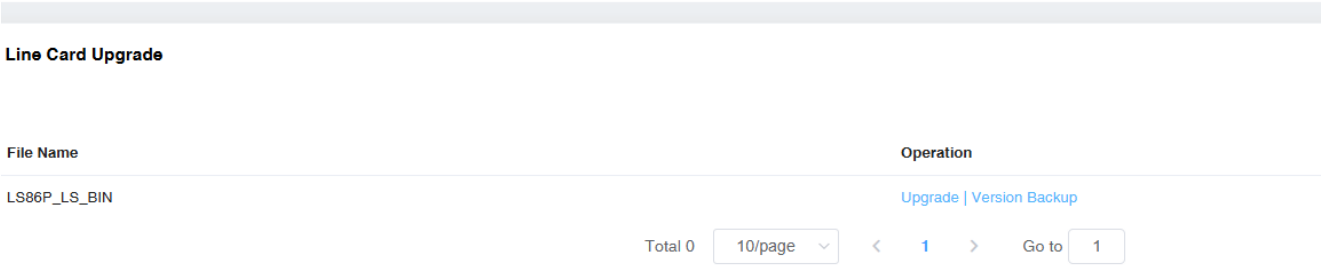
7.9.5 System Upgrade

In the navigation bar, click "System" and then "System Upgrade" to enter the system upgrade page.

System Upgrade

Note:



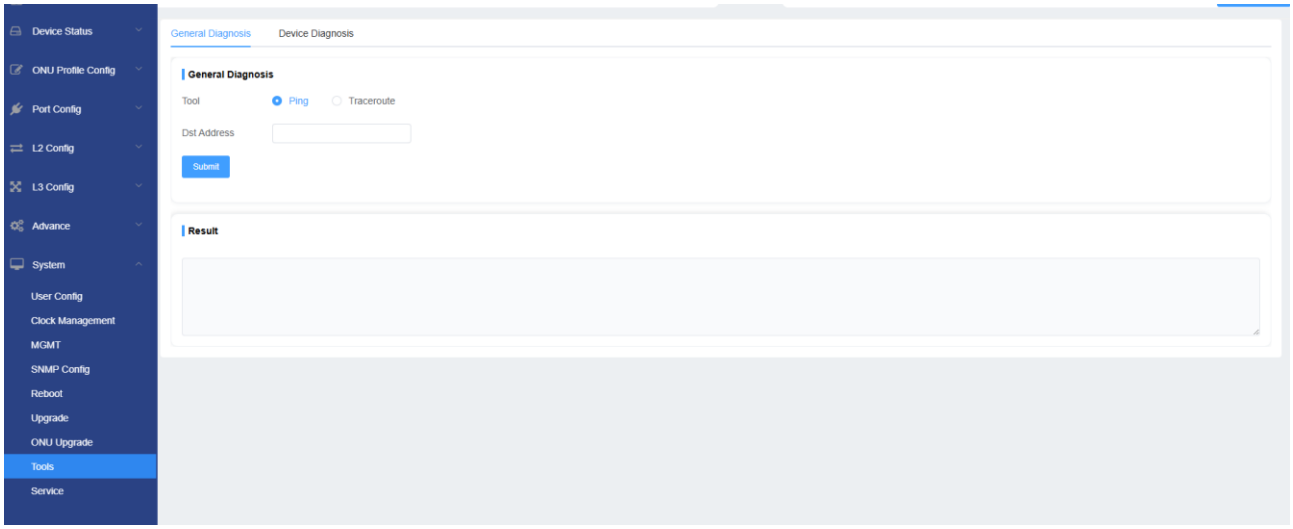


1. Please make sure that the system files you are upgrading match the device type, and the system files that do not match will cause the device to fail to boot normally.
2. It may take 3 to 5 minutes to upgrade the system file, click the "Confirm Upgrade" button and confirm, the file will be uploaded to the device, please wait patiently.
3. If there is an error during the upgrade process, do not restart or power off the device, otherwise the device may fail to boot. Please try the upgrade again later.
4. After the upgrade is completed, please save the configuration and restart the device to run the new system. Upgrading system software is often used to address known issues or to improve specific functionality, so if your device is functioning properly, you don't need to upgrade your system software as often.

7.9.6 Tools

7.9.6.1 General Diagnosis

In the navigation bar, click "System" and then "Diagnostic Tools" to enter the Ping page.



Ping is used to test whether the switch is connected to other devices.

If you need to do a ping test, enter an IP address, such as your computer's IP address, in the text box to the right of the "Destination Address" and click the "Submit" button. If the switch is connected to the address you entered, the device can quickly return the test result; If you can't connect, it will take a little longer for the device to return results.

8. Interface Configuration

8.1 Introduction

This section helps user to learn various kinds of interface that our switch supports and consult configuration information about different interface types.

For detailed description of all interface commands used in this section, refer to *Interface configuration command*. For files of other commands appeared in this section, refer to other parts of the manual.

The introduction includes communication information that can be applied to all interface types.

8.1.1 Supported Interface Types

For information about interface types, please refer to the following table.

Interface Type	Task	Reference
Uplink interface	Configures 10G uplink interface (tg0/0/x) Configures 100G uplink interface (cg0/0/x) Supports breakout configuration (10G/25G)	Configuring Ethernet Interface
PON interface	Configures XGS-PON interface (gpon0/0/x) Supports gpon pon-type mode switching (gpon/xgpon/xgspon-only)	Configuring PON Interface
Logical Interface	Loopback interface VLAN interface Aggregation interface	Configuring Logical Interface

The XGPL-16000 switch supports two categories of interfaces: uplink interfaces and logical interfaces.

Uplink interfaces refer to physical Ethernet ports that support high-speed transmission. These are based on the hardware module inserted, and typically support 10Gbps, 25Gbps, or 100Gbps rates.

The supported uplink interfaces on this model include:

- 10G Ethernet interface (tg0/0/x)
- 100G Ethernet interface (cg0/0/x)
- XGS-PON interface (gpon0/0/x)

Logical interfaces are virtual interfaces that do not correspond to a specific physical port. These are configured manually by the user for internal forwarding or management purposes.

The supported logical interfaces of our switch include:

- Loopback interface
- VLAN interface
- Aggregation interface (Link Aggregation Group, LAG)

8.1.2 Interface Configuration Introduction

The following description applies to the configuration process of all interfaces. Take the following steps to perform interface configuration in global configuration mode:

Run the **interface** command to enter the interface configuration mode and start configuring interface. At this time, the switch prompt becomes ‘config_’ plus the shortened form of the interface to be configured. Use these interfaces in terms of their numbers. Numbers are assigned during installation(exworks) or when an interface card are added to the system. Run the **show interface** command to display these interfaces. Each interface that the device supports provides its own state as follows:

```
OLT#show interface
tg0/0/1 is down, line protocol is down
   ifIndex is 1
   Hardware is 10Giga-FX, address is a8f7.e0e9.682a (bia a8f7.e0e9.682a)
   Encapsulation ARPA
   Full-duplex, 10000Mb/s, Flow-Control Off
   5 minutes input rate 0 bits/sec, 0 packets/sec
   Real time input rate 0.0%, 0 bits/sec, 0 packets/sec
   Real time output rate 0.0%, 0 bits/sec, 0 packets/sec
   peak input rate 0 bits/sec,
   peak output rate 0 bits/sec,
   Received 0 packets, 0 bytes
   0 broadcasts, 0 unicasts, 0 multicasts
   0 error, 0 PAUSE, 0 FCS
```

To configure a 10G interface:

```
OLT#show interface tg0/0/1
```

The switch prompt becomes config_tg0/0/1.

To configure an XGS-PON interface:

```
Show interface gpon0/0/1
gpon pon-type xgspon-only
```

To configure a 100G uplink port with breakout mode:

```
Show interface cg0/0/1
switchport flex-portmode seperate speed 10G
or
switchport flex-portmode seperate speed 25G
```

You can configure interface-specific commands in interface configuration mode. These commands define protocols and applications to be executed on the interface and will remain active until you exit the interface configuration mode or switch to another interface.

Once the interface configuration has been completed, use the show command in the following chapter 'Monitoring and Maintaining Interface' to test the interface status.

To quickly view all interface status in summary form, you may use:

show interface brief

This will list all port names, status, VLAN, speed and type.

There is no need to add a space between the interface type and the interface number.
For example, tg0/0/1 or gpon0/0/1 are both valid input formats.
Interface configuration commands can be entered while in interface configuration mode. These commands define the protocols or behaviors to be applied on the selected interface. Configuration remains active until the user exits the interface mode or switches to another interface.
Once the interface configuration has been completed, use the appropriate show commands (e.g., show interface, show interface brief) to verify the interface status. See the following chapter Monitoring and Maintaining Interface for details.

8.2 Interface Configuration

8.2.1 Configuring Interface Common Attribute

The following content describes the command that can be executed on an interface of any type and configures common attributes of interface. The common attributes of interface that can be configured include: interface description, bandwidth and delay and so on.

8.2.1.1 Adding Description

Adding description about the related interface helps to memorize content attached to the interface. This description only serves as the interface note to help identify uses of the interface and has no effect on any feature of the interface. This description will appear in the output of the following commands: **show running-config** and **show interface**. Use the following command in interface configuration mode if user wants to add a description to any interface.

Command	Description
description *string*	Adds description to the currently-configured interface.

For examples relevant to adding interface description, please refer to the following section 'Interface Description Example'.

8.2.1.2 Configuring Bandwidth

The upper protocol uses bandwidth information to perform operation decision. Use the following command to configure bandwidth for the interface:

Command	Description
bandwidth*kilobps*	Configures bandwidth for the currently configured interface.

The bandwidth is just a routing parameter, which doesn't influence the communication rate of the actual physical interface.

8.2.1.3 Configuring Time Delay

The upper protocol uses time delay information to perform operation decision. Use the following command to configure time delay for the interface in the interface configuration mode.

Command	Description
delay*tensofmicroseconds*	Configures time delay for the currently configured interface.

The configuration of time delay is just an information parameter. Use this command cannnot adjust the actual time delay of an interface.

8.2.2 Monitoring and Maintaining Interface

The following tasks can monitor and maintain interface:

- Checking interface state
- Initializing and deleting interface
- Shutting down and enabling interface

8.2.2.1 Checking Interface State

Our switch supports displaying several commands related to interface information, including version number of software and hardware, interface state. The following table lists a portion of interface monitor commands. For the description of these commands, please refer to 'Interface configuration command'.

Use the following commands:

Command	Description
show interface [type [slot|port]]	Displays interface state.
show running-config	Displays current configuration.

8.2.2.2 Initializing and Deleting Interface

You can dynamically establish and delete logical interfaces. This also applies to the sub interface and channalized interface. Use the following command to initialize and delete interface in global configuration mode:

Command	Description
no interface type [*slot*|*port*]	Initializes physical interface or deletes virtual interface.

8.2.2.3 Shutting down and Enabling Interface

When an interface is shut down, all features of this interface are disabled, and also this interface is marked as unavailable interface in all monitor command displays. This information can be transmitted to other switches via dynamic routing protocol.

Use the following command to shutdown or enable an interface in the interface configuration mode:

Command	Description
shutdown	Shuts down an interface.
no shutdown	Enables an interface.

You can use the **show interface** command and the **show running-config** command to check whether an interface has been shut down. An interface that has been shut down is displayed as 'administratively down' in the **show interface** command display. For more details, please refer to the following example in 'Interface Shutdown Example'.

8.2.3 Configuring Logistical Interface

This section describes how to configure a logical interface. The contents are as follows:

- Configuring null interface
- Configuring loopback interface.
- Configuring aggregation interface
- Configuring VLAN interface

8.2.3.1 Configuring Null Interface

The whole system supports only one null interface. Its functions are similar to those of applied null devices on most operating systems. The null interface is always available, but it never sends or receives communication information. The interface configuration command **no ip unreachable** is the only one command available to the null interface. The null interface provides an optional method to filtrate communication. That is, the unwanted network communication can be routed to the null interface; the null interface can function as the access control list.

You can run the following command in global configuration mode to specify the null interface:

Command	Description
interface null*0*	Enters the null interface configuration state.

The null interface can be applied in any command that takes the interface type as its parameter.

The following case shows how to configure a null interface for the routing of IP 192.168.20.0.

ip route 192.168.20.0 255.255.255.0 null 0

8.2.3.2 Configuring Loopback Interface

The loopback interface is a logistical interface. It always functions and continues BGP session even in the case that the outward interface is shut down. The loopback interface can be used as the terminal address for BGP session. If other switches try to reach the loopback interface, a dynamic routing protocol should be configured to broadcast the routes with loopback interface address. Messages that are routed to the loopback interface can be re-routed to the switch and be handled locally. For messages that are routed to the loopback interface but whose destination is not the IP address of the loopback interface, they will be dropped. This means that the loopback interface functions as the null interface.

Run the following command in global configuration mode to specify a loopback interface and enter the interface configuration state:

Command	Description
interface loopback*number*	Enter the loopback interface configuration state.

8.2.3.3 Configuring Aggregation Interface

The inadequate bandwidth of a single Ethernet interface gives rise to the birth of the aggregation interface. It can bind several full-duplex interfaces with the same rate together, greatly improving the bandwidth.

Run the following command to define the aggregation interface:

Command	Description
Interface port-aggregator *number*	Configures the aggregation interface

8.2.3.4 Configuring VLAN Interface

V VLAN interface is the routing interface in switch. The VLAN command in global configuration mode only adds layer 2 VLAN to system without defining how to deal with the IP packet whose destination address is itself in the VLAN. If there is no VLAN interface, this kind of packets will be dropped.

Run the following command to define VLAN interface:

Command	Description
Interface vlan*number*	Configures VLAN interface.

8.2.3.5 Configuring Super VLAN Interface

The Super VLAN technology provides a mechanism: hosts in different VLANs of the same switch can be allocated in the same Ipv4 subnet and use the same default gateway; lots of IP addresses are, therefore, saved. The Super VLAN technology puts different VLANs into a group where VLANs use the same management interface and hosts use the same IPv4 network section and gateway. VLAN belonging to Super VLAN is called as SubVLAN. No SubVLAN can possess the management interface by configuring IP address. You can configure a Super VLAN interface through a command line. The procedure of configuring a Super VLAN interface is shown as follows:

Command	Description
[no] interface supervlan*index*	Enter the Super VLAN interface configuration mode. If the specified Super VLAN interface does not exist, the system will create a Super VLAN interface. index is the index of the Super VLAN interface. Its effective value ranges from 1 to 32. no means to delete Super VLAN interface.
[no] subvlan[*setstr*] [add *addstr*][remove*remstr*]	Configure SubVLAN in Super VLAN. The added Sub VLAN cannot possess a management interface or cannot belong to other Super VLANs. In original state, Super VLAN does not contain any Sub VLAN. Only one sub command can only be used every time. setstr means to set the Sub VLAN list. For example, List 2,4-6 indicate VLAN 2, 4, 5 and 6. add means to add VLAN list in the original SubVLAN list. addstr means the character string whose format is the same as the above. remove means to delete VLAN list in the original SubVLAN list. remstr is the list's character string whose format is the same as the above. no means to delete all SubVLANs in SuperVLAN. The no command cannot be used with other sub commands.

After you configure the Super VLAN interface, you can configure the IP address for the Super VLAN interface. The Super VLAN interface is also a routing port, which can be configured as other ports are.

8.3 Interface Configuration Example

8.3.1 Configuring Public Attribute of Interface

8.3.1.1 Interface Description Example

The following example shows how to add description related to an interface. This description appears in the configuration file and interface command display.

interface vlan 1

ip address 192.168.1.23 255.255.255.0

8.3.1.2 Interface Shutdown Example

The following example shows how to shut down the Ethernet interface 0/1:

interface GigaEthernet0/1

shutdown

The following example shows how to enable the interface:

interface GigaEthernet0/1

no shutdown

8.3.1.3 Configuring PON Port Mode (XGS-PON / XG-PON / GPON)

The following examples show how to switch the working mode of a PON port (e.g. gpon0/0/1) between GPON, XG-PON, and XGS-PON.

Switching XGS-PON Port to GPON Mode

Switch> enable

Switch# config

Switch(config)# interface gpon0/0/1

Switch(config-gpon0/0/1)# gpon pon-type gpon

All GPON configuration including ONU configuration will be discarded, continue?(y/n)y

Switching PON Port to XG-PON Mode

Switch(config)# interface gpon0/0/1

Switch(config-gpon0/0/1)# gpon pon-type xgpon

All GPON configuration including ONU configuration will be discarded, continue?(y/n)y

Switching PON Port to XGS-PON Mode

Switch(config)# interface gpon0/0/1

Switch(config-gpon0/0/1)# gpon pon-type xgspon-only

All GPON configuration including ONU configuration will be discarded, continue?(y/n)y

8.3.1.4 Configuring Uplink Port Breakout Mode (10G / 25G)

The following example shows how to configure breakout speed for a 100G uplink port.

This setting allows the port to be split into multiple 10G or 25G logical interfaces.

Switch(config)# interface cg0/0/2

Switch(config-cg0/0/2)# switchport flex-portmode seperate speed 10G

Switch(config)# interface cg0/0/2

Switch(config-cg0/0/2)# switchport flex-portmode seperate speed 25G

9. Interface Range Configuration

9.1 Interface Range Configuration Task

9.1.1 Understanding Interface Range

In the process of configuring interface tasks, there are cases when you have to configure the same attribute on ports of the same type. In order to avoid repeated configuration on each port, we provide the **interface range** configuration mode. You can configure ports of the same type and slot number with the same configuration parameters. This reduces the workload.

when entering the **interface range** mode, all interfaces included in this mode must have been established.

9.1.2 Entering Interface Range Mode

Run the following command to enter the **interface range** mode.

Step	Command	Description
1	interface range*typeslot*/<*port1* - *port2* | port3>[, <port1 - port2|port3>]	Enters the range mode. All ports included in this mode accord to the following conditions: (1) The slot number is set to slot. (2) The port numbers before/after the hyphen must range between port1 and port2, or equal to port3. (3) Port 2 must be less than port 1 (4) There must be space before/after the hyphen or the comma.

10. Port Physical Characteristics Configuration

10.1Configuring the Ethernet Interface

The section describes how to configure the Ethernet interface. The switch supports the10Mbps Ethernet and the 100Mbps fastEthernet. The detailed configuration is shown as follows. The step described in section 1.1.1 is mandatory. Steps described in other sections are optional.

10.1.1 Selecting Ethernet Interface

Run the following command in global configuration mode to enter the Ethernet interface configuration mode:

Run…	To…
interface fastethernet [*slot*|*port*]	Enter the fastEthernet interface configuration mode
interface gigaethernet [*slot*|*port*]	Enter the gigabit Ethernet interface configuration mode.

You can run the **show interface fastethernet** command to display the state of fastEthernet interface. You can run the **show interface gigaethernet** command to display the state of the gigabit Ethernet interface.

10.1.2 Configuring Interface Speed

The uplink interfaces of the XGPL-16000 support high-speed fixed-rate operation based on the optical module used. Speed can be configured manually or based on port breakout mode.

Run…	To…
switchport flex-portmode seperate speed 10G	Configure the 100G port to operate in 10G breakout mode
switchport flex-portmode seperate speed 25G	Configure the 100G port to operate in 25G breakout mode
no switchport flex-portmode	Restore to default 100G mode

The uplink ports of XGPL-16000 support automatic transceiver detection.
SFP+ ports (tg0/0/x) automatically detect 1G or 10G transceivers
100G ports (cg0/0/x) automatically detect 40G or 100G transceivers
If port breakout is required (e.g., splitting a 100G port into 4 x 25G), use the switchport flex-portmode command.

10.1.3 Configuring Flow Control on the Interface

When the interface is in full-duplex mode, the flow control is achieved through the PAUSE frame defined by 802.3X. When the interface is in half-duplex mode, the flow control is achieved through back pressure.

Run…	To…
flow-control on/off	Enable or disable the flow control on the interface.
no flow-control	Resume the default settings. The default settings have no flow control.

11. Port Additional Characteristics Configuration

11.1 Configuring the Ethernet Interface

The switch supports the 10Mbps/100Mbps Ethernet interfaces. See the following content for detailed configuration. Among the configuration, the first step is mandatory while others are optional.

11.1.1 Configuring Flow Control for the Port

You can control the flow rate on the incoming and outgoing ports through configuration.

Run the following commands in previliged mode to limit the flow rate of the port.

Each band is defaulted as 128 kbps.

Command	Purpose
configure	Enters the global configuration mode.
interface f1/0	Enters the to-be-configured port.
[no] switchport rate-limit *band* { ingress|egress}	Configures the flow rate limits for the port. The parameter **band** represents the to-be-limited flow rate. The parameter **ingress** means the function works at the incoming port. The parameter **egress** means the function works at the outgoing port.
exit	Exits the global configuration mode.
exit	Returns the EXEC mode.

11.1.2 Comfiguring the Rate Unit for the Port

Run the following commands to modify the rate unit of the flow on a port. The rate unit can be one of these values: 16K, 64K, 128K, 1M, 10M and 40M.

Command	Purpose
Configure	Enters the global configuration mode.
[**no**] **rate-unit count**	Configures the rate unit for a port.
exit	Returns the EXEC mode.

11.1.3 Configuring the Storm Control on the Port

The ports of the switch may receives the attack by the continuous abnormal unicast (MAC address lookup failing), multicast or broadcast message. In this case, the attacked ports or the whole switch may break down. The storm control mechanism of the port is therefore generated.

Command	Purpose
storm-control {**broadcast** | **multicast** | **unicast**} **threshold count**	Performs the storm control to the broadcast/multicast/unicast message.
no storm-control {**broadcast** | **multicast** | **unicast**} **threshold**	Cancels the storm control.

11.2 Secure Port Configuration

11.2.1 Overview

You can control the access function of the secure port, enabling the port to run in a certain range according to your configuration. If you enable the security function of a port through configuring the number of secure MAC addresses for the port. If the number of secure MAC addresses exceeds the upper limitation and MAC addresses are insecure, secure port violation occurs. You should take actions according to different violation modes.

The secure port has the following functions:

- Configuring the number of secure MAC addresses
- Configuring static secure MAC addresses

  If the secure port has no static secure MAC address or the number of static secure MAC addresses is smaller than that of secure MAC addresses, the port will learn dynamic MAC addresses.
- Dropping violated packets when secure port violation occurs

The section describes how to configure the secure port for the switch.

11.2.2 Configuration Task of the Secure Port

- Configuring Secure Port Mode
- Configuring the Static MAC Address of the Secure Port

11.3 Configuring the Secure Port

11.3.1 Configuring the Secure Port Mode

There are two static secure port modes: accept and reject. If it is the **accept** mode, only the flow whose source address is same to the local MAC address can be received by the port for communication. If it is the **reject** mode, only the flow whose source address is different to the local MAC address can be received by the port.

Run the following commands in EXEC mode to enable or disable the secure port function:

Command	Purpose
configure	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[no] switchport port-security mode static {accept | reject}	Configures the secure port mode.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the configuration.

11.3.2 Configuring the Static MAC Address of the Secure Port

After you configure the static MAC address of the secure port, In **accept** mode, the flow whose source address is same to the local MAC address can be received by the port for communication. In **reject** mode, the flow whose source address is different to the local MAC address can be received by the port.

Run the following commands in EXEC modeto configure the static MAC address of the secure port:

Command	Purpose
configure	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[no] switchport port-security static mac-address *mac-addr*	Adds or deletes the static MAC address of the secure port. • ***mac-addr***is the configured MAC address.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the configuration.

12. Configuring Port Mirroring

Configuring Port Mirroring Task List

- Configuring port mirroring
- Displaying port mirroring information

12.1 Configuring Port Mirroring Task

12.1.1 Configuring Port Mirroring

Through configuring port mirroring, you can use one port of a switch to observe the traffic on a group of ports. Enter the privilege mode and perform the following steps to configure port mirroring:

Command	Description
configure	Enters the global configuration mode.
mirror session*session_number* {destination {interface*interface-id*} | source {interface*interface-id* [, | -]rx] }	Configures port mirroring. session-number is the number of the port mirroring. destination is the destination port of the mirroring. source is the source port of mirroring. rx means the input data of mirroring.
exit	Enters the management mode again.
write	Saves the configuration.

12.1.2 Displaying Port Mirroring Information

Run show to display the configuration information of port mirroring.

Command	Description
show mirror [session *session_number]*	Displays the configuration information about port mirroring. session-number is the number of the port mirroring.

13. Configuring MAC Address Attribute

13.1MAC Address Configuration Task List

- Configuring Static Mac Address
- Configuring Mac Address Aging Time
- Configring VLAN-shared MAC Address
- Displaying Mac Address Table
- Clearing Dynamic Mac Address

13.2MAC address Configuration Task

13.2.1 Configuring Static Mac Address

Static MAC address entries are MAC address entries that do not age by the switch and can only be deleted manually. According to the actual requirements during the operation process, you can add and delete a static MAC address. Use the following command in privileged level to add and delete a static MAC address.

Command	Purpose
configure	Enters the global configuration mode.
[no] mac address-table static*mac-addr*vlan *vlan-id*interface *interface-id*	Adds/deletes a static MAC address entry. Mac-addr indicates the MAC address. Vlan-id indicates the VLAN number. Valid value is from 1~4094. Interface-id indicates the interface name.
exit	Returns to EXEC mode.
write	Saves configuration.

13.2.2 Configuring MAC Address Aging Time

When a dynamic MAC address is not used during the specified aging time, the switch will delete this MAC address from the MAC address table. The aging time of the switch MAC address can be configured in terms of needs. The default aging time is 300 seconds.

Configure the aging time of MAC address in the privileged mode as follows:

Command	Purpose
configure	Enters the global configuration mode
mac address-table aging-time [0 | 10-1000000]	Configures the aging time of MAC address. 0 indicates no-age of the MAC address. Valid value is from 10 to 1000000 in seconds.
exit	Returns to the management mode.
write	Saves configuration.

13.2.3 Displaying MAC Address Table

Since debugging and management are required in operation process, we want to know content of the switch MAC address table. Use the show command to display content of the switch MAC address table.

Command	Purpose
show mac address-table {dynamic [interface interface-id | vlan vlan-id] | static}	Displays content of the MAC address table. Dynamic indicates the MAC address that acquires dynamically. Vlan-id indicates the VLAN number. Valid value is from 1 to 4094. Interface-id indicates the interface name. Static indicates the static MAC address table.

13.2.4 Clearing Dynamic MAC Address

The acquired MAC addresses need to be cleared in some circumstances.

Use the following command to delete a dynamic MAC address in privileged mode:

Command	Purpose
clear mac address-table dynamic [address*mac-addr* | interface*interface-id* | vlan*vlan-id*]	Deletes a dynamic MAC address entry. Dynamic indicates the MAC address that dynamically acquires. Mac-addr is the MAC address. Interface-id indicates the interface name. Vlan-id indicates the VLAN number. Valid value is from 1 to 4094.

14. Configuring MAC List

14.1MAC List Configuration Task

14.1.1 Creating MAC List

To apply the MAC list on the port, you must first create the MAC list. After the MAC list is successfully created, you log in to the MAC list configuration mode and then you can configure items of the MAC access list.
Perform the following operations to add and delete a MAC list in privilege mode:

Run…	To…
configure	Log in to the global configuration mode.
[**no**] **mac access-list***name*	Add or delete a MAC list. **name** means the name of the MAC list.

14.1.2 Configuring Items of MAC List

You can use the permit or deny command to configure the permit or deny items of the MAC list. Multiple permit or deny items can be configured on a MAC list.
The mask of multiple items configured in a MAC list must be the same. Otherwise, the configuration may be out of effect (see the following example). The same item can only be configured once in the same MAC address.
Perform the following operations in MAC list configuration mode to configure the items of the MAC list:

Run…	To…
[no] {deny | permit} {**any** | **host** *src-mac-addr*} {**any** | **host** *dst-mac-addr*}**[**ethertype**]**	Add/Delete an item of the MAC list. You can rerun the command to add or delete multiple items of the MAC list. **any** means any MAC address can be compatible; **src-mac-addr** means the source MAC address; **dst-mac-addr** means the destination MAC address. **ethertype** means the type of matched Ethernet packet.
exit	Log out from the MAC list configuration mode

	and enter the global configuration mode again.
exit	Enter the management mode again.
write	Save configuration.

MAC list configuration example

Switch_config#mac acce 1

Switch-config-macl#permit host 1.1.1 any

Switch-config-macl#permit host 2.2.2 any

The above configuration is to compare the source MAC address, so the mask is the same. The configuration is successful.

Switch_config#mac acce 1

Switch-config-macl#permit host 1.1.1 any

Switch-config-macl#permit any host 1.1.2

Switch-config-macl#2003-11-19 18: 54: 25 rule conflict,all the rule in the acl should match!

The first line on the above configuration is to compare source MAC addresses, while the second line is to compare destination MAC addresses. Therefore, the mask is different. The configuration fails.

14.1.3 Applying MAC List

The created MAC list can be applied on any physical port. Only one MAC list can be applied to a port. The same MAC list can be applied to multiple ports.

Enter the privilege mode and perform the following operation to configure the MAC list.

Run…	To…
configure	Enter the global configuration mode.
interface f0/1	Log in to the port that is to be configured.
[**no**] **mac access-group** *name*	Apply the created MAC list to the port or delete the applied MAC list from the port. **name** means the name of the MAC list.
exit	Enter the global configuration mode again.
exit	Enter the management mode again.
write	Save configuration.

15. Configuring 802.1x

15.1 802.1x Configuration Task List

- Configuring 802.1x port authentication
- Configuring 802.1x multiple port authentication
- Configuring maximum times for 802.1x ID authentication
- Configuring 802.1x re-authentication
- Configuring 802.1x transmission frequency
- Configuring 802.1x user binding
- Configuring authentication method for 802.1x port
- Selecting authentication type for 802.1x port
- Configuring 802.1x accounting
- Configuring guest-vlan
- Forbidding Supplicant with multiple network cards
- Resuming default 802.1x configuration
- Monitoring 802.1x authentication configuration and state

15.2 802.1x Configuration Task

15.2.1 Configuring 802.1x Port Authentication

802.1x defines three control methods for the port: mandatory authentication approval, mandatory authentication disapproval and 802.1x authentication startup.

Mandatory authentication approval means the port has already passed authentication. The port does not need any authentication any more, and all users can perform dara access control through the port. The authentication method is defaulted by the port. Mandatory authentication disapproval means the port authentication does not get passed no matter what kind of method is applied. No user can perform the data access control through the port.

802.1x authentication startup means the port is to run 802.1x authentication protocol. 802.1x authentication will be applied to users who access the port. Only users who pass the authentication can perform data access control through the port. After the 802.1x authentication is started up, the AAA authentication method must be configured.

Run the following command to enable the 802.1x function before configuring 802.1x:

Run…	To…
dot1x enable	Enable the 802.1x function.

Run the following command to start up the 802.1x authentication:

Run…	To…
dot1x port-control auto	Configure the 802.1x protocol control method on the port.
aaa authentication dot1x {default |list name} method	Configure the AAA authentication of 802.1x.

Run one of the following commands in port configuration mode to select 802.1x control method:

Run…	To…
dot1x port-control auto	Start up the 802.1x authentication method on the port.
dot1x port-control force-authorized	Approve the mandatory port authentication.
dot1x port-control force-unauthorized	Disapprove the mandatory port authentication.

15.2.2 Configuring 802.1x Multiple Port Authentication

802.1x authentication is for the authentication of single host user. In this case, the switch allows only one user to perform authentication and access control. Other users cannot be authenticated and access unless the previous user exits authentication and access. In the case the port connects multiple hosts through switch devices, such as 1108 switch, that do not support 802.1x, you can start up the multiple port access function to make sure that all host users can access.

After a port is configured to multiple host authentication of 802.1x, the switch authenticates different host users. When authentication is approved, the host will be allowed to access through the switch (the MAC address of host is used for control). Theoretically, 802.1x cannot limit the number of host users. Because the switch controls the user authentication through the MAC address of user, the number of host users will be limited by the size of the MAC address table of the switch.

Run the following command in interface configuration mode to activate 802.1x multiple host authentication:

Run…	To…
dot1x multiple-hosts	Set the 802.1x multiple port authentication.

15.2.3 Configuring Maximum Times for 802.1x ID Authentication

When 802.1x authentication starts or 802.1x authentication is being performed again, 802.1x sends ID authentication request to guest hosts. If the request message is dropped or delayed because network problems, the requirement message will be sent again. If the message is resent certain times, 802.1x stops to send the message and the ID authentication fails.

You can reset the maximum times of ID authentication request according to different network conditions, ensuring the clients are authenticated successfully by the authentication server.

Run the following command in interface configuration command to set the maximum times for ID authentication request:

Run…	To
dot1x max-req *count*	Set the maximum times for ID authentication request.

15.2.4 Configuring 802.1x Re-authentication

After first authentication is approved, the client will be authenticated every a certain time to ensure the legality of the client. In this case, the re-authentication function needs to be enabled.

After the re-authentication function is enabled, 802.1x will periodically send the authentication request to the host.

You can run the following commands to configure the re-authentication function.

Run…	To…
dot1x re-authentication	Enable the re-authentication function.
dot1x timeout re-authperiod *time*	Configure the period of re-authentication.
dot1x reauth-max *time*	Configure the retry times after the re-authentication fails.

15.2.5 Configuring 802.1x Transmission Frequency

In the process of 802.1x authentication, data texts will be sent to the host. The data transmission can be adjusted by controlling 802.1x transmission frequency so that the host response is successful.

Run the following command to configure the transmission frequency:

Run…	To…
dot1x timeout tx-period *time*	Set the message transmission frequency of 802.1x.

15.2.6 Configuring 802.1x User Binding

When 802.1x authentication is performed, you can bind a user to a certain port to ensure the security of port access. Run the following command in interface configuration mode to start up 802.1x user binding.

Run…	To…
dot1x user-permit*xxxz*	Configure a user that is bound to a port.

15.2.7 Configuring Authentication Method for 802.1x Port

The 802.1x authentication can be performed in different methods at different ports. In the default configuration, the 802.1x authentication adopts the **default** method.

Run the following command in interface configuration mode to configure the method of the 802.1x authentication:

Run…	To…
dot1x authentication method *yyy*	Configure the method of the 802.1x authentication.

15.2.8 Selecting Authentication Type for 802.1x Port

You can select the type for the 802.1x authentication. The 802.1x authentication type determines whether AAA uses Chap authentication or Eap authentication. Eap authentication supports the md5-challenge mode and the eap-tls mode. Challenge required by MD5 is generated locally when the Chap authentication is adopted, while challenge is generated at the authentication server when the eap authentication is adopted. Each port adopts only one authentication type. The authentication type of global configuration is adopted by default. Once a port is set to an authentication type, the port will use the authentication type unless you run the **No** command to resume the default value.

Eap-tls takes the electronic certificate as the authentication warrant and complies with the handshake rules in Translation Layer Security (tls). Therefore, high security is guaranteed.

Run the following command in global configuration mode to configure the authentication type:

Run…	To…
dot1x authen-type {**chap**|**eap**}	Select chap or eap.

Also run the following command in interface configuration mode:

Run…	To…
dot1x authentication type {**chap**|**eap**}	Select chap or eap or the configured authentication type in global mode.

15.2.9 Configuring 802.1x Accounting

The 802.1x authentication and 802.1x accounting can be performed at the same time. It working mechanism is: after the dot1x authentication is approved, judge whether the accounting function is enabled on the authentication interface; if the accounting function is enabled, send the accounting request through the AAA interface; when the AAA module returns successful request response message, the AAA interface can forward texts.

The accounting can adopt various accounting methods configured in the AAA module. For details, refer to AAA configuration.

After the beginning of accounting, dot1x periodically sends **update** message to the server through the AAA interface for obtaining correct accounting information. According to different AAA configuration, the AAA module decides whether to send the **update** message.

At the same time, You are required to enable the dot1x re-authentication function so that the switch can know when supplicant is abnormal.

Run the following commands in interface configuration mode to enable the dot1x accounting and to configure the accounting method:

Run…	To…
dot1xaccounting enable	Enable the dot1x accounting.
dot1x accounting method {*method name***}**	Configure the accounting method. Its default value is **default**.

15.2.10 Configuring 802.1x guest-vlan

Guest-vlan gives releavant ports some access rights (such as downloading client software) when the client does not respond. Guest-vlan can be any configured vlan in the system. If the configured guest-vlan does not meet the conditions, ports cannot run in the guest-vlan.

There is no access right if the authentication fails.

Run the following command in the global mode to enable the guest-vlan:

Run…	To…
Dot1x guest-vlan	Enable the guest-vlan at all ports.

When the original value of **guest-vlan id** at each port is 0, guest-vlan cannot function even if guest-vlan is enabled in global mode. Only when **guest-vlan id** is configured in port configuration mode, guest-vlan can function.

Run the following command in port configuration mode to configure **guest-vlan id**:

Run…	To…
Dot1x guest-vlan {id(1-4094)}	Enable guest-vlan at all ports.

15.2.11 Forbidding Supplicant with Multiple Network Cards

Forbid the Supplicant with multiple network adapters to prevent agents. Run the following command in port configuration mode:

Run…	To…
dot1x forbid multi-network-adapter	Forbid the Supplicant with multiple network adapters.

15.2.12 Resuming Default 802.1x Configuration

Run the following command to resume all global configuration to default configuration:

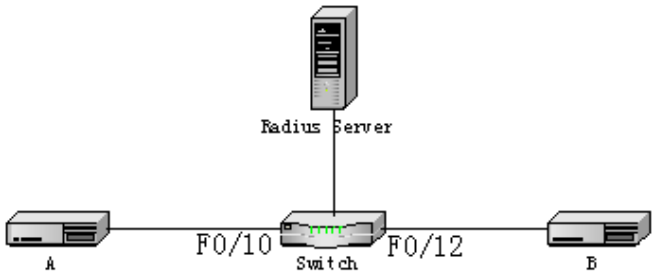
Run…	To…
dot1x default	Resume all global configuration to default configuration.

15.2.13 Monitoring 802.1x Authentication Configuration and State

To monitor the configuration and state of 802.1x Authentication and decide which 802.1x parameter needs to be adjusted, run the following command in management mode:

Run…	To…
show dot1x {*interface* ….}	Monitor the configuration and state of 802.1x authentication.

15.3 802.1x Configuration Example



Host A connects port F0/10 of the switch. Host B connects port F0/12. The IP address of the radius-server host is 192.168.20.2. The key of radius is TST. Port F0/10 adopts remote radius authentication and user binding. Port F0/12 adopts local authentication of eap type, and Multi-hosts are enabled at Port F0/12.

Global configuration

username switch password 0 TST

username TST password 0 TST

aaa authentication dot1x TST-F0/10 radius

aaa authentication dot1x TST-F0/12 local

interface VLAN1

ip address 192.168.20.24 255.255.255.0

radius-server host 192.168.20.2 auth-port 1812 acct-port 1813

radius-server key TST

Configuring port F0/10

interface FastEthernet0/10

dot1x port-control auto

dot1x authentication method TST-F0/10

dot1x user-permit radius-TST

Configuring port F0/12

interface FastEthernet0/12

dot1x multiple-hosts

dot1x port-control auto

dot1x authentication method TST-F0/12

dot1x authentication type eap

16. VLAN Configuration

16.1 VLAN Introduction

Virtual LAN (VLAN) refers to a group of logically networked devices on one or more LANs that are configured so that they can communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments. In 1999 IEEE established IEEE 802.1Q Protocol Standard Draft used to standardize VLAN realization project. Because VLANs are based on logical instead of physical connections, it is very flexible for user/host management, bandwidth allocation and resource optimization.

There are the following types of Virtual LANs:

- Port-Based VLAN: each physical switch port is configured with an access list specifying membership in a set of VLANs.
- 802.1Q trunk mode is supported on the interface.
- Access mode interface is supported.
- Port-Based Vlan is to ascribe port to one subset of vlan that the switch supports. If this vlan subset has only one vlan, then this port is access port. If this vlan subset has multiple vlan, then this port is trunk port. There is one default vlan among the multiple vlan, and the vlan id is the port vlan id (PVID).
- Vlan-allowed range is supported on the interface.
- Vlan-allowed parameter is used to control vlan range that the port belongs. Vlan-untagged parameter is used to configure port to send packets without vlan tag to the corresponding vlan.

16.2 VLAN Configuration Task List

- Adding/Deleting VLAN
- Configuring switch port
- Creating/Deleting VLAN interface
- Monitoring configuration and state of VLAN

16.3 VLAN Configuration Task

16.3.1 Adding/Deleting VLAN

A virtual LAN, commonly known as a VLAN, is a group of hosts with a common set of requirements that communicate as if they were attached to the same wire, regardless of their physical location. A VLAN has the same attributes as a physical LAN, but it allows for end stations to be grouped together even if they are not located on the same LAN segment. A VLAN may have multiple ports and all unicast, multicast and broadcast message can only be forwarded from the same VLAN to the terminal. Each VLAN is a logistical network. If the data wants to reach another VLAN, it must be forwarded by router or bridge.

Run the following command to configure VLAN

Run…	To…
vlan vlan-id	Enter the VLAN configuration mode.
name str	Name in the vlan configuration mode.
Exit	Exit vlan configuration mode, and establish vlan.
vlan vlan-range	Establish multiple VLANs at the same time.
no vlan vlan-id | vlan-range	Delete one or multiple VLANs.

Vlan can perform dynamic addtion and deletion via vlan management protocol GVRP.

16.3.2 Configuring Switch Port

The switch port supports the following modes: access mode, trunk mode and dot1q-tunnel mode.

- The access mode indicates that this port is only subordinate to one vlan and only sends and receives untagged ethernet frame.
- The trunk mode indicates that this port is connected to other switches and can send and receive tagged ethernet frame.
- The dot1q-tunnel mode takes uncontionally the received packets as the ones without tag. The switch chip automatically adds pvid of the port as the new tag, therefore allowing switch to ignore the different vlan partitions that connected to the network. Then the packet will be delivered unchangedly to the other port in the other subnetwork of the same customer. The transparent transmission is realized in this way.

Each port has one default vlan and pvid,and all the data without vlan tag received on the port belong to the data packets of the vlan.

Trunk mode can ascribe port to multiple vlan and also can configure which kind of packet to forward and the number of vlan that belongs, that is, the packet sent on the port is tagged or untagged, and the vlan list that the port belongs.

Run the following command to configure the switch port:

Run…	To…
switchport pvid *vlan-id*	Configure pvid of switch port.
switchport mode access|trunk|dot1q-tunnel	Configure port mode of the switch.
switchport trunk vlan-allowed …	Configure vlan-allowed range of switch port.
switchport trunk vlan-untagged …	Configure vlan-untagged range of switch port.

Note

Not all switches support dot1q-tunnel feature. Some switches only support globally enabling/disabling this feature, and cannot configure different strategies for different ports.

The command to globally enable dot1q-tunnel is as follows:

Command	Description
double-tagging	Globally enables double-tagging feature of the switch.

16.3.3 Creating/Deleting VLAN Interface

Vlan interface can be established to realize network management or layer 3 routing feature. The vlan interface can be used to specify ip address and mask. Run the following command to configure vlan interface:

Run…	To…
[no] interface vlan *vlan-id*	Create/Delete a VLAN interface.

16.3.4 Configuring Super VLAN Interface

The Super VLAN technology provides a mechanism: Hosts in different VLANs that run the same switch can be allocated in the same Ipv4 subnet; lots of IP addresses are, therefore, saved. The Super VLAN technology classifies different VLANs into a group. The VLANs in this group uses the same management interface. Hosts in the group use the same IPv4 network section and gateway. VLAN belonging to Super VLAN is called as SubVLAN. No SubVLAN can possess the management interface by configuring IP address.
You can configure a Super VLAN interface through the command line. The procedure of configuring a Super VLAN interface is shown as follows:

Command	Description
[no] interface supervlan*index*	Enters the interface configuration mode . If the specified Super VLAN interface does not exists, the system will create a Super VLAN interface. index is the index of Super VLAN interface. Its effective value ranges from 1 to 32. no means deleting Super VLAN interface.
[no] subvlan[*setstr*] [add *addstr*] [remove *remstr*]	Configures SubVlan in Super VLAN. The added Sub VLAN cannot possess the management interface. In original state, Super VLAN does not include Sub VLAN. Only one sub command can be used every time. setstr means to set the Sub VLAN list. For example, List 2,4-6 indicate VLAN 2, 4, 5 and 6. add means to add VLAN list in the original SubVLAN list. addstr means the character string whose format is the same as the above. remove means to delete VLAN list in the original SubVLAN list. remstr is the list's character string whose format is the same as the above. no means to delete all SubVLANs in SuperVLAN. The no command cannot be used with other sub commands.

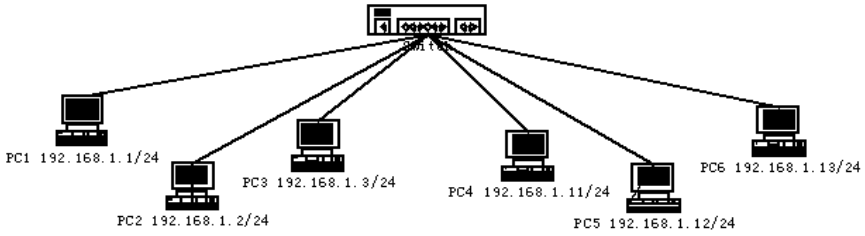
After you configure the Super VLAN interface, you can configure the IP address for the Super VLAN interface. The Super VLAN interface is also a routing port, which can be configured as other ports are.

16.3.5 Monitoring Configuration and State of VLAN

Run the following commands in EXEC mode to monitor configuration and state of VLAN:

Run…	To…
show vlan [id*x* | interface*intf*]	Display configuration and state of VLAN.
show interface {vlan | supervlan} *x*	Display the states of vlan ports.

16.4Configuration Examples



Users PC1~PC6 connect the switch through ports 1~6. The IP addresses of these PCs belong to the network section 192.168.1.0/24. Though group PC1~PC3 and group PC4~PC6 are located at different layer-2 broadcast domains, PC1~PC6 can ping each other and manage the switch through the IP address 192.168.1.100. To do this, you need to configure port 1~3 to VLAN1 and port 4~6 to VLAN. Then you need to add VLAN 1 and 2 to a SuperVlan as its SubVLANs. You need to perform the following configuration on the switch:

interface fastethernet 0/4

switchport pvid 2

!

interface fastethernet 0/5

switchport pvid 2

!

interface fastethernet 0/6

switchport pvid 2

!

interface supervlan 1

subvlan 1,2

ip address 192.168.1.100 255.255.255.0

ip proxy-arp subvlan

17. GVRP Configuration

17.1Configuring GVRP

17.2Introduction

GVRP (GARP VLAN Registration Protocol GARP VLAN) is a GARP (GARP VLAN Registration Protocol GARP VLAN) application that provides IEEE 802.1Q-compliant VLAN pruning and dynamic VLAN creation on 802.1Q trunk ports.

With GVRP, the switch can exchange the VLAN configuration information with the other GVRP switches, prune the unnecessary broadcast and unknown unicast traffic, and dynamically create and manage the VLANs on the switches that are connected through the 802.1Q trunk ports.

17.3 Configuring Task List

17.3.1 GVRP Configuration Task List

- Enabling/Disabling GVRP Globally
- Enabling/Disabling GVRP on the Interface
- Monitoring and Maintenance of GVRP

17.4 GVRP Configuration Task

17.4.1 Enabling/Disabling GVRP Globally

Perform the following configuration in global configuration mode.

Command	Description
[no] gvrp	Enables/disables GVRP globally.

It is disabled by default.

17.4.2 Enabling/Disabling GVRP on the Interface

Perform the following configuration in interface configuration mode:

Command	Description
[no] gvrp	Enables/disables interface GVRP.

In order for the port to become an active GVRP participant, you must enable GVRP globally first and the port must be an 802.1Q trunk port,
It is enabled by default.

17.4.3 Monitoring and Maintenance of GVRP

Perform the following operations in EXEC mode:

Command	Description
show gvrp statistics [interface port_list]	Displays GVRP statistics.
show gvrp status	Displays GVRP global state information.
[no] debug gvrp [packet | event]	Enables/disables GVRP data packet and event debug switches. All debug switches will be enabled/disabled if not specified the concrete switch.

Display GVRP statistics:

switch#show gvrp statistics interface Tthernet0/1

GVRP statistics on port Ethernet0/1

GVRP Status: Enabled

GVRP Failed Registrations: 0

GVRP Last Pdu Origin: 0000.0000.0000

GVRP Registration Type: Normal

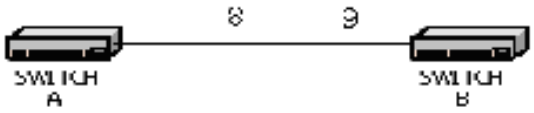
Display GVRP global state information:

switch#show gvrp status

gvrp is enabled!

17.5Configuration Example

The network connection is as follows. In order to make the VLAN configuration information of Switch A and Switch B identical, you can enable GVRP on Switch A and Switch B. The configuration is as follows:



(1) Configure the interface 8 that Switch A connects to Switch B to trunk:

Switch_config_g0/8# switchport mode trunk

(2) Enable global GVRP of switch A:

Switch_config#gvrp

(3) Enable GVRP of interface 8 of Switch A:

Switch_config_g0/8#gvrp

(4) Configure VLAN 10, Vlan 20 and Vlan30 on Switch A

Switch_config#vlan 10

Switch_config#vlan 20

Switch_config#vlan 30

(5) Configure the interface 9 that Switch A connects to Switch B to trunk:

Switch_config_g0/9# switchport mode trunk

(6) Enable global GVRP of switch B:

Switch_config#gvrp

(7) Enable GVRP of interface 9 of Switch B

Switch_config_g0/9#gvrp

(8) Configure VLAN 40, Vlan 50 and Vlan60 on Switch B

Switch_config#vlan 40

Switch_config#vlan 50

Switch_config#vlan 60

After completing the configuration, the VLAN configuration information will be displayed respectively on Switch A and Switch B, that is, VLAN10, VLAN20,VLAN30, VLAN40, VLAN50 and VLAN60 on both switches.

18. Private VLAN Settings

18.1 Private VLAN Settings

18.2 Overview of Private VLAN

Private VLAN has settled the VLAN application problems facing ISPs: If ISP provides each user with a VLAN, the support by each device of 4094 VLANs will restrict the total of ISP-supported users.

18.3 Private VLAN Type and Port Type in Private VLAN

Private VLAN subdivides the L2 broadcast domain of a VLAN into multiple sub-domains, each of which consists of a private VLAN pair: a primary VLAN and a secondary VLAN. One private VLAN domain may have multiple private VLAN pairs and each private VLAN pair stands for a sub-domain. There is only one primary VLAN in a private VLAN domain and all private VLAN pairs share the same primary VLAN. The IDs of secondary VLANs in each sub-domain differ with each other.

18.3.1 Having One Primary VLAN Type

- Primary VLAN: It is relevant to a promiscuous port and only one primary VLAN exists in the private VLAN. Each port in the primary VLAN is a member in the primary VLAN.

18.3.2 Having Two Secondary VLAN Types

- Isolated VLAN: No layer-2 communication can be conducted between two ports in the same isolated VLAN. Also, there is only one isolated VLAN in a private VLAN. The isolated VLAN must be related with the primary VLAN.
- Community VLAN: Layer-2 communication can be conducted between two ports in the same VLAN, but they have no communication with the ports in another community VLAN. One private VLAN may contain multiple community VLANs. The community VLAN must be related with the primary VLAN.

18.3.3 Port Types Under the Private VLAN Port

- Promiscuous port: it belongs to the primary VLAN. It can communicate with all other ports, including the isolated port and community port of a secondary VLAN in the same private VLAN.
- Isolated port: It is the host port in the isolated VLAN. In the same private VLAN, the isolated port is totally L2 isolated from other ports except the promiscuous port, so the flows received from the isolated port can only be forwarded to the promiscuous port.
- Community port: It is the host port in the community VLAN. In a private VLAN, the community ports of the same community VLAN can conduct L2 communication each other or with the promiscuous port, but not with the community ports of other VLANs and the isolated ports in the isolated VLANs.

18.3.4 Modifying the Fields in VLAN TAG

This functionality supports to modify the VLAN ID and priority in VLAN tag and decides whether the egress packets of private VLAN carry the tag or not.

18.4Private VLAN Configuration Task List

- Configuring Private VLAN
- Configuring the association of private VLAN domains
- Configuring the L2 port of private VLAN to be the host port
- Configuring the L2 port of private VLAN to be the promiscuous port
- Modifying related fields of egress packets in private VLAN
- Displaying the configuration information of private VLAN

18.5Private VLAN Configuration Tasks

The conditions for a private VLAN peer to take effect are listed below:

1. Having the primary VLAN
2. Having the secondary VLAN
3. Having the association between primary VLAN and secondary VLAN
4. Having the promiscuous port in primary VLAN

18.5.1 Configuring Private VLAN

Use the following commands to set VLAN to be a private VLAN.

Command	Purpose
vlan*vlan-id*	Enters the VLAN mode.
private-vlan {primary|community|isolated}	Configures the features of private VLAN.
no private-vlan {primary|community|isolated}	Deletes the features of private VLAN.
show vlan private-vlan	Displays the configuration of private VLAN.
exit	Exits from Vlan configuration mode.

18.5.2 Configuring the Association of Private VLAN Domains

Run the following commands to associate the primary VLAN and the secondary VLAN.

Command	Purpose
vlan *vlan-id*	Enters the primary VLAN configuration mode.
private-vlan association {*svlist*| **add***svlist*| **remove***svlist*}	Sets the to-be-associated secondary VLAN.
no private-vlan association	Clears all associations between the current primary VLAN and all secondary VLANs.
exit	Exits the VLAN configuration mode.

18.5.3 Configuring the L2 Port of Private VLAN to Be the Host Port

Run the following commands to set the L2 port of private VLAN to be the host port:

Command	Purpose
Interface*interface*	Enters the interface configuration mode.
switchport mode private-vlan host	Sets the layer-2 port to be in host's port mode.
no switchport mode	Deletes the private VLAN mode configuration of L2 port.
switchport private-vlan host-association*p_vid s_vid*	Associates the L2 host port with private VLAN.
no switchport private-vlan host-association	Deletes the association between L2 host port and private VLAN.
exit	Exits from the interface configuration mode.

18.5.4 Configuring the L2 Port of Private VLAN to Be the Promiscuous Port

Run the following commands to set the L2 port of private VLAN to be the promiscuous port:

Command	Purpose
Interface*interface*	Enters the interface configuration mode.
switchport mode private-vlan promiscuous	Sets the layer-2 port to be in promiscuous port mode.
no switchport mode	Deletes the private VLAN mode configuration of L2 port.
switchport private-vlan mapping *p_vid{svlist | addsvlist |* **remove** *svlist}*	Associates the L2 promiscuous port with private VLAN.
no switchport private-vlan mapping	Deletes the association between L2 promiscuous port and private VLAN.
exit	Exits from the interface configuration mode.

18.5.5 Modifying Related Fields of Egress Packets in Private VLAN

Run the following commands to modify related fields of the egress packets in private VLAN:

Command	Purpose
Interface *interface*	Enters the interface configuration mode.
switchport private-vlan tag-pvid *vlan-id*	Sets the VLAN ID field in the tag of egress packet.
switchport private-vlan tag-pri*pri*	Sets the priority field in the tag of egress packet.
[no] switchport private-vlan untagged	Sets whether the egress packets have the tag or not.
exit	Exits from interface configuration mode.

18.5.6 Displaying the Configuration Information of Private VLAN

Run the following commands in global, interface or VLAN configuration mode to display the private VLAN configuration information of private VLAN and L2 port:

Command	Purpose
show vlan private-vlan	Displays the configuration of private VLAN.
show vlan private-vlan interface *interface*	Displays the configuration of the L2 port in the private VLAN.

18.6Configuration Example

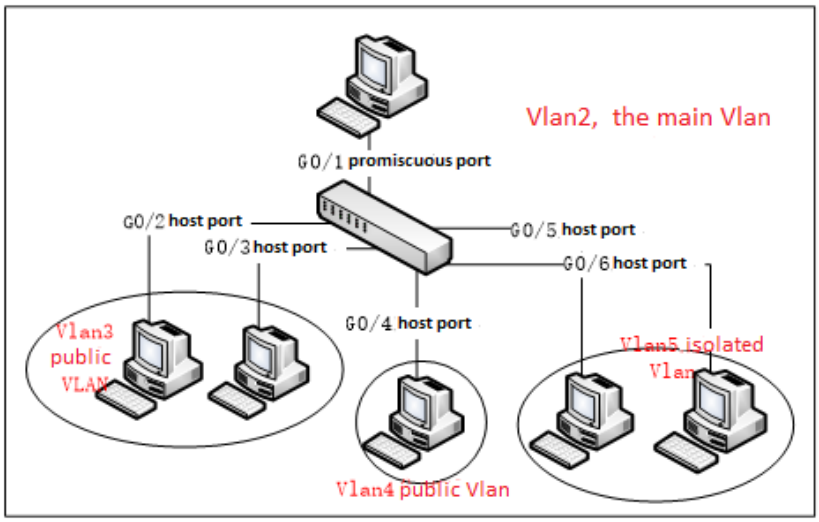


Figure 1: Typical Configuration of Private VLAN

As shown in figure 1, port G0/1 is the promiscuous port in primary VLAN 2 and ports G0/2-G0/6 are host ports, among which ports G0/2 and G0/3 are host ports (public ports) of Community VLAN 3, port G0/4 is that of Community VLAN 4, and ports G0/5 and G0/6 are host ports of Isolated VLAN 5.

According to the definition of private VLAN, L2 communication can be conducted between promiscuous port G0/1 and host ports of all sub-VLAN domains, so it is between host ports G0/2 and G0/3 of community VLAN 3, but they cannot conduct L2 communication with other host ports of secondary VLANs. L2 communication cannot go on between ports G0/5 and G0/6 in Isolated VLAN 5, but the two ports can conduct L2 communication with promiscuous port G0/1.

The commands requiring to be entered in a switch are shown below:

Switch_config#interface GigaEthernet0/1
Switch_config_g0/1#switchport mode private-vlan promiscuous
Switch_config_g0/1#switchport private-vlan mapping 2 3-5
Switch_config_g0/1#switchport pvid 2

Switch_config#interface GigaEthernet0/2
Switch_config_g0/2#switchport mode private-vlan host
Switch_config_g0/2#switchport private-vlan host-association 2 3
Switch_config_g0/2#switchport pvid 3

Switch_config#interface GigaEthernet0/3
Switch_config_g0/3#switchport mode private-vlan host
Switch_config_g0/3#switchport private-vlan host-association 2 3
Switch_config_g0/3#switchport pvid 3

Switch_config#interface GigaEthernet0/4
Switch_config_g0/4#switchport mode private-vlan host
Switch_config_g0/4#switchport private-vlan host-association 2 4
Switch_config_g0/4# switchport pvid 4

Switch_config#interface GigaEthernet0/5
Switch_config_g0/5#switchport mode private-vlan host
Switch_config_g0/5#switchport private-vlan host-association 2 5
Switch_config_g0/5#switchport pvid 5

Switch_config#interface GigaEthernet0/6
Switch_config_g0/5#switchport mode private-vlan host
Switch_config_g0/5#switchport private-vlan host-association 2 5
Switch_config_g0/5#switchport pvid 5

Switch_config#vlan 2
Switch_config_vlan2#private-vlan primary
Switch_config_vlan2#private-vlan association 3-5

Switch_config#vlan 3
Switch_config_vlan3#private-vlan community

Switch_config#vlan 4
Switch_config_vlan4#private-vlan community

Switch_config#vlan 5
Switch_config_vlan5#private-vlan isolated

Switch_config#show vlan private-vlan

Primary	Secondary	Type	Ports
2	3	community	g0/1, g0/2, g0/3
2	4	community	g0/1, g0/4
2	5	isolated	g0/1, g0/5, g0/6

19. STP Configuration

19.1Configuring STP

19.1.1 STP Introduction

The standard Spanning Tree Protocol (STP) is based on the IEEE 802.1D standard. A switch stack appears as a single spanning-tree node to the rest of the network, and all stack members use the same bridge ID. Unless otherwise noted, the term switch refers to a standalone switch and to a switch stack.

The STP uses a spanning-tree algorithm to select one switch of a redundantly connected network as the root of the spanning tree. The algorithm calculates the best loop-free path through a switched Layer 2 network by assigning a role to each port based on the role of the port in the active topology.

STP is a Layer 2 link management protocol that provides path redundancy while preventing loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two stations. Multiple active paths among end stations cause loops in the network. If a loop exists in the network, end stations might receive duplicate messages. Switches might also learn end-station MAC addresses on multiple Layer 2 interfaces. These conditions result in an unstable network. Spanning-tree operation is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or a switched LAN of multiple segments.

The STP uses a spanning-tree algorithm to select one switch of a redundantly connected network as the root of the spanning tree. The algorithm calculates the best loop-free path through a switched Layer 2 network by assigning a role to each port based on the role of the port in the active topology:

The standard Spanning-Tree Protocol (STP) is defined in IEEE 802.1D. It simplifies the LAN topology comprising several bridges to a sole spinning tree, preventing network loop from occurring and ensuring stable work of the network.

The algorithm of STP and its protocol configure the random bridging LAN to an active topology with simple connections. In the active topology, some bridging ports can forward frames; some ports are in the congestion state and cannot transmit frames. Ports in the congestion state may be concluded in the active topology. When the device is ineffective, added to or removed from the network, the ports may be changed to the transmitting state.

In the STP topology, a bridge can be viewed as root. For every LAN section, a bridging port will forward data from the network section to the root. The port is viewed as the designated port of the network section. The bridge where the port is located is viewed as the designated bridge of the LAN. The root is the designated bridge of all network sections that the root connects. In ports of each bridge, the port which is nearest to the root is the root port of the bridge. Only the root port and the designated port (if available) is in the transmitting state. Ports of another type are not shut down but they are not the root port or the designated port. We call these ports are standby ports.

The following parameters decide the structure of the stabilized active topology:

(1) Identifier of each bridge

(2) Path cost of each port

(3) Port identifier for each port of the bridge

The bridge with highest priority (the identifier value is the smallest) is selected as the root. Ports of each bridge have the attribute **Root Path Cost**, that is, the minimum of path cost summation of all ports from the root to the bridge. The designated port of each network segment refers to the port connecting to the network segment and having the minimum path cost.

When two ports on a switch are part of a loop, the spanning-tree port priority and path cost settings control which port is put in the forwarding state and which is put in the blocking state. The spanning-tree port priority value represents the location of a port in the network topology and how well it is located to pass traffic. The path cost value represents the media speed.

Our switch standard supports two modes of spanning tree protocol 802.1D STP and 802.1w RSTP. Some models of the switch support distributing STP mode according to VLAN and MSTP spanning tree protocol. For more details, please refer to 'STP Mode and Model Table' in chapter 2.

This chapter describes how to configure the standard spanning tree protocol that switch supports.

802.1D STP and 802.1w RSTP are abbreviated to SSTP and RSTP in this article. SSTP means Single Spanning-tree.

19.1.2 SSTP Configuratiom Task List

- Selecting STP Mode
- ■
- ■
  - ■ Disabling/Enabling STP
  - ■ Configuring the Switch Priority
  - ■ Configuring the Hello Time
  - ■ Configuring the Max-Age Time
  - ■ Configuring the Forward Delay Time
  - ■ Configuring Port Priority
  - ■ Configuring Path Cost
  - ■ Configuring the Auto-Designated port
  - ■ Monitoring STP Status

19.1.3 SSTP Configuration Task

19.1.3.1 Selecting STP Mode

Run the following command to configure the STP mode:

Command	Purpose
spanning-tree mode {sstp | rstp}	Selects the STP configuration.

19.1.3.2 Disabling/Enabling STP

Spanning tree is enabled by default. Disable spanning tree only if you are sure there are no loops in the network topology.

Follow these steps to disable spanning-tree:

Command	Purpose
no spanning-tree	Disables STP.

To enable spanning-tree, use the following command:

Command	Purpose
spanning-tree	Enables default mode STP (SSTP).
spanning-tree mode {sstp | rstp}	Enables a certain mode STP.

19.1.3.3 Configuring the Switch Priority

You can configure the switch priority and make it more likely that a standalone switch or a switch in the stack will be chosen as the root switch.

Follow these steps to configure the switch priority:

Command	Purpose
spanning-tree sstp priority*value*	Modifies sstp priority value.
no spanning-tree sstp priority	Returns sstp priority to default value (32768).

19.1.3.4 Configuring the Hello Time

User can configure the interval between STP data units sent by the root switch through changing the hello time.

Use the following command to configure Hello Time of SSTP:

Command	Purpose
spanning-tree sstp hello-time*value*	Configures sstp Hello Time.
no spanning-tree sstp hello-time	Returns sstp Hello Time to default value (4s).

19.1.3.5 Configuring the Max-Age Time

Use the sstp max age to configure the number of seconds a switch waits without receiving spanning-tree configuration messages before attempting a reconfiguration.

Follow these steps to configure the maximum-aging time:

Command	Purpose
spanning-tree sstp max-age*value*	Configures the sstp max-age time.
no spanning-tree sstp max-age	Returns the max-age time to default value (20s).

19.1.3.6 Configuring the Forward Delay Time

Configure sstp forward delay to determine the number of seconds an interface waits before changing from its spanning-tree learning and listening states to the forwarding state.

Use the following command to configure sstp forward delay:

Command	Purpose
spanning-tree sstp*forward-time*	Configures sstp Forward time.
no spanning-tree sstp forward-time	Returns forward time to default value (15s).

19.1.3.7 Configuring the Port Priority

If a loop occurs, spanning tree uses the port priority when selecting an interface to put into the forwarding state. You can assign higher priority values (lower numerical values) to interfaces that you want selected first and lower priority values (higher numerical values) that you want selected last. If all interfaces have the same priority value, spanning tree puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

Follow these steps to configure the port priority of an interface:

Command	Purpose
spanning-tree port-priority *value*	Configures the port priority for an interface.
spanning-tree sstp port-priority*value*	Modifies sstp port priority.
no spanning-tree sstp port-priority	Returns port priority to default value (128).

19.1.3.8 Configuring the Path Cost

Follow these steps to configure the cost of an interface:

Command	Purpose
spanning-tree cost *value*	Configures the cost for an interface.
spanning-tree sstp cost*value*	Modifies sstp path cost.
no spanning-tree sstp cost	Returns path cost to default value.

19.1.3.9 Configuring Auto-Designated Port

The auto-designated port is a special function of the switch. The function allows line card to automatically send BPDU to the auto-designated port, reducing the load of the MSU.

The auto-designated port function is effective in STP mode.

In global configuration mode, run the following commands to configure the auto-designated port function of switch:

Command	Purpose
spanning-tree designated-auto	Enables the auto-designated port function.
no spanning-tree designated-auto	Disables the auto-designated port function.

19.1.3.10 Monitoring STP State

To monitor the STP configuration and state, use the following command in management mode:

Command	Purpose
show spanning-tree	Displays spanning-tree information on active interfaces only.
show spanning-tree detail	Displays a detailed summary of interface information.
show spanning-tree interface	Displays spanning-tree information for the specified interface.

19.1.4 Configuring VLAN STP

19.1.4.1 Overview

In SSTP mode, the whole network has only one STP entity. The state of the switch port in the STP decides its state in all VLANs. In the case that multiple VLANs exist in the network, the separation of the single STP and the network topology may cause communication congestion in some parts of network.
Our switches run independent SSTP on a certain number of PurposeVLANs, ensuring that the port has different state in different VLANs and that the load balance is realized between VLANs.
Note that the switch can run the independent STP in up to 30 VLANs. Other VLAN topologies are not controlled by the STP.

19.1.4.2 VLAN STP Configuration Task

In global configuration mode, run the following commands to configure SSTP attributes in VLAN:

Command	Purpose
spanning-tree mode pvst	Starts the VLAN-based STP distribution mode.
spanning-tree vlan *vlan-list*	Distributes the STP case for the designated VLAN. vlan-list: the list of VLAN The switch distributes STP case for up to 30 VLANs.
no spanning-tree vlan *vlan-list*	Deletes the STP case in the designated

	VLA.
spanning-tree vlan *vlan-list* priority *value*	Configures the priority for the STP in the designated VLAN.
no spanning-tree *vlan-list* priority	Resumes the STP priority in the VLAN to the default configuration.
spanning-tree vlan *vlan-list* forward-time *value*	Configures Forward Delay for the designated VLAN.
no spanning-tree vlan *vlan-list* forward-time	Resumes Forward Delay of the designated VLAN to the default configuration.
spanning-tree vlan *vlan-list* max-age *value*	Configures Max-age for the designated VLAN.
no spanning-tree vlan *vlan-list* max-age	Resumes Max-age of the designated VLAN to the default configuration.
spanning-tree vlan *vlan-list* hello-time *value*	Configures HELLO-TIME for the designated VLAN.
no spanning-tree vlan *vlan-list* hello-time	Resumes HELLO-TIME of the designated VLAN to the default configuration.

In port configuration mode, run the following command to configure attributes of the port:

Command	Purpose
spanning-tree vlan *vlan-list* cost	Configures the path cost of the designated VLAN for the port.
no spanning-tree vlan *vlan-list* cost	Resumes the default path cost of the designated VLAN for the port.
spanning-tree vlan *vlan-list* port-priority	Configures the port priority in the VLAN.
no spanning-tree vlan *vlan-list* port-priority	Resumes the default port priority in the VLAN.

In monitor or configuration mode, run the following command to check the STP state in the specified VLAN:

Command	Purpose
show spanning-tree vlan *vlan-list*	Check the STP state in the VLAN.

19.1.5 RSTP Configuration Task List

- Enabling/Disabling Switch RSTP
- Configuring the Switch Priority
- Configuring the Forward Delay Time
- Configuring the Hello time
- Configuring the Max-Age
- Configuring the Path Cost
- Configuring the Port Priority
- Enabling Protocol Conversation Check

19.1.6 RSTP Configuration Task

19.1.6.1 Enabling/Disabling Switch RSTP

Follow these configurations in the global configuration mode:

Command	Purpose
spanning-tree mode rstp	Enables RSTP
no spanning-tree mode	Returns STP to default mode (SSTP)

19.1.6.2 Configuring the Switch Priority

You can configure the switch priority and make it more likely that a standalone switch or a switch in the stack will be chosen as the root switch.

Follow these steps to configure the switch priority:

Follow these configurations in the global configuration mode:

Command	Purpose
spanning-tree rstp priority*value*	Modifies rstp priority value.
no spanning-tree rstp priority	Returns rstp priority to default value.

If the priority of all bridges in the whole switch network uses the same value, then the bridge with the least MAC address will be chosen as the root bridge. In the situation when the RSTP protocol is enabled, if the bridge priority value is modified, it will cause the recalculation of spanning tree.

The bridge priority is configured to 32768 by default.

19.1.6.3 Configuring the Forward Delay Time

Link failures may cause network to recalculate the spanning tree structure. But the latest configuration message can no be conveyed to the whole network. If the newly selected root port and the specified port immediately start forwarding data, this may cause temporary path loop. Therefore the protocol adopts a kind of state migration mechanism. There is an intermediate state before root port and the specified port starting data forwarding, after the intermediate state passing the Forward Delay Time, the forward state begins. This delay time ensures the newly configured message has been conveyed to the whole network. The Forward Delay characteristic of the bridge is related to the network diameter of the switch network. Generally, the grater the network diameter, the longer the Forward Delay Time should be configured.
Follow these configurations in the global configuration mode:

Command	Purpose
spanning-tree rstp forward-time *value*	Configures Forward Delay
no spanning-tree rstp forward-time	Returns Forward Delay Time to default value (15s).

If you configure the Forward Delay Time to a relatively small value, it may leads to a temporary verbose path. If you configure the Forward Delay Time to a relatively big value, the system may not resume connecting for a long time. We recommend user to use the default value.
The Forward Delay Time of the bridge is 15 seconds.

19.1.6.4 Configuring the Hello Time

The proper hello time value can ensure that the bridge detect link failures in the network without occupying too much network resources.
Follow these configurations in the global configuration mode:

Command	Purpose
spanning-tree rstp hello-time *value*	Configures Hello Time
no spanning-tree rstp hello-time	Returns Hello Time to default value.

We recommend user to use the default value.
The default Hello Time is 4 seconds.

19.1.6.5 Configuring the Max-Age

The ma-age is the number of seconds a switch waits without receiving spanning-tree configuration messages before attempting a reconfiguration.

Follow these configurations in the global configuration mode:

Command	Purpose
spanning-tree rstp max-age*value*	Configures the max-age value.
no spanning-tree rstp max-age	Returns the max-age time to default value (20s).

We recommend user to use the default value.

if you configure the Max Age to a relatively small value, then the calculation of the spanning tree will be relatively frequent, and the system may regard the network block as link failure. If you configure the Max Age to a relatively big value, then the link status will go unnoticed in time.

The Max Age of bridge is 20 seconds by default.

19.1.6.6 Configuring the Path Cost

The spanning-tree path cost default value is derived from the media speed of an interface. If a loop occurs, spanning tree uses cost when selecting an interface to put in the forwarding state. You can assign lower cost values to interfaces that you want selected first and higher cost values to interfaces that you want selected last. If all interfaces have the same cost value, spanning tree puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

Beginning in interface configuration mode, follow these steps to configure the cost of an interface:

Command	Purpose
spanning-tree rstp cost*value*	Configures the cost for an interface.
no spanning-tree rstp cost	Returns path cost to default value.

The modification of the priority of the Ethernet port will arise the recalculation of the spanning tree. We recommend user to use the default value and let RSTP protocol calculate the path cost of the current Ethernet interface.

When the port speed is 10Mbps, the path cost of the Ethernet interface is 2000000.

When the port speed is 100Mbps, the path cost of the Ethernet interface is 200000.

19.1.6.7 Configuring the Port Priority

If a loop occurs, spanning tree uses the port priority when selecting an interface to put into the forwarding state. You can assign higher priority values (lower numerical values) to interfaces that you want selected first, and lower priority values (higher numerical values) that you want selected last. If all interfaces have the same priority value, spanning tree puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

Follow these configurations in the interface configuration mode:

Command	Purpose
spanning-tree rstp port-priority*value*	Configures the port priority for an interface.
no spanning-tree rstp port-priority	Returns the port priority to the default value.

Note

The modification of the priority of the Ethernet interface will arise the recalculation of the spanning tree.

The default Ethernet interface priority is 128.

19.2 Configuring MTSP

19.2.1 MSTP Overview

19.2.1.1 Introduction

Multiple Spanning Tree Protocol (MSTP) is used to create simple complete topology in the bridging LAN. MSTP can be compatible with the earlier Spanning Tree Protocol (STP) and Rapid Spanning Tree Protocol (RSTP).

Both STP and RSTP only can create sole STP topology. All VLAN messages are forwarded through the only STP. STP converges too slow, so RSTP ensures a rapid and stable network topology through the handshake mechanism.

MSTP inherits the rapid handshake mechanism of RSTP. At the same time, MST allows different VLAN to be distributed to different STPs, creating multiple topologies in the network. In networks created by MSTP, frames of different VLANs can be forwarded through different paths, realizing the load balance of the VLAN data.

Different from the mechanism that VLAN distributes STP, MSTP allows multiple VLANs to be distributed to one STP topology, effectively reducing STPs required to support lots of VLANs.

19.2.1.2 MST Domain

In MSTP, the relationship between VLAN and STP is described through the MSTP configuration table. MSTP configuration table, configuration name and configuration edit number makes up of the MST configuration identifier.

In the network, interconnected bridges with same MST configuration identifier are considered in the same MST region. Bridges in the same MST region always have the same VLAN configuration, ensuring VLAN frames are sent in the MST region.

19.2.1.3 IST, CST, CIST and MSTI

Figure 2.1 shows an MSTP network, including three MST regions and a switch running 802.1D STP.

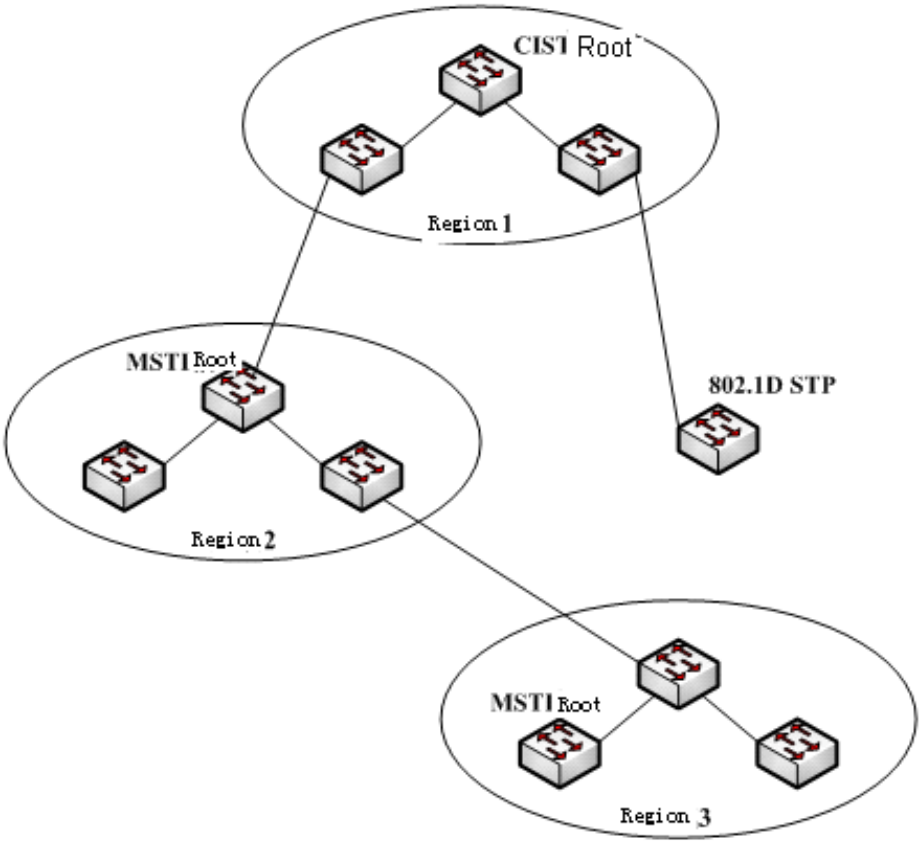


Figure 2.1 MSTP topology

1. CIST

Common and Internal Spanning Tree (CIST) means the spanning tree comprised by all single switches and interconnected LAN. These switches may belong to different MST regions. They may be switches running traditional STP or RSTP. Switches running STP or RSTP in the MST regions are considered to be in their own regions.

After the network topology is stable, the whole CIST chooses a CIST root bridge. An internal CIST root bridge will be selected in each region, which is the shortest path from the heart of the region to CIST root.

2. CST

If each MST region is viewed as a single switch, Common Spanning Tree (CST) is the spanning tree connecting all “single switches”. As shown in Figure 2.1, region 1, 2 and 3 and STP switches make up of the network CST.

3. IST

Internal Spanning Tree (IST) refers to part of CIST that is in an MST region, that is, IST and CST make up of the CIST.

4. MSTI

The MSTP protocol allows different VLANs to be distributed to different spanning trees. Multiple spanning tree instances are then created. Normally, No.0 spanning tree instance refers to CIST, which can be expanded to the whole network. Every spanning tree instance starting from No.1 is in a certain region. Each spanning tree instance can be distributed with multiple VLANs. In original state, all VLANs are distributed in CIST.
MSTI in the MST region is independent. They can choose different switches as their own roots.

19.2.1.4 Port Role

Ports in MSTP can function as different roles, similar to ports in RSTP.

1. Root port

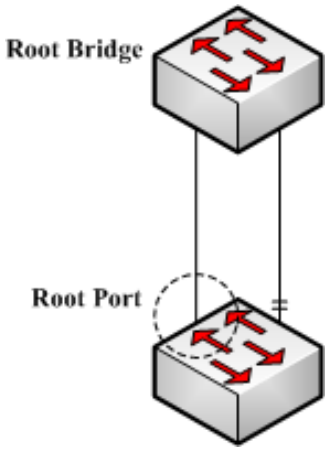


Figure 2.2 Root port

Root port stands for the path between the current switch and the root bridge, which has minimum root path cost.

2. Alternate port

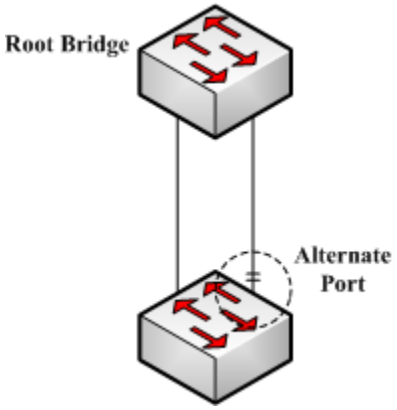


Figure 2.3 Alternate port

The alternate port is a backup path between the current switch and the root bridge. When the connection of root port is out of effect, the alternate port can promptly turn into a new root port without work interruption.

3. Designated port

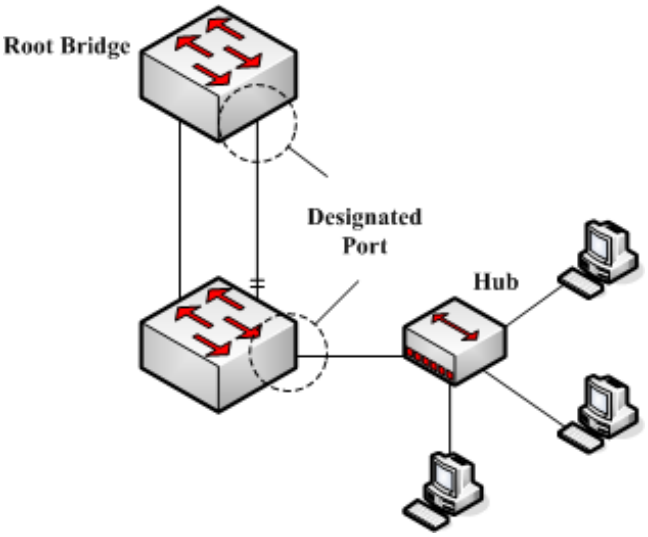


Figure 2.4 Designated port

The designated port can connect switches or LAN in the next region. It is the path between the current LAN and root bridge.

4. Backup port

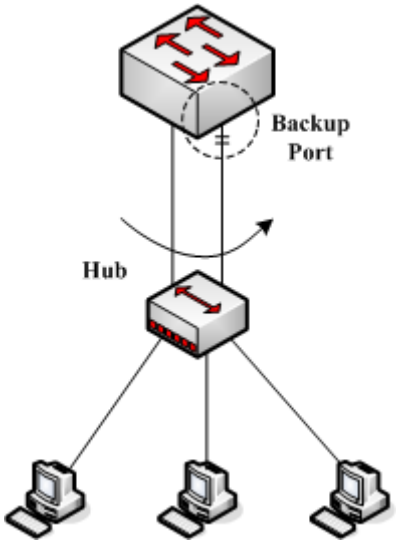


Figure 2.5 Backup port

When two switch ports directly connect or both connect to the same LAN, the port with lower priority is to be the backup port, the other port is to be the designated port. If the designated port breaks down, the backup port becames the designated port to continue working.

5. Master port

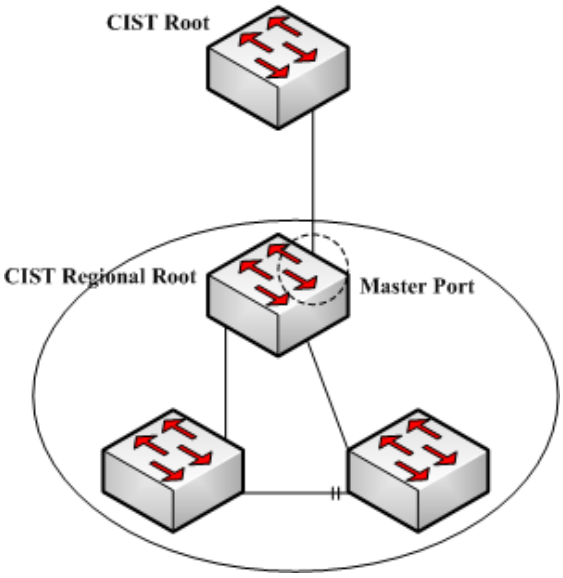


Figure 2.6 Master port

The Master port is the shortest path between MST region and CIST root bridge. Master port is the root port of the root bridge in the CIST region.

6. Boundary port

The concept of boundary port in CIST is a little different from that in each MSTI. In MSTI, the role of the boundary port means that the spanning tree instance does not expand on the port.

7. Edge port

In the RSTP protocol or MSTP protocol, edge port means the port directly connecting the network host. These ports can directly enter the forwarding state without causing any loop in the network.

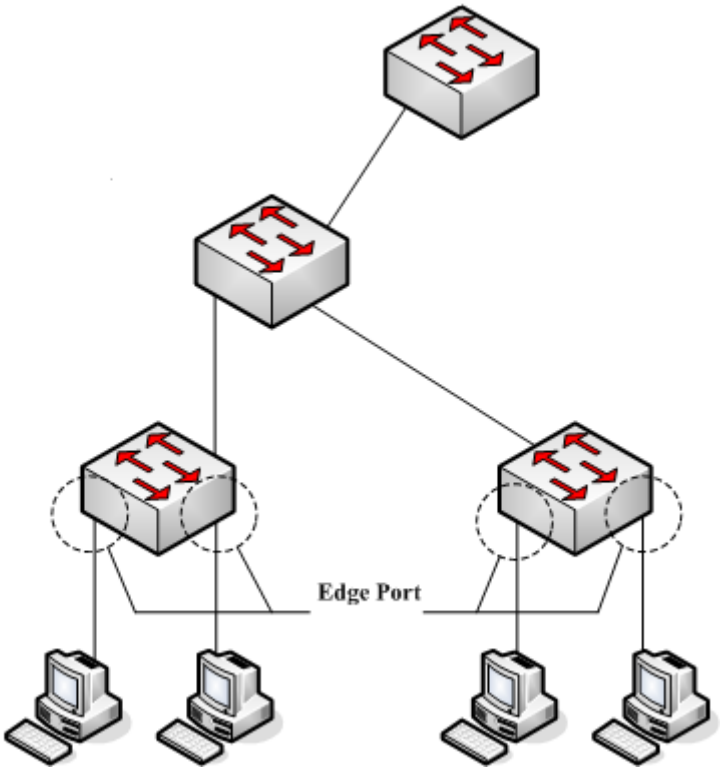


Figure 2.7 Edge port

In original state, MTSP and RSTP do not take all ports as edge ports, ensuring the network topology can be rapidly created. In this case, if a port receives BPDU from other switches, the port is resumed from the edge state to the normal state. If the port receives 802.1D STP BPDU, the port has to wait for double Forward Delay time and then enter the forwarding state.

19.2.1.5 MSTP BPDU

Similar to STP and RSTP, switches running MSTP can communicate with each other through Bridge Protocol Data Unit (BPDU). All configuration information about the CIST and MSTI can be carried by BPDU. Table 2.1 and Table 2.2 list the structure of BPDU used by the MSTP.

Table 2.1 MSTP BPDU

Field Name	Byte Number
Protocol Identifier	1 – 2
Protocol Version Identifier	3
BPDU Type	4
CIST Flags	5
CIST Root Identifier	6 – 13
CIST External Root Path Cost	14 – 17
CIST Regional Root Identifier	18 – 25
CIST Port Identifier	26 – 27
Message Age	28 – 29
Max Age	30 – 31
Hello Time	32 – 33
Forward Delay	34 – 35
Version 1 Length	36
Version 3 Length	37 – 38
Format Selector	39
Configuration Name	40 – 71
Revision	72 – 73
Configuration Digest	74 – 89
CIST Internal Root Path Cost	90 – 93
CIST Bridge Identifier	94 – 101
CIST Remaining Hops	102
MSTI Configuration Messages	103 ~

Table 2.2 MST configuration information

Field Name	Byte Number
MSTI FLAGS	1
MSTI Regional Root Identifier	2 – 9
MSTI Internal Root Path Cost	10 – 13
MSTI Bridge Priority	14
MSTI Port Priority	15
MSTI Remaining Hops	16

19.2.1.6 Stable State

The MSTP switch performs calculation and compares operations according to the received BPDU, and finally ensures that:

(1) One switch is selected as the CIST root of the whole network.

(2) Each switch and LAN segment can decide the minimum cost path to the CIST root, ensuring a complete connection and prevent loops.

(3) Each region has a switch as the CIST regional root. The switch has the minimum cost path to the CIST root.

(4) Each MSTI can independently choose a switch as the MSTI regional root.

(5) Each switch in the region and the LAN segment can decide the minimum cost path to the MSTI root.

(6) The root port of CIST provides the minimum-cost path between the CIST regional root and the CIST root.

(7) The designated port of the CIST provided its LAN with the minimum-cost path to the CIST root.

(8) The Alternate port and the Backup port provides connection when the switch, port or the LAN does not work or is removed.

(9) The MSTI root port provides the minimum cost path to the MSTI regional root.

(10) The designated port of MSTI provides the minimum cost path to the MSTI regional root.

(11) A master port provides the connection between the region and the CIST root. In the region, the CIST root port of the CIST regional root functions as the master port of all MSTI in the region.

19.2.1.7 Hop Count

Different from STP and RSTP, the MSTP protocol does not use Message Age and Max Age in the BPDU configuration message to calculate the network topology. MSTP uses Hop Count to calculate the network topology.

To prevent information from looping, MSTP relates the transmitted information to the attribute of hop count in each spanning tree. The attribute of hop count for BPDU is designated by the CIST regional root or the MSTI regional root and reduced in each receiving port. If the hop count becomes 0 in the port, the information will be dropped and then the port turns to be a designated port.

19.2.1.8 STP Compatibility

MSTP allows the switch to work with the traditional STP switch through protocol conversion mechanism. If one port of the switch receives the STP configuration message, the port then only transmits the STP message. At the same time, the port that receives the STP information is then considered as a boundary port.

When a port is in the STP-compatible state, the port will not automatically resume to the MSTP state even if the port does not receive the STP message any more. In this case, you can run spanning-tree mstp migration-check to clear the STP message that the port learned, and make the port to return to the MSTP state. The switch that runs the RSTP protocol can identify and handle the MSTP message. Therefore, the MSTP switch does not require protocol conversion when it works with the RSTP switch.

19.2.2 MSTP Configuration Task List

- Default MSTP configuration
- Enabling and disabling MSTP
- Configuring MSTP region
- Configuring network root
- Configuring secondary root
- Configuring bridge priority
- Configuring time parameters of STP
- Configuring network diameter
- Configuring maximum hop count
- Configuring port priority
- Configuring path cost for port
- Configuring port connection type
- Activating MST-compatible mode

19.2.2.1 Activating MST-Compatible Mode

The MSTP protocol that our switches support is based on IEEE 802.1s. In order to be compatible with other MSTPs, especially MSTP that the Cisco switches support, the MSTP protocol can work in MST-compatible mode. Switches running in MSTP-compatible mode can identify the message structure of other MSTPs, check the contained MST regional identifier and establish the MST region.
The MST-compatible mode and the STP-compatible mode are based on MSTP protocol conversion mechanism. If one port of the switch receives BPDU in compatible mode, the port automatically changes to the mode and sends BPDU in compatible mode. To resume the port to standard MST mode, you can run **spanning-tree mstp migration-check**.

In global configuration mode, run the following commands to activate or disable the MST-compatible mode:

Command	Purpose
spanning-tree mstp mst-compatible	Activates the MST-compatible mode for the switch.
no spanning-tree mstp mst-compatible	Disables the MST-compatible mode for the switch.

The main function of the compatible mode is to create the MST area for switches and other MSTP-running switches. In actual networking, make sure that the switch has the same configuration name and the same edit number. It is recommended to configure switches running other MSTP protocols to the CIST root, ensuring that the switch enters the compatible mode by receiving message.
If the MST-compatible mode is not activated, the switch will not resolve the whole BPDU-compatible content and take the content as the common RSTP BPDU. In this way, the switch cannot be in the same area with the MST-compatible switch that it connects.
A port in compatible mode cannot automatically resumes to send standard MST BPDU even if the compatible mode is shut down in global configuration mode. In this case, run migration-check.

- Restart the protocol conversion check.
- Check the MSTP message.

19.2.3 MSTP Configuration Task

19.2.3.1 Default MSTP Configuration

Attribute	Default Settings
STP mode	SSTP (PVST, RSTP and MSTP is not started)
Area name	Character string of MAC address
Area edit level	0
MST configuration list	All VLANs are mapped in CIST (MST00).
Spanning-tree priority (CIST and all MSTI)	32768
Spanning-tree port priority (CIST and all MSTI)	128
Path cost of the spanning-tree port (CIST and all MSTI)	1000 Mbps: 20000 100 Mbps: 200000 10 Mbps: 2000000
Hello Time	2 seconds
Forward Delay	15 seconds
Maximum-aging Time	20 seconds
Maximum hop count	20

19.2.3.2 Enabling and Disabling MSTP

The STP protocol can be started in PVST or SSTP mode by default. You can stop it running when the spanning-tree is not required.

Run the following command to set the STP to the MSTP mode:

Command	Purpose
spanning-tree	Enables STP in default mode.
spanning-tree mode mstp	Enables MSTP.

Run the following command to disable STP:

Command	Purpose
no spanning-tree	Disables the STP.

19.2.3.3 Configuring MST Area

The MST area where the switch resides is decided by three attributes: configuration name, edit number, the mapping relation between VLAN and MSTI. You can configure them through area configuration commands. Note that the change of any of the three attributes will cause the change of the area where the switch resides. In original state, the MST configuration name is the character string of the MAC address of the switch. The edit number is 0 and all VLANs are mapped in the CIST (MST00). Because different switch has different MAC address, switches that run MSTP are in different areas in original state. You can run spanning-tree mstp instance instance-id vlan vlan-list to create a new MSTI and map the designated VLAN to it. If the MSTI is deleted, all these VLANs are mapped to the CIST again.

Run the following command to set the MST area information:

Command	Purpose
spanning-tree mstp name*string*	Configures the MST configuration name. string means the character string of the configuration name. It contains up to 32 characters, capital sensitive. The default value is the character string of the MAC address.
no spanning-tree mstp name	Sets the MST configuration name to the default value.
spanning-tree mstp revision*value*	Sets the MST edit number. value represents the edit number, ranging from 0 to 65535. The default value is 0.
no spanning-tree mstp revision	Sets the MST edit number to the default value.
spanning-tree mstp instance*instance-id* vlan*vlan-list*	Maps VLAN to MSTI. instance-id represents the instance number of the spanning tree, meaning an MSTI. It ranges from 1 to 15. vlan-list means the VLAN list that is mapped to the spanning tree. It ranges from 1 to 4094. instance-id is an independent value representing a spanning tree instance. vlan-list can represent a group of VLANs, such as ”1,2,3”, ”1-5” and “1,2,5-10”.
no spanning-tree mstp instance*instance-id*	Cancels the VLAN mapping of MSTI and disables the spanning tree instance. instance-id represents the instance number of the spanning tree, meaning an MSTI. It ranges from 1 to 15.

Run the following command to check the configuration of the MSTP area:

Command	Purpose
show spanning-tree mstp region	Displays the configuration of the MSTP area.

19.2.3.4 Configuring Network Root

In MSTP, each spanning tree instance has a bridge ID, containing the priority value and MAC address of the switch. During the establishment of spanning tree topology, the switch with comparatively small bridge ID is selected as the network root.

MSTP can set the switch to the network switch through configuration. You can run the command **Spanning-tree mstpSpanning-tree mstp*instance-id*rootroot** to modify the priority value of the switch in a spanning tree instance from the default value to a sufficiently small value, ensuring the switch turns to be the root in the spanning tree instance.

In general, after the previous command is executed, the protocol automatically check the bridge ID of the current network root and then sets the priority field of the bridge ID to **24576** when the value **24576** ensures that the current switch becomes the root of the spanning tree.

If the network root's priority value is smaller than the value **24576**, MSTP automatically sets the spanning tree's priority of the current bridge to a value that is 4096 smaller than the priority value of the root. Note that the number **4096** is a step length of network priority value.

When setting the root, you can run the **diameter** subcommand to the network diameter of the spanning tree network. The keyword is effective only when the spanning tree instance ID is 0. After the network diameter is set, MSTP automatically calculates proper STP time parameters to ensure the stability of network convergence. Time parameters include Hello Time, Forward Delay and Maximum Age. The subcommand Hello-time can be used to set a new hello time to replace the default settings.

Run the following command to set the switch to the network root:

Command	Purpose
spanning-tree mstp*instance-id*root primary [diameter*net-diameter* [hello-time*seconds*]]	Sets the switch to the root in the designated spanning tree instance. instance-id represents the number of the spanning tree instance, ranging from 0 to 15. net-diameter represents the network diameter, which is an optional parameter. It is effective when instance-id is 0. It ranges from 2 to 7. seconds represents the unit of the hello time, ranging from 1 to 10.
no spanning-tree mstp*instance-id*root	Cancels the root configuration of the switch in the spanning tree. instance-id means the number of the spanning tree instance, ranging from 0 to 15.

Run the following command to check the MSTP message:

Command	Purpose
show spanning-tree mstp [instance*instance-id*]	Checks the MSTP message.

19.2.3.5 Configuring Secondary Root

After the network root is configured, you can run **spanning-tree mstp*instance-id*root secondary** to set one or multiple switches to the secondary roots or the backup roots. If the root does not function for certain reasons, the secondary roots will become the network root.

Different from the primary root configuration, after the command to configure the primary root is run, MSTP sets the spanning tree priority of the switch to **28672**. In the case that the priority value of other switches is the default value **32768**, the current switch can be the secondary root.

When configuring the secondary root, you can run the subcommands **diameter** and **hello-time** to update the STP time parameters. When the secondary root becomes the primary root and starts working, all these parameters starts functioning.

Run the following command to set the switch to the secondary root of the network:

Command	Purpose
spanning-tree mstp*instance-id*root secondary [diameter*net-diameter* [hello-time*seconds*]]	Sets the switch to the secondary root in the designated spanning tree instance. instance-id represents the number of the spanning tree instance, ranging from 0 to 15. net-diameter represents the network diameter, which is an optional parameter. It is effective when instance-id is 0. It ranges from 2 to 7. seconds represents the unit of the hello time, ranging from 1 to 10.
no spanning-tree mstp*instance-id*root	Cancels the root configuration of the switch in the spanning tree. instance-id means the number of the spanning tree instance, ranging from 0 to 15.

Run the following command to check the MSTP message:

Command	Purpose
show spanning-tree mstp [instance*instance-id*]	Checks the message about the MST instance.

19.2.3.6 Configuring Bridge Priority

In some cases, you can directly set the switch to the network root by configuring the bridge priority. It means that you can set the switch to the network root without running the subcommand **root**. The priority value of the switch is independent in each spanning tree instance. Therefore, the priority of the switch can be set independently.

Run the following command to configure the priority of the spanning tree:

Command	Purpose
spanning-tree mstp*instance-id*priority*value*	Sets the priority of the switch. instance-id represents the number of the spanning tree instance, ranging from 0 to 15. value represents the priority of the bridge. It can be one of the following values: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440
no spanning-tree mstp*instance-id*priority	Resumes the bridge priority of the switch to the default value. instance-id means the number of the spanning tree instance, ranging from 0 to 15.

19.2.3.7 Configuring STP Time Parameters

The following are STP time parameters:

- Hello Time:

The interval to send the configuration message to the designated port when the switch functions as the network root.

- Forward Delay:

Time that the port needs when it changes from the **Blocking** state to the **learning** state and to the **forwarding** state in STP mode.

- Max Age:

The maximum live period of the configuration information about the spanning tree.

To reduce the shock of the network topology, the following requirements for the time parameters must be satisfied:

- 2 x (fwd_delay - 1.0) >= max_age
- max_age >= (hello_time + 1) x 2

Command	Purpose
spanning-tree mstp hello-time*seconds*	Sets the parameter Hello Time. The parameter seconds is the unit of Hello Time, ranging from 1 to 10 seconds. Its default value is two seconds.
no spanning-tree mstp hello-time	Resumes Hello Time to the default value.
spanning-tree mstp forward-time*seconds*	Sets the parameter Forward Delay. The parameter seconds is the unit of Forward Delay, ranging from 4 to 30 seconds. Its default value is 15 seconds.
no spanning-tree mstp forward-time	Resumes Forward Delay to the default value.
spanning-tree mstp max-age*seconds*	Sets the parameter Max Age. The parameter seconds is the unit of Max Age, ranging from 6 to 40 seconds. Its default value is 20 seconds.
no spanning-tree mstp max-age	Resumes Max Age to the default value.

It is recommended to modify STP time parameters by setting root or network diameter, which ensures correct modification of time parameters.

The newly-set time parameters are valid even if they do not comply with the previous formula's requirements. Pay attention to the notification on the console when you perform configuration.

19.2.3.8 Configuring Network Diameter

Network diameter stands for the maximum number of switches between two hosts in the network, representing the scale of the network.

You can set the MSTP network diameter by running the command **spanning-tree mstp diameter*net-diameter***. The parameter **net-diameter** is valid only to CIST. After configuration, three STP time parameters are automatically updated to comparatively better values.

Run the following command to configure **net-diameter**:

Command	Purpose
spanning-tree mstp diameter*net-diameter*	Configures net-diameter. The parameter net-diameter ranges from 2 to 7. The default value is 7.
no spanning-tree mstp diameter	Resumes net-diameter to the default value.

The parameter **net-diameter** is not saved as an independent setup in the switch. Only when modified by setting the network diameter can the time parameter be saved.

19.2.3.9 Configuring Maximum Hop Count

Run the following command to configure the maximum hop count.

Command	Purpose
spanning-tree mstp max-hops*hop-count*	Sets the maximum hops. hop-count ranges from 1 to 40. Its default value is 20.
no spanning-tree mstp*hop-count*	Resumes the maximum hop count to the default value.

19.2.3.10 Configuring Port Priority

If a loop occurs between two ports of the switch, the port with higher priority will enter the **forwarding** state and the port with lower priority is blocked. If all ports have the same priority, the port with smaller port number will first enter the **forwarding** state.

In port configuration mode, run the following command to set the priority of the STP port:

Command	Purpose
spanning-tree mstp*instance-id*port-priority*priority*	Sets the priority of the STP port. instance-id stands for the number of the spanning tree instance, ranging from 0 to 15. priority stands for the port priority. It can be one of the following values: 0, 16, 32, 48, 64, 80, 96, 112 128, 144, 160, 176, 192, 208, 224, 240
spanning-tree port-priority*value*	Sets the port priority in all spanning tree instances. value stands for the port priority. It can be one of the following values: 0, 16, 32, 48, 64, 80, 96, 112 128, 144, 160, 176, 192, 208, 224, 240
no spanning-tree mstp*instance-id* port-priority	Resumes the port priority to the default value.
no spanning-tree port-priority	Resumes the port priority to the default value in all spanning tree instances.

Run the following command to check the information about the MSTP port.

Command	Purpose
show spanning-tree mstpinterface*interface-id*	Check MSTP port information. interface-id stands for the port name, such as “F0/1” and “FastEtnernet0/3”.

19.2.3.11 Configuring Path Cost of the Port

In MSTP, the default value of the port's path cost is based on the connection rate. If a loop occurs between two switches, the port with less path cost will enter the forwarding state. The less the path cost is, the higher rate the port is. If all ports have the same path cost, the port with smaller port number will first enter the forwarding state.

In port configuration mode, run the following command to set the path cost of the port:

Command	Purpose
spanning-tree mstp*instance-id*cost*cost*	Sets the path cost of the port. instance-id stands for the number of the spanning tree instance, ranging from 0 to 15. cost stands for the path cost of the port, which ranges from 1 to 200000000.
spanning-tree cost*value*	Sets the path cost of the port in all spanning tree instances. Value stands for the path cost of the port, which ranges from 1 to 200000000.
no spanning-tree mstp*instance-id*cost	Resumes the path cost of the port to the default value.
no spanning-tree cost	Resumes the path cost of the port to the default value in all spanning tree instances.

19.2.3.12 Configuring Port Connection Type

If the connection between MSTP-supported switches is the point-to-point direct connection, the switches can rapidly establish connection through handshake mechanism. When you configure the port connection type, set the port connection to the point-to-point type.

The protocol decides whether to use the point-to-point connection or not according to the duplex attribute. If the port works in full-duplex mode, the protocol considers the connection is a point-to-point one. If the port works in the half-duplex mode, the protocol considers the connection is a shared one.

If the switch that the port connects run the RSTP protocol or the MSTP protocol, you can set the port connection type to **point-to-point**, ensuring that a handshake is rapidly established.

In port configuration mode, run the following command to set the port connection type.

Command	Purpose
spanning-tree mstp point-to-point force-true	Sets the port connection type to point-to-point.
spanning-tree mstp point-to-point force-false	Sets the port connection type to shared.
spanning-tree mstp point-to-point auto	Automatically checks the port connection type.
no spanning-tree mstp point-to-point	Resumes the port connection type to the default settings.

19.2.3.13 Activating MST-Compatible Mode

The MSTP protocol that our switches support is based on IEEE 802.1s. In order to be compatible with other MSTPs, especially MSTP that the Cisco switches support, the MSTP protocol can work in MST-compatible mode. Switches running in MSTP-compatible mode can identify the message structure of other MSTPs, check the contained MST regional identifier and establish the MST region.

The MST-compatible mode and the STP-compatible mode are based on MSTP protocol conversion mechanism. If one port of the switch receives BPDU in compatible mode, the port automatically changes to the mode and sends BPDU in compatible mode. To resume the port to standard MST mode, you can run **spanning-tree mstp migration-check**.

In global configuration mode, run the following commands to enable or disable the MST-compatible mode:

Command	Purpose
spanning-tree mstp mst-compatible	Enable the MST-compatible mode of the switch.
no spanning-tree mstp mst-compatible	Disable the MST-compatible mode of the switch.

The main function of the compatible mode is to create the MST area for switches and other MSTP-running switches. In actual networking, make sure that the switch has the same configuration name and the same edit number. It is recommended to configure switches running other MSTP protocols to the CIST root, ensuring that the switch enters the compatible mode by receiving message. If the MST-compatible mode is not activated, the switch will not resolve the whole BPDU-compatible content and take the content as the common RSTP BPDU. In this way, the switch cannot be in the same area with the MST-compatible switch that it connects.

A port in compatible mode cannot automatically resumes to send standard MST BPDU even if the compatible mode is shut down in global configuration mode. In this case, run **migration-check**.

19.2.3.14 Restarting Protocol Conversion Check

MSTP allows the switch to work with the traditional STP switch through protocol conversion mechanism. If one port of the switch receives the STP configuration message, the port then only transmits the STP message. At the same time, the port that receives the STP information is then considered as a boundary port.

When a port is in the STP-compatible state, the port will not automatically resume to the MSTP state even if the port does not receive the STP message any more. In this case, you can run spanning-tree mstp migration-check to clear the STP message that the port learned, and make the port to return to the MSTP state. The switch that runs the RSTP protocol can identify and handle the MSTP message. Therefore, the MSTP switch does not require protocol conversion when it works with the RSTP switch.

In global configuration mode, run the following command to clear all STP information that is detected by all ports of the switch:

Command	Purpose
spanning-tree mstp migration-check	Clears all STP information that is detected by all ports of the switch.

In port configuration mode, run the following command to clear STP information detected by the port.

Command	Purpose
spanning-tree mstp migration-check	Clears STP information detected by the port.

19.2.3.15 Checking MSTP Information

In monitor command, global configuration command or port configuration command, run the following command to check all information about MSTP.

Command	Purpose
show spanning-tree	Checks MSTP information. (Information about SSTP, PVST, RSTP and MSTP can be checked)
show spanning-tree detail	Checks the details of MSTP information. (Information about SSTP, PVST, RSTP and MSTP can be checked)）
show spanning-tree interface *interface-id*	Checks the STP interface information. (Information about SSTP, PVST, RSTP and MSTP can be checked)）
show spanning-tree mstp	Checks all MST instances.
show spanning-tree mstp region	Checks the MST area configuration.
show spanning-tree mstp instance *instance-id*	Checks information about a MST instance.
show spanning-tree mstp detail	Checks detailed MST information.
show spanning-tree mstp interface *interface-id*	Checks MST port configuration.
show spanning-tree mstp protocol-migration	Checks the protocol conversion state of the port.

20. STP Optional Characteristic Configuration

20.1 Configuring STP Optional Characteristic

20.1.1 STP Optional Characteristic Introduction

The spanning tree protocol module of the switch supports seven additional features (the so-called optional features). These features are not configured by default. The supported condition of various spanning tree protocol modes towards the optional characteristics is as follows:

Optional Characteristic	Single STP	PVST	RSTP	MSTP
Port Fast	Yes	Yes	No	No
BPDU Guard	Yes	Yes	Yes	Yes
BPDU Filter	Yes	Yes	No	No
Uplink Fast	Yes	Yes	No	No
Backbone Fast	Yes	Yes	No	No
Root Guard	Yes	Yes	Yes	Yes
Loop Guard	Yes	Yes	Yes	Yes

20.1.1.1 Port Fast

Port Fast immediately brings an interface configured as an access or trunk port to the forwarding state from a blocking state, bypassing the listening and learning states. You can use Port Fast on interfaces connected to a single workstation or server, to allow those devices to immediately connect to the network, rather than waiting for the spanning tree to converge.

Interfaces connected to a single workstation or server should not receive bridge protocol data units (BPDUs). An interface with Port Fast enabled goes through the normal cycle of spanning-tree status changes when the switch is restarted.

Because the purpose of Port Fast is to minimize the time interfaces must wait for spanning-tree to converge, it is effective only when used on interfaces connected to end stations. If you enable Port Fast on an interface connecting to another switch, you risk creating a spanning-tree loop.

You can enable this feature by using the spanning-tree portfast interface configuration or the spanning-tree portfast default global configuration command.

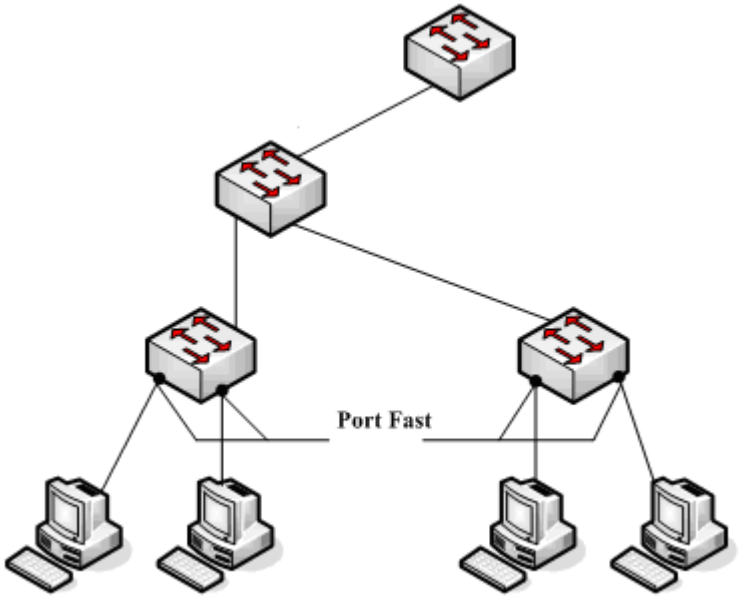


Figure 1.1 Port Fast

Instruction:

For the rapid convergent spanning tree protocol, RSTP and MSTP, can immediately bring an interface to the forwarding state, and therefore there is no need to use Port Fast feature.

20.1.1.2 BPDU Guard

The BPDU guard feature can be globally enabled on the switch or can be enabled per port, but the feature operates with some differences.

At the global level, you enable BPDU guard on Port Fast-enabled ports by using the spanning-tree portfast bpduguard default global configuration command. Spanning tree shuts down ports that are in a Port Fast-operational state if any BPDU is received on them. In a valid configuration, Port Fast-enabled ports do not receive BPDUs. Receiving a BPDU on a Port Fast-enabled port means an invalid configuration, such as the connection of an unauthorized device, and the BPDU guard feature puts the port in the error-disabled state. When this happens, the switch shuts down the entire port on which the violation occurred.

To prevent the port from shutting down, you can use the**errdisable detect cause bpduguard shutdown VLAN global configuration** command to shut down just the offending VLAN on the port where the violation occurred.

At the interface level, you enable BPDU guard on any port by using the**spanning-tree bpduguard enable interface configuration** command without also enabling the Port Fast feature. When the port receives a BPDU, it is put in the error-disabled state.

The BPDU guard feature provides a secure response to invalid configurations because you must manually put the interface back in service. Use the BPDU guard feature in a service-provider network to prevent an access port from participating in the spanning tree.

20.1.1.3 BPDU Filter

The BPDU filtering feature can be globally enabled on the switch or can be enabled per interface, but the feature operates with some differences.

In SSTP/PVST mode, if a **Port Fast** port with BPDU filter configured receives the BPDU, the features BPDU Filter and Port Fast at the port will be automatically disabled, resuming the port as a normal port. Before entering the **Forwarding** state, the port must be in the **Listening** state and **Learning** state.

The BPDU Filter feature can be configured in global configuration mode or in port configuration mode. In global configuration mode, run the command **spanning-tree portfast bpdufilter** to block all ports to send BPDU out. The port, however, can still receive and process BPDU.

20.1.1.4 Uplink Fast

The feature **Uplink Fast** enables new root ports to rapidly enter the **Forwarding** state when the connection between the switch and the root bridge is disconnected.

A complex network always contains multiple layers of devices, as shown in figure 1.2. Both aggregation layer and the access layer of the switch have redundancy connections with the upper layer. These redundancy connections are normally blocked by the STP to avoid loops.

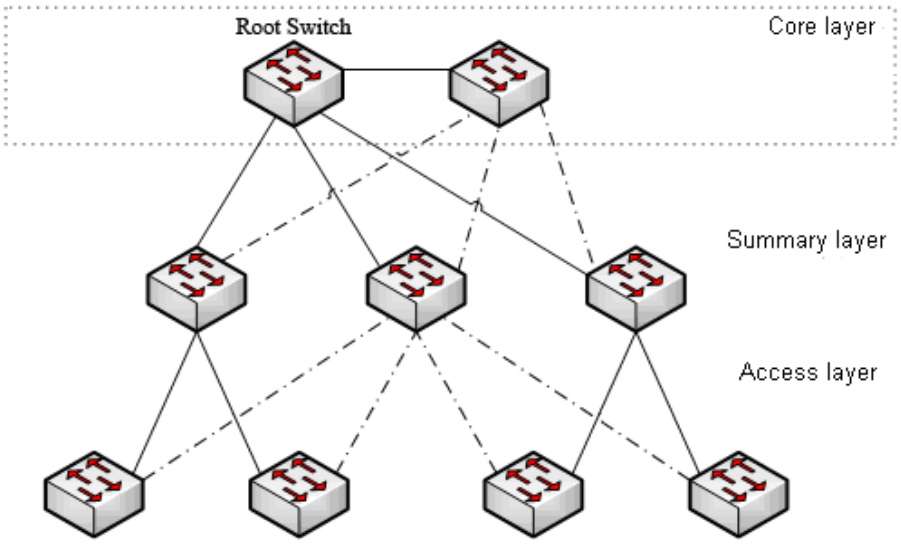


Figure 1.2 Switching network topology

Suppose the connection between a switch and the upper layer is disconnected (called as Direct Link Failure), the STP chooses the Alternate port on the redundancy line as the root port. Before entering the **Forwarding** state, the Alternate port must be in the **Listening** state and **Learning** state. If the **Uplink Fast** feature is configured by running the command **spanning-tree uplinkfast** in global configuration mode, new root port can directly enter the forwarding state, resuming the connection between the switch and the upper layer. Figure 1.3 shows the working principle of the **Uplink Fast** feature. The port for switch C to connect switch B is the standby port when the port is in the original state. When the connection between switch C and root switch A is disconnected, the previous **Alternate** port is selected as new root port and immediately starts forwarding.

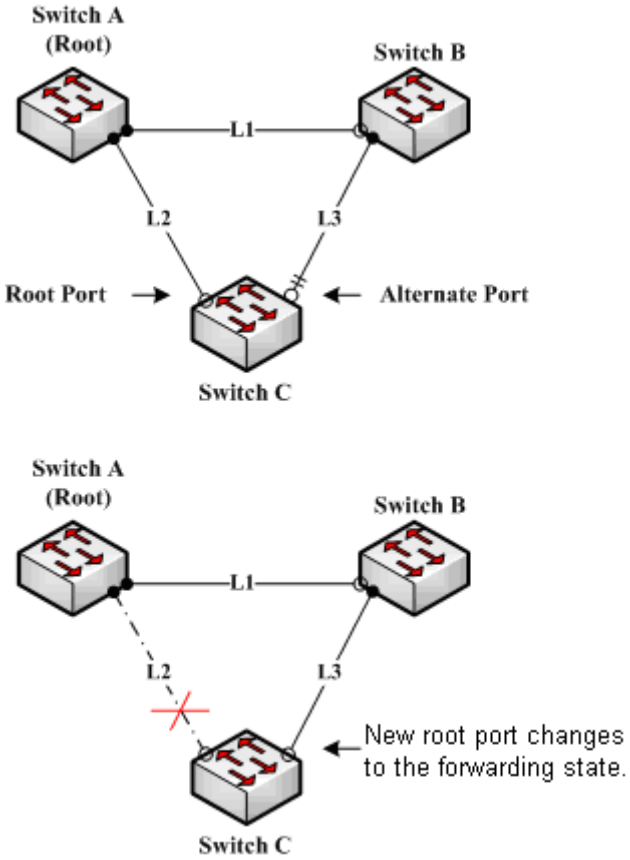


Figure 1.3 Uplink Fast

Note

The Uplink Fast feature adjusts to the slowly convergent SSTP and PVST. In RSTP and MSTP mode, new root port can rapidly enter the Forwarding state without the Uplink Fast function.

20.1.1.5 Backbone Fast

The **Backbone Fast** feature is a supplement of the **Uplink Fast** technology. The **Uplink Fast** technology makes the redundancy line rapidly work in case the direct connection to the designated switch is disconnected, while the **Backbone Fast** technology detects the indirect-link network blackout in the upper-layer network and boosts the change of the port state.

In figure 1.3, Connection L2 between switch C and switch A is called as the direct link between switch C and root switch A. If the connection is disconnected, the **Uplink Fast** function can solve the problem. Connection L1 between switches A and B is called as the indirect link of switch C. The disconnected indirect link is called as indirect failure, which is handled by the **Backbone Fast**function.

The working principle of the Backbone Fast function is shown in Figure 1.4.

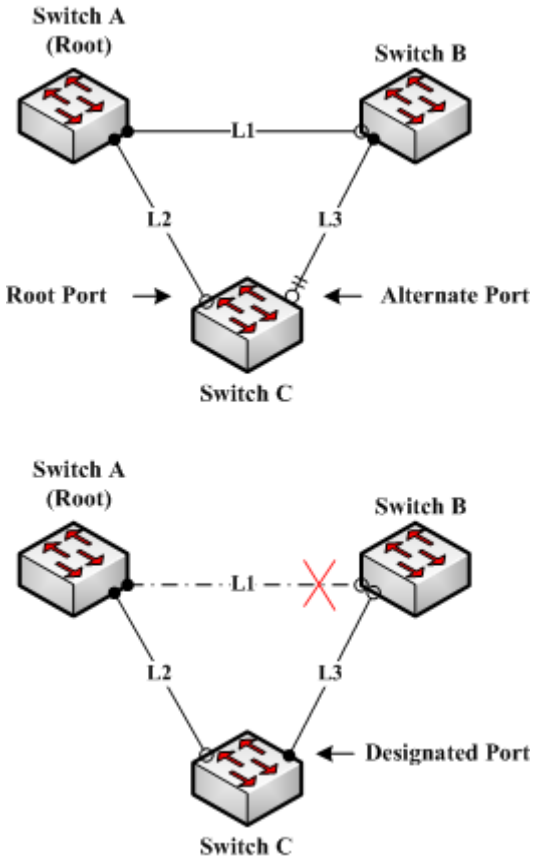


Figure 1.4 Backbone Fast

Suppose the bridge priority of switch C is higher than that of switch B. When L1 is disconnected, switch B is selected to send BPDU to switch C because the bridge priority is used as root priority. To switch C, the information contained by BPDU is not prior to information contained by its own. When Backbone Fast is not enabled, the port between switch C and switch B ages when awaiting the bridge information and then turns to be the designated port. The aging normally takes a few seconds. After the function is configured in global configuration mode by running the command **spanning-tree backbonefast**, when the Alternate port of switch C receives a BPDU with lower priority, switch C thinks that an indirect-link and root-switch-reachable connection on the port is disconnected. Switch C then promptly update the port as the designated port without waiting the aging information.

After the Backbone Fast function is enabled, if BPDU with low priority is received at different ports, the switch will perform different actions. If the Alternate port receives the message, the port is updated to the designated port. If the root port receives the low-priority message and there is no other standby port, the switch turns to be the root switch.

Note that the Backbone Fast feature just omits the time of information aging. New designated port still needs to follow the state change order: the listening state, then the learning state and finally the forwarding state.

Similar to Uplink Fast, the Backbone Fast feature is effective in SSTP and PVST modes.

20.1.1.6 Root Guard

The Root Guard feature prevents a port from turning into a root port because of receiving high-priority BPDU. The Layer 2 network of a service provider (SP) can include many connections to switches that are not owned by the SP. In such a topology, the spanning tree can reconfigure itself and select a customer switch as the root switch, as shown in Figure 17-8. You can avoid this situation by enabling root guard on SP switch interfaces that connect to switches in your customer's network. If spanning-tree calculations cause an interface in the customer network to be selected as the root port, root guard then places the interface in the root-inconsistent (blocked) state to prevent the customer's switch from becoming the root switch or being in the path to the root. If a switch outside the SP network becomes the root switch, the interface is blocked (root-inconsistent state), and spanning tree selects a new root switch. The customer's switch does not become the root switch and is not in the path to the root.

If the switch is operating in multiple spanning-tree (MST) modes, root guard forces the interface to be a designated port. If a boundary port is blocked in an internal spanning-tree (IST) instance because of root guard, the interface also is blocked in all MST instances. A boundary port is an interface that connects to a LAN, the designated switch of which is either an IEEE 802.1D switch or a switch with a different MST region configuration.

Root guard enabled on an interface applies to all the VLANs to which the interface belongs. VLANs can be grouped and mapped to an MST instance.
You can enable this feature by using the spanning-tree guard root interface configuration command.

Root Guard feature acts differently somehow in SSTP/PVST and RSTP/MSTP. In SSTP/PVST mode, Root port is always blocked by Root Guard. In RSTP/MSTP mode, Root port won't be blocked until receiving higher level BPDU. A port which formerly plays the Root role will not be blocked.

20.1.1.7 Loop Guard

You can use loop guard to prevent alternate or root ports from becoming designated ports because of a failure that leads to a unidirectional link. This feature is most effective when it is enabled on the entire switched network. Loop guard prevents alternate and root ports from becoming designated ports, and spanning tree does not send BPDUs on root or alternate ports.
You can enable this feature by using the spanning-tree loopguard default global configuration command.
When the switch is operating in PVST+ or rapid-PVST+ mode, loop guard prevents alternate and root ports from becoming designated ports, and spanning tree does not send BPDUs on root or alternate ports.
When the switch is operating in MST mode, BPDUs are not sent on nonboundary ports only if loop guard in all MST instances blocks the interface. On a boundary port, loop guard blocks the interface in all MST instances.

Loop Guard feature acts differently somehow in SSTP/PVST and RSTP/MSTP. In SSTP/PVST mode, the designated port is always be blocked by Loop Guard. In RSTP/MSTP mode, the port will be blocked only when it changes into the designated port because of inaccessibility to receiving BPDU. Loop Guard will not block a port, which is provided with the designated role due to receiving the lower level BPDU.

20.1.2 Configuring STP Optional Characteristic

20.1.2.1 STP Optional Characteristic Configuration Task

-
-

- Configuring Port Fast

- Configuring BPDU Guard

- Configuring BPDU Filter
  -
  -
- Configuring Uplink Fast

20.1.2.2 Configuring Port Fast

An interface with the Port Fast feature enabled is moved directly to the spanning-tree forwarding state without waiting for the standard forward-time delay.

Use the following command to configure the port fast feature in the global configuration mode:

command	purpose
spanning-tree port fast default	Globally enables port fast feature. It is valid to all interfaces.
no spanning-tree portfast default	Globally disables port fast feature. It has no effect on the interface configuration.

Note

The port fast feature only applies to the interface that connects to the host. The BPDU Guard or BPDU Filter must be configured at the same time when the port fast feature is configured globally.

Use the following command to configure the port fast feature in the interface configuration mode:

command	purpose
spanning-tree portfast	Enables port fast feature on the interface.
no spanning-tree portfast	Disables port fast feature on the interface. It has no effect on the global configuration.

20.1.2.3 Configuring BPDU Guard

When you globally enable BPDU guard on ports that are Port Fast-enabled (the ports are in a Port Fast-operational state), spanning tree shuts down Port Fast-enabled ports that receive BPDUs.
In a valid configuration, Port Fast-enabled ports do not receive BPDUs. Receiving a BPDU on a Port Fast-enabled port means an invalid configuration, such as the connection of an unauthorized device, and the BPDU guard feature puts the port in the error-disabled state. When this happens, the switch shuts down the entire port on which the violation occurred.

To prevent the port from shutting down, you can use the **errdisable detect cause bpduguard shutdown vlan global configuration** command to shut down just the offending VLAN on the port where the violation occurred.

The BPDU guard feature provides a secure response to invalid configurations because you must manually put the port back in service. Use the BPDU guard feature in a service-provider network to prevent an access port from participating in the spanning tree.
Follow these steps to globally enable the BPDU guard feature:

command	purpose
spanning-tree portfast bpduguard	Globally enables bpdu guard feature. It is valid to all interfaces.
no spanning-tree portfast bpduguard	Globally disables bpdu guard feature.

Instruction:
Globally enabling port fast feature may result in broadcast storm. The BPDU Guard or BPDU Filter should be configured for protection sake.

Follow these steps to enable the BPDU guard feature in interface configuration mode:

Command	Purpose
spanning-tree bpduguard enable	Enables bpdu guard feature on the interface.
spanning-tree bpduguard disable	Disables bpdu guard feature on the interface. It has no effect on the global configuration.
no spanning-tree bpduguard	Disables bpdu guard feature on the interface. It has no effect on the global configuration.

20.1.2.4 Configuring BPDU Filter

When you globally enable BPDU filtering on Port Fast-enabled interfaces, it prevents interfaces that are in a Port Fast-operational state from sending or receiving BPDUs. The interfaces still send a few BPDUs at link-up before the switch begins to filter outbound BPDUs. You should globally enable BPDU filtering on a switch so that hosts connected to these interfaces do not receive BPDUs. If a BPDU is received on a Port Fast-enabled interface, the interface loses its Port Fast-operational status, and BPDU filtering is disabled.
Follow these steps to globally enable the BPDU filter feature.:

Command	Purpose
spanning-tree portfast bpdufilter	Globally enables bpdu filter feature. It is valid to all interfaces.
no spanning-tree portfast bpdufilter	Globally disables bpdu filter feature.

Instruction:
Globally enabling port fast feature may result in broadcast storm. The BPDU Guard or BPDU Filter should be configured for protection sake.

Follow these steps to enable the BPDU filter feature in the interface configuration mode :

Command	Purpose
spanning-tree bpdufilter enable	Enables bpdu filter feature on the interface.
spanning-tree bpdufilter disable	Disables bpdu filter feature. It has no effect on the global configuration.
no spanning-tree bpdufilter	Disables bpdu filter feature. It has no influence on the global configuration.

20.1.2.5 Configuring Uplink Fast

If a switch loses connectivity, it begins using the alternate paths as soon as the spanning tree selects a new root port. By enabling UplinkFast with the spanning-tree uplinkfast global configuration command, you can accelerate the choice of a new root port when a link or switch fails or when the spanning tree reconfigures itself. The root port transitions to the forwarding state immediately without going through the listening and learning states, as it would with the normal spanning-tree procedures.
Uplink Fast feature is only valid in SSTP/PVST mode.

Follow these steps to globally enable UplinkFast.:

Command	Purpose
spanning-tree uplinkfast	Enables uplink fast feature.
no spanning-tree uplinkfast	Disables uplink fast feature.

20.1.2.6 Configuring Backbone Fast

BackboneFast is a complementary technology to the UplinkFast feature, which responds to failures on links directly connected to access switches. BackboneFast optimizes the maximum-age timer, which controls the amount of time the switch stores protocol information received on an interface. When a switch receives an inferior BPDU from the designated port of another switch, the BPDU is a signal that the other switch might have lost its path to the root, and BackboneFast tries to find an alternate path to the root.

Backbone fast feature is only valid in SSTP/PVST mode.

Follow these steps to globally enable BackboneFast.:

Command	Purpose
spanning-tree backbonefast	Enables backbone fast feature.
no spanning-tree backbonefast	Disables backbone fast feature.

20.1.2.7 Configuring Root Guard

Root guard enabled on an interface applies to all the VLANs to which the interface belongs. Do not enable the root guard on interfaces to be used by the UplinkFast feature. With UplinkFast, the backup interfaces (in the blocked state) replace the root port in the case of a failure. However, if root guard is also enabled, all the backup interfaces used by the UplinkFast feature are placed in the root-inconsistent state (blocked) and are prevented from reaching the forwarding state.

Root Guard feature acts differently somehow in SSTP/PVST and RSTP/MSTP. In SSTP/PVST mode, Root port is always blocked by Root Guard. In RSTP/MSTP mode, Root port won't be blocked until receiving higher level BPDU. A port which formerly plays the Root role will not be blocked.

Follow these steps to enable root guard on an interface.:

Command	Purpose
spanning-tree guard root	Enables root guard feature on the interface.
no spanning-tree guard	Disables root guard and loop guard features on the interface.
spanning-tree guard none	Disables root guard and loop guard features on the interface.

20.1.2.8 Configuring Loop Guard

You can use loop guard to prevent alternate or root ports from becoming designated ports because of a failure that leads to a unidirectional link. This feature is most effective when it is configured on the entire switched network. Loop guard operates only on interfaces that are considered point-to-point by the spanning tree. Loop Guard feature acts differently somehow in SSTP/PVST. In SSTP/PVST mode,, the designated port is always blocked by Loop Guard. In RSTP/MSTP, the designated port is always blocked by Loop Guard. In RSTP/MSTP mode, the port will be blocked only when it changes into the designated port because of inaccessibility to receiving BPDU. A port which is provided with the designated role due to receiving the lower level BPDU will not be blocked by Loop Guard.

Follow these steps to enable loop guard in global configuration mode.:

Command	Purpose
spanning-tree loopguard default	Globally enables loop guard feature. It is valid to all interfaces.
no spanning-tree loopguard default	Globally disables loop guard.

Follow these steps to enable loop guard in the interface configuration mode.:

Command	Purpose
spanning-tree guard loop	Enables loop guard feature on the interface.
no spanning-tree guard	Disables root guard and loop guard feature on the interface.
spanning-tree guard none	Disables root guard and loop guard on the interface.

21. Link Aggregation Configuration

21.1 Configuring Port Aggregation

21.1.1 Overview

Link aggregation, also called trunking, is an optional feature available on the Ethernet switch and is used with Layer 2 Bridging. Link aggregation allows logical merge of multiple ports in a single link. Because the full bandwidth of each physical link is available, inefficient routing of traffic does not waste bandwidth. As a result, the entire cluster is utilized more efficiently. Link aggregation offers higher aggregate bandwidth to traffic-heavy servers and reroute capability in case of a single port or cable failure.

Supported Features:

- Static aggregation control is supported

Bind a physical port to a logical port, regardless whether they can actually bind to a logical port.
Aggregation control of LACP dynamic negotiation is supported
Only a physical port that passes the LACP protocol negotiation can bind to a logical port. Other ports won't bind to the logical port.

- Aggregation control of LACP dynamic negotiation is supported

When a physical port is configured to bind to a logical port, the physical port with LACP negotiation can be bound to a logical port. Other ports cannot be bound to the logical port.

- Flow balance of port aggregation is supported.

After port aggregation, the data flow of the aggregation port will be distributed to each aggregated physical port.

21.1.2 Port Aggregation Configuration Task List

- Configuring logical channel used for aggregation
- Aggregation of physical port
- Selecting load balance mode after port aggregation
- Monitoring the concrete condition of port aggregation

21.1.3 Port Aggregation Configuration Task

21.1.3.1 Configuring Logical Channel Used to Aggregation

You should establish a logical port before binding all the physical ports together. The logical port is used to control the channel formed by these binding physical ports.
Use the following command to configure the logical channel:

Command	Description
interface port-aggregator id	Configures aggregated logical channel.

21.1.3.2 Aggregation of Physical Port

To aggregate multiple physical ports into a logical channel, you can use static aggregation or LACP protocol for negotiation.
In the case when the static aggregation is used, it is required that the link of the physical port should be up, and the VLAN attribute of aggregation port and physical port should be identical, and then this port will be aggregated to the logical channel, regardless of whether the current port accords with the conditions of port aggregation and whether the port that connects with the physical port accords with the aggregation conditions.

Prerequisites for ports to be aggregated:

- The link of the port must be up and the port should be negotiated to full-duplex mode.
- The speed of all physical ports should be same during aggregation process, that is, if there is one physical port that has been aggregated successfully, then the speed of the second physical port must be the same as the first configured one. Also the vlan attributes of all physical ports must be identical to the aggregated port.

LACP packets are exchanged between ports in these modes:

- Active—Places a port into an active negotiating state, in which the port initiates negotiations with remote ports by sending LACP packets.
- Passive—Places a port into a passive negotiating state, in which the port responds to LACP packets it receives but does not initiate LACP negotiation. In this mode, the port channel group attaches the interface to the bundle.

If both ports use Passive method, then the aggregation fails. This is because both sides will wait for the other side to launch aggregation negotiation process.

VALN attributes: PVID, Trunk attribute, vlan-allowed range and vlan-untagged range.

Use the following command to perform aggregation on the physical ports:

Command	Description
aggregator-group*agg-id*mode { lacp | static }	Configures aggregation option of the physical port.

21.1.3.3 Selecting Load Balance Method After Port Aggregation

You can select the load share method to ensure that all ports can share the data traffic after the aggregation of all physical ports. The switch can provides up to six load balance strategy:

- src-mac

It is to share the data traffic according to the source MAC address, that is, the message with same MAC address attributes is to get through a physical port.

- dst-mac

It is to share the data traffic according to the destination MAC address, that is, the message with same MAC address attributes is to get through a physical port.

- both-mac

It is to share the data traffic according to source and destination MAC addresses, that is, the message with same MAC address attributes is to get through a physical port.

- src-ip

It is to share the data traffic according to the source IP address, that is, the message with same IP address attributes is to get through a physical port.

- dst-ip

It is to share the data traffic according to the destination IP address, that is, the message with same IP address attributes is to get through a physical port.

- both-ip

It is to share the data traffic according to the destination and source IP addresses, that is, the message with same IP address attributes is to get through a physical port.

Use the following command to configure load balance method:

Command	Description
aggregator-group load-balance	Configures load balance method.

21.1.3.4 Monitoring the Concrete Conditions of Port Aggregation

Use the following command to monitor port aggregation state in EXEC mode:

Command	Description
show aggregator-group	Displays port aggregation state.

22. PDP Configuration

22.1 PDP Overview

22.1.1 Overview

PDP is specially used to discover network equipment, that is, it is used to find all neighbors of a known device. Through PDP, the network management program can use SNMP to query neighboring devices to acquire network topology.

Our company's switches can discover the neighboring devices but they do not accept SNMP queries. Therefore, switches only run at the edge of network, or they cannot acquire a complete network topology. PDP can be set on all SNAPs (e.g. Ethernet).

22.1.2 PDP Configuration Tasks

- Default PDP Configuration
- Setting the PDP Clock and Information Storage
- Setting the PDP Version
- Starting PDP on a Switch
- Starting PDP on a Port
- PDP Monitoring and Management

22.1.2.1 Default PDP Configuration

Function	Default Settings
Global configuration mode	This function is not enabled by default.
Interface configuration mode	Starts up.
PDP clock (packet transmission frequency)	60 seconds
PDP information storage	180 seconds
PDP version	2

22.1.2.2 Setting the PDP Clock and Information Storage

To set the PDP packet transmission frequency and the PDP information storage time, you can run the following commands in global configuration mode.

Command	Purpose
pdp timer seconds	Sets the transmission frequency of the PDP packets.
pdp holdtime seconds	Sets the PDP information storage time.

22.1.2.3 Setting the PDP Version

To set the PDP version, you can run the following command in global configuration mode.

Command	Purpose
pdp version {1|2}	Setts the PDP version.

22.1.2.4 Starting PDP on a Switch

To enable PDP, you can run the following commands in global configuration mode.

Command	Purpose
pdp run	Starts PDP on a switch.

22.1.2.5 Starting PDP on a Port

To enable PDP on a port by default, you can run the following command in port configuration mode.

Command	Purpose
pdp enable	Starts PDP on a port of a switch.

22.1.2.6 PDP Monitoring and Management

To monitor the PDP, run the following commands in EXEC mode:

Command	Purpose
show pdp traffic	Displays the counts of received and transmitted PDP packets.
show pdp neighbor [detail]	Displays neighbors that PDP discovers.

22.1.3 PDP Configuration Example

Example 1: Starting PDP

Switch_config# pdp run

Switch_config# int f0/1

Switch_config_f0/1#pdp enable

Example 2: Setting the PDP clock and information storage

Switch_config#pdp timer 30

Switch_config#pdp holdtime 90

Example 3: Setting the PDP version

Switch_config#pdp version 1

Example 4: Monitoring PDP

Switch_config#show pdp neighbor

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

S - Switch, H - Host, I - IGMP, r - Repeater

Device-ID Local-Intf Hldtme Port-ID Platform Capability

Switch Fas0/1 169 Gig0/1 COMPANY, RISC R S

23. LLDP Configuration

23.1 LLDP

23.1.1 LLDP Introduction

The 802.1ABlink layer discovery protocol (LLDP) at 802.1AB helps to detect network troubles easily and maintain the network topology.

LLDP is a unidirectional protocol. One LLDP agent transmits its state information and functions through its connected MSAP, or receives the current state information or function information about the neighbor. However, the LLDP agent cannot request any information from the peer through the protocol.

During message exchange, message transmission and reception do not affect each other. You can configure only message transmission or reception or both.

LLDP is a useful management tool, providing management personnel exact network mapping, traffic data and trouble detection information.

23.1.2 LLDP Configuration Task List

- Disabling / enabling LLDP
- Configuring holdtime
- Configuring timer
- Configuring reinit
- Configuring to-be-sent tlv
- Configuring the transmission / reception mode
- Configuring show-relative commands
- Configuring deletion commands
- Configuring debugging commands

23.1.3 LLDP Configuration Task

23.1.3.1 Disabling / enabling LLDP

LLDP is disabled by default. You need start up LLDP before it runs.

Run the following command in global configuration mode to enable LLDP:

Command	Purpose
lldprun	Runs LLDP.

Run the following command to disable LLDP:

Command	Purpose
nolldprun	Disables LLDP.

23.1.3.2 Configuring holdtime

You can control the timeout time of transmitting the LLDP message through modifying **holdtime**:

Run the following command in global configuration mode to configure **holdtime** of LLDP:

Command	Purpose
lldpholdtime*time*	Configures the timeout time of LLDP.
nolldpholdtime	Resumes the timeout time to the default value, 120 seconds.

23.1.3.3 Configuring timer

You can control the interval of the switch to transmit message by configuring the timer of LLDP.

Run the following command in global configuration mode to configure **timer** of LLDP:

Command	Purpose
lldptimer*time*	Configures the interval of message transmission of LLDP.
no lldptimer	Resumes the default interval, that is, 30 seconds.

23.1.3.4 Configuring reinit

You can control the interval of the switch to continuously transmit two messages by configuring **reinit** of LLDP.
Run the following command in global configuration mode to configure **reinit** of LLDP:

Command	Purpose
lldpreinit *time*	Configures the interval of LLDP to continuously transmit message.
no lldpreinit	Resumes the default interval of continuously transmitting message; the default interval value is two seconds.

23.1.3.5 Configuring To-Be-Sent TLV

You can choose TLV which requires to be sent by configuring **tlv-select** of LLDP. By default, all TLVs are transmitted.
Run the following commands in global configuration mode to add or delete **tlv** of LLDP:

Command	Purpose
lldptlv-select*tlv-type*	Tlvs or tlv-types which needs to be added include: macphy-confg management-address port-description port-vlan system-capabilities system-description system-name
no lldptlv-select*tlv-type*	Tlvs or tlv-types which needs to be deleted include: macphy-confg management-address port-description port-vlan system-capabilities system-description system-name

23.1.3.6 Configuring the Transmission or Reception Mode

LLDP can work under three modes: transmit-only, receive-only and transmit-and-receive.

By default, LLDP works under the transmit-and-receive mode. You can modify the working mode of LLDP through the following commands.

Run the following command in interface configuration mode to configure the working mode of LLDP:

Command	Purpose
[no] **lldptransmit**	Sets the port to the transmit-only mode or disables the transmit-only mode of the port.
[no] **lldpreceive**	Sets the port to the receive-only mode or disables the receive-only mode of the port.

23.1.3.7 Configuring Show-Relative Commands

You can observe the information about the neighbor, statistics or port state received by the LLDP module by running show-relative commands.

Run the following commands in EXEC or global configuration mode:

Command	Purpose
showlldperrors	Displays the error information about the LLDP module.
showlldpinterface*interface-name*	Displays the information about port state, that is, the transmission mode and the reception mode.
showlldpneighbors	Displays the abstract information about the neighbor.
showlldpneighborsdetail	Displays the detailed information about the neighbor.
showlldptraffic	Displays all received and transmitted statistics information.

23.1.3.8 Configuring the Deletion Commands

You can delete the received neighbor lists and all statistics information by running the following command in EXEC mode.

Command	Purpose
clearlldpcounters	Deletes all statistics data.
clearlldptable	Deletes all received neighbor information.

23.1.3.9 Configuring Debugging Commands

To easily monitor the LLDP module, run the following commands in EXEC mode:

Command	Purpose
debuglldperrors	Reports some error information about the LLDP module.
debuglldpevents	Reports some special events about the LLDP module.
debuglldppackets	Reports the message transmission event of the LLDP module.
debuglldp states	Reports the information about the state of the LLDP port.

24. FlexLinkLite Configuration

24.1 FlexLinkLite Configuration

24.1.1 FlexLinkLite Overview

FlexLinkLite is used in a network environment to easily construct two uplink links, which back up each other. If STP is not enabled in this network environment, FlexLinkLite can avoid the loop and conduct fast switchover when a link is out of effect.

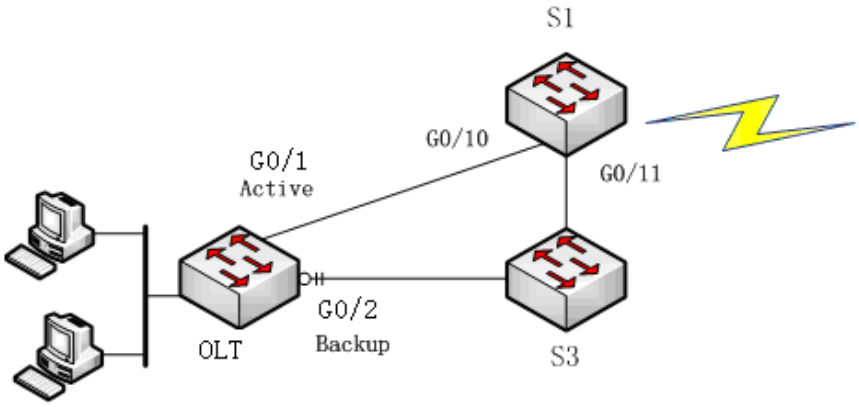


Figure 1: FlexLinkLite-enabled network

FlexLinkLite includes a pair of ports that back up each other. As shown in figure 1, FlexLinkLite is enabled on switch S2, and G5/1 and G5/2 are two ports that back up each other, the former being an active port while the latter being a backup port. In normal case, the active port forwards data and the backup port blocks data so as to avoid data loopback. If the active port's link is out of effect, the backup port will immediately begin to forward data.

A pair of ports, which back up each other, can be two physical ports, or a physical port and an aggregation port, or two aggregation ports. The port on which FlexLinkLite is set cannot be used for STP calculation or EAPS settings.

In case the links of two ports are up, the preempt mode is used to select which port to forward data. FlexLinkLite only supports the preempt based on the preset role. As shown in figure 1, when a link is out of effect and the preempt is set, port G0/1 will replace port G0/2 to forward data and port G5/2 will block data.

FlexLinkLite also has a topology change notification mechanism. As shown in figure 1, port G0/2 of switch S2 replaces port G0/1 to start forwarding data; S2 sends the TCN packets positively, and S1, after receiving these TCN packets, immediately clears the MAC addresses that are learned by the downlink ports, G0/10 and G0/11, and switches the downlink data flow rapidly to the correct link. In general, the TCN mechanism can assure the successful switchover of the two-way flow in 50ms.

24.1.2 FlexLinkLite Configuration

24.1.2.1 Run the following commands to set the backup port:

Run the following commands to set the FlexLinkLite backup port:

Command	Purpose
Switch# configure	Enters the global configuration mode of the switch.
Switch_config# interface *intf-name*	Enters the interface configuration mode. Intf-name: stands for the name of a port, such as G0/1 or F0/10.
Switch_config_intf# switchport backup interface *backup-intf-name* as [active | backup]	Sets another port to be the backup port of the current port. backup-intf-name: represents the name of another port. active: Stands for the active port, to which backup-intf-name corresponds, when the current port is a backup one. backup: Stands for the backup port, to which backup-intf-name corresponds, when the current port is an active one.

After **switchport backup interface** is set on an interface, the corresponding settings will automatically generate on the backup port without any manual operations.

However, if **no switchport backup interface** is run, a pair of ports, which back up each other, will be deleted.

24.1.2.2 Setting the Preempt of a Backup Port

Command	Purpose
Switch_config_intf# switchport bakcup interface preempt mode [none | role]	Sets the preempt mode. none: represents no preempt. role: means the role-based preempt, which is the default settings of the active port.
Switch_config_intf# switchport backup interface preempt delay [immediately | *time-sec*]	Sets the delay of the preempt. That is, it refers to the waiting time during which the link state will be resumed to preempt start. immediately: conducts the preempt without any delay. time-sec: means the delay of preempt, whose unit is second. The default value is three seconds. The value ranges between 1 and 600 seconds.

switchport backup interface preempt mode role is deemed as the default settings of each backup port pair.

24.1.2.3 Setting the Transmission and Reception of TCN Packets

Command	Purpose
Switch_config_intf# switchport bakcup interface tcn transmit	Allows a port to transmit the TCN packets.
Switch_config_intf# switchport backup interface tcn accept	Allows a port to process the TCN packets.

The **transmit** command can be enabled on the device with a configured backup port. When a backup port is switched, it will transmit the TCN packets.

The **accept** command can be enabled on the uplink device. If this command is enabled on a uplink device, it can receive the TCN packets and delete the MAC addresses that are learned by the downlink port.

24.1.3 FlexLinkLite Configuration Example

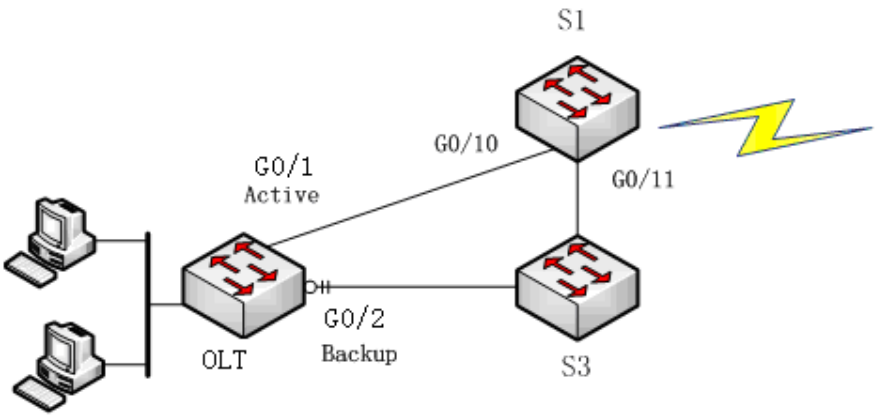


Figure 2: FlexLinkLite configuration example

Configuration

Run the following commands to set the backup port:

Switch# config

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport backup interface g0/2 as backup

Enable the default role-based preempt and set the delay to 15 seconds:

Switch_config_g0/1# switchport backup interface preempt delay 15

Make the following settings to enable the TCN packets to be transmitted:

Switch_config_g0/1# switchport backup interface tcn transmit

Switch_config_g0/1# interface g0/2

Switch_config_g0/2# switchport backup interface tcn transmit

Switch_config_g0/2# exit

Browse the state of the port:

Switch_config# show backup interfaces

Backup interface pairs:

Active	Backup	State	Preemption
G0/1	G0/2	Active Up/Backup Down	Role/15/0

Make the following settings to enable the TCN packets to be received:

Switch# config

Switch_config# interface range g0/10 , 11

Switch_config_if_range# switchport backup interface tcn accept

Switch_config_if_range# exit

Switch_config#

25. BackupLink Configuration

25.1 BackupLink Overview

25.1.1 Overview

Link aggregation, also called trunking, is an optional feature available on the Ethernet switch and is used with Layer 2 Bridging. Link aggregation allows logical merge of multiple ports in a single link. Because the full bandwidth of each physical link is available, inefficient routing of traffic does not waste bandwidth. As a result, the entire cluster is utilized more efficiently. Link aggregation offers higher aggregate bandwidth to traffic-heavy servers and reroute capability in case of a single port or cable failure.

Supported Features:

Static aggregation control is supported

Bind a physical port to a logical port, regardless whether they can actually bind to a logical port.

Aggregation control of LACP dynamic negotiation is supported

Only a physical port that passes the LACP protocol negotiation can bind to a logical port. Other ports won't bind to the logical port.

Aggregation control of LACP dynamic negotiation is supported

When a physical port is configured to bind to a logical port, the physical port with LACP negotiation can be bound to a logical port. Other ports cannot be bound to the logical port.

Flow balance of port aggregation is supported.

After port aggregation, the data flow of the aggregation port will be distributed to each aggregated physical port.

25.1.2 Port Aggregation Configuration Task

Configuring logical channel used for aggregation

Aggregation of physical port

Selecting load balance mode after port aggregation

Monitoring the concrete condition of port aggregation

25.1.2.1 Configuring Logical Channel Used to Aggregation

You should establish a logical port before binding all the physical ports together. The logical port is used to control the channel formed by these binding physical ports.

Use the following command to configure the logical channel:

Command	Description
interface port-aggregator id	Configures aggregated logical channel.

25.1.2.2 Aggregation of Physical Port

To aggregate multiple physical ports into a logical channel, you can use static aggregation or LACP protocol for negotiation.

In the case when the static aggregation is used, it is required that the link of the physical port should be up, and the VLAN attribute of aggregation port and physical port should be identical, and then this port will be aggregated to the logical channel, regardless of whether the current port accords with the conditions of port aggregation and whether the port that connects with the physical port accords with the aggregation conditions.

Prerequisites for ports to be aggregated:

- The link of the port must be up and the port should be negotiated to full-duplex mode.
- The speed of all physical ports should be same during aggregation process, that is, if there is one physical port that has been aggregated successfully, then the speed of the second physical port must be the same as the first configured one. Also the vlan attributes of all physical ports must be identical to the aggregated port.

LACP packets are exchanged between ports in these modes:

- Active—Places a port into an active negotiating state, in which the port initiates negotiations with remote ports by sending LACP packets.
- Passive—Places a port into a passive negotiating state, in which the port responds to LACP packets it receives but does not initiate LACP negotiation. In this mode, the port channel group attaches the interface to the bundle.

If both ports use Passive method, then the aggregation fails. This is because both sides will wait for the other side to launch aggregation negotiation process.

VALN attributes: PVID, Trunk attribute, vlan-allowed range and vlan-untagged range.

Use the following command to perform aggregation on the physical ports:

Command	Description
aggregator-group*agg-id***mode** { **lacp** | **static** }	Configures aggregation option of the physical port.

25.1.2.3 Selecting Load Balance Method after Port Aggregation

You can select the load share method to ensure that all ports can share the data traffic after the aggregation of all physical ports. The switch can provides up to six load balance strategy:

- src-mac

It is to share the data traffic according to the source MAC address, that is, the message with same MAC address attributes is to get through a physical port.

- dst-mac

It is to share the data traffic according to the destination MAC address, that is, the message with same MAC address attributes is to get through a physical port.

- both-mac

It is to share the data traffic according to source and destination MAC addresses, that is, the message with same MAC address attributes is to get through a physical port.

- src-ip

It is to share the data traffic according to the source IP address, that is, the message with same IP address attributes is to get through a physical port.

- dst-ip

It is to share the data traffic according to the destination IP address, that is, the message with same IP address attributes is to get through a physical port.

- both-ip

It is to share the data traffic according to the destination and source IP addresses, that is, the message with same IP address attributes is to get through a physical port.

Use the following command to configure load balance method:

Command	Description
aggregator-group load-balance	Configures load balance method.

25.1.2.4 Monitoring the Concrete Conditions of Port Aggregation

Use the following command to monitor port aggregation state in EXEC mode:

Command	Description
show aggregator-group	Displays port aggregation state.

26. EAPS Configuration

26.1 Introduction of EAPS

26.1.1 Overview

The Ethernet ring protection protocol is a special type of link-layer protocol specially designed for constructing the ring Ethernet topology. The Ethernet protection protocol can shut down one link in a complete ring topology, preventing the data loop from forming the broadcast storm. If a link is broken, the protocol immediately resumes the link that is previously shut down. In this way, the nodes among the ring network can communicate with each other.

The ring protection protocol and STP are both used for topology control on the link layer. STP is suitable for all kinds of complicated networks, which transmits the change of network topology hop by hop. The ring protection protocol is used for ring topology and adopts the pervasion mechanism to transmit the change of network topology. Therefore, the convergence of the ring protection protocol in the ring network is better than STP. In a sound network, the ring protection protocol can resume network communication within less than 50ms.

Remark:

EAPS supports to set a switch to be a node of multiple physical ring to construct complicated topology.

26.1.2 Related Concepts of EAPS

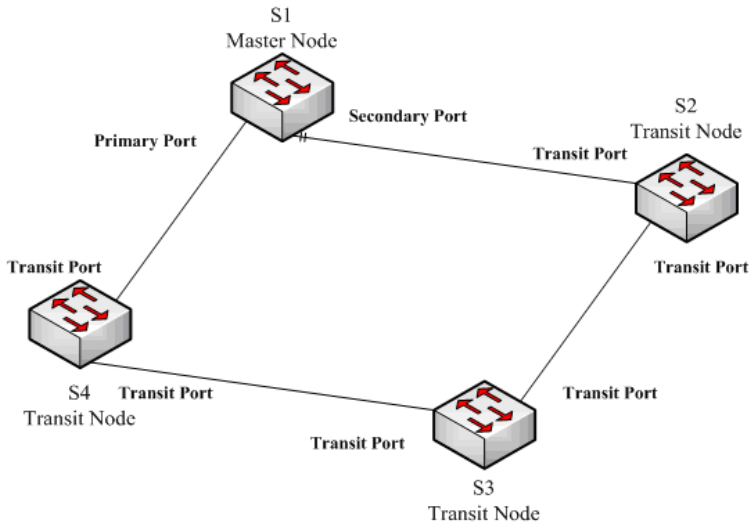


Figure 1.1 EAPS Ethernet ring

26.1.2.1 Roles of Ring's Nodes

Each switch on an Ethernet ring is a ring node. The ring nodes are classified into master nodes and transit nodes. Only one switch on the Ethernet ring can serve as a mere master node and other switches are worked as transit nodes.

Master node: It positively knows whether the ring's topology is complete, removes loopback, control other switches to update topology information.

Transit node: It only checks the state of the local port of the ring, and notifies the master node of the invalid link.

The role of each node can be specified by user through configuration. The thing is that each switch in the same ring can be set to only one kind of node. In figure 1.1, switch S1 is the master node of ring network, while switches S2, S3 and S4 are transit nodes.

26.1.2.2 Role of the Ring's Port

EAPS demands each switch has two ports to connect the ring network. Each port of the ring network also needs to be specified through configuration and the protocol supports the following kinds of port roles:

Primary port: the primary port can be configured only on the master node. The master node transmits the ring detection packets through the primary port.

Secondary port: the secondary port can be configured only on the master node. The master node receives the ring detection packets from the secondary port and judges whether the topology of the ring network is complete. In complete topology, the master node blocks the data packets on the secondary port, and prevents loopback from occurring; after a link on the ring network is interrupted, the master node will open the secondary port to forwarding the data packets.

Transit port: the transmit port can only be configured on the transit node. Both ports through which the transit node connects the ring network are all transit ports.

Each port of the ring network can be configured as only one port role after the node's role of the switch and the control VLAN are configured. As shown in figure 1.1, the port through which master node S1 connects transit node S4 is a primary port, the port through which S1 connects S2 is a secondary port, and the ports through which other switches connect the ring network are all transit ports.

Remark:

To configure a same switch to belong to multiple rings, the switch must connect different rings through different physical ports.

26.1.2.3 Control VLAN and Data VLAN

A private control VLAN is used between master node and transit node to transmit protocol packets. This control VLAN is specified by user through configuration and ring's ports are added also by user to the control VLAN, which guarantees that the protocol packets can be normally forwarded. In general, each port of the ring network is in the forwarding state in the control VLAN and the ports which do not belong to the ring network cannot forward the packets of control VLAN.

You can specify different control VLAN for each ring on a switch. The control VLAN is only used to forward the control packets of the ring network, not for L2/L3 communication. For example, if the VLAN port that corresponds to the control VLAN is established, the IP address of the VLAN port cannot be pinged through other devices.

The VLANs except the control VLAN are all data VLANs, which are used to transmit the packets of normal services or the management packets.

The data VLAN can be used for normal L2/L3 communication. For example, you can establish a VLAN port corresponding to data VLAN and configure dynamic routing protocols.

26.1.2.4 Aging of the MAC Address Table

The Ethernet ring protection protocol can transmit data packets to the correct link by controlling the aging of the switch's MAC address table when the topology changes. In general, the time for a MAC address to age in the MAC address table is 300 seconds. The ring protection protocol can control the aging of the MAC address table in a short time.

26.1.2.5 Symbol of a Complete Ring Network

Both the master node and the transit node can show whether the current ring network is complete through the state symbol "COMPLETE". On the master node, only when all links of the ring network are normal, the primary port is in forwarding state and the secondary port is in blocking state can the "COMPLETE" symbol be real; on the transit node, only when its two transit ports are in forwarding state can the "COMPLETE" symbol be true.

The state symbol of the ring network helps user to judge the topology state of the current network.

26.1.3 Types of EAPS Packets

The EAPS packets can be classified into the following types, as shown in table 1.1.

Table 1.1 Types of EAPS packets

Type of the packet	Remarks
Loopback detection （HEALTH）	It is transmitted by the master node to detect whether the topology of the ring network is complete.
LINK-DOWN	Indicates that link interruption happens in the ring. This kinds of packets are transmitted by the transit node.
RING-DOWN-FLUSH-FDB	It is transmitted by the master node after interruption of the ring network is detected and the packets show the MAC address aging table of the transit node.
RING-UP-FLUSH-FDB	It is transmitted by the master node after interruption of the ring network is resumed and the packets show the MAC address aging table of the transit node.

26.1.4 Ring Protection Mechanism

26.1.4.1 Ring Detection and Control of Master Node

The master node transmits the HEALTH packets to the control VLAN through the primary port in a configurable period. In normal case, the HEALTH packets will pass through all other nodes of the ring network and finally arrive at the secondary port of the master node.

The secondary port blocks all data VLANs in primitive condition. When receiving the HEALTH packets continuously, the secondary port keeps blocking data VLANs and blocking the loop. If the secondary port does not receive the HEALTH packets from the primary port in a certain time (which can be configured), it will regard the ring network is out of effect. Then the master node removes the blocking of data VLANs on the secondary port, ages the local MAC address table, and transmits the RING-DOWN-FLUSH-FDB packets to notify other nodes.

If the master node receives the HEALTH packets at the secondary port that is open to data VLANs, the ring network is resumed. In this case, the master node immediately blocks data VLANs on the secondary port, updates the local topology information and reports other nodes to age the MAC address table through RING-UP-FLUSH-FDB packets.

You can configure related commands on the Hello-time node and the Fail-time node to modify the interval for the primary port to transmit the HEALTH packets and the time limit for the secondary port to wait for the HEALTH packets.

26.1.4.2 Notification of Invalid Link of Transit Node

After the transit port of the transit node is out of effect, the LINK-DOWN packet will be immediately transmitted by the other transit port to notify other nodes. In normal case, the packet passes through other transit nodes and finally arrives at one port of the master node.

After the master node receives the LINK-DOWN packet, it thinks that the ring network is invalid. In this case, the master node removes the blocking of data VLANs on its secondary port, ages the local MAC address table, transmits the RING-DOWN-FLUSH-FDB packet and notifies other nodes.

26.1.4.3 Resuming the Link of the Transit Node

After the transit port is resumed, it does not immediately transmit the packets of data VLANs, but enters the Pre-Forwarding state. A transit port in pre-forwarding state only transmits and receives the control packets from the control VLAN.

If there is only one transit port invalid in the ring network and when the port enters the pre-forwarding state, the secondary port of the master node can receive the HEALTH packet from the primary port again. In this case, the master node blocks data VLANs on the secondary port again and transmits the notification of ageing address table outside. After the node with a transit port in pre-forwarding state receives the notification of aging address table, the node will first modify the pre-forwarding port to the forwarding port and then ages the local MAC address table.

If a transit mode does not receives the notification of aging address table from the master node, it thinks that the link to the master node is already out of effect, the transit node will automatically set the pre-forwarding port to be a forwarding one.

You can configure the related commands through the pre-forward-time node to modify the time for the transit port to keep the pre-forwarding state.

26.2 Ring Protection Configuration

26.2.1 Default EAPS Settings

The ring protection protocol cannot be set together with STP.

After STP is disabled, you are recommended to run **spanning-tree bpdu-terminal** to keep the ring node from forwarding BPDU, which leads to the storm.

See the following table:

Table 2.1 Default settings of the Ethernet ring protection protocol and STP.

Spanning tree protocol	**spanning-tree mode rstp**
Ring Protection	There is no configuration.

26.2.2 Requisites before Configuration

Before configuring MEAPS, please read the following items carefully:

- One of important functions of the ring protection protocol is to stop the broadcast storm, so please make sure that before the ring link is reconnected all ring nodes are configured.If the ring network is connected in the case that the configuration is not finished, the broadcast storm may easily occur.
- EAPS is well compatible with STP, but the port under the control of EAPS is not subject to STP.
- The ring protection protocol supports a switch to configure multiple ring networks.
- Configuring ring control VLAN will lead to the automatic establishment of corresponding system VLAN.
- The port of each ring can forward the packets from the control VLAN of the ring, while other ports, even in the Trunk mode, cannot forward the packets from the control VLAN.
- By default, Fail-time of the master node is triple longer than Hello-time, so that packet delay is avoided from shocking the ring protection protocol. After Hello-time is modified, Fail-time need be modified accordingly.
- By default, Pre-Forward-Time of the transit node is triple longer than Hello-time of the master node so that it is ensured that the master node can detect the recovery of the ring network before the transit port enters the pre-forwarding state. If Hello-time configured on the master node is longer than Fre-Forward-Time of the transit node, loopback is easily generated and broadcast storm is then triggered.

- The physical interface, the fast-Ethernet interface, the gigabit-Ethernet interface and the aggregation interface can all be set to be the ring's interfaces. If link aggregation, 802.1X or port security has been already configured on a physical interface, the physical interface cannot be set to be a ring's interface any more.

The versions of switch software prior to version 2.0.1L and the versions of hi-end switch software prior to version 4.0.0M do not support the configuration of the converged port.

26.2.3 MEAPS Configuration Tasks

- Configuring the Master Node
- Configuring the Transit Node
- Configuring the Ring Port
- Browsing the State of the Ring Protection Protocol

26.2.4 Ring Protection Configuration

26.2.4.1 Configuring the Master Node

Configure a switch to be the master node of a ring network according to the following steps:

Command	Purpose
Switch#config	Enters the switch configuration mode.
Switch_config#ether-ring *id*	Sets a node and enters the node configuration mode. id: Instance ID
Switch_config_ring#control-vlan *vlan-id*	Configures the control VLAN. Vlan-id: ID of the control VLAN
Switch_config_ring#master-node	Configures the node type to be a master node.
Switch_config_ring#hello-time *value*	This step is optional. Configures the cycle for the master node to transmit the HEALTH packets. Value: It is a time value ranging from 1 to 10 seconds and the default value is 1 second.
Switch_config_ring#fail-time *value*	This step is optional. Configures the time for the secondary port to wait for the HEALTH packets.

Command	Purpose
	Value: It is a time value ranging from 3 to 30 seconds and the default value is 3 second.
Switch_config_ring#exit	Saves the current settings and exits the node configuration mode.

Remarks:

The no ether-ring *id* command is used to delete the node settings and port settings of the Ethernet ring.

26.2.4.2 Configuring the Transit Node

Configure a switch to be the transit node of a ring network according to the following steps:

Command	Purpose
Switch#config	Enters the switch configuration mode.
Switch_config#ether-ring *id*	Sets a node and enters the node configuration mode. id: Instance ID
Switch_config_ring#control-vlan *vlan-id*	Configures the control VLAN. Vlan-id: ID of the control VLAN
Switch_config_ring#transit-node	Configures the node type to be a transit node.
Switch_config_ring#pre-forward-time *value*	This step is optional. Configures the time of maintaining the pre-forward state on the transit port. Value: It is a time value ranging from 3 to 30 seconds and the default value is 3 second.
Switch_config_ring#exit	Saves the current settings and exits the node configuration mode.

26.2.4.3 Configuring the Ring Port

Configure a port of a switch to be the port of Ethernet ring according to the following steps:

Command	Purpose
Switch#config	Enters the switch configuration mode.
Switch_config#interface *intf-name*	Enters the interface configuration mode. intf-name: Stands for the name of an interface.
Switch_config_intf#ether-ring *id* {primary-port | secondary-port | transit-port }	Configures the type of the port of Ethernet ring. ID of the node of Ethernet ring
Switch_config_intf#exit	Exits from interface configuration mode.

Remarks:

The **no ether-ring***id***primary-port** { **secondary-port** | **transit-port** } command can be used to cancel the port settings of Ethernet ring.

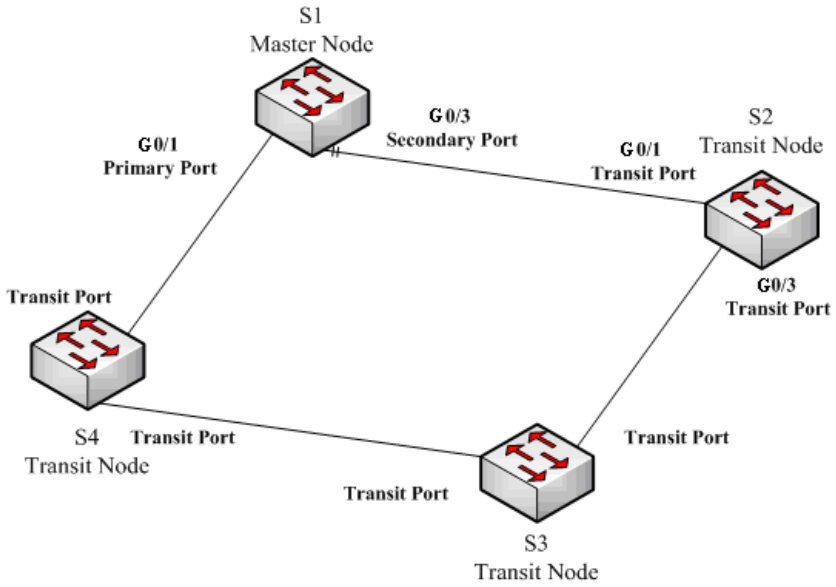
26.2.4.4 Browsing the State of the Ring Protection Protocol

Run the following command to browse the state of the ring protection protocol:

Command	Purpose
show ether-ring *id*	Browses the summary information about the ring protection protocol and the port of Ethernet ring. id: ID of Ethernet ring
show ether-ring *id* detail	Browses the detailed information about the ring protection protocol and the port of Ethernet ring.
show ether-ring *id* interface *intf-name*	Browses the state of the Ether-ring port or that of the common port.

26.2.5 MEAPS configuration

26.2.5.1 Configuration Example



MEAPS configuration

As shown in figure 2.1, master node S1 and transit node S2 are configured as follows. As to the settings of other nodes, they are same to S2's settings.

Configuring switch S1:

Shuts down STP and configures the Ether-ring node:

S1_config#no spanning-tree

S1_config#ether-ring 1

S1_config_ring1#control-vlan 2

S1_config_ring1#master-node

The following commands are used to set the time related parameters:

S1_config_ring1#hello-time 2

S1_config_ring1#fail-time 6

Exits from the node configuration mode:

S1_config_ring1#exit

Configures the primary port and the secondary port:

S1_config#interface gigaEthernet 0/1

S1_config_g0/1#ether-ring 1 primary-port

S1_config_g0/1#exit

S1_config#interface gigaEthernet 0/3

S1_config_g0/3#ether-ring 1 secondary-port

S1_config_g0/3#exit

Establishes the control VLAN:

S1_config#vlan 2

S1_config_vlan2#exit

S1_config#interface range g0/1 , 3

S1_config_if_range#switchport mode trunk

S1_config_if_range#exit

Configuring switch S2:

S1_config#no spanning-tree

S1_config#ether-ring 1

S1_config_ring1#control-vlan 2

S1_config_ring1#transit-node

S1_config_ring1#pre-forward-time 8

S1_config_ring1#exit

S1_config#interface gigaEthernet 0/1

S1_config_g0/1#ether-ring 1 transit-port

S1_config_g0/1#exit

S1_config#interface gigaEthernet 0/3

S1_config_g0/3#ether-ring 1 transit-port

S1_config_g0/3#exit

S1_config#vlan 2

S1_config_vlan2#exit

S1_config#interface range gigaEthernet 0/1 , 3

S1_config_if_range#switchport mode trunk

S1_config_if_range#exit

27. MEAPS Settings

27.1 MEAPS Introduction

27.1.1 MEAPS Overview

EAPS is a protocol specially applied on the link layer of the Ethernet ring. When the Ethernet ring is complete, you should prevent the broadcast storm from occurring on the data loopback. But when a link of an Ethernet ring is broken, you should enable the backup link rapidly to resume the communication of different nodes in the ring. The role of switch is specified by you through configuration.

EAPS only supports the single-ring structure, while MEAPS, an expansion on the basis of EAPS, can support not only the single ring but also the level-2 multi-ring structure. The later structure consists of the aggregation layer in the middle, constructed by aggregation equipment through the Ethernet ring for fast switching, and the access layer at the outside, connected by the access equipment. Different levels of rings are connected through the tangency or intersection mode. See the specific topology in the following figure:

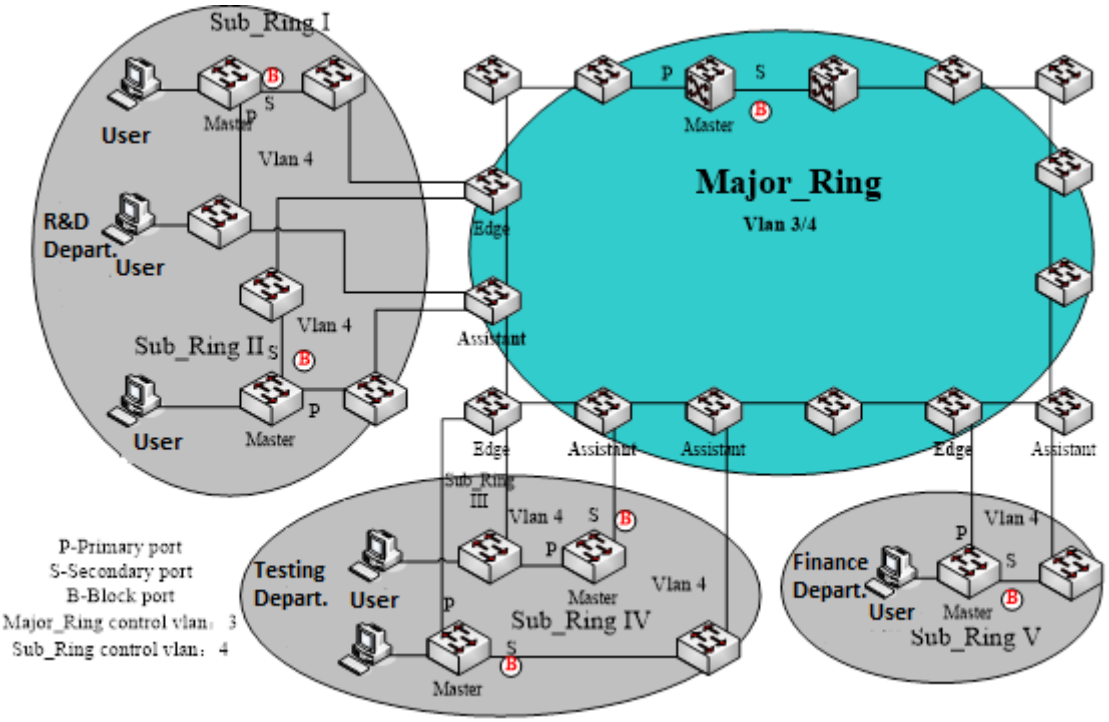


Figure 1: MEAPS topology

The ring protection protocol and STP are both used for topology control on the link layer. STP is suitable for all kinds of complicated networks, which transmits the change of network topology hop by hop. The ring protection protocol is used for ring topology and adopts the pervasion mechanism to transmit the change of network topology. Therefore, the convergence of the ring protection protocol in the ring network is better than STP. In a sound network, the ring protection protocol can resume network communication within less than 50ms.

27.1.2 Basic Concepts of MEAPS

27.1.2.1 Domain

The domain specifies the protection range of the Ethernet loopback protection protocol and is marked by ID, which consists of integers; A group of switches that support the same protection data and have the same control VLAN can form a domain after they are connected with each other. One domain may include only one ring or multiple rings that intersect each other. See the following figure.

One MEAPS domain has the following factors: MEAPS ring, control VLAN, master node, transit node, edge node and assistant edge node.

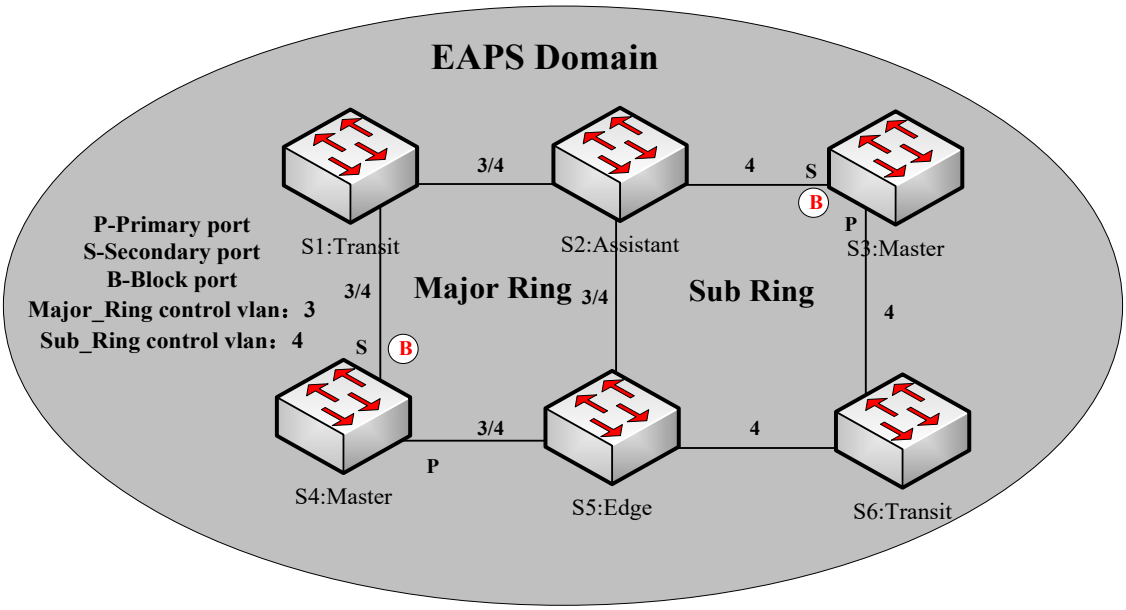


Figure 2: Simple MEAPS model

27.1.2.2 Ring

One ring corresponds to an ring Ethernet topology physically, which is a group of switches that are connected each other into a ring. One MEAPS domain may include only one MEAPS ring or multiple rings that intersect each other.

27.1.2.3 Major Ring

When a domain includes many rings, you should choose one ring from them as a major ring. The primary and secondary ports of each node on the major ring should be added into the main control VLAN and the sub control VLAN at the same time. See the following figure.

27.1.2.4 Sub Ring

When a domain includes many rings, the included rings except the major ring are called as sub rings. The primary and secondary ports of each node on the sub ring should be added into the sub control VLAN. See the following figure.

27.1.2.5 Control VLAN

The control VLAN is a concept against the data VLAN, and in MEAPS, the control VLAN is just used to transmit the MEAPS packets. Each MEAPS has two control VLANs, that is, the main control VLAN and the sub control VLAN.

You need to specify the main control VLAN when configuring the major ring or the sub ring. During configuration you just need to specify the main control VLAN and take a VLAN, the ID of which is 1 more than the ID of the main control VLAN, as the sub control VLAN. The major ring will be added to the main control VLAN and the sub control VLAN at the same time, while the sub ring will only be added to the sub control VLAN. See number 3 and number 4 beside each port on figure 2.

The main-ring protocol packets are transmitted in the main control VLAN, while the sub-ring protocol packets are transmitted in the sub control VLAN. The sub control VLAN on the major ring is the data VLAN of the major ring. The ports of a switch that access the Ethernet ring belong to the control VLAN, and only those ports that access the Ethernet ring can be added into the control VLAN.

Remarks:

The MEAPS port of the major ring should belong to both the main control VLAN and the sub control VLAN; the MEAPS port of the sub ring only belongs to the sub control VLAN. The major ring is regarded as a logical node of the sub ring and the packets of the sub ring are transparently transmitted through the major ring; the packets of the major ring are transmitted only in the major ring.

27.1.2.6 Data VLAN

The data VLAN is used to transmit data packets. The data VLAN can include the MEAPS port and the non-MEAPS port. Each domain protects one or multiple data VLANs. The topology that is calculated by the ring protection protocol in a domain is effective only to the data VLAN in this domain.

Whether the data VLAN is created or not has no influence on the work of the ring state machine, where the MEAPS port is controlled by the MEAPS module and the non-MEAPS port is controlled by the STP module.

Remarks:

The processing methods which are similar to that of the MSTP module can be used, that is, the status of a port in the default STP instance is decided by the link status of the port, no matter what the VLAN configuration of a port is.

27.1.2.7 Master Node

The master node works as policy making and control of a ring. Each ring must possess only one master node. The master node takes active attitude to know whether the ring's topology is complete, removes loopback, control other switches to update topology information. See the following figure, where S3 is the master node of the sub ring and S4 is the master node of the major ring.

27.1.2.8 Transit Node

All switches on the Ethernet except the master node can be called as the transit nodes. The transit node only checks the state of the local port of the ring, and notifies the master node of the invalid link. See the following figure, in which S1, S2, S5 and S6 are all transit nodes.

27.1.2.9 Edge Node and Assistant Node

When the sub ring and the major ring are intersected, there are two intersection points, two switches beside which are called as the edge node for one and the assistant node for the other. The two nodes are both the nodes of the sub ring. There are no special requirements as to which switch will be set to be the edge node or the assistant node if their configurations can distinguish themselves. However, one of them must be set as the edge node and the other must be set as the assistant node. The edge node or the assistant node is a role that a switch takes on the sub ring, but the switch takes a role of the transit node or the master node when it is on the major ring. See the following figure, in which S2 is the assistant node and S5 is the edge node.

27.1.2.10 Primary Port and Secondary Port

The two ports through which the master node accesses the Ethernet ring are called as the primary port and the secondary port. The roles of the two ports are decided by the clients.

The primary port is in forwarding state when it is up. Its function is to forward the packets of the data VLAN on the master node and to receive and forward the control packets on the control VLAN. The master node will transmit the loopback detection packets from the primary port to the control VLAN. If the link of the primary port is resumed from the invalid status, the master node requires sending the address aging notification to the control VLAN promptly and then starts to transmit the loopback detection packets from the primary port.

The secondary port is in forwarding or blocking state when it is up. The master node receives the ring detection packets from the secondary port and judges whether the topology of the ring network is complete. In complete topology, the master node blocks the data packets on the secondary port, and prevents loopback from occurring; after a link on the ring network is interrupted, the master node will open the secondary port to forwarding the data packets.

Remarks:

A port can be set as the primary port or the secondary port of a node and it cannot be set to be both the primary port and the secondary port.

27.1.2.11 Transit Port

The two ports for the transit node to access the Ethernet ring are both transit ports. Users can decide the role of the two ports through configuration.

The transit port is in forwarding or pre-forwarding state when it is up. A transit port receives the control packets from the control VLAN and at the same time forwards these packets to other ports in the control VLAN. After the transit port resumes from the invalid state, it first enters the pre-forwarding state, receives and forwards only the control packets, and blocks the data VLAN. After the transit node receives the notification of the aging address table, it enters the forwarding state.

Remarks:

A port can be set as the primary port or the transit port of a node and it cannot be reset.

27.1.2.12 Common Port and Edge Port

The edge node and the assistant node are the places where the sub ring and the major ring intersect. As to the two ports that access the Ethernet, one is a common port, which is the public port of the sub ring and the major ring; the other is the edge port in the sub ring. The roles of the two ports are decided by users through configuration.

The common port is on the main-ring port and so its state is decided by the state of the main-ring port. The common port itself has no operations or notifications. When the link, connecting the common port, changes, the sub-ring node where the common port lies will not be notified. The existence of the common port just guarantees the completeness of the ring.

The edge port of the edge node is in forwarding or preforwarding state when it is up. Its basic characteristics are consistent with those of the transit port except one function. The exceptional function is that when the edge port is up and its corresponding main-ring port is also up, it will transmit the edge-hello packets from the main-ring port to detect the completeness of the major ring.

The edge port of the assistant node is in forwarding, pre-forwarding or EdgePreforwarding state when it is up. Besides the same characteristics of the transit port, it also has one more state, the EdgePreforwarding state. If the edge port is in forwarding state and the main-ring port that the edge port corresponds to has not received the edge-hello packets, the state of the edge port is changed into the EdgePreforwarding state, and it only receives and forwards the control packets and blocks the data VLAN until the corresponding main-ring port receives the Edge-hello packets again.

The edge port of the edge node and the assistant node is to help detect the completeness of the major ring. For more details, see the channel status checkup mechanism of the sub-ring protocol packets on the major ring in the following chapter.

Remarks:

Each port can be set as the only edge port of a node and it cannot be configured again; the common port can be borne only on a port of the major ring and it cannot be configured on a port without a corresponding main-ring port.

27.1.2.13 FLUSH MAC FDB

The Ethernet ring protection protocol can transmit data packets to the correct link by controlling the aging of the switch's MAC address table when the topology changes. In general, the time for a MAC address to age in the MAC address table is 300 seconds. The ring protection protocol can control the aging of the MAC address table in a short time.

27.1.2.14 Complete Flag of Ring

Both the master node and the transit node can show whether the current ring network is complete through the state symbol "COMPLETE". On the master node, only when all links of the ring network are normal, the primary port is in forwarding state and the secondary port is in blocking state can the "COMPLETE" symbol be real; on the transit node, only when its two transit ports are in forwarding state can the "COMPLETE" symbol be true.
The state symbol of the ring network helps user to judge the topology state of the current network.

27.1.3 Types of EAPS Packets

The EAPS packets can be classified into the following types, as shown in table 1.1.

Table 1.1 Types of EAPS packets

Type of the packet	Remarks
HEALTH	It is transmitted by the master node to detect whether the topology of the ring network is complete.
LINK-DOWN	Indicates that link interruption happens in the ring. This kinds of packets are transmitted by the transit node.
RING-DOWN-FLUSH-FDB	It is transmitted by the master node after interruption of the ring network is detected and the packets show the MAC address aging table of the transit node.
RING-UP-FLUSH-FDB	It is transmitted by the master node after interruption of the ring network is resumed and the packets show the MAC address aging table of the transit node.
EDGE-HELLO	It is decided by the edge port of the edge node, transmitted by the main-ring port that the edge node corresponds to, and detects whether the major ring is complete.

27.1.4 Ring Protection Mechanism

27.1.4.1 Polling mechanism

The primary port transmits the HEALTH packets to the control VLAN. In normal case, the HEALTH packets will pass through all other nodes of the ring and finally arrive at the secondary port of the master node.

The secondary port blocks all data VLANs in primitive condition. When receiving the HEALTH packets continuously, the secondary port keeps blocking data VLANs and blocking the loop. If the secondary port does not receive the HEALTH packets from the primary port in a certain time (which can be configured), it will regard the ring network is out of effect. Then the master node removes the blocking of data VLANs on the secondary port, ages the local MAC address table, and transmits the RING-DOWN-FLUSH-FDB packets to notify other nodes.

If the master node receives the HEALTH packets at the secondary port that is open to data VLANs, the ring network is resumed. In this case, the master node immediately blocks data VLANs on the secondary port, updates the local topology information and reports other nodes to age the MAC address table through RING-UP-FLUSH-FDB packets.

As shown in the following figure, the master node, S4, transmits the HELLO packets periodically. If the loopback has no troubles, the HELLO packets will arrive at the secondary port of the master node, and the master node will block data forwarding of the data VLAN that the secondary port belongs to, preventing the loopback from happening.

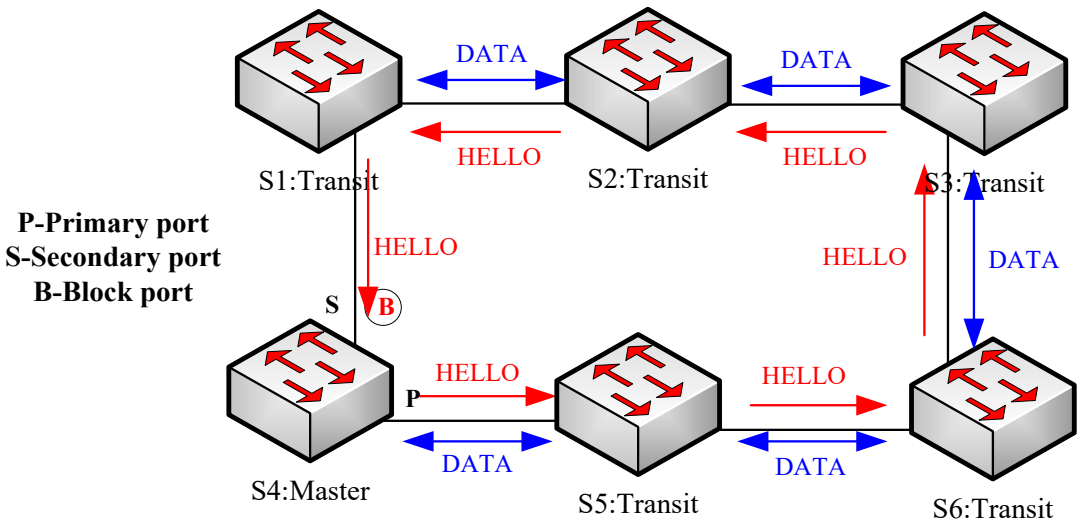


Figure 3: Polling

Remarks:

You can configure related commands on the Hello-time node and the Fail-time node to modify the interval for the primary port to transmit the HEALTH packets and the time limit for the secondary port to wait for the HEALTH packets.

27.1.4.2 Notification of Invalid Link of Transit Node

Link state notification is a mechanism faster than the polling mechanism to change the ring topology:

After the transit port of the transit node is out of effect, the LINK-DOWN packet will be immediately transmitted by the other transit port to notify other nodes. In normal case, the packet passes through other transit nodes and finally arrives at one port of the master node.

After the master node receives the LINK-DOWN packet, it thinks that the ring network is invalid. In this case, the master node removes the blocking of data VLANs on its secondaryport, ages the local MAC address table, transmits the RING-DOWN-FLUSH-FDB packet and notifies other nodes. As shown in the following figure, trouble occurs on the link between node S3 and node S6. After node S3 and node S6 detect that trouble has already occurred on the link, they block the ports that the troubled link corresponds to and transmit the LINK-DOWN packets respectively from the other port; when the master node receives the LINK-DOWN packets, holds that the trouble occurs on the loopback, and decides not to wait for the fail-time any more.

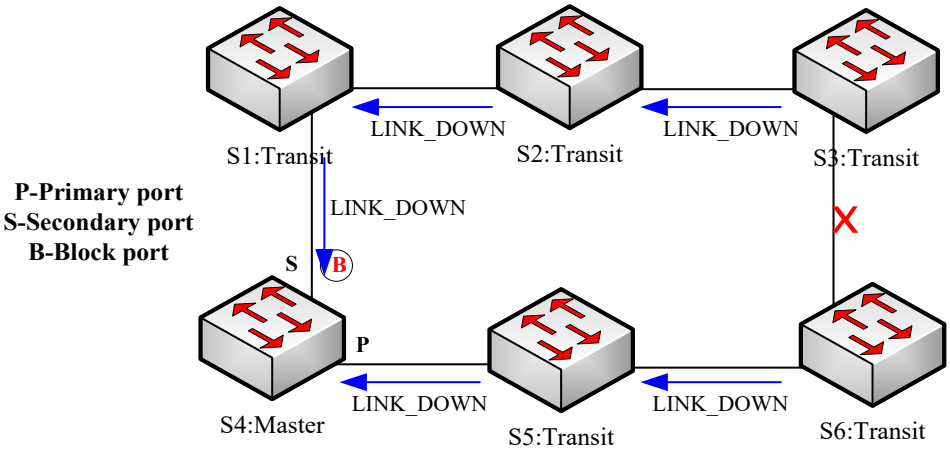


Figure 4: Link status change notification

After the transit port is resumed, it does not immediately transmit the packets of data VLANs, but enters the Pre-Forwarding state. A transit port in pre-forwarding state only transmits and receives the control packets from the control VLAN.

If there is only one transit port invalid in the ring network and when the port enters the pre-forwarding state, the secondary port of the master node can receive the HEALTH packet from the primary port again. In this case, the master node blocks data VLANs on the secondary port again and transmits the notification of ageing address table outside. After the node with a transit port in pre-forwarding state receives the notification of aging address table, the node will first modify the pre-forwarding port to the forwarding port and then ages the local MAC address table.

If a transit mode does not receives the notification of aging address table from the master node, it thinks that the link connecting the master node is already out of effect, and the transit node will automatically set the pre-forwarding port to be a forwarding one.

Remarks:

You can configure the related commands through the pre-forward-time node to modify the time for the transit port to keep the pre-forwarding state.

27.1.4.3 Channel Status Checkup Mechanism of the Sub-Ring Protocol Packet on the Major ring

The ports on the major ring are simultaneously added to the control VLAN of the major ring and the control VLAN of the sub ring. Hence, the protocol packets of the sub ring should be broadcast among the edge ports of the edge node and the assistant node through the channel, provided by the major ring. In this case, the whole major ring is just like a node of the sub ring (similar as a virtual transit node), as shown in the following figure:

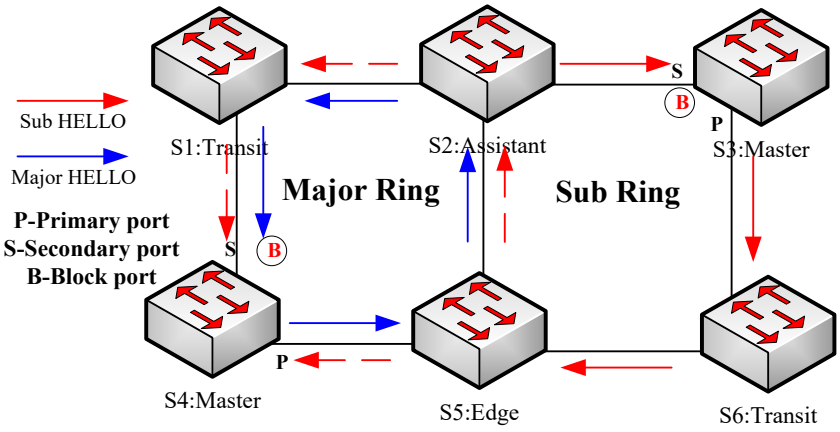


Figure 5: Intersection of the major ring and the sub ring

When trouble occurs on the link of the major ring, and when the channel of the sub-ring protocol packets between the edge node and the assistant node are interrupted, the master node of the sub ring cannot receive the HELLO packets that the master node itself transmits. In this case, the Fail Time times out, and the master node of the sub ring changes to the Failed state and opens its secondary port.

The above-mentioned processes have an effective protection towards general networking, guaranteeing not only the prevention of the broadcast loopback but also the corresponding functions of the backup link. The dual homing networking mode is always used in actual networking, as shown in the following figure. The two sub rings in the dual homing networking, sub ring I and sub ring II, interconnect through the edge node and assistant node, and forms a big ring. When the major ring has troubles, the secondary ports of the master nodes of all sub rings open and forms the broadcast loop (marked by the arrow) in the big ring.

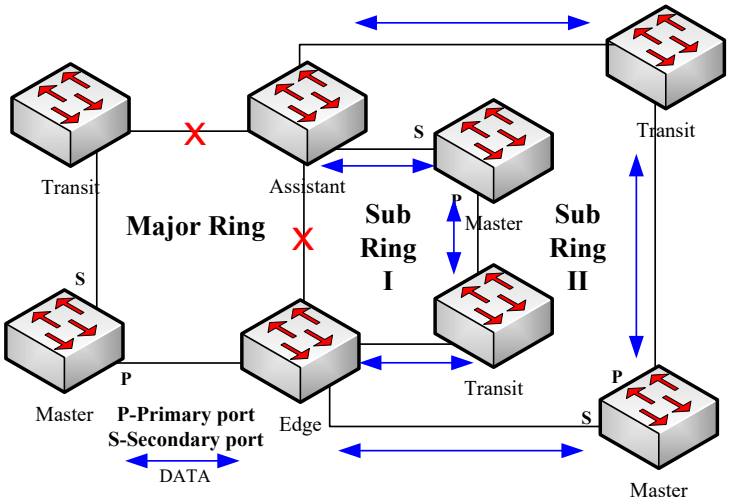


Figure 6: Broadcast storm triggered by the dual homing networking mode

The channel status checkup mechanism of the sub-ring protocol packet on the major ring is introduced to solve the problem about the dual homing ring. This mechanism is to monitor the status of the channel link on the major ring between the edge node and the assistant node, which requires the help of the edge node and the assistant node. The purpose of this mechanism is to keep the data loop from happening by blocking the edge port of the edge node before the secondary port of the master node on the sub ring opens. The edge node is the trigger of the mechanism, while the assistant node is the listener and decider of this mechanism. Once the notification message from the edge node cannot be received, the edge node will instantly be in blocked state until this notification message is received again. The results of the mechanism, which bring about after the troubles on the major ring, are shown in the following figure:

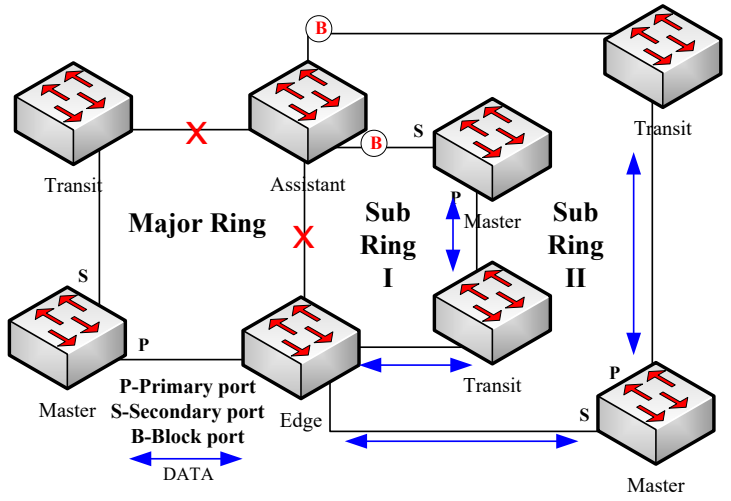


Figure 7: Results of the channel status checkup mechanism

But you should pay special attention to this point that the edge port of the assistant node must be blocked before the secondary port of the master node on the sub ring opens. Otherwise, the broadcast storm will happen.

The whole procedure of this mechanism is described as follows:

1. Check the channel status on the major ring between the edge node and the assistant node.

The edge node of the sub ring periodically transmits the Edge-Hello packets to the major ring through the two ports of the major ring, and these packets pass through all nodes on the major ring in sequence and finally arrive the assistant node, as shown in the following figure. If the assistant node can receive the edge-hello packet in the regulated time, it indicates that the channel of this packet is normal; if not, it indicates that the channel is interrupted. The edge-hello packet is the control packet of the sub ring, but is transmitted and received by the ports on the major ring and is transferred to the sub ring for processing.

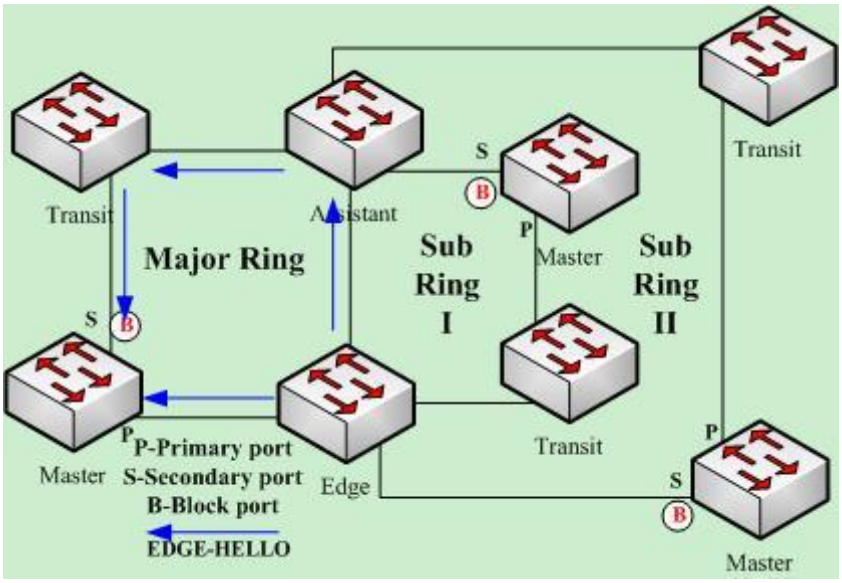


Figure 8. Check the channel status on the major ring between the edge node and the assistant node.

2. The edge node blocks the edge port at the interruption of the channel.

If the assistant node cannot receive the edge-hello packet during Edge Fail Time, the assistant holds that the channel of the sub-ring protocol packet—the edge-hello packet—is interrupted, changes its edge port's status into the Edge-Preforwarding status instantly, blocks the forwarding of the data packets (though still receives and forwards the control packet), and immediately transmits the LINK-DOWN packet to the master node for the master node to open the secondary port to avoid communication interruption among all nodes on the ring.

Remarks:

In order to guarantee that the edge port first changes into the edge-preforwarding status and then the master node opens the secondary port, you shall be sure that the cycle for the edge node to transmit the edge-hello packet, Edge Hello Time, is smaller than the cycle for the master node to transmit the Hello packet, Hello Time; similarly, the Edge Fail Time of the assistant node should be smaller than Fail Time. At the same time, Fail Time is generally the triple of Hello Time, and Edge Fail Time is also the triple of Edge Hello Time.

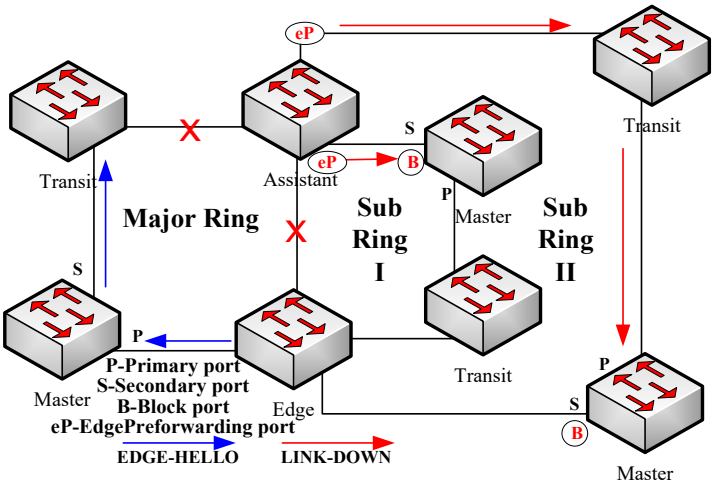


Figure 9: The edge node blocks the edge port at the interruption of the channel.

3. Channel recovery

When the link of the major ring and the communication between the edge node and the assistant node resumes, the channel of the sub-ring protocol packet resumes to the normal function. In this case, the master node of the sub ring receives the Hello packet again, which is transmitted by the master node itself, and therefore it switches to the Complete status, blocks the secondary port and transmits the RING-UP-FLUSH-FDB packet to the ring. At the same time, the status of the edge port of the assistant node changes from Edge-Preforwarding to Forwarding, guaranteeing a smooth communication among all nodes on the ring. The following figure shows that the channel is resumed and then the communication on the ring is also resumed.

Note

Before the edge node opens the blocked edge port, the secondary port of the master node on the sub ring should be blocked to prevent the broadcast storm from happening.

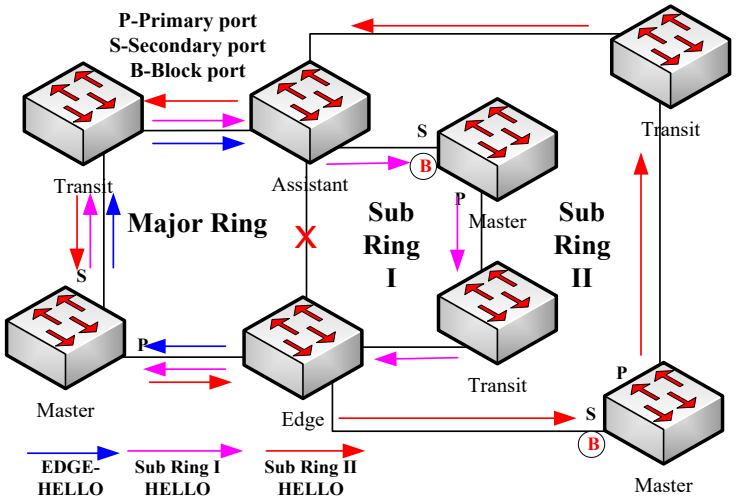


Figure 10: Channel recovery

27.2 Ring Protection Configuration

27.2.1 Requisites before Configuration

Before configuring MEAPS, please read the following items carefully:

- One of important functions of the ring protection protocol is to stop the broadcast storm, so please make sure that before the ring link is reconnected all ring nodes are configured. If the ring network is connected in the case that the configuration is not finished, the broadcast storm may easily occur.
- Set the ring protection protocol to realize the compatibility of STP. The users are allowed to set “no spanning-tree”, SSTP, RSTP and MSTP.
- After an instance of the ring's node is set, users are forbidden to change the basic information of the node (excluding the time parameters) unless the current ring’s node is deleted and then reset.
- If you run **show** to browse the configured node and find its state is **init**, it shows that the node’s configuration is unfinished and therefore the node cannot be started. In this case, you are required to change or add basic information to complete the configuration of the node.
- The ring protection protocol supports a switch to configure multiple ring networks.
- The configuration of the control VLAN of the ring network does not automatically establish the corresponding systematic VLAN. You need to establish the systematic VLAN manually through global VLAN configuration command.
- The port of each ring can forward the packets from the control VLAN of the ring, while other ports, even in the Trunk mode, cannot forward the packets from the control VLAN.
- By default, Fail-time of the master node is triple longer than Hello-time, so that packet delay is avoided from shocking the ring protection protocol. After Hello-time is modified, Fail-time need be modified accordingly.
- By default, Pre-Forward-Time of the transit node is triple longer than Hello-time of the master node so that it is ensured that the master node can detect the recovery of the ring network before the transit port enters the pre-forwarding state. If Hello-time configured on the master node is longer than Fre-Forward-Time of the transit node, loopback is easily generated and broadcast storm is then triggered.
- Users cannot set Edge Hello Time and Edge Fail Time, and their default values are decided by Hello Time and Fail Time respectively for their values are 1/3 of Hello Time and Fail Time respectively.
- The physical interface, the fast-Ethernet interface, the gigabit-Ethernet interface and the aggregation interface can all be set to be the ring's interfaces. If link aggregation, 802.1X or port security has been already configured on a physical interface, the physical interface cannot be set to be a ring’s interface any more.
- This protocol is similar with the original EAPS in functions, but its ring’s topology has more expansibility and flexibility. Hence, MEAPS and EAPS are partially compatible, and the intersection configuration can be done on the MEAPS ring and the EAPS ring. But a same physical port cannot be simultaneously set to support MEAPS and EAPS.

27.2.2 MEAPS Configuration Tasks

- Configuring the Master Node
- Configuring the Transit Node
- Configuring the Edge Node and the Assistant Node
- Configuring the Ring Port
- Browsing the State of the Ring Protection Protocol

27.2.3 Ring Protection Configuration

27.2.3.1 Configuring the Master Node

Configure a switch to be the master node of a ring network according to the following steps:

Command	Purpose
Switch#**config**	Enters the switch configuration mode.
Switch_config#**mether-ring** *id1* **domain***id2*	Sets a node and enters the node configuration mode. *id1*: instance ID of a node *id2*: instance ID of a domain (omitted when it is 0)
Switch_config_ring1#**master-node**	It is an obligatory step. Configures the node type to be a master node.
Switch_config_ring1#**major-ring[sub-ring]**	It is an obligatory step. Sets the node's level to be one of the major or sub ring node.
Switch_config_ring1#**control-vlan***vlan-id*	It is an obligatory step. Sets the control VLAN and establishes VLAN "id" and VLAN "id-1". *vlan-id*: ID of the control VLAN
Switch_config_ring1#**hello-time***value*	This step is optional. Configures the cycle for the master node to transmit the HEALTH packets. *value*: It is a time value ranging from 1 to 10 seconds and the default value is 3 seconds.
Switch_config_ring1#**fail-time***value*	This step is optional. Configures the time for the secondary port to wait for the HEALTH packets. *value*: It is a time value ranging from 3 to 30 seconds and the default value is 9 seconds.
Switch_config_ring1#**exit**	Saves the current settings and exits the node configuration mode.
Switch_config#	

Remarks:

The no mether-ring *id*domain*id2* command is used to delete the node settings and the node's port settings of the ring.

Remarks:

During configuration, both the major ring and the sub-ring should be set to have the same control VLAN—the control VLAN of the major ring. After this configuration is successfully set, the control VLAN of major ring and the control VLAN of sub-ring are created on the major ring, and at the same time the sub-ring control VLAN is created on the sub-ring and the major-ring control VLAN is forbidden on the sub-ring.

27.2.3.2 Configuring the Transit Node

Configure a switch to be the transit node of a ring network according to the following steps:

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config#**mether-ring** *id1* **domain***id2*	Sets a node and enters the node configuration mode. *id1*: instance ID of a node *id2*: instance ID of a domain (omitted when it is 0)
Switch_config_ring1# **transit -node**	It is an obligatory step. Configures the node type to be a transit node.
Switch_config_ring1#**major-ring[sub-ring]**	It is an obligatory step. Sets the node's level to be one of the major or sub ring node.
Switch_config_ring1#**control-vlan***vlan-id*	It is an obligatory step. Sets the control VLAN and establishes VLAN "id" and VLAN "id-1". *vlan-id*: ID of the control VLAN
Switch_config_ring1#**pre-forward-time***value*	This step is optional. Configures the time of maintaining the pre-forward state on the transit port. *value*: It is a time value ranging from 3 to 30 seconds and the default value is 9 seconds.
Switch_config_ring#exit	Saves the current settings and exits the node configuration mode.
Switch_config#	

27.2.3.3 Configuring the Edge Node and the Assistant Node

Configure a switch to be the master node of a ring network according to the following steps:

Command	Purpose
Switch# **config**	Enters the switch configuration mode.
Switch_config#**mether-ring** *id1* **domain***id2*	Sets a node and enters the node configuration mode. *id1*: instance ID of a node *id2*: instance ID of a domain (omitted when it is 0)
Switch_config_ring1#**edge-node[assistant-node]**	It is an obligatory step. Sets the node type to be an edge node.
Switch_config_ring1#**sub-ring**	This step can be omitted. The edge node must be the sub-ring node.
Switch_config_ring1#**control-vlan***vlan-id*	It is an obligatory step. Sets the control VLAN and establishes VLAN “id” and VLAN “id-1”. *vlan-id*: ID of the control VLAN
Switch_config_ring1#**pre-forward-time***value*	This step is optional. Configures the time of maintaining the pre-forwarding state of the edge port. *value*: It is a time value ranging from 3 to 30 seconds and the default value is 9 seconds.
Switch_config_ring1#**exit**	Saves the current settings and exits the node configuration mode.
Switch_config#	

27.2.3.4 Configuring a Single Sub-Ring Networking Mode

Configure a switch to be the master node of a ring network according to the following steps:

Command	Purpose
Switch# **config**	Enters the switch configuration mode.
Switch_config#**mether-ring** *id1* **domain***id2*	Sets a node and enters the node configuration mode. *id1*: instance ID of a node *id2*: instance ID of a domain (omitted when it is 0)
Switch_config_ring1#**edge-node[assistant-node]**	It is an obligatory step. Sets the node type to be an edge node.
Switch_config_ring1#**sub-ring**	This step can be omitted. The edge node must be the sub-ring node.
Switch_config_ring1#**control-vlan***vlan-id*	It is an obligatory step. Sets the control VLAN and establishes VLAN “id” and VLAN “id-1”. *vlan-id*: ID of the control VLAN
Switch _config_ring2#**single-subring-mode**	It is an obligatory step. You can complete the ring configuration even if not using this command, but the system cannot enter the single-ring networking mode. In single sub-ring networking mode, the channel state of sub-ring protocol packet is not checked, and dual-affiliation networking must not exist in the ring. This command takes effect only on the edge node and the assistant node.
Switch_config_ring1#**pre-forward-time***value*	This step is optional. Configures the time of maintaining the pre-forwarding state of the edge port. *value*: It is a time value ranging from 3 to 30 seconds and the default value is 9 seconds.
Switch_config_ring1#**exit**	Saves the current settings and exits the node configuration mode.
Switch_config#	

27.2.3.5 Configuring the Ring Port

Configure a port of a switch to be the port of Ethernet ring according to the following steps:

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config#interface *intf-name*	Enters the interface configuration mode.
Switch_config_intf#mether-ring *id1* **domain** *id2* **primary-port [secondary-port | transit-port | common-port | edge-port]**	Configures the type of the port of Ethernet ring. *id1*: instance ID of a node *id2*: instance ID of a domain (omitted when it is 0)
Switch_config_intf#exit	Exits from interface configuration mode.

Remarks:

The command, **no mether-ring *id1*domain *id2*primary-port [secondary-port | transit-port | common-port | edge-port]**, can be used to cancel the settings of the ring's port.

27.2.3.6 Browsing the State of the Ring Protection Protocol

Run the following command to browse the state of the ring protection protocol:

Command	Purpose
show mether-ring	Browses the summary information about the ring protection protocol and the ports of ring.
show mether-ring *id1* **domain** *id2*	Browses the summary information about the designated ring protection protocol and the ports of ring. *id1*: instance ID of a node *id2*: instance ID of a domain (omitted when it is 0)
show mether-ring *id1* **domain** *id2* **detail**	Browses the detailed information about the designated ring protection protocol and the port of Ethernet ring.
show mether-ring *id1* **domain** *id2* **interface** *intf-name*	Browses the states of the designated ring ports or those of the designated common ports.

27.3Appendix

27.3.1 Working Procedure of MEAPS

MEAPS adopts three protection mechanisms to support the single-ring or evel-2 multi-ring structure. The following sections shows, from the complete state to the link-down state, then to recovery and finally to the complete state again, the details of MEAPS running and the change of the MEAPS topology by typical examples.

27.3.2 Complete state

The complete state of the ring, which is advocated for only one ring, is monitored and maintained by the polling mechanism. In complete status, all links on the whole ring are in UP state, which finds expression in the state of the master node. In order to prevent the broadcast storm from occurring, the master node will block its secondary port. At the same time, the master node will periodically transmit the Hello packets from its primary port. These hello packets will pass through the transit node in sequence and finally return to the master node from its secondary port. The ring in complete state is shown in the following figure. The major ring and two sub rings are all in complete state. The hello packet of the major ring is only broadcast in the major ring, while the hello packet of the sub ring can be transparently transmitted through the major ring, then return to the sub ring, and finally get the secondary port of the master node on the sub ring.

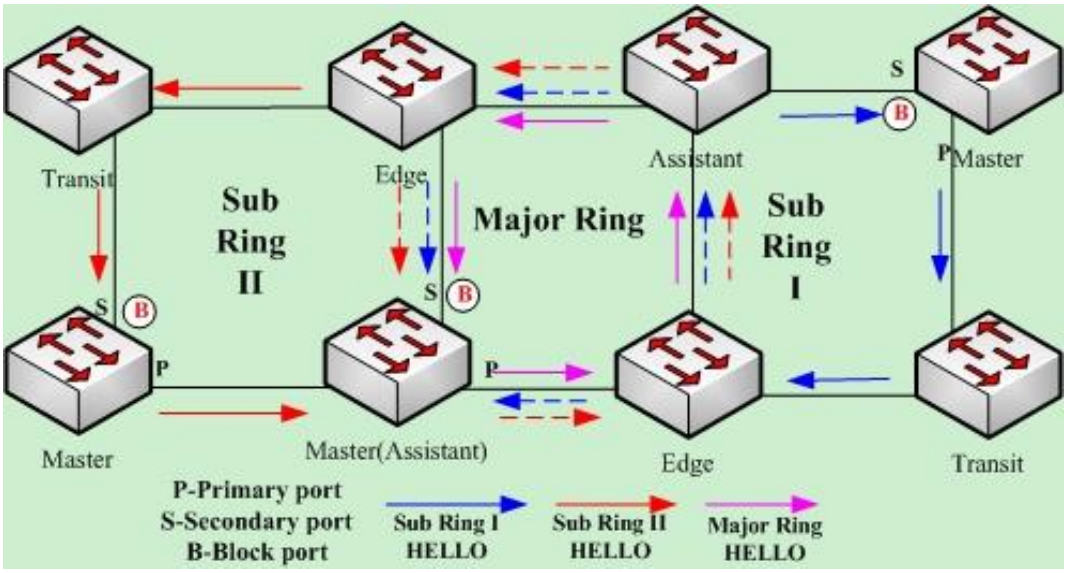


Figure 11: Complete state

27.3.2.1 Link-Down

The link-down state of the ring is decided by the polling mechanism, the notification of the link state change and the channel status checkup mechanism of the sub-ring protocol packet. Surely the link-down state of the ring is also advocated as to only one ring. When some link in the ring is in link-down state, the ring changes from the compete state to the troubled state, that is, the link-down state.

If link-down occurs on a link, the polling mechanism and the link status change notification mechanism will both function. The transit node, on which link-down occurs, will transmit the link-down packet to the master node through the Up port at its other side; at the same time, the polling mechanism will monitor and change promptly the state of the ring through Fail Time. When a trouble occurs on the sub-ring protocol channel, the trouble will be handled by the channel status checkup mechanism of the sub-ring protocol packet on the major ring. As shown in the following figure, the trouble notification message on the link of the major ring and on the common link is only transmitted on the major ring and finally transmitted to the master node; the trouble notification message on the link of sub ring 2 will be transmitted to the master node of the sub ring, which can be transparently transmitted through the major ring.

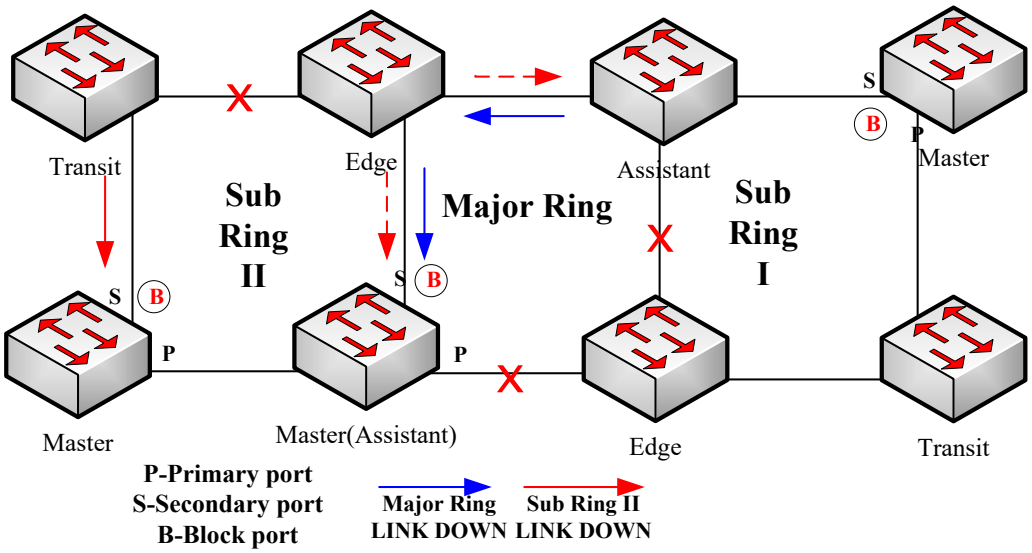


Figure 12: Ring transmitting the trouble and notifying the master node

After the master node receives the link-down packet, its state will be changed to the Failed state and at the same time the secondary port will be opened, the FDB table will be refreshed, and the RING-DOWN-FLUSH-FDB packets will be transmitted from two ports for notifying all nodes. As shown in the following figure, the master node on the major ring notifies the transit node on the major ring of refreshing FDB; sub ring 1 has troubles on its channel, so the edge port of the assistant node will be blocked; the master node of sub ring 2 notifies the transit nodes on the sub ring to refresh FDB and then the transparent transmission will be conducted on the major ring.

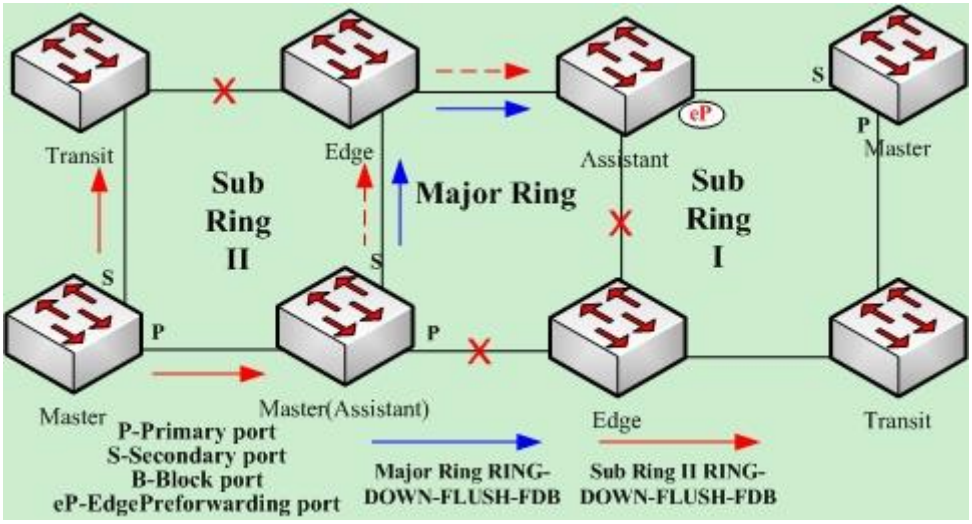


Figure 13: Ring transmitting troubles and refreshing FDB

27.3.2.2 Recovery

When the port on the transit node is recovered, the transit node will shift to its Preforwarding state. The processing procedure when the port of the transit node is recovered is shown in the following figure. The link of the major ring will recover, while the transit node, which connects the link of the major ring, changes into the Preforwarding state, blocks the data packets but allows the Hello packets of the control packet to pass through; similarly, the transit node on sub ring 2 also changes into the Preforwarding state; when the hello packet on sub ring 1 arrives the edge node, due to the fact that the resumed transit node only allows the control packet of the major to pass through and that the hell packet of sub ring 1 is just like the data packet of the major ring, the hello packet cannot be forwarded.

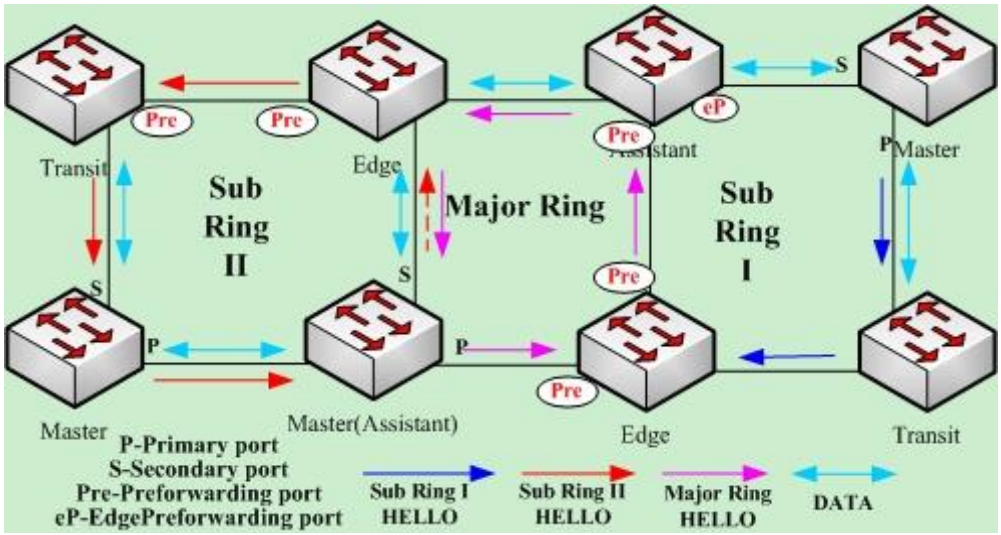


Figure 14: Recovery of the ring's link and the shift of the transit node to preforwarding

The transit port can transmit the control packet in preforwarding state, so the secondary port of the master node can receive the hello packet from the primary port. Hence, the master node shifts its state to Complete, blocks the secondary port and transmits the RING-UP-FLUSH-FDB packet from the primary port. After the transit node receives the RING-UP-FLUSH-FDB packet, the transit node will shift back to the Link-Up state, open the blocked port and refresh the FDB table. The procedure of ring recovery is shown in the following figure. The master node on the major ring changes into the complete state, blocks the secondary port, transmits the RING-UP-FLUSH-FDB packet to all transit nodes on the major ring and makes these transit nodes to shift back to their link-up state, to open the blocked port and to refresh the FDB table; similarly, the transit node and the master node on sub ring 2 also take on the corresponding change; due to the sub-ring protocol packet's channel recovery on sub ring 1, the secondary port of the master node can receive the hello packet from the primary port, and the master node shifts its state back to the complete state, blocks the secondary port, transmits the RING-UP-FLUSH-FDB packet and makes the assistant node open the edge port and sub ring 1 resume to its complete state.

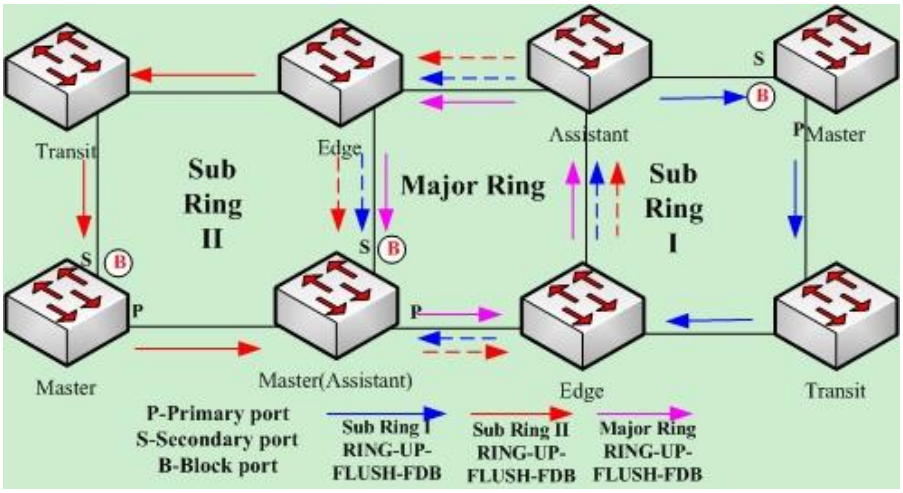
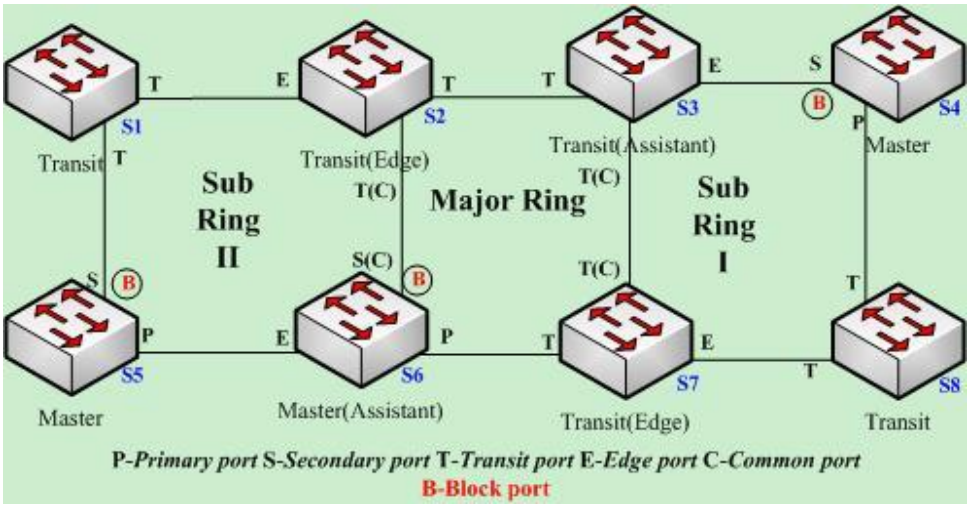


Figure 15: Ring recovery

Of course, if the transit node in Preforwarding state does not receive the RING-UP-FLUSH-FDB packet and Fail Time also exceeds, the transit node will open the blocked transit port and resume data communication.

27.3.3 MEAPS configuration

27.3.3.1 Configuration Example



MEAPS configuration

As shown in figure 2.1, master node S1 and transit node S2 are configured as follows. As to the settings of other nodes, they are the same as S2's settings.

Configuring switch S1:

The following commands are used to set the sub-ring transit node, node 2:

Switch_config#mether-ring 2 domain 1

Switch_config_ring2#transit-node

Switch_config_ring2#sub-ring

Switch_config_ring2#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring2#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring2#quit

The following commands are used to set the transit port of node 2:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 2 domain 1 transit-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 2 domain 1 transit-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

Configuring switch S2:

The following commands are used to set the major-ring transit node, node 1:

Switch_config#mether-ring 1 domain 1

Switch_config_ring1#transit-node

Switch_config_ring1#major-ring

Switch_config_ring1#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring1#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring1#quit

The following commands are used to set the transit port of node 1:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 1 domain 1 transit-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 1 domain 1 transit-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

The following commands are used to set the sub-ring edge node, node 2:

Switch_config#mether-ring 2 domain 1

Switch_config_ring2#edge-node

Switch_config_ring2#sub-ring *(this can be omitted)*

Switch_config_ring2#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring2#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring2#quit

The following commands are used to set the common port and edge port of node 2:

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 2 domain 1 common-port

Switch_config_g0/2#quit

Switch_config#interface gigaEthernet 0/3

Switch_config_g0/3#mether-ring 2 domain 1 edge-port

Switch_config_g0/3#switchport mode trunk

Switch_config_g0/3#quit

Configuring switch S3:

The following commands are used to set the major-ring transit node, node 1:

Switch_config#mether-ring 1 domain 1

Switch_config_ring1#transit-node

Switch_config_ring1#major-ring

Switch_config_ring1#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring1#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring1#quit

The following commands are used to set the transit port of node 1:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 1 domain 1 transit-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 1 domain 1 transit-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

The following commands are used to set the sub-ring assistant node, node 4:

Switch_config#mether-ring 4 domain 1

Switch_config_ring4#assistant-node

Switch_config_ring4#sub-ring *(it can be omitted)*

Switch_config_ring4#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring4#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring4#quit

The following commands are used to set the common port and edge port of node 2:

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 4 domain 1 common-port

Switch_config_g0/2#quit

Switch_config#interface gigaEthernet 0/3

Switch_config_g0/3#mether-ring 4 domain 1 edge-port

Switch_config_g0/3#switchport mode trunk

Switch_config_g0/3#quit

Configuring switch S4:

The following commands are used to set the sub-ring master node, node 4:

Switch_config#mether-ring 4 domain 1

Switch_config_ring4#master-node

Switch_config_ring4#sub-ring

Switch_config_ring4#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring4#hello-time 4

Switch_config_ring4#fail-time 12

Exits from the node configuration mode:

Switch_config_ring4#quit

The following commands are used to set the primary port and secondary port of node 4:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 4 domain 1 primary-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 4 domain 1 secondary-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

Configuring switch S5:

The following commands are used to set the sub-ring master node, node 2:

Switch_config#mether-ring 2 domain 1

Switch_config_ring2#master-node

Switch_config_ring2#sub-ring

Switch_config_ring2#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring2#hello-time 4

Switch_config_ring2#fail-time 12

Exits from the node configuration mode:

Switch_config_ring2#quit

The following commands are used to set the primary port and secondary port of node 2:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 2 domain 1 primary-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 2 domain 1 secondary-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

Configuring switch S6:

The following commands are used to set the major-ring master node, node 1:

Switch_config#mether-ring 1 domain 1

Switch_config_ring1#master-node

Switch_config_ring1#major-ring

Switch_config_ring1#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring1#hello-time 4

Switch_config_ring1#fail-time 12

Exits from the node configuration mode:

Switch_config_ring1#quit

The following commands are used to set the transit port of node 1:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 1 domain 1 primary-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 1 domain 1 secondary-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

The following commands are used to set the sub-ring assistant node, node 2:

Switch_config#mether-ring 2 domain 1

Switch_config_ring2#assistant-node

Switch_config_ring2#sub-ring *(This can be omitted)*

Switch_config_ring2#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring2#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring2#quit

The following commands are used to set the common port and edge port of node 2:

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 2 domain 1 common-port

Switch_config_g0/2#quit

Switch_config#interface gigaEthernet 0/3

Switch_config_g0/3#mether-ring 2 domain 1 edge-port

Switch_config_g0/3#switchport mode trunk

Switch_config_g0/3#quit

Configuring switch S7:

The following commands are used to set the major-ring transit node, node 1:

Switch_config#mether-ring 1 domain 1

Switch_config_ring1#transit-node

Switch_config_ring1#major-ring

Switch_config_ring1#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring1#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring1#quit

The following commands are used to set the transit port of node 1:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 1 domain 1 transit-port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 1 domain 1 transit-port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

The following commands are used to set the sub-ring edge node, node 4:

Switch_config#mether-ring 4 domain 1

Switch_config_ring4#edge-node

Switch_config_ring4#sub-ring *(This can be omitted)*

Switch_config_ring4#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring4#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring4#quit

The following commands are used to set the common port and edge port of node 4:

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 4 domain 1 common-port

Switch_config_g0/2#quit

Switch_config#interface gigaEthernet 0/3

Switch_config_g0/3#mether-ring 4 domain 1 edge-port

Switch_config_g0/3#switchport mode trunk

Switch_config_g0/3#quit

Configuring switch S8:

The following commands are used to set the sub-ring transit node, node 4:

Switch_config#mether-ring 4 domain 1

Switch_config_ring4# transit -node

Switch_config_ring4#sub-ring

Switch_config_ring4#control-vlan 2

The following commands are used to set the time related parameters:

Switch_config_ring4#pre-forward-time 12

Exits from the node configuration mode:

Switch_config_ring4#quit

The following commands are used to set the transit port of node 4:

Switch_config#interface gigaEthernet 0/1

Switch_config_g0/1#mether-ring 4 domain 1 transit -port

Switch_config_g0/1#switchport mode trunk

Switch_config_g0/1#quit

Switch_config#interface gigaEthernet 0/2

Switch_config_g0/2#mether-ring 4 domain 1 transit -port

Switch_config_g0/2#switchport mode trunk

Switch_config_g0/2#quit

27.3.4 Unfinished Configurations (to be continued)

- Unfinished basic information configuration: there is one of the ring's role, the ring's grade and the control VLAN unset. One exceptional case is that when a node's role has configured to be the edge node or assistant node, the default ring's grade is sub-ring.
- Contradiction of basic information: When a node's role is edge-node or assistant-node, the default ring's grade is sub-ring; when the ring's grade is major-ring, prompt information will appear.
- Sub ring having no corresponding major-ring node: When a node's role is edge-node or assistant-node, this node is borne on the major-ring node; if there is no corresponding major-ring node to compulsorily create the sub-ring edge node or sub-ring assistant node, prompt information will appear (in this case, you can use the **show** command to browse the MEAPS state; if you find the basic information is complete but the state is **init**, it indicates that the configuration of the ring's node has not finished).
- Conflicts arising during control VLAN configuration: If the control VLAN, which is configured by a node, conflicts with other configured nodes, prompt information will appear (in this case, you can use the **show** command to browse the MEAPS state; if you find the basic information is complete but the state is **init**, it indicates that the configuration of the ring's node has not finished).
- If a sub-ring node corresponding to a major-ring node is configured, the ID of the sub-ring node must be bigger than that of the major-ring node; if the sub-ring node's ID is less than the major-ring node's ID, the sub-ring node cannot be created and related prompt information pops out.

28. ELPS Configuration

28.1 ELPS Overview

28.1.1 Overview

If DHCP snooping is enabled in a VLAN, the DHCP packets which are received from all distrusted physical ports in a VLAN will be legally checked. The DHCP response packets which are received from distrusted physical ports in a VLAN will then be dropped, preventing the faked or mis-configured DHCP server from providing address distribution services. For the DHCP request packet from distrusted ports, if the hardware address field in the DHCP request packet does not match the MAC address of this packet, the DHCP request packet is then thought as a fake packet which is used as the attack packet for DHCP DOS and then the switch will drop it.

Run the following commands in global configuration mode.

Command	Purpose
Ip dhcp-relay snoopingvlan*vlan_id*	Enables DHCP-snooping in a VLAN.
no ip dhcp-snooping vlan*vlan_id*	Disables DHCP-snooping in a VLAN.

Setting an Interface to a DHCP-Trusting Interface

If an interface is set to be a DHCP-trusting interface, the DHCP packets received from this interface will not be checked.

Run the following commands in physical interface configuration mode.

Command	Purpose
dhcp snooping trust	Sets an interface to a DHCP-trusting interface.
no dhcp snooping trust	Resumes an interface to a DHCP-distrusted interface.

The interface is a distrusted interface by default.

Enabling DAI in a VLAN

When dynamic ARP monitoring is conducted in all physical ports of a VLAN, a received ARP packet will be rejected if the source MAC address and the source IP address of this packet do not match up with the configured MAC-IP binding relationship. The binding relationship on an interface can be dynamically bound by DHCP or configured manually. If no MAC addresses are bound to IP addresses on a physical interface, the switch rejects forwarding all ARP packets.

Command	Purpose
ip arp inspection vlan *vlanid*	Enables dynamic ARP monitoring on all distrusted ports in a VLAN.
no ip arp inspection vlan *vlanid*	Disables dynamic ARP monitoring on all distrusted ports in a VLAN.

Setting an Interface to an ARP-Trusting Interface

ARP monitoring is not enabled on those trusted interfaces. The interfaces are distrusted ones by default.

Run the following commands in interface configuration mode.

Command	Purpose
arp inspection trust	Sets an interface to an ARP-trusting interface.
no arp inspection trust	Resumes an interface to an ARP-distrusting interface.

Enabling Source IP Address Monitoring in a VLAN

After source IP address monitoring is enabled in a VLAN, IP packets received from all physical ports in the VLAN will be rejected if their source MAC addresses and source IP addresses do not match up with the configured MAC-to-IP binding relationship. The binding relationship on an interface can be dynamically bound by DHCP or configured manually. If no MAC addresses are bound to IP addresses on a physical interface, the switch rejects forwarding all IP packets received from the physical interface.

Run the following commands in global configuration mode.

Command	Purpose
ip verify source vlan *vlanid*	Enables source IP address checkup on all distrusted interfaces in a VLAN.
no ip verify source vlan *vlanid*	Disables source IP address checkup on all interfaces in a VLAN.

If the DHCP packet (also the IP packet) is received, it will be forwarded because global snooping is configured.

Setting an Interface to the One Which is Trusted by IP Source Address Monitoring

Source address checkup is not enabled on an interface if the interface has a trusted source IP address.

Run the following commands in interface configuration mode.

Command	Purpose
ip-source trust	Sets an interface to the one with a trusted source IP address.
no Ip-source trust	Resumes an interface to the one with a distrusted source IP address.

Configuring the TFTP Server for Backing up Interface Binding

After the switch configuration is rebooted, the previously-configured interface binding will be lost. In this case, there is no binding relationship on this interface. After source IP address monitoring is enabled, the switch rejected forwarding all IP packets. After the TFTP server is configured for interface binding backup, the binding relationship will be backed up to the server through the TFTP protocol. After the switch is restarted, the switch automatically downloads the binding list from the TFTP server, securing the normal running of the network.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping database-agent *ip-address*	Configures the IP address of the TFTP server which is to back up interface binding.
no ip dhcp-relay snooping database-agent	Cancels the TFTP Server for backing up interface binding.

Configuring a File Name for Interface Binding Backup

When backing up the interface binding relationship, the corresponding file name will be saved on the TFTP server. In this way, different switches can back up their own interface binding relationships to the same TFTP server.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping db-file *name*	Configures a file name for interface binding backup.
no ip dhcp-relay snooping db-file	Cancels a file name for interface binding backup.

Configuring the Interval for Checking Interface Binding Backup

The MAC-to-IP binding relationship on an interface changes dynamically. Hence, you need check whether the binding relationship updates after a certain interval. If the binding relationship updates, it need be backed up again. The default interval is 30 minutes.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping write *num*	Configures the interval for checking interface binding backup.
no ip dhcp-relay snooping write	Resumes the interval of checking interface binding backup to the default settings.

Configuring Interface Binding Manually

If a host does not obtain the address through DHCP, you can add the binding item on an interface of a switch to enable the host to access the network. You can run **no ip source binding MAC IP** to delete items from the corresponding binding list.

Note that the manually-configured binding items have higher priority than the dynamically-configured binding items. If the manually-configured binding item and the dynamically-configured binding item have the same MAC address, the manually-configured one updates the dynamically-configured one. The interface binding item takes the MAC address as the unique index.

Run the following commands in global configuration mode.

Command	Purpose
ip source binding *MAC IP* interface *name*	Configures interface binding manually.
no ip source binding *MAC IP*	Cancels an interface binding item.

L2 Switch Forwarding DHCP Packets

The following command can be used to forward the DHCP packets to the designated DHCP server to realize DHCP relay. The negative form of this command can be used to shut down DHCP relay.

This command can only be used to enable DHCP relay on L2 switches, while on L3 switches, DHCP relay is realized by the DHCP server.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay agent	Enables DHCP relay.
ip dhcp-relay helper-address*address***vlan***vlan-id*	Configures the destination address and VLAN of the relay.

Monitoring and Maintaining DHCP-Snooping

Run the following commands in EXEC mode:

Command	Purpose
show ip dhcp-relay snooping	Displays the information about DHCP-snooping configuration.
show ip dhcp-relay snooping binding	Displays the effective address binding items on an interface.
show ip dhcp-relay snooping binding all	Displays all binding items which are generated by DHCP snooping.
[**no**] **debug ip dhcp-relay** [**snooping** | binding | **event**]	Enables or disables the switch of DHCP relay snooping.

The following shows the information about the DHCP snooping configuration:

```
switch#show ip dhcp-relay snooping
ip dhcp-relay snooping vlan 3
ip arp inspection vlan 3
DHCP Snooping trust interface:
FastEthernet0/1
ARP Inspect interface:
FastEthernet0/11
```

The following shows the binding information about dhcp-relay snooping:

```
switch#show ip dhcp-relay snooping binding
Hardware Address    IP Address    remainder time Type        VLAN    interface

a8-f7-e0-26-23-89 192.2.2.101     86400     DHCP_SN       3     FastEthernet0/3
```

The following shows all binding information about dhcp-relay snooping:

```
switch#show ip dhcp-relay snooping binding all
Hardware Address    IP Address    remainder time Type        VLAN    interface

a8-f7-e0-32-1c-59 192.2.2.1     infinite     MANUAL     1     FastEthernet0/2
a8-f7-e0-26-23-89 192.2.2.101     86400     DHCP_SN      3     FastEthernet0/3
```

The following shows the information about dhcp-relay snooping.

```
switch#debug ip DHCP-snooping packet
DHCPR:    receive l2 packet from vlan 3, diID: 3
DHCPR:    DHCP packet len 277
DHCPR:    add binding on interface FastEthernet0/3
DHCPR:    send packet continue
DHCPR:    receive l2 packet from vlan 3, diID: 1
DHCPR:    DHCP packet len 300
DHCPR:    send packet continue
DHCPR:    receive l2 packet from vlan 3, diID: 3
DHCPR:    DHCP packet len 289
DHCPR:    send packet continue
DHCPR:    receive l2 packet from vlan 3, diID: 1
DHCPR:    DHCP packet len 300
DHCPR:    update binding on interface FastEthernet0/3
DHCPR:    IP address:    192.2.2.101, lease time 86400 seconds
DHCPR:    send packet continue
```

29. UDLD Configuration

29.1 Unidirectional Link Detection (UDLD)

29.1.1 UDLD Overview

UDLD is a L2 protocol that monitors the physical location of the cable through the devices which are connected by optical cable or twisted-pair, and detects whether the unidirectional link exists. Only when the connected device supports UDLD can the unidirectional link be detected and shut down. The unidirectional link can cause a lot of problems, including the STP topology ring. Hence, when detecting a unidirectional link, UDLD will shut down the affected interface and notify uses.

UDLD works with the physical-layer protocol mechanism to judge the status if the physical link. On the physical layer, the physical signals and incorrect detections are automatically negotiated and processed, while UDLD processes other matters, such as detecting the ID of a neighbor and shutting down the incorrect connection port. If you enable automatic negotiation and UDLD, the detection at layer 1 and layer 2 can prevent physical/logical links and other protocols' problems.

29.1.1.1 UDLD Mode

UDLD supports two modes, the normal mode (default) and the aggressive mode. In normal mode, UDLD can detect the existence of a unidirectional link according to the unidirectional services of the link. In aggressive mode, UDLD can detect not only the existence of a unidirectional link as in the previous mode but also connection interruption which cannot be detected by L1 detection protocols.

In **normal** mode, if UDLD determines that the connection is gone, UDLD will set the state of the port to **undetermined**, not to **down**. In **aggressive** mode, if UDLD determines that the link is gone and the link cannot be reconnected, it is thought that interrupted communication is a severe network problem and UDLD will set the state of the protocol to **linkdown** and the port is in **errdisable** state. No matter in what mode, if UDLD maintains it is a bidirectional link, the port will be set to **bidirectional**.

In **aggressive** mode, UDLD can detect the following cases of the unidirectional link:

- On the optical fiber or the twisted pair, an interface cannot receive or transmit services.
- On the optical fiber or the twisted pair, the interface of one terminal is down and the interface of the other terminal is up.
- One line in the optical cable is broken, and therefore the data can only be transmitted or only be received.

In previous cases, UDLD will shut down the affected interface.

29.1.1.2 Running Mechanism

UDLD is a L2 protocol running on the LLC layer, which uses 01-00-0c-cc-cc-cc as its destination MAC address. SNAP HDLC is similar to 0x0111. When it runs with layer-1 FEFI and automatic negotiation, the completeness of a link in the physical layer and the logical link layer can be checked.

UDLD can provide some functions that FEFI and automatic negotiation cannot conduct, such as checking and caching the neighbor information, shutting down any mis-configured port and checking the faults and invalidation on the logical ports except the point-to-point logical ports.

UDLD adopts two basic mechanisms: learn the information about neighbors and save it in the local cache. When a new neighbor is detected or a neighbor applies for synchronizing the cache again, a series of UDLD probe/echo (hello) packets will be transmitted.

UDLD transmits the probe/echo packets on all ports and, when a UDLD echo information is received on the ports, a detection phase and an authentication process are triggered. If all effective conditions are satisfied (port is connected in two directions and the cable is correctly connected), this port will be up. Otherwise, the port will be down.

Once a link is established and labeled as bidirectional, UDLD will transmit a probe/echo message every 15 seconds.

29.1.1.3 State of the Port

The UDLD interface may be in one of the following states:

Port state	Remark
Detection	Means that the interface is in detection state.
Unknown	Means that the interface is in unknown state, that is, it may be in detection state or it has not conducted detection.
Unidirectional	Means that the unidirectional connection has been detected.
Bidirectional	Means that the bidirectional connection has been detected.

29.1.1.4 Maintaining the Cache of the Neighbor

UDLD transmits the Probe/Echo packets regularly on each active interface to maintain the completeness of the neighbor's cache. Once a Hello message is received, it will be saved in the memory temporally and an interval that is defined by hold-time will also be saved. If the hold-time times out, the corresponding cache is fully cleared. If a new Hello message is received in the hold-time, the new Hello message will replace the old one and the timer will be reset to zero.

Once a UDLD-running interface is disabled or the device on the interface is restarted, all the caches on the interface will be removed to maintain the completeness of the UDLD cache. UDLD transmits at least one message to notify the neighbor to remove the corresponding cache items.

29.1.1.5 Echo Detection

The echo mechanism is the basis of the detection algorithm. Once a UDLD device learns a new neighbor or another synchronization request from an asynchronous neighbor, it will start or restart the detection window of the local terminal and transmit an echo message for full agreement. Because all neighbors are demanded a corresponding action, the echo sender expects an **echos** message. If the checkup window is over before a legal echo is received, this link is thought to be a unidirectional one. In this case, link reconnection will be triggered or the **link down** process on the port is enabled.

29.1.2 UDLD Configuration Task List

- Globally Enabling or Disabling UDLD
- Enabling or Disabling the UDLD Interface
- Setting the Message Interval of the Aggressive Mode
- Restarting the Interface Shut Down by UDLD
- Displaying the UDLD State

29.1.3 UDLD Configuration Tasks

29.1.3.1 Globally Enabling or Disabling UDLD

In global configuration mode, run the following command to enable the UDLD function of all interfaces.

Command	Purpose
udld [enable | aggressive]	Enables the UDLD modules of all interfaces in some mode.

In global configuration mode, run the following command to disable the UDLD function of all interfaces.

Command	Purpose
no udld [enable | aggressive]	Shuts down the UDLD modules of all interfaces.

If you enable or disable the UDLD function in global configuration mode, the UDLD function will be performed on all interfaces.

UDLD of the Aggressive mode is a variation of UDLD, which can provide extra benefits. When UDLD is in aggressive mode and the port stops transmitting the UDLD packets, UDLD will try to establish a link with its neighbor again. If the times of tries exceed a certain number, the state of the port is changed into the Error-Disable state and the link of the port is down. When UDLD is running, the ports at both terminals should run in the same mode, or the expecting result cannot be obtained.

29.1.3.2 Enabling or Disabling the UDLD Interface

In interface configuration mode, run the following command to enable the UDLD function of an interface.

Command	Purpose
udld port [**aggressive**]	Enables the UDLD module of an interfaces in some mode. If the **aggressive** parameter is not entered, the UDLD function of the interface is enabled in **normal** mode; if the **aggressive** parameter is entered, the UDLD function of the interface is enabled in **aggressive** mode.

In interface configuration mode, run the following command to disable the UDLD function of an interface.

Command	Purpose
no udld port [**aggressive**]	Disables the UDLD module of the interface by entering the corresponding command in some mode.

When UDLD is running, the ports at both terminals should run in the same mode, or the expecting result cannot be obtained.

29.1.3.3 Setting the Message Interval of the Aggressive Mode

In global configuration mode, run the following command to set the message interval of the aggressive mode.

Command	Purpose
udld message *time*	Sets the message interval of the aggressive mode.

29.1.3.4 Restarting the Interface Shut Down by UDLD

In the EXEC mode, run the following command to restart the interface that is shut down by the UDLD module.

Command	Purpose
udld reset	Restarts the interface shut down by UDLD.

29.1.3.5 Displaying the UDLD State

Run the following command to display the states of the UDLD modules of all current interfaces.

Command	Purpose
show udld	Displays the states of the UDLD modules of all current interfaces.

Run the following command to display the state of the UDLD module of the specified interface.

Command	Purpose
show udld *interface*	Displays the state of the UDLD module of the specified interface.

The UDLD displaying command is used to browse the state and the mode of UDLD, the current detection state, the state of the current link and some information about the neighbors.

It is used to display the running states of the UDLD modules of the current interfaces.

```
Switch#show udld

Interface FastEthernet0/1
---
Port enable administrative configuration setting:    Enabled
Port enable operational state:    Enabled
Current bidirectional state:    Bidirectional
Current operational state:    Advertisment
Message interval: 15
Time out interval: 5
Entry 1
      ---
Expiration time: 42
Cache Device index: 1
Device ID:    CAT0611Z0L9
Port ID:    FastEthernet0/1
Neighbor echo 1 device:    S35000202
Neighbor echo 1 port:    FastEthernet0/1

Message interval: 15
Time out interval: 5
UDLD Device name:    Switch

Interface FastEthernet0/2
---
```

```
Port enable administrative configuration setting:    Disabled
Port enable operational state:    Disabled
Current bidirectional state:    Unknown

Interface FastEthernet0/3
---
Port enable administrative configuration setting:    Disabled
Port enable operational state:    Disabled
Current bidirectional state:    Unknown

……
```

It is used to display the operational state of the UDLD module of the current interface.

```
Switch#show udld interface f0/1
Interface FastEthernet0/1
---
Port enable administrative configuration setting:    Enabled
Port enable operational state:    Enabled
Current bidirectional state:    Bidirectional
Current operational state:    Advertisment
Message interval: 15
Time out interval: 5
Entry 1
      ---
Expiration time: 42
Cache Device index: 1
Device ID:    CAT0611Z0L9
Port ID:    FastEthernet0/1
Neighbor echo 1 device:    S35000202
Neighbor echo 1 port:    FastEthernet0/1

Message interval: 15
Time out interval: 5
UDLD Device name:    Switch
```

29.1.4 Configuration Example

29.1.4.1 Network Environment Requirements

Configure the UDLD protocol on the ports that connect two switches.

29.1.4.2 Network Topology

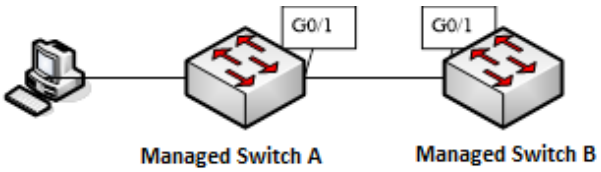


Figure 2 Network topology

29.1.4.3 Configuration Procedure

Configuring managed switch A:

Switch_config#udld enable

Switch_config#

Configuring managed switch B:

Switch_config#udld enable

Switch_config#

Entering the **show** command on managed switch A:

Switch_config#show udld interface g0/1

Interface g0/1

Port enable administrative configuration setting: Enabled

Port enable operational state: Enabled

Current bidirectional state: Unknown

Current operational state: Detection

Message interval: 15

Time out interval: 1

Entry 1

Expiration time: 44

Cache Device index: 1

Device ID: XGS-6350-12X8TR

Port ID: FastEthernet0/1

Neighbor echo 1 device: XGS-6350-12X8TR

Neighbor echo 1 port: FastEthernet0/1

Message interval: 15
Time out interval: 1
UDLD Device name: XGS-6350-12X8TR
Switch_config#
Switch_config#show udld interface f0/1

Interface FastEthernet0/1

Port enable administrative configuration setting: Enabled
Port enable operational state: Enabled
Current bidirectional state: Unknown
Current operational state: Advertisment
Message interval: 15
Time out interval: 7
Entry 1

Expiration time: 43
Cache Device index: 1
Device ID: XGS-6350-12X8TR
Port ID: FastEthernet0/1
Neighbor echo 1 device: XGS-6350-12X8TR
Neighbor echo 1 port: FastEthernet0/1

Message interval: 15
Time out interval: 7
UDLD Device name: XGS-6350-12X8TR
Switch_config#
Switch_config#show udld interface f0/1

Interface FastEthernet0/1

Port enable administrative configuration setting: Enabled
Port enable operational state: Enabled
Current bidirectional state: Bidirectional
Current operational state: Advertisment
Message interval: 15
Time out interval: 15
Entry 1

Expiration time: 36

Cache Device index: 1

Device ID: XGS-6350-12X8TR

Port ID: FastEthernet0/1

Neighbor echo 1 device: XGS-6350-12X8TR

Neighbor echo 1 port: FastEthernet0/1

Message interval: 15

Time out interval: 15

UDLD Device name: XGS-6350-12X8TR

Switch_config#

From the information above, you can find the three phases of the link state which UDLD detects:

Detection phase: In this phase, the UDLD packets are transmitted every other second.

Unknown phase: In this phase, the UDLD packets are transmitted every eight seconds.

Known bidirectional/unidirectional connection phase: Once a link is established and labeled as bidirectional, UDLD will transmit a probe/echo message every 16 seconds.

30. IGMP-Snooping Configuration

30.1 IGMP-snooping Configuration

30.1.1 IGMP-snooping Configuration Task

The task of IGMP-snooping is to maintain the relationships between VLAN and group address and to update simultaneously with the multicast changes, enabling layer-2 switches to forward data according to the topology structure of the multicast group.

The main functions of IGMP-snooping are shown as follows:

- Listening IGMP message;
- Maintaining the relationship table between VLAN and group address;
- Keeping the IGMP entity of host and the IGMP entity of router in the same state to prevent flooding from occurring.

Because igmp-snooping realizes the above functions by listening the **query** message and **report** message of igmp, igmp-snooping can function properly only when it works on the multicast router, that is, the switch must periodically receive the igmp **query** information from the router. The **router age** timer of igmp-snooping must be set to a time value that is bigger than the group query period of the multicast router connecting igmp-snooping. You can check the multicast router information in each VLAN by running **show ip igmp-snooping**.

- Enabling/Disabling IGMP-snooping of VLAN
- Adding/Deleting static multicast address of VLAN
- Configuring immediate-leave of VLAN
- Configuring the function to filter multicast message without registered destination address
- Configuring the Router Age timer of IGMP-snooping
- Configuring the Response Time timer of IGMP-snooping
- Configuring IGMP Querier of IGMP-snooping
- Monitoring and maintaining IGMP-snooping
- IGMP-snooping configuration example

30.1.1.1 Enabling/Disabling IGMP-Snooping of VLAN

Perform the following configuration in global configuration mode:

Command	Description
ip igmp-snooping [vlan*vlan_id*]	Enables IGMP-snooping of VLAN.
no ip igmp-snooping [vlan*vlan_id*]	Resumes the default configuration.

If vlan is not specified, all vlans in the system, including vlans created later, can be enabled or disabled.
In the default configuration, IGMP-snooping of all VLANs is enabled, just as the **ip igmp-snooping** command is configured.

IGMP-snooping can run on up to 16 VLANs.

To enable IGMP-snooping on VLAN3, you must first run **no ip IGMP-snooping** to disable IGMP-snooping of all VLANs, then configure **ipIGMP-snooping VLAN 3** and save configuration.

30.1.1.2 Adding/Deleting Static Multicast Address of VLAN

Hosts that do not support IGMP can receive corresponding multicast message by configuring the static multicast address.
Perform the following configuration in global configuration mode:

Command	Description
ip igmp-snoopingvlan*vlan_id* static*A.B.C.D* interface*intf*	Adds static multicast address of VLAN.
no ip igmp-snooping vlan*vlan_id* static*A.B.C.D* interface*intf*	Deletes static multicast address of VLAN.

30.1.1.3 Configuring immediate-leave of VLAN

When the characteristic immediate-leave is configured, the switch can delete the port from the port list of the multicast group after the switch receives the **leave** message. The switch, therefore, does not need to enable the timer to wait for other hosts to join the multicast. If other hosts in the same port belongs to the same group and their users do not want to leave the group, the multicast communication of these users may be affected. In this case, the **immediate-leave** function should not be enabled.

Perform the following configuration in global configuration mode:

Command	Description
ip igmp-snooping vlan *vlan_id* immediate-leave	Configures the immediate-leave function of the VLAN.
no ip igmp-snooping vlan*vlan_id*immediate-leave	Sets immediate-leave of VLAN to its default value.

The **immediate-leave** characteristic of VLAN is disabled by default.

30.1.1.4 Configuring the Function to Filter Multicast Message Without Registered Destination Addresss

When multicast message target fails to be found (DHL, the destination address is not registered in the switch chip through igmp-snooping), the default process method is to send message on all ports of VLAN.Through configuration, you can change the process method and all multicast messages whose destination addresses are not registered to any port will be dropped.

Command	Description
ip igmp-snooping dlf-frames*filter*	Drops multicast message whose destination fails to be found.
no ip igmp-snooping dlf-frames	Resumes the fault configuration (forward).

Note

(1) The attribute is configured for all VLANs.

(2) The default method for the switch to handle this type of message is forward (message of this type will be broadcasted within VLAN).

30.1.1.5 Configuring Router Age Timer of IGMP-snooping

The **Router Age** timer is used to monitor whether the IGMP inquirer exists. IGMP inquirers maintains multicast addresses by sending **query** message. IGMP-snooping works through communication between IGMP inquier and host.

Perform the following configuration in global configuration mode:

Command	Description
ip igmp-snooping timer router-age*timer_value*	Configures the value of Router Age of IGMP-snooping.
no ip igmp-snooping timer router-age	Resumes the default value of Router Age of IGMP-snooping.

Note

For how to configure the timer, refer to the query period setup of IGMP inquirer. The timer cannot be set to be smaller than query period. It is recommended that the timer is set to three times of the query period.

The default value of Router Age of IGMP-snooping is 260 seconds.

30.1.1.6 Configuring Response Time Timer of IGMP-Snooping

The **response time** timer is the upper limit time that the host reports the multicast after IGMP inquirer sends the **query** message. If the **report** message is not received after the timer ages, the switch will delete the multicast address.

Perform the following configuration in global configuration mode:

Command	Description
ip igmp-snooping timer response-time*timer_value*	Configures the value of Response Time of IGMP-snooping.
no ip igmp-snooping timer response-time	Resumes the default value of Response Time of IGMP-snooping.

Note

The timer value cannot be too small. Otherwise, the multicast communication will be unstable.

The value of Response Time of IGMP-snooping is set to ten seconds.

30.1.1.7 Configuring Querier of IGMP-Snooping

If the multicast router does not exist in VLAN where IGMP-snooping is activated, the **querier** function of IGMP-snooping can be used to imitate the multicast router to regularly send IGMP **query** message. (The function is global, that is, it can be enabled or disabled in VLAN where IGMP-snooping is globally enabled) When the multicast router does not exist in LAN and multicast flow does not need routing, the automatic query function of the switch can be activated through IGMP snooping, enabling IGMP snooping to work properly. Perform the following configuration in global configuration mode:

Command	Description
[no] ip igmp-snooping querier [address*[ip_addr*]	Configures the querier of IGMP-snooping. The optional parameter address is the source IP address of query message.

The **IGMP-snooping querier** function is disabled by default. The source IP address of fake **query** message is 10.0.0.200 by default.

If the querier function is enabled, the function is disabled when the multicast router exists in VLAN; the function can be automatically activated when the multicast router times out.

30.1.1.8 Monitoring and Maintaining IGMP-Snooping

Perform the following operations in management mode:

Command	Description
show ip igmp-snooping	Displays IGMP-snooping configuration information.
show ip igmp-snooping timer	Displays the clock information of IGMP-snooping.
show ip igmp-snooping groups	Displays information about the multicast group of IGMP-snooping.
show ip igmp-snooping statistics	Displays statistics information about IGMP-snooping.
[no] debug ip igmp-snooping [packet | timer | event | error]	Enables and disables packet/clock debug/event/mistake print switch of

	IGMP-snooping. If the debug switch is not specified, all debug switches will be enabled or disabled.

Display VLAN information about IGMP-snooping running:

```
switch#show ip igmp-snooping
igmp-snooping response time:    10 s
vlan 1
------------
   running
   Router: 90.0.0.120(F0/2)
```

Display information about the multicast group of IGMP-snooping:

```
switch#show ip igmp-snooping groups
Vlan Source       Group         Type Port(s)
---- ---------------- ---------------- ---- ------------------------------------
 1 0.0.0.0      234.5.6.6      IGMP F0/2
 1 0.0.0.0      239.255.255.250 IGMP F0/2
```

Display IGMP-snooping timer:

```
switch#show ip igmp-snooping timers
vlan 1 router age : 251 Indicating the timeout time of the router age timer
vlan 1 multicast address 0100.5e00.0809 response time : 1    Indicating the period from when the last multicast
 group query message is received to the current time; if no host on the port respond when the timer times out,
 the port will be deleted..
```

Display IGMP-snooping statistics:

```
switch#show ip igmp-snooping statistics
vlan 1
------------
   v1_packets:    0     IGMP v1    packet number
   v2_packets:    6     IGMP v2    packet number
   v3_packets:    0     IGMP v3    packet number
   general_query_packets:    5    General query of the packet number
   special_query_packets:    0    Special query of the packet number
   join_packets:    6     Number of report packets
   leave_packets:    0    Number of Leave packets
   send_query_packets:    0     Rserved statistics option
   err_packets:    0     Number of incorrect packets
```

Debug the message timer of IGMP-snooping:

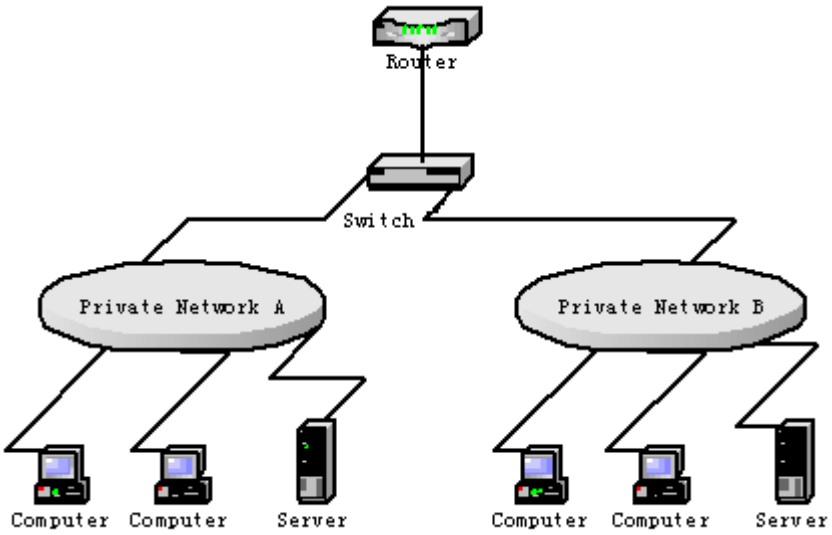
```
switch#debug ip igmp-snooping packet
rx: s_ip:  90.0.0.3, d_ip:  224.0.8.9  Source and destination IP addresses where packets are received
    type:  16(V2-Report), max resp:  00, group address:  224.0.8.9  Type and content of packet
rx: s_ip:  90.0.0.90, d_ip:  224.0.0.1
    type:  11(Query), max resp:  64, group address:  0.0.0.0
rx: s_ip:  90.0.0.3, d_ip:  224.0.8.9
    type:  16(V2-Report), max resp:  00, group address:  224.0.8.9
rx: s_ip:  90.0.0.3, d_ip:  224.0.0.2
    type:  17(V2-Leave), max resp:  00, group address:  224.0.8.9
rx: s_ip:  90.0.0.90, d_ip:  224.0.8.9
    type:  11(Query), max resp:  0a, group address:  224.0.8.9
```

Debug the message timer of IGMP-snooping:

```
switch#debug ip igmp-snooping timer
tm: vlan 1 igmp router age expiry at port 2(F0/2)
tm: multicast item 0.0.0.0->224.0.8.9(0100.5e00.0809) response time expiry at port F0/4  Inquerying the response timer expiry
```

30.1.1.9 IGMP-Snooping Configuration Example

Figure 1 shows network connection of the example.



Configuring Switch

(1) Enable IGMP-snooping of VLAN 1 connecting Private Network A.

Switch_config#ip igmp-snooping vlan 1

(2) Enable IGMP-snooping of VLAN 2 connecting Private Network B.

Switch_config#ip igmp-snooping vlan 2

31. IGMP-Proxy Configuration

31.1 IGMP-proxy Configuration

31.1.1.1 IGMP-proxy Configuration Tasks

The IGMP Proxy allows the VLAN where the multicast user is located to receive the multicast source from other VLANs. The IGMP Proxy runs on layer 2 independently without other multicast routing protocols. IGMP proxy will be transmitted by the IGMP packets of the proxied VLAN to the proxying VLAN and maintain the hardware forward table of the multicast user of the agent VLAN according to these IGMP packets. IGMP proxy divides different VLANs into two kinds: proxied VLANs and proxying VLANs. The downstream multicast VLANs can be set to the proxied VLANs, while the upstream multicast VLANs can be set to the proxying VLANs.

Although IGMP proxy is based on IGMP snooping, two are independent in application; IGMP Snooping will not be affected when IGMP proxy is enabled or disabled, while IGMP proxy can run only when IGMP Snooping is enabled.

IGMP proxy cannot be used unless the following conditions are met:

(1) L3 switch

(2) Avoiding to enable IP multicast routing at the same time

(3) Preventing a vlan to act as downstream vlan and also upstream vlan

- Enabling/Disabling IGMP-Proxy
- Adding/deleting VLAN agent relationship
- Adding/deleting static multicast source entries
- Monitoring and Maintaining IGMP-Proxy
- Setting the Example of IGMP Proxy

31.1.1.2 Enabling/Disabling IGMP-Proxy

Run the following commands in global configuration mode.

Command	Purpose
ip igmp-proxyenable	Enables IGMP proxy.
no ip igmp-proxyenable	Resumes the default settings.

IGMP-proxy cannot be enabled after IP multicast-routing is enabled. The previously enabled IGMP proxy is automatically shut down if IP multicast routing is enabled. The shutdown of ip multicast-routing will not lead to the automatic enablement of IGMP proxy.

31.1.1.3 Adding/Deleting VLAN Agent Relationship

Run the following commands in global configuration mode.

Command	Purpose
ip igmp-proxyagent-vlan a*vlan_map* **client-vlan map** c*vlan_map*	Adds the agent VLAN (avlan_map) to manage the represented vlan (cvlan_map).
no ip igmp-proxyagent-vlan a*vlan_map* **client-vlan map** c*vlan_map*	Deletes the agent relationship.

Note

(1) The represented VLAN cannot be configured before vlan is designated by avlan_map; also, the agent VLAN cannot be configured before cvlan_map.
(2) The represented and agent VLANs must accept the control of IGMP-Snooping.

31.1.1.4 Adding/Deleting Static Multicast Source Entries

Run the following commands in global configuration mode.

Command	Purpose
ip igmp-proxy source multi_ipsrc_ip **svlan** vlan_id **sport** intf_name	Adds entries of the static source multicast.
no ip igmp-proxy source multi_ipsrc_ip **svlan** vlan_id **sport** intf_name	Deletes entries of the static source multicast.

Note

The SVLAN mentioned here is the multicast source VLAN and the vlan ID of SVLAN cannot be that of represented VLAN.

31.1.1.5 Monitoring and Maintaining IGMP-Proxy

Run the following commands in EXEC mode:

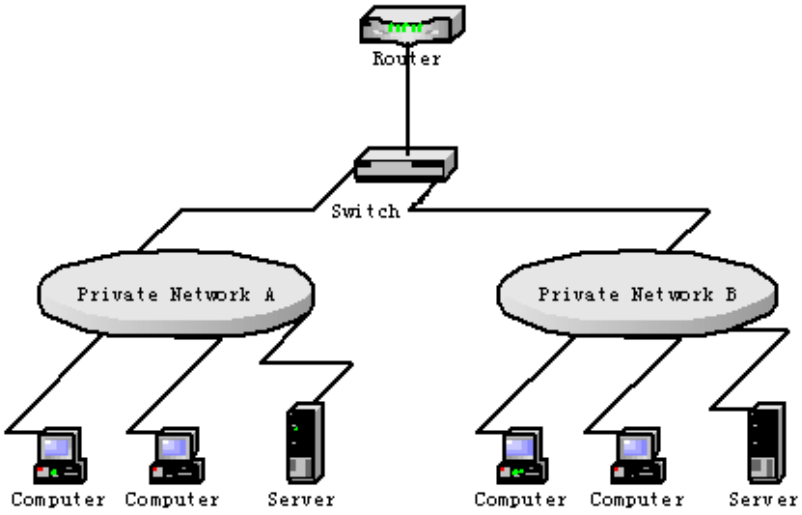
Command	Operation
show ip igmp-proxy	Displays the information about IGMP proxy.
show ip igmp-proxy mcache *[delete | nonsync | sync| static]*	Displays the forwarding cache of IGMP proxy. delete: display those entries of which hardware caches are deleted but software caches do not time out. nonsync: display those entries that have been processed but not yet synchronized to the hardware cache.. Sync: display those entries already in the hardware cache. All entries are to be displayed if no filtration conditions are specified. static: only display the entries of static multicast cache.
[**no**] **debug ip igmp-proxy** *[error | event | packet]*	Enables or disables the IGMP-proxy debug switch.

The following example shows how to display the forwarding caches of IGMP proxy:

```
Switch# show ip igmp-proxy mcache
Codes: '+' synchronization, '-' deleted, 'S' static
    '^' unsynchronization

Item 1: Group 225.1.1.2
 +(192.168.213.163, 2, G3/24)
   VLAN 3,4
```

31.1.1.6 IGMP-Proxy Configuration Example

The network topology is shown in figure 1.



Switch configuration:

(1) Enable IGMP snooping and IGMP proxy.

Switch_config#ip igmp-snooping

Switch_config#ip igmp-proxy enable

(2) Add VLAN 2 as the agent VLAN of the represented VLAN 3.

Switch_config#ip igmp-proxy agent-vlan 2 client-vlan map 3

32. MLD-Snooping Configuration

32.1 MLD-Snooping Configuration

32.1.1 IPv6 Multicast Overview

The task of MLD snooping is to maintain the forwarding relationship of IPv6 group addresses in VLAN and synchronize with the change of the multicast group, enabling the data to be forwarded according to the topology of the multicast group. Its functions include monitoring MLD-snooping packets, maintaining the table between group address and VLAN, keep the MLD-snooping host the same with the MLD-snooping router and solve the flooding problems.

When a L2 device has not got MLD snooping run, the multicast data will be broadcast at the second layer; when the L2 device gets MLD snooping run, the multicast data of the known multicast group will not be broadcast at the second layer but be sent to the designated receiver, and the unknown multicast data will be dropped.

Because MLD-snooping solves the above-mentioned problems by monitoring the Query or Report packets of MLD-Snooping, MLD snooping can work normally only when there exists the multicast router.

32.1.2 MLD-Snooping Multicast Configuration Tasks

- Enabling/Disabling MLD-Snooping
- Enabling/Disabling the Solicitation of Hardware Forward of Multicast Group
- Adding/Deleting the Static Multicast Address of VLAN
- Setting Router Age Timer of MLD-Snooping
- Setting Response Time Timer of MLD-Snooping
- Setting the Port of the Static Multicast Router
- Setting the Immediate Leave Function
- Monitoring and Maintaining MLD-Snooping

32.1.2.1 Enabling/Disabling MLD-Snooping Multicast

Run the following commands in global configuration mode.

Command	Purpose
ipv6 mld-snooping-snooping	Enables MLD snooping multicast.
no ipv6 mld-snooping-snooping	Disables MLD snooping.

After MLD-Snooping is enabled and the multicast packets fail to be found, the multicast packets whose destination addresses are not registered are dropped.

32.1.2.2 Enabling/Disabling the Solicitation of Hardware Forward of Multicast Group

Run the following commands in global configuration mode.

Command	Purpose
ipv6 mld-snooping solicitation	Enables the solicitation of hardware forward of multicast group.
no ipv6 mld-snooping solicitation	Disables the solicitation of hardware forward of multicast group.

32.1.2.3 Adding/Canceling the Static Multicast Address of VLAN

Run the following commands in global configuration mode.

Command	Purpose
ipv6 mld-snooping vlan*vlan_id* **static***X:X:X:X:X:X* **interface***intf*	Adds the static multicast address of VLAN.
no ipv6 mld-snooping vlan*vlan_id* **static***X:X:X:X:X:X* **interface***intf*	Removes the static multicast address of VLAN.

32.1.2.4 Setting Router Age Timer of MLD-Snooping

Run the following commands in global configuration mode.

Command	Operation
ipv6 mld-snooping timer router-age*timer_value*	Sets the router age of MLD-Snooping.
no ipv6 mld-snooping timer router-age	Resumes the default router age of MLD-Snooping.

The settings of this timer shall refer to the query period settings of MLD-Snooping and be larger than the query period. It is recommended to set the router age timer to be triple of the query period.

The default router age of MLD snooping is 260 seconds.

32.1.2.5 Setting Response Time Timer of MLD-Snooping

Run the following commands in global configuration mode.

Command	Operation
ipv6 mld-snooping timer response-time*timer_value*	Sets the response time of MLD-Snooping.
no ipv6 mld-snooping timer response-time	Resumes the default response time of MLD-Snooping.

Note

The value of the timer cannot be set too small, or the multicast communication may be unstable.

The default response time of MLD snooping is 15 seconds.

32.1.2.6 Setting the Port of the Static Multicast Router

Run the following commands in global configuration mode.

Command	Operation
ipv6 mld-snooping vlan *WORD* **mrouter** interface *inft_name*	Sets the static multicast router's port of MLD snooping in Vlan **word**.
no ipv6 mld-snooping vlan *WORD* **mrouter** interface *inft_name*	Deletes the static multicast router's port of MLD snooping in Vlan **word**.

32.1.2.7 Enabling/Disabling Immediate Leave

Run the following commands in global configuration mode.

Command	Purpose
ipv6 mld-snooping vlan *WORD***immediate-leave**	Enables the immediate-leave functionality.
no ipv6 mld-snooping vlan *WORD***immediate-leave**	Resumes the default settings.

32.1.2.8 Monitoring and Maintaining MLD-Snooping Multicast

Run the following commands in EXEC mode:

Command	Operation
show ipv6 mld-snooping	Displays the configuration of MLD-Snooping.
show ipv6 mld-snooping timer	Displays the clock of MLD-Snooping.
show ipv6 mld -snooping groups	Displays the multicast group of MLD-Snooping.
show ipv6 mld-snooping statistics	Displaysthe statistics information of MLD-Snooping
show ipv6 mld-snooping vlan	Displays the configuration of MLD-Snooping in VLAN.
show ipv6 mld-snooping mac	Displays the multicast MAC addresses recorded by MLD snooping.

The MLD-Snooping information is displayed below:

```
#show ipv6 mld-snooping

Global MLD snooping configuration:
-----------------------------------
Globally enable    :    Enabled
Querier            :    Enabled
Querier address    :    FE80:    :    3FF:    FEFE:    FD00:    1
Router age         :    260 s
Response time      :    10 s
Handle Solicitation    :    Disabled

Vlan 1:
----------
Running
Routers:    SWITCH(querier);
```

The multicast group of MLD-Snooping is displayed blow:

```
#show ipv6 mld--snooping groups

Vlan Group        Type Port(s)
---- ---------------- ---- -------------------------------------
1 FF02:   :   1:   FF32:   1B9B MLD   G2/23
1 FF02:   :   1:   FF00:   2   MLD   G2/23
1 FF02:   :   1:   FF00:   12 MLD   G2/23
1 FF02:   :   1:   FF13:   647D MLD   G2/23
2 FF02:   :   1:   FF00:   2   MLD   G2/22
2 FF02:   :   1:   FF61:   9901 MLD   G2/22
```

The timer of MLD-Snooping is displayed blow:

#show ipv6 mld-snooping timers

vlan 1 Querier on port 0 : 251

#

Querier on port 0: 251 meaning the router age timer times out.

vlan 2 multicast address 3333.0000.0005 response time : This shows the time period from receiving a multicast query packet to the present; if there is no host to respond when the timer times out, the port will be canceled.

The MLD-snooping statistics information is displayed below:

```
#show ipv6 mld-snooping statistics
vlan 1
------------
v1_packets:   0      quantity of v1 packets
v2_packets:   6      quantity of v2 packets
v3_packets:   0      quantity of v3 packets
general_query_packets:   5   Quantity of general query packets
special_query_packets:   0   Quantity of special query packets
listener_packets:   6   Quantity of Report packets
     done_packets:   0   Quantity of Leave packets
     err_packets:   0    Quantity of error packets
```

The MLD-Snooping proxying is displayed below:

```
#show ipv6 mld-snooping mac
Vlan Mac          Ref Flags
---- ---------- ---- ------
 1 3333:   0000:   0001   1 2
2 3333:   ff61:   9901   1 0
FF02:   :   1:   FF61:   9901
 1 3333:   0000:   0002   1 2
1 3333:   ff00:   0002   1 0
FF02:   :   1:   FF00:   2
1 3333:   ff00:   0012   1 0
FF02:   :   1:   FF00:   12
1 3333:   ff13:   647d   1 0
FF02:   :   1:   FF13:   647D
1 3333:   ff32:   1b9b   1 0
FF02:   :   1:   FF32:   1B9B
2 3333:   ff00:   0002   1 0
FF02:   :   1:   FF00:   2
1 3333:   ff00:   0001   1 2
    1    3333:   ff8e:   7000   1 2
```

33. OAM Configuration

33.1 OAM Configuration

33.1.1 OAM Overview

EFM OAM of IEEE 802.3ah provides point-to-point link trouble/performance detection on the single link. However, EFM OAM cannot be applied to EVC and so terminal-to-terminal Ethernet monitoring cannot be realized. OAM PDU cannot be forwarded to other interfaces. Ethernet OAM regulated by IEEE 802.3ah is a relatively slow protocol. The maximum transmission rate is 10 frames per second and the minimum transmission rate is 1 frame per second.

33.1.1.1 OAM Protocol's Attributes

- Supporting Ethernet OAM devices and OAM attributes

The Ethernet OAM connection process is called as the Discovery phase when the OAM entity finds the OAM entity of the remote device and a stable session will be established. During the phase, the connected Ethernet OAM entities report their OAM mode, Ethernet OAM configuration information and local-node-supported Ethernet OAM capacity to each other by interacting the information OAM PDU. If the loopback configuration, unidirectional link detection configuration and link-event configuration have been passed on the Ethernet OAM of the two terminals, the Ethernet OAM protocol will start working on the link layer.

- Link monitoring

The Ethernet OAM conducts the link monitoring through Event Notification OAM PDU. If the link has troubles and the local link monitors the troubles, the local link will transmits Event Notification OAM PDU to the peer Ethernet OAM to report the normal link event. The administrator can dynamically know the network conditions through link monitoring. The definition of a normal link event is shown in table 1.

Table 1 Definition of the normal link event

Normal Link Event	Definition
Period event of error signal	Specifies the signal number *N* as the period. The number of error signals exceeds the defined threshold when *N* signals are received.
Error frame event	The number of error frames exceeds the defined threshold during the unit time.
Period event of error frame	Specifies the frame number *N* as the period. The number of error frames exceeds the defined threshold when *N* frames are received.
Second frame of error frame	Specifies that the number of seconds of the error frame exceeds the defined threshold in the designated *M* second.

- Remote trouble indication

It is difficult to check troubles in the Ethernet, especially the case that the network performance slows down while physical network communication continues. OAM PDU defines a flag domain to allow Ethernet OAM entity to transmit the trouble information to the peer. The flag can stand for the following emergent link events:

- Link Fault: The physical layer detects that the reception direction of the local DTE has no effect. If troubles occur, some devices at the physical layer support unidirectional operations and allows trouble notification from remote OAM.
- Dying Gasp: If an irrecoverable local error occurs, such as OAM shutdown, the interface enters the **error-disabled** state and then is shut down.
- Critical Event: Uncertain critical events occur (critical events are specified by the manufacturer).

Information OAM PDU is continuously transmitted during Ethernet OAM connection. The local OAM entity can report local critical link events to remote OAM entity through Information OAM PDU. The administrator thus can dynamically know the link's state and handle corresponding errors in time.

- Remote loopback

OAM provides an optional link-layer-level loopback mode and conducts error location and link performance testing through non-OAM-PDU loopback. The remote loopback realizes only after OAM connection is created. After the OAM connection is created, the OAM entity in active mode triggers the remote loopback command and the peer entity responses the command. If the remote terminal is in loopback mode, all packets except OAM PDU packets and Pause packets will be sent back through the previous paths. Error location and link performance testing thus can be conducted. When remote DTE is in remote loopback mode, the local or remote statistics data can be queried and compared randomly. The query operation can be conducted before, when or after the loopback frame is transmitted to the remote DTE. Regular loopback check can promptly detect network errors, while segmental loopback check can help locating these network errors and then remove these errors.

- Round query of any MIB variables described in chapter 30 of *802.3*.

33.1.1.2 OAM Mode

The device can conduct the OAM connection through two modes: active mode and passive mode. The device capacity in different mode is compared in table 2. Only OAM entity in active mode can trigger the connection process, while the OAM entity in passive mode has to wait for the connection request from the peer OAM entity. After the remote OAM discovery process is done, the local entity in active mode can transmit any OAM PDU packet if the remote entity is in active mode, while the local entity's operation in active mode will be limited if the remote entity is in passive mode. This is because the device in active mode does not react on remote loopback commands and variable requests transmitted by the passive remote entity.

Table 2 Comparing device capacity in active and passive modes

Capacity	Active Mode	Passive Mode
Initializing the Ethernet OAM discovery process	Yes	No
Responding to the OAM discovery initialization process	Yes	Yes
Transmitting the Information OAM PDU packet	Yes	Yes
Permitting to transmit the Event Notification OAM PDU packet	Yes	Yes
Allowing to transmit the Variable Request OAM PDU packet	Yes	No
Allowing to transmit Variable Response OAM PDU packet	Yes	Yes
Allowing to transmit the Loopback Control OAM PDU packet	Yes	No
Responding to Loopback Control OAM PDU	Yes，but the peer terminal must be in active mode.	Yes
Allowing to transmit specified OAM PDU	Yes	Yes

After the Ethernet OAM connection is established, the OAM entities at two terminals maintain connection by transmitting the Information OAM PDU packets. If the Information OAM PDU packet from the peer OAM entity is not received in five seconds, the connection times out and a new OAM connection then requires to be established.

33.1.1.3 Components of the OAM Packet

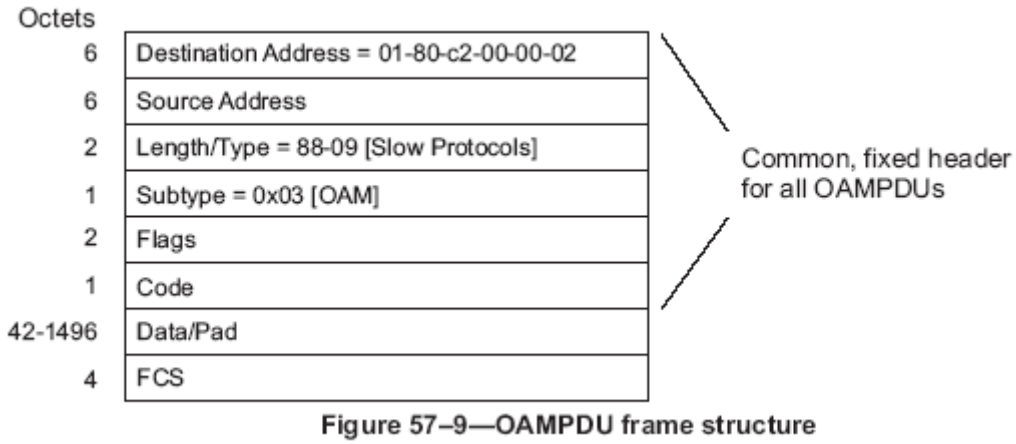


Figure 1 Components of the OAM packet

The following are the meanings of the fields of the OAM packet:

- Destination address: means the destination MAC address of the Ethernet OAM packet.
- Source address: Source MAC address of the Ethernet OAM packet

  It is the MAC address of the transmitter terminal's port and also a unicast MAC address.
  - Length/Type: Always adopts the Type encoding. The protocol type of the Ethernet OAM packet is 0x8809.
  - Subtype: The subtype of the protocol for Ethernet OAM packets is 0x03.
  - Flags: a domain where the state of Ethernet OAM entity is shown
  - Code: a domain where the type of the OAMPDU packet is shown
  - Data/Pad: a domain including the OAMPDU data and pad values
  - FCS: checksum of the frame

Table 3 Type of the CODE domain

CODE	OAMPDU
00	Information
01	Event Notification
02	Variable Request
03	Variable Response
04	Loopback Control
05-FD	Reserved
FE	Organization Specific
FF	Reserved

The Information OAM PDU packet is used to transmit the information about the state of the OAM entity to the remote OAM entity to maintain the OAM connection.

The Event Notification OAMPDU packet is used to monitor the link and report the troubles occurred on the link between the local and remote OAM entities.

The Loopback control OAMPDU packet is mainly used to control the remote loopback, including the state of the OAM loopback from the remote device. The packet contains the information to enable or disable the loopback function. You can open or shut down the remote loopback according to the contained information.

33.1.2 OAM Configuration Task List

- Enabling OAM on an interface
- Enabling remote OAM loopback
- Configuring OAM link monitoring
- Configuring the trouble notification from remote OAM entity
- Displaying the information about OAM protocol

33.1.3 OAM Configuration Tasks

33.1.3.1 Enabling OAM on an Interface

Run the following command to enable OAM:

Procedure	Command	Purpose
Step1	**config**	Enters the global configuration mode.
Step2	**interface** intf-type intf-id	Enters the interface configuration mode.
Step3	**ethernet oam**	Enables Ethernet OAM on an interface.
Step4	**ethernet oam** [**max-rate** oampdus | **min-rate** seconds | **mode** {**active** | **passive**} | **timeout** seconds]	Configures optional OAM parameters: ● The **max-rate** parameter is used to configure the maximum number of OAMPDUs transmitted per second. It ranges between 1 and 10 and its default value is 10. ● The **min-rate** parameter is used to configure the minimum transmission rate of OAMPDU. Its unit is second. It ranges between 1 and 10 and its default value is 1. ● The **mode {active | passive}** parameter is used to set the mode of OAM. The

		OAM connection can be established between two interfaces only when at least one interface is in active mode. ● The **timeout** parameter is used to set the timeout time of the OAM connection. It ranges between 1 and 30 seconds and its default value is 1 second.

You can run **no Ethernet oam** to shut down the OAM function.

The remote OAM loopback cannot be enabled on the physical interface that belongs to the aggregation interface.

33.1.3.2 Enabling Remote OAM Loopback

The procedure to enable remote loopback on an interface is shown in the following table:

Procedure	Command	Purpose
Step1	**config**	Enters the global configuration mode.
Step2	**interface** intf-type intf-id	Enters the interface configuration mode.
Step3	**ethernet oam remote-loopback {supported | timeout** seconds**}**	Configures optional loopback parameters from the remote OAM: ● The **supported** parameter is used to enable an interface to support the remote loopback of Ethernet OAM. Remote loopback is not supported by default. ● The **timeout** parameter is used to configure the timeout time of remote loopback. It ranges between 1 and 10 and its default value is 2.
Step4	**exit**	Exits from interface configuration mode.
Step5	**exit**	Exits from the global configuration mode.
Step6	**ethernet oam remote-loopback {start | stop} interface** intf-type intf-id	Enables or disables remote loopback on an interface.

The remote OAM loopback cannot be enabled on the physical interface that belongs to the aggregation interface.

33.1.3.3 Configuring OAM Link Monitoring

You can configure the low threshold and the high threshold of OAM link monitoring.

The procedure to configure the OAM link monitoring on an interface is shown in the following table:

Procedure	Command	Purpose
Step1	**config**	Enters the global configuration mode.
Step2	**interface** intf-type intf-id	Enters the interface configuration mode.
Step3	**ethernet oam link-monitor supported**	Enables link monitoring on an interface. The link monitoring is supported by default.
Step4	**ethernet oam link-monitor symbol-period {threshold {high {** symbols **|none} | low {**symbols**}} | window** symbols**}**	Sets the high and low threshold of the periodical event of the error signal, which triggers the error link events. The **threshold high** parameter is used to configure the high threshold. Its unit is signal number. It ranges between 1 and 65535 and its default value is **none**. The **threshold high** parameter is used to configure the low threshold. Its unit is signal number. It ranges between 0 and 65535 and its default value is **1**. The **window** parameter is used to configure the window size of the round-query period. The unit of the window size is the number of the 100M signal. The window size ranges between 10 and 600 on a 1000M Ethernet interface and its default value is 10 in this case, while the window size ranges between 1 and 60 on a 100M Ethernet interface and its default value is 1 in this case.
Step5	**ethernet oam link-monitor frame {threshold {high {** symbols **|none} | low {**symbols**}} | window** symbols**}**	Sets the high and low thresholds of the error frame event, which triggers the link events of error frame. The **threshold high** parameter is used to configure the high threshold. Its unit is signal number. It ranges between 1 and 65535 and its default value is **none**. The **threshold high** parameter is used to configure the low threshold. Its unit is signal

		number. It ranges between 0 and 65535 and its default value is **1**. The **window** parameter is used to configure the window size of the round-query period. Its unit is second. It ranges between 1 and 60 and its default value is 1.
Step6	**ethernet oam link-monitor frame-period {threshold {high {** symbols **|none} | low {**symbols**}} | window** symbols**}**	Sets the high and low thresholds of the period event of error frame, which triggers the link events of error frame period. The **threshold high** parameter is used to configure the high threshold. Its unit is signal number. It ranges between 1 and 65535 and its default value is **none**. The **threshold high** parameter is used to configure the low threshold. Its unit is signal number. It ranges between 0 and 65535 and its default value is **1**. The **window** parameter is used to configure the window size of the round-query period. The unit of the window size is the number of the 14881 frames. The window size ranges between 100 and 6000 on a 1000M Ethernet interface and its default value is 100 in this case, while the window size ranges between 10 and 600 on a 100M Ethernet interface and its default value is 10 in this case.
Step7	**ethernet oam link-monitor frame-seconds {threshold {high {** symbols **|none} | low {**symbols**}} | window** symbols**}**	Sets the high and low thresholds of the second event of error frame, which triggers the link events of error frame's second. The **threshold high** parameter is used to configure the high threshold. Its unit is signal number. It ranges between 1 and 900 and its default value is **none**. The **threshold low** parameter is used to configure the low threshold. Its unit is signal number. It ranges between 0 and 900 and its default value is **1**. The **window** parameter is used to configure

		the window size of the round-query period. Its unit is second. It ranges between 10 and 900 and its default value is 60.
Step8	**ethernet oam link-monitor receive-crc {threshold {high {** symbols **|none} | low {**symbols**}} | window** symbols**}**	Sets the high and low thresholds of the error CRC frame event, which triggers the link events of CRC checksum error. The **threshold high** parameter is used to configure the high threshold. Its unit is signal number. It ranges between 1 and 65535 and its default value is **none**. The **threshold high** parameter is used to configure the low threshold. Its unit is signal number. It ranges between 0 and 65535 and its default value is **1**. The **window** parameter is used to configure the window size of the round-query period. Its unit is second. It ranges between 1 and 180 and its default value is 10.
Step9	**ethernet link-monitor on**	Enables the local link monitoring. When the link monitoring function is supported, the local link monitoring is automatically enabled.

33.1.3.4 Configuring the Trouble Notification From Remote OAM Entity

You can configure an **error-disable** action on an interface. The local interface will enter the errdisabled state in the following cases:

1. The high threshold of a normal link event on a local interface is exceeded.
2. The remote interface which connects the local interface enters the errdisabled state.
3. The OAM function on the remote interface which connects the local interface is shut down by the administrator.

The procedure to configure the remote OAM trouble indication on an interface is shown in the following table:

Procedure	Command	Purpose
Step1	**config**	Enters the global configuration mode.
Step2	**interface** intf-type intf-id	Enters the interface configuration mode.
Step3	**ethernet oam remote-failure {critical-event | dying-gasp | link-fault} action error-disable-interface**	Configures the trigger action of a remote OAM trouble on an interface: ● The **critical-event** parameter is used to enable an interface to enter the **errdisabled** state when an undesignated critical event occurs. ● The **dying-gasp** parameter is used to enable the local interface to enter the **errdisabled** state if the high threshold of a normal link event on a local interface is exceeded or if the remote interface which connects the local interface enters the **errdisabled** state or if the OAM function on the remote interface which connects the local interface is shut down by the administrator. ● The **link-fault** parameter is used to enable an interface to enter the **errdisabled** state when the receiver detects signal loss.

The managed switch cannot generate the LINK FAULT packets and the Critical Event packets. However, these packets will be handled if they are received from the remote terminal. Our router can transmit and receive the Dying Gasp packet. When the local port enters the **errdisabled** state or is closed by the administrator or the OAM function of the local port is closed by the manager, the Dying Gasp packet will be transmitted to the remote terminal that connects the local port.

33.1.3.5 Displaying the Information About OAM Protocol

Table 4 Displaying the information about OAM protocol

Command	Purpose
show ethernet oam discovery interface [intf-type intf-id]	Displays the OAM discovery information on all interfaces or a designated interface.
show ethernet oam statistics {pdu | link-monitor | remote-failure} interface [intf-type intf-id]	Displays the OAM statistics information on all interfaces or a designated interface. ● The **pdu** parameter is used to classify and count the OAM packets according to the code-domain value of the OAM packet. ● The **link-monitor** parameter is used to display the detailed statistics information of normal link events. ● The **remote-failure** parameter is to display the detailed statistics information about the remote trouble.
show ethernet oam configuration interface [intf-type intf-id]	Displays the OAM configuration information on all interfaces or a designated interface.
show ethernet oam runtime interface [intf-type intf-id]	Displays the OAM running information on all interfaces or a designated interface.

33.1.4 Configuration Example

33.1.4.1 Network Environment Requirements

You need configure the OAM protocol on the interface where two managed switches connect for capturing the information about managed switch receiving error frames on user access side.

33.1.4.2 Network Topology

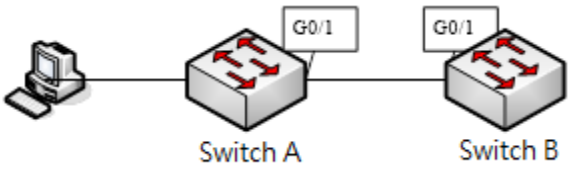


Figure 2 Network topology

33.1.4.3 Configuration Procedure

Configuring switch A:

Switch_config_g0/1#ethernet oam

Switch_config_g0/1#ethernet oam mode passive

Switch_config_g0/1#ethernet oam link-monitor frame threshold low 10

Switch_config_g0/1#ethernet oam link-monitor frame window 30

Switch_config_g0/1#show ethernet oam configuration int g0/1

GigaEthernet0/1

General

Admin state : enabled

Mode : passive

PDU max rate : 10 packets/second

PDU min rate : 1 seconds/packet

Link timeout : 1 seconds

High threshold action: no action

Remote Failure

Link fault action : no action

Dying gasp action : no action

Critical event action: no action

Remote Loopback

Is supported : not supported

Loopback timeout : 2

Link Monitoring

Negotiation : supported

Status : on

Errored Symbol Period Event

Window : 10 * 100M symbols

Low threshold : 1 error symbol(s)

High threshold : none

Errored Frame Event

Window : 30 seconds

Low threshold : 10 error frame(s)

High threshold : none

Errored Frame Period Event

Window : 100 * 14881 frames

Low threshold : 1 error frame(s)

High threshold : none

Errored Frame Seconds Summary Event

Window : 60 seconds

Low threshold : 1 error second(s)

High threshold : none

Errored CRC Frames Event

Window : 1 seconds

Low threshold : 10 error frame(s)

High threshold : none

Configuring switch B:

Switch_config_g0/1#ethernet oam

Switch_config_g0/1#show ethernet oam statistics link-monitor int g0/1

GigaEthernet0/1

Local Link Events:

Errored Symbol Period Event:

No errored symbol period event happened yet.

Errored Frame Event:

No errored frame event happened yet.

Errored Frame Period Event:

No errored frame period event happened yet.

Errored Frame Seconds Summary Event:

No errored frame seconds summary event happened yet.

Errored CRC Frames Event:

No errored CRC frame event happened yet.

Remote Link Events:

Errored Symbol Period Event:

No errored symbol period event happened yet.

Errored Frame Event:

No errored frame event happened yet.

Errored Frame Period Event:

No errored frame period event happened yet.

Errored Frame Seconds Summary Event:

No errored frame seconds summary event happened yet.

Errored CRC Frames Event:

No errored CRC frame event happened yet.

34. CFM and Y1731 Configuration

34.1 Overview

34.1.1 Stipulations

34.1.1.1 Format Stipulation in the Command Line

Syntax	Meaning
Bold	Stands for the keyword in the command line, which stays unchanged and must be entered without any modification. It is presented as a bold in the command line.
{italic}	Stands for the parameter in the command line, which must be replaced by the actual value. It must be presented by the italic in the brace.
<*italic*>	Stands for the parameter in the command line, which must be replaced by the actual value. It must be presented by the italic in the point bracket.
[ ]	Stands for the optional parameter, which is in the square bracket.
{ x | y | ... }	Means that you can choose one option from two or more options.
[x | y | ...]	Means that you can choose one option or none from two or more options.
{ x | y | ... } *	Means that you has to choose at least one option from two or more options, or even choose all options.
[x | y | ...] *	Means that you can choose multiple options or none from two or more options.
&<1-n>	Means that the parameter before the “&” symbol can be entered *n* times.
#	Means that the line starting with the “#” symbol is an explanation line.

34.2 CFM Configuration

34.2.1 CFM Configuration Task List

- Adding the Maintenance Domain
- Adding the Maintenance Association
- Adding MIP (Maintenance domain Intermediate Point)
- Adding MEP (Maintenance association End Point)
- Starting CFM

34.2.2 CFM Maintenance Task List

- Using the Loopback Function
- Using the Linktrace Function

34.2.3 CFM Configuration

34.2.3.1 Adding the Maintenance Domain

Configuration mode: Global

Command	Purpose
ethernet cfm md mdnf {string} **mdn**<char_string> [**level**<0-7> | **creation**<MHF_creation_type> | **sit**<sender_id_type> | **ip**<IP_address>]	Adds a maintenance domain whose name is **char_string**. Note: The system enters the maintenance domain configuration mode after the maintenance domain is added.

34.2.3.2 Adding the Maintenance Association

Configuration mode: maintenance domain

Command	Purpose
ma manf {string} **man**<char_string>**ci** {100ms | 1s | 10s | 1min | 10min} **meps**<mepids> [**vlan**<1-4094> | **creation**<MHF_creation_type> | **sit**<sender_id_type> | **ip**<IP_address>]	Adds a maintenance association whose name is **char_string**.

34.2.3.3 Adding MIP (Maintenance Domain Intermediate Point)

Configuration mode: physical interface

Command	Purpose
ethernet cfm mip add level <*0-7*>[vlan <*1-4094*>]	Adds a designated VLAN and hierarchical MIP to the designated physical interface.

34.2.3.4 Adding MEP (Maintenance association End Point)

Configuration mode: physical interface

Command	Purpose
ethernet cfm mep add mdnf *{string}* **mdn** <*char_string*> **manf** *{string}* **man** <*char_string*> **mepid** <*1-8191*>[**direction** *{up* | *down}* **| ip** <*ip_address*>]	Adds a designated maintenance domain and an MEP to the designated physical interface.

34.2.3.5 Starting CFM

Configuration mode: Global

Command	Purpose
ethernet cfm *{enable}*	Starts CFM.

34.2.4 CFM Maintenance

34.2.4.1 Using the Loopback Function

Configuration mode: EXEC

Command	Purpose
ethernet cfm loopback mdnf {string} **mdn** <char_string> **manf** {string} **man** <char_string> **mepid** <1-8191> **mac** <AA: BB: CC: DD: EE: FF> **number** <1-64>	Uses a designated MEP to conduct loopback towards itself.

34.2.4.2 Using the Linktrace Function

Configuration mode: EXEC

Command	Purpose
ethernet cfm linktrace mdnf {string} **mdn** <char_string> **manf** {string} **man** <char_string> **mepid** <1-8191> **mac** <AA: BB: CC: DD: EE: FF> [**ttl** {1-255} | **fdb-only** {yes}]<char_string> **manf** {string} **man** <char_string> **mepid** <1-8191>**mac** <AA: BB: CC: DD: EE: FF>**ttl** <1-255>	Uses a designated MEP to conduct loopback towards itself.

34.2.5 Configuration Example

You want to add a maintenance domain whose name is customer and hierarchy is 5, set a customer1 maintenance association for vlan1, configure the transmission interval of CCM of the maintenance association to 1s and add an MEP whose MEPID is 2009 to physical port1.

Switch_config#ethernet cfm md mdnf string mdn customer level 5

Switch_config_cfm#ma manf string man customer1 vlan 1 ci 1s meps 1-2,2009

Switch_config_cfm#interface g0/1

Switch_config_g0/1#ethernet cfm mep add mdnf string mdn customer manf string man customer1 mepid 2009 direction DOWN

Switch_config_g0/1#exit

Switch_config#ethernet cfm enable

34.3 Y1731 Configuration

34.3.1 Configuration Task List

- Specifying an MEP to Forward AIS Frame
- Enabling Frame Delay Measurement
- Displaying the Information About OAM Protocol

34.3.1.1 Specifying an MEP to Forward AIS Frame

Run the following commands specify an MEP to transmit AIS frames:

Procedure	Command	Purpose
Step1	**config**	Enters the global configuration mode.
Step2	**ethernet y1731 ais-mep timer** *time*	Designates the transmission interval of AIS packets. <1> -- 1 frame per second <2> -- 1 frame per minute The default transmission value is 1 second.
Step3	**interface** intf-type intf-id	Enters the interface configuration mode.
Step4	**ethernet y1731ais-mep***MEGID MEPID*	Specifies an MEP to transmit AIS frames. MEGID is the name of MEG to which MEP belongs. MEPID is the identifier of the specified MEP.

You can run **noethernet y1731 ais-mep timer** to resume the default transmission period of AIS frames and run **no ethernet y1731 ais-mep *MEGID MEPID*** to delete AIS transmitter, MEP.

34.3.1.2 Displaying the Information About OAM Protocol

Run show to browse Y1731 configuration:

Command	Purpose
show ethernet y1731 ais-mep	The above-mentioned command is used to show the MEPs that can transmit AIS frames.
show ethernet y1731 detect*MEGID* **[***MEPID* **]**	The above-mentioned command is used to display the detection information about the continuous check of MEG, including whether continuity is lost or whether other

	faults occur. MEGID is the name of MEG. MEPID is the symbol of to-be-displayed MEP.
show ethernet y1731 interface *interface-name*	Displaying MEP and MIP Configurations on a Port ***interface-name***stands for port identifier.
show ethernet y1731 meglist [*MEGID* **]**	The above-mentioned command is used to display the configuration of all MEG or the detailed configuration about a certain MEG. MEGID is the name of to-be-displayed MEG.
show ethernet y1731 miplist	The above-mentioned command is used to display the information about all configured MIPs.
show ethernet y1731 traffic	The above-mentioned command is used to display some statistics information about the Y.1731 module, including statistics of the received and transmitted OAM packets and the system error.

34.3.1.3 Deleting Y1731 Configuration or Statistics Information

Run **clear** to browse Y1731 configuration and statistics information:

Command	Purpose
clear ethernet y1731 counters	The above-mentioned command is used to delete the transmission statistics information about the OAM packets and the system error information.

35. DHCP-Snooping Configuration

35.1 DHCP-Snooping Configuration

35.1.1 DHCP-Snooping Configuration Tasks

DHCP-Snooping is to prevent the fake DHCP server from providing the DHCP service by judging the DHCP packets, maintaining the binding relationship between MAC address and IP address. The L2 switch can conduct the DAI function and the IP source guard function according to the binding relationship between MAC address and IP address. The DHCP-snooping is mainly to monitor the DHCP packets and dynamically maintain the MAC-IP binding list. The L2 switch filters the packets, which do not meet the MAC-IP binding relationship, to prevent the network attack from illegal users.

- Enabling/Disabling DHCP-snooping
- Enabling DHCP-snooping in a VLAN
- Setting an interface to a DHCP-trusting interface
- Enabling DAI in a VLAN
- Setting an interface to an ARP-trusting interface
- Enabling source IP address monitoring in a VLAN
- Setting an interface to the one which is trusted by IP source address monitoring
- Configuring the TFTP server for backing up DHCP-snooping binding
- Configuring a file name for DHCP-snooping binding backup
- Configuring an interval for DHCP-snooping binding backup
- Configuring or adding the binding relationship manually
- Monitoring and maintaining DHCP-snooping
- Examples for DHCP-snooping configuration

35.1.1.1 Enabling/Disabling DHCP-Snooping

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping	Enables DHCP snooping.
no ip dhcp-relay snooping	Resumes the default settings.

This command is used to enable DHCP snooping in global configuration mode. After this command is run, the switch is to monitor all DHCP packets and form the corresponding binding relationship.

If the client obtains the address of a switch before this command is run, the switch cannot add the corresponding binding relationship.

35.1.1.2 Enabling DHCP-Snooping in a VLAN

If DHCP snooping is enabled in a VLAN, the DHCP packets which are received from all distrusted physical ports in a VLAN will be legally checked. The DHCP response packets which are received from distrusted physical ports in a VLAN will then be dropped, preventing the faked or mis-configured DHCP server from providing address distribution services. For the DHCP request packet from distrusted ports, if the hardware address field in the DHCP request packet does not match the MAC address of this packet, the DHCP request packet is then thought as a fake packet which is used as the attack packet for DHCP DOS and then the switch will drop it.

Run the following commands in global configuration mode.

Command	Purpose
Ip dhcp-relay snoopingvlan*vlan_id*	Enables DHCP-snooping in a VLAN.
no ip dhcp-snooping vlan*vlan_id*	Disables DHCP-snooping in a VLAN.

35.1.1.3 Setting an Interface to a DHCP-Trusting Interface

If an interface is set to be a DHCP-trusting interface, the DHCP packets received from this interface will not be checked.

Run the following commands in physical interface configuration mode.

Command	Purpose
dhcp snooping trust	Sets an interface to a DHCP-trusting interface.
no dhcp snooping trust	Resumes an interface to a DHCP-distrusted interface.

The interface is a distrusted interface by default.

35.1.1.4 Enabling DAI in a VLAN

When dynamic ARP monitoring is conducted in all physical ports of a VLAN, a received ARP packet will be rejected if the source MAC address and the source IP address of this packet do not match up with the configured MAC-IP binding relationship. The binding relationship on an interface can be dynamically bound by DHCP or configured manually. If no MAC addresses are bound to IP addresses on a physical interface, the switch rejects forwarding all ARP packets.

Command	Purpose
ip arp inspection vlan *vlanid*	Enables dynamic ARP monitoring on all distrusted ports in a VLAN.
no ip arp inspection vlan *vlanid*	Disables dynamic ARP monitoring on all distrusted ports in a VLAN.

35.1.1.5 Setting an Interface to an ARP-Trusting Interface

ARP monitoring is not enabled on those trusted interfaces. The interfaces are distrusted ones by default.

Run the following commands in interface configuration mode.

Command	Purpose
arp inspection trust	Sets an interface to an ARP-trusting interface.
no arp inspection trust	Resumes an interface to an ARP-distrusting interface.

35.1.1.6 Enabling Source IP Address Monitoring in a VLAN

After source IP address monitoring is enabled in a VLAN, IP packets received from all physical ports in the VLAN will be rejected if their source MAC addresses and source IP addresses do not match up with the configured MAC-to-IP binding relationship. The binding relationship on an interface can be dynamically bound by DHCP or configured manually. If no MAC addresses are bound to IP addresses on a physical interface, the switch rejects forwarding all IP packets received from the physical interface.

Run the following commands in global configuration mode.

Command	Purpose
ip verify source vlan *vlanid*	Enables source IP address checkup on all distrusted interfaces in a VLAN.
no ip verify source vlan *vlanid*	Disables source IP address checkup on all interfaces in a VLAN.

If the DHCP packet (also the IP packet) is received, it will be forwarded because global snooping is configured.

35.1.1.7 Setting an Interface to the One Which is Trusted by IP Source Address Monitoring

Source address checkup is not enabled on an interface if the interface has a trusted source IP address. Run the following commands in interface configuration mode.

Command	Purpose
ip-source trust	Sets an interface to the one with a trusted source IP address.
no Ip-source trust	Resumes an interface to the one with a distrusted source IP address.

35.1.1.8 Configuring the TFTP Server for Backing up Interface Binding

After the switch configuration is rebooted, the previously-configured interface binding will be lost. In this case, there is no binding relationship on this interface. After source IP address monitoring is enabled, the switch rejected forwarding all IP packets. After the TFTP server is configured for interface binding backup, the binding relationship will be backed up to the server through the TFTP protocol. After the switch is restarted, the switch automatically downloads the binding list from the TFTP server, securing the normal running of the network.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping database-agent *ip-address*	Configures the IP address of the TFTP server which is to back up interface binding.
no ip dhcp-relay snooping database-agent	Cancels the TFTP Server for backing up interface binding.

35.1.1.9 Configuring a File Name for Interface Binding Backup

When backing up the interface binding relationship, the corresponding file name will be saved on the TFTP server. In this way, different switches can back up their own interface binding relationships to the same TFTP server.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping db-file *name*	Configures a file name for interface binding backup.
no ip dhcp-relay snooping db-file	Cancels a file name for interface binding backup.

35.1.1.10 Configuring the Interval for Checking Interface Binding Backup

The MAC-to-IP binding relationship on an interface changes dynamically. Hence, you need check whether the binding relationship updates after a certain interval. If the binding relationship updates, it need be backed up again. The default interval is 30 minutes.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay snooping write *num*	Configures the interval for checking interface binding backup.
no ip dhcp-relay snooping write	Resumes the interval of checking interface binding backup to the default settings.

35.1.1.11 Configuring Interface Binding Manually

If a host does not obtain the address through DHCP, you can add the binding item on an interface of a switch to enable the host to access the network. You can run **no ip source binding MAC IP** to delete items from the corresponding binding list.

Note that the manually-configured binding items have higher priority than the dynamically-configured binding items. If the manually-configured binding item and the dynamically-configured binding item have the same MAC address, the manually-configured one updates the dynamically-configured one. The interface binding item takes the MAC address as the unique index.

Run the following commands in global configuration mode.

Command	Purpose
ip source binding *MAC IP* interface *name*	Configures interface binding manually.
no ip source binding *MAC IP*	Cancels an interface binding item.

35.1.1.12 L2 Switch Forwarding DHCP Packets

The following command can be used to forward the DHCP packets to the designated DHCP server to realize DHCP relay. The negative form of this command can be used to shut down DHCP relay.

This command can only be used to enable DHCP relay on L2 switches, while on L3 switches, DHCP relay is realized by the DHCP server.

Run the following commands in global configuration mode.

Command	Purpose
ip dhcp-relay agent	Enables DHCP relay.
ip dhcp-relay helper-address*address***vlan***vlan-id*	Configures the destination address and VLAN of the relay.

35.1.1.13 Monitoring and Maintaining DHCP-Snooping

Run the following commands in EXEC mode:

Command	Purpose
show ip dhcp-relay snooping	Displays the information about DHCP-snooping configuration.
show ip dhcp-relay snooping binding	Displays the effective address binding items on an interface.
show ip dhcp-relay snooping binding all	Displays all binding items which are generated by DHCP snooping.
[**no**] **debug ip dhcp-relay** [**snooping** | binding | **event**]	Enables or disables the switch of DHCP relay snooping.

The following shows the information about the DHCP snooping configuration:

```
switch#show ip dhcp-relay snooping
ip dhcp-relay snooping vlan 3
ip arp inspection vlan 3
DHCP Snooping trust interface:
FastEthernet0/1
ARP Inspect interface:
FastEthernet0/11
```

The following shows the binding information about dhcp-relay snooping:

```
switch#show ip dhcp-relay snooping binding
Hardware Address    IP Address    remainder time Type        VLAN    interface

a8-f7-e0-26-23-89 192.2.2.101     86400     DHCP_SN      3     FastEthernet0/3
```

The following shows all binding information about dhcp-relay snooping:

```
switch#show ip dhcp-relay snooping binding all
Hardware Address    IP Address    remainder time Type        VLAN    interface

a8-f7-e0-32-1c-59 192.2.2.1     infinite     MANUAL     1     FastEthernet0/2
a8-f7-e0-26-23-89 192.2.2.101     86400     DHCP_SN      3     FastEthernet0/3
```

The following shows the information about dhcp-relay snooping.

```
switch#debug ip DHCP-snooping packet
DHCPR:    receive l2 packet from vlan 3, diID: 3
DHCPR:    DHCP packet len 277
DHCPR:    add binding on interface FastEthernet0/3
DHCPR:    send packet continue
DHCPR:    receive l2 packet from vlan 3, diID: 1
DHCPR:    DHCP packet len 300
DHCPR:    send packet continue
DHCPR:    receive l2 packet from vlan 3, diID: 3
DHCPR:    DHCP packet len 289
DHCPR:    send packet continue
DHCPR:    receive l2 packet from vlan 3, diID: 1
DHCPR:    DHCP packet len 300
DHCPR:    update binding on interface FastEthernet0/3
DHCPR:    IP address:    192.2.2.101, lease time 86400 seconds
DHCPR:    send packet continue
```

35.1.1.14 Example of DHCP-Snooping Configuration

The network topology is shown in figure 1.

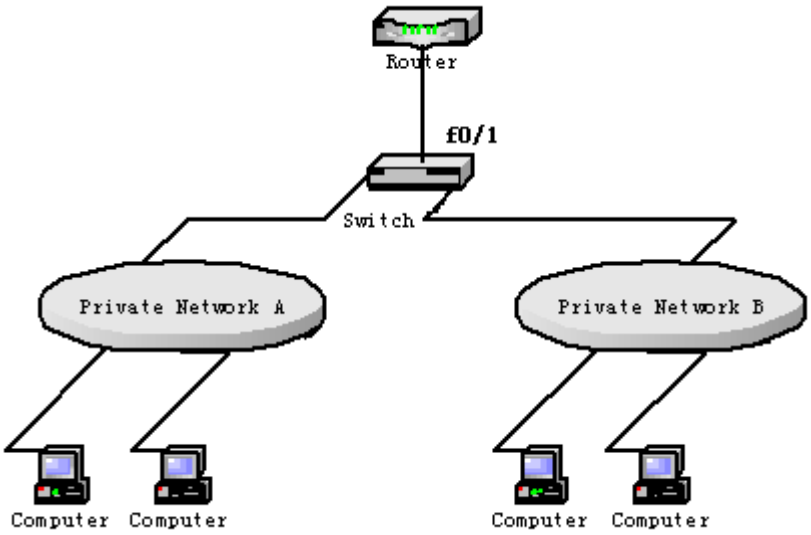


Figure 1 Configuring Switch

(1) Enable DHCP snooping in VLAN 1 which connects private network A.

Switch_config# ip dhcp-relay snooping

Switch_config#ip dhcp-relay snooping vlan 1

(2) Enable DHCP snooping in VLAN 2 which connects private network B.

Switch_config# ip dhcp-relay snooping

Switch_config# ip dhcp-relay snooping vlan 2

(3) Sets the interface which connects the DHCP server to a DHCP-trusting interface.

Switch_config_f0/1# dhcp snooping trust

36. MACFF Configuration

36.1 MACFF Settings

36.1.1 Configuration Tasks

MACFF is to isolate downlink ports of the same VLAN in a switch from exchanging inter-access packets, enabling these packets to be allocated to the default gateway of client through DHCP server and then to downlink ports. By capturing the ARP packets between downlink ports, MACFF can prevent downlink ports from learn ARPs; MACFF replies the gateway's MAC address, enabling all inter-access packets among all downlink ports to pass through the gateway.

MACFF needs the support of DHCPR-snooping, so before enabling MACFF you have to make sure that DHCPR-snooping works normally. ICMP redirection on the gateway is closed by default. The VLAN management address must be configured for MACFF-enabled switch.

- Enabling or Disabling MACFF
- Enabling MACFF in VLAN
- Configuring the Default AR of MACFF in VLAN
- Configuring other ARs of MACFF in VLAN
- Specifying a Physical Port to Shut down MACFF

36.1.1.1 Enabling/Disabling MVC

Run the following commands in global configuration mode.

Command	Purpose
macff enable	Enables MACFF.
no macff enable	Resumes the default settings.

This command is used to enable MACFF in global configuration mode.After this command is run, all ARP packets are listened by switch.

You have to make sure that DHCP-Snooping is enabled before configuring this command. If the client obtains the address of a switch before this command is run, the switch cannot add the corresponding binding relationship.

36.1.1.2 Enabling MACFF in VLAN

If MACFF is enabled in a VLAN, the DHCP packets which are received from all DHCP-snooping untrusted physical ports in a VLAN will be legally checked.

If the destination IP address is the IP address of any DHCP client, on which the physical port that receives the ARP packets is located, these ARP packets will be dropped; if these are ARP response packets, these packets will also be dropped.

The VLAN on which MACFF is enabled must be configured to have a management address. DHCP snooping shall also be enabled on this VLAN.

Run the following commands in global configuration mode.

Command	Purpose
macffvlan*vlan_id* **enable**	Enables MACFF in a VLAN.
no macffvlan*vlan_id* **enable**	Disables MACFF in a VLAN.

36.1.1.3 Configuring the Default AR of MACFF in VLAN

When you set the address on client manually, the switch shall automatically enables default AR as the MACFF-specified default gateway. There is only one default AR.

Run the following commands in global configuration mode.

Command	Purpose
macffvlan*vlan_id* **default-ar** *A.B.C.D*	Sets the default AR of MACFF in VLAN.
no macff vlan *vlan_id* default-ar *A.B.C.D*	Deletes the default AR of MACFF in VLAN.

Before configuring this command, you can run **ip source binding *xx-xx-xx-xx-xx-xxA.B.C.D* interface *name***to add the client binding table on the switch. If you do not do this, MACFF will regard the manually configured client as illegal client and MACFF will not serve this client.

36.1.1.4 Configuring Other ARs of MACFF in VLAN

After other ARs of MACFF are configured, MACFF allows DHCP client to access these ARs directly without forwarding packets via the default gateway allocated by DHCP server.
This function can be applied on some servers in the network segment of client or on other service addresses.
Run the following commands in global configuration mode.

Command	Purpose
macffvlan*vlan_id***other_ar** *A.B.C.D*	Configures other ARs of MACFF in VLAN.
no macffvlan*vlan_id* **other_ar** *A.B.C.D*	Deletes other ARs of MACFF in VLAN.

36.1.1.5 Specifying a Physical Port to Shut down MACFF

If you specify a physical port to close MACFF, packets on this port will not be isolated and ARP packets will not be listened.
Run the following commands in physical interface configuration mode.

Command	Operation
macff disable	Specifies a physical port to shut down MACFF.
no macff disable	Specifies a physical port to enable MACFF (it is enabled by default).

In default settings, the ports are allowed to enable MACFF.

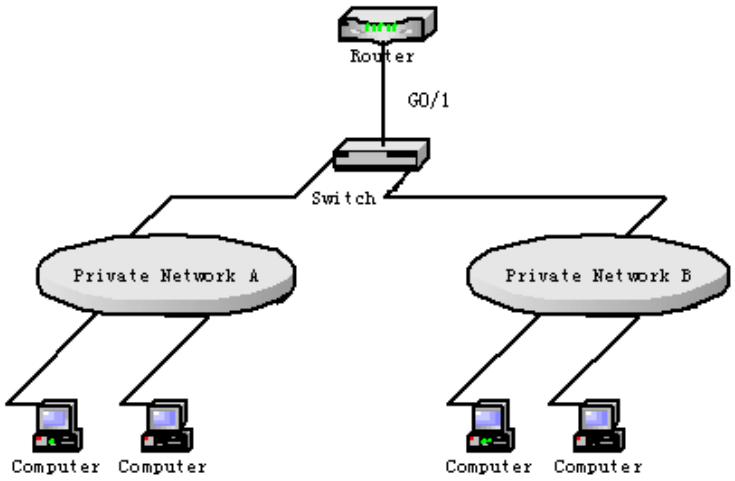
36.1.1.6 Opening MACFF Debugging

Run the following commands in global configuration mode.

Command	Operation
debug macff	Opens MACFF debugging.
no debug macff	Closes MACFF debugging.

36.1.1.7 MACFF Configuration Example

The network topology is shown in figure 1.



Switch configuration:

(1) Enable MACFF in VLAN1, which connects private network A. The default gateway allocated by DHCP server is 192.168.2.1.

Switch_config#arp 192.168.2.1 a8: f7: e0: 17: 92: ed

Switch_config#ip dhcp-relay snooping

Switch_config#ip dhcp-relay snooping vlan 1

Switch_config#macff enable

Switch_config#macff vlan 1 enable

(2) Enable MACFF in VLAN2, which connects private network B. The default gateway allocated by DHCP server is 192.168.2.2 (If necessary, the default gateway can also be 192.168.2.1).

Switch_config#arp 192.168.2.2 a8: f7: e0: ea: 74: ee

Switch_config#ip dhcp-relay snooping vlan 2

Switch_config#macff vlan 2 enable

(3) Sets the ports that connect DHCP server, default gateway and other ARs respectively to be trusted.

Switch_config_g0/1#dhcp snooping trust

(4) If the downlink host A of VLAN 1 is manually configured IP and default gateway, the IP address is 192.168.2.102 and the MAC address is a8-f7-e0-59-18-b7. The default gateway, 192.168.2.1, enables MACFF to take effect. (If the client is not configured manually, this step will not be performed)）

Switch_config#arp 192.168.2.1 a8: f7: e0: 17: 92: ed

Switch_config_g0/1#ip source binding a8-f7-e0-59-18-b7 192.168.2.102 interface GigaEthernet0/1

Switch_config_g0/1#macff vlan 1 default-ar 192.168.2.1

(5) Specify a physical port in MACFF-enabled VLAN to shut down MACFF.

Switch_config_g0/1#macff disable

(6) Configures other ARs that are in the same network segment of client. MACFF allows the client to perform direct access without the help of gateway. (the ports where other APs are should be set to trusted ports)

Switch_config_g0/1#macff disable

37. IEEE 1588 Transparent Clock Configuration

37.1 Task List for IEEE1588 Transparent Clock Configuration

- Enabling the Transparent Clock
- Creating the Transparent Clock Port
- Configuring the Link Delay Calculation Mode
- Configuring the Forwarding Mode of Sync Packets
- Configuring the Domain Filtration Function
- Setting the Transmission Interval of Pdelay_Req Packets

37.2Tasks for IEEE1588 Transparent Clock Configuration

37.3Enabling the Transparent Clock

The IEEE1588 transparent clock is an intermediate device to connect the master and slave clocks. The IEEE1588 transparent clock can effectively reduce time synchronization interference caused by switch's delay processing and ensure ns-level time synchronization by verifying the dwell time when sync packets pass through the transparent clock.

In global configuration mode, run the following command to enable the transparent clock:

Command	Purpose
ptp enable	Enables the PTP transparent clock.

In global configuration mode, run the following command to shut down the transparent clock and delete all already added PTP ports:

Command	Purpose
noptp enable	Closes the PTP transparent clock.

The IEEE1588 clock synchronization protocol is independent from the underneath level protocols. It is based on either Ethernet or IPv4/UDP. To enable the transparent clock to transmit and receive IPv4- or UDP-based packets, you have to enable PTP in L3 port mode.

Run the following command in L3 port mode to enable PTP:

Command	Purpose
ptp enable	Enables the PTP transparent clock.

37.3.1 Creating the Transparent Clock Port

The transparent clock can include multiple PTP ports to connect the master and slave clock respectively. Run the following commands in port configuration mode to create the PTP ports:

Command	Purpose
ptp start l2	Creates the PTP L2 port.
Ptp start l3	Creates the PTP L3 port.

Run the following command in port configuration mode to delete the PTP ports:

Command	Purpose
no ptp start	Delete the PTP port.

37.3.2 Configuring the Link Delay Calculation Mode

The PTP transparent clock supports two link delay modes (E2E and P2P) to help the master and slave clocks switch between the two modes, among which P2P is the default mode. In E2E mode, TC can process **Delay_Req,Delay_Resp** packets; In P2P mode, the path-delay mechanism is running on each PTP port, the Pdelay_Req packets are transmitted periodically, and the **Pdelay_Resp** and **Pdelay_Resp_Folllow_Up** packets are responded to. The two modes are incompatible with each other. For example, if it is in P2P mode, the **Delay_Req** packets received from the clock will be dropped.
Run the following command in global configuration mode to configure an authentication mode:

Command	Purpose
ptp delay-mechanism e2e	Sets TC to work in E2E mode.

To configure the authentication mode, you also can run the following command in interface configuration mode:

Command	Purpose
ptp delay-mechanism p2p	Sets TC to work in P2P mode.

37.3.3 Configuring the Forwarding Mode of Sync Packets

There are two ways to forward Sync packets: straight forwarding and store-forward.
In straight forwarding mode, the PTP port immediately forwards after receiving Sync packets, re-encapsulates the Follow_UP packets after receiving them and then forwards them out from the corresponding port.
In store-forward mode, the PTP port shall not forward Sync packets after receiving them but store them first, receive corresponding Follow_up packets and then forward the two kinds of packets together.
The straight forwarding mode is the default one. In this mode, the time to handle Sync packets is apparently less than the time to handle Follow_up packets and hence in case of multi-level TC cascading the risk of packet disorder arises. That's why the store-forward mode is recommended in case of multi-level TC cascading. However, in normal cases, we recommend the straight forwarding mode for it can lessen the residence time of Sync packets at the maximum level and reduce its impact on time synchronization.
Run the following command in global configuration mode to configure an authentication mode:

Command	Purpose
ptp sync-mechanism store-forward	Sets the forwarding method of **Sync** packets to **store-forward**.

To switch the forwarding mode over to straight forwarding, run the following command in global configuration mode:

Command	Purpose
ptp sync-mechanism straight-forward	Sets the forwarding method of **Sync** packets to **store-forward**.

37.3.4 Configuring the Domain Filtration Function

PTP devices can be classified through their domains for only PTP clocks in the same domain can exchange PTP synchronization packets and PTP devices in different domains cannot conduct time synchronization.
After the domain filtration function is enabled, the PTP packets in other domains are dropped; if domain filtration is disabled, TC will not conduct the domain checkup.
Before domain filtration, you have to set the domain in which the PTP port is located. Run the following command in port mode:

Command	Purpose
ptp domain *number*	Sets the domain to which the PTP port belongs. The default domain of this port is domain0.

To configure the authentication mode, you also can run the following command in interface configuration mode:

Command	Purpose
ptp domain-filter	Enables domain filtration, which is enabled by default.

Run the following command in global mode to shut down domain filtration:

Command	Purpose
no ptp domain-filter	Closes domain filtration.

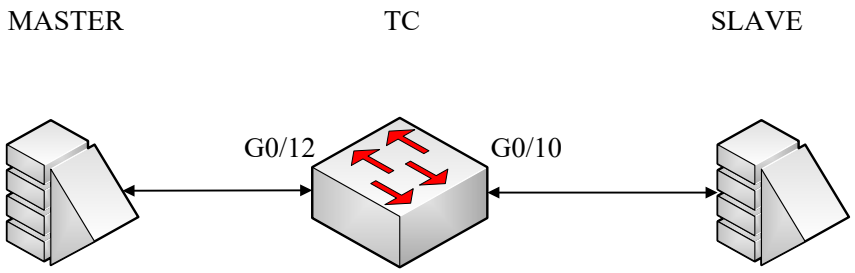
37.3.5 Setting the Transmission Interval of Pdelay_Req Packets

During the path-delay process, you can set the transmission interval of Pdelay_Req packets.
Run the following command to configure the transmission frequency.

Command	Purpose
ptp pdelay-interval *time*	**time** stands for the transmission interval, which ranges from -4 to 4. The actual transmission interval is *time* powers of 2. For example, if time is 0, the actual transmission interval is 1 second.

37.4PTP TC Configuration Example

See the following figure:



MASTER here stands for the master clock, which is a L2 PTP device. **SLAVE** here stands for the master clock, which is a L3 PTP device. TC stands for a switch that supports transparent clock. The master clock connects port g0/12 of the switch, while the slave clock connects port g0/10 of the switch. MASTER, TC and SLAVE are all working in P2P mode. Ports g0/10 and G0/12 belong to VLAN1.

Global configuration

ptp enable

ptp delay-mechanism p2p

Configuration of L3 port

Ip add 192.168.0.2 255.0.0.0

ptp enable

Configuration of port g0/10

ptp start l2

Configuration of port g0/12

ptp start l3

38. Layer 2 Tunnel Protocol Configuration

38.1 Configuring Layer-2 Protocol Tunnel

38.1.1 Introduction

Layer-2 protocol tunnel allows users between two sides of the switch to transmit the specified layer 2 protocol on their own network without being influenced by the relevant layer 2 software module of the switch. The switch is a transparent media for users.

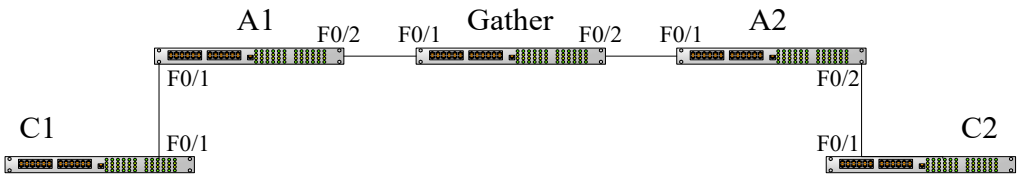
38.1.2 Configuring Layer-2 Protocol Tunnel

Use the command line on the interface of the switch to configure tunnel function of the layer 2 protocol. The configuration steps are as follows:

Command	Description
configure	Enters global configuration mode.
interface *<intf_name>*	Enters interface configuration mode of the switch. Only the switch port supports layer 2 protocol tunnel (including physical port and aggregation port).
[no] l2protocol-tunnel *[stp]*	Enables layer 2 protocol of the tunnel function. Currently we only support tunnel function of stp protocol.
[CTRL] + Z	Returns to EXEC mode.
write	Saves configuration.

38.1.3 Configuration Example of Layer 2 Protocol Tunnel

Network environment is as follows:



A1/A2/Gather belong to core network, C1/C2 are switches distributed in two places. Customer wants to combine two of its network to one , that is, the core network is a transparent transmission channel for the customer. If user wants to realize the transparent transmission of STP, then the following configurations should be configured on each switch:

(1) The f0/2 of Switch A1, f0/1 and f0/2 of Gather, f0/1 of A2 should be configured to trunk mode.

(2) The f0/1 of switch A1, f0/2 of A2 should be configured to Access, and enables tunnel function of the STP protocol.

39. Loopback Detection Configuration

39.1 Setting Loopback Detection

39.1.1 Introduction of Loopback Detection

The loopback in a network may trigger the repeated transmission of broadcast, multicast or unicast packets, wasting network resources and even leaving network breakdown. To avoid the above-mentioned troubles, it is necessary to provide a detection mechanism to promptly notify users of detecting network connection and configuration at the occurrence of loopback and to take troubled ports under control. Loopback detection can check whether loopback happens on a port of a to-be-tested device by transmitting a detection packet from this port and checking whether this packet can be received still on this port. When the device finds that loopback exists on its port, it can transmit alarm promptly to the network management system for administrators to detect network problems in time; thus, long time of network disconnection can be prevented. Moreover, loopback detection is capable of having ports under control. You can opt for port block, port MAC-learning forbidding or error-disable according to actual requirements to make corresponding ports under control and lessen the loopback's network influence to the minimum level.

The managed switches support loopback detection in the following aspects:

- Supporting to set loopback detection on the port
- Supporting to set the destination MAC address for loopback detection packets
- Supporting to conduct loopback detection to at most 10 specified ports
- Supporting to set the transmission interval of loopback detection packets and the recovery time of controlled port
- Supporting to control port, including port block, port MAC-learn forbidding, and error-disable
- Supporting to set whether loopback exists on a port by default

39.1.1.1 Format of Loopback Detection Packet

Field	Length/Byte	Value
DMAC	6	0x0180C2B0000A (default value, configurable)
SMAC	6	MAC address of the switch
TPID	2	0x8100, VLAN tag type
TCI	2	Specific value of the VLAN tag, priority, VLAN ID
TYPE	2	Protocol type, which ranges from 0 to 9001
CODE	2	Protocol sub-type, which represents loopback detection and is 0x0001
VERSION	2	0x0000 (currently reserved)
Length	2	0x0008, length of the header of loopback detection packet
RESERVE	2	Reserved field
SYSMAC	6	MAC address of the switch
SEQUENCE	4	Sequence ID of packet, which is generated randomly by the system before the packet is transmitted
DiID	4	Port ID, which is the ID of the global port of 85 Series
End	2	0x0000, end character

39.1.2 Loopback Detection Configuration Tasks

- Configuring Loopback Detection Globally
- Configuring Port Loopback Detection
- Setting a Port to Perform Loopback Detection toward Specified VLAN
- Configuring the Loopback Detection Interval on a Port
- Setting a Port under Control
- Setting Loopback to Exist on a Port by Default
- Displaying the Configuration of Global Loopback Detection
- Displaying the Information about the Loopback Detection Port

39.1.3 Setting Loopback Detection

39.1.3.1 Configuring Loopback Detection Globally

Enabling or disabling loopback detection globally means enabling or disabling loopback detection on all physical ports. Global configuration is just like a switch. Only when this switch is opened can enabled loopback detection on a port take effect.

Command	Purpose
[no] loopback-detection	Sets loopback detection globally.

39.1.3.2 Configuring Port Loop Check

If you want to enable or disable loopback detection on a specified port, you should first enable loopback detection globally.

Command	Purpose
[no] loopback-detection enable	Configures port loopback detection.

39.1.3.3 Configuring a Port to Conduct Loopback Detection in Specified VLAN

If you set loopback detection in a specified VLAN, a port shall transmit multiple detection packets with specified VLAN tag regularly and the port can transmit up to 10 detection packets with specified VLAN tag. One point to be noted is that the port must exist in the specified VLAN, or the configuration takes no effect. If loopback detection happens in VLAN2 to VLAN8, ports are configured to be in trunk mode, and trunk vlan-allowed is vlans 5-8, the packets with tags 2-4 transmitted by the switch cannot pass through this port and the configuration hence takes no effect.

Command	Purpose
[no] loopback-detection vlan-control *vlanlist*	Configures a port to conduct loopback detection in specified VLAN.

39.1.3.4 Configuring the Loopback Detection Interval of Port (Packet transmission interval, controlled port recovery time)

Command	Purpose
[no] loopback-detection hello-time *time*	Configures the transmission interval of port loopback detection packets.

Because a network is always changeable, loopback detection is a continuous process. The port will transmit loopback detection packets in a regular time. This regular time is called as the transmission interval of loopback detection packets. The default transmission interval of the system is 3 seconds.

Command	Purpose
[no] loopback-detection recovery-time *time*	Configures the transmission interval of port loopback detection packets.

This command above is used to set the automatic recovery time of a port when loopback disappears. In default settings, if a port has not received the already transmitted loopback detection packet within 10 seconds, it is regarded that loopback vanishes. It is recommended to set the recovery time to be triple of the packet transmission time; if the transmission time is set to be a very small value, you'd better set the recovery time to be at least 10 seconds longer than the transmission time.

39.1.3.5 Configuring Port Control

Command	Purpose
[no] loopback-detection control {block|learning|shutdown}	Configures port control.

When a port detects that loopback exists in its network, you can set port control to manage this port. The control state of a port can be **block**, **nolearn**, **shutdown** or **trap**. When any control state is set and loopback exists on a port, the trap alarm message will be transmitted. It is not configured by default.
When loopback detection is enabled globally, a loopback detection packet is transmitted from a port, on which loopback detection is enabled, and received again by this port, the port may get the following four control actions:
Block: When loopback is found, this port is then isolated from other ports. Hence the packets entering this port cannot be forwarded to other ports. The port is then in protocol down state and its MAC address table list ages.

Nolearn: means to forbid the port to learn MAC addresses. When loopback is detected, the port will not conduct MAC address learning any more and at the same time the MAC address table of this port ages.
shutdown: Means to close the port. When loopback is detected, except that trap message will be transmitted and the port's MAC address table ages, the port will be automatically closed and it cannot forward packets any more until the err-disable-recover time.
Trap: It means that the port only reports alarm. When loopback is detected, the port only reports alarm and ages its MAC address table without any further action.
When the port is in block state, it cannot forward incoming packets and at the same time it transmits loopback detection packets continuously. When loopback disappears, the port will recover automatically. In default settings, if a port has not received the already transmitted loopback detection packet within 10 seconds, it is regarded that loopback vanishes.
In block state, the port protocol is down; in shutdown state, the port's link is down directly.

39.1.3.6 Configuring the Destination MAC Address of Loopback Detection Packet

Command	Purpose
[no] loopback-detection dest-mac *Mac-address*	Configures the destination MAC address of loopback detection packet.

The default destination MAC address of loopback detection packet is **01-80-C2-00-00-0a**. If you have set other destination MAC, it will be used as the destination MAC address of loopback detection packet.

39.1.3.7 Configuring Loopback to Exist on a Port by Default

Command	Purpose
[no] loopback-detection existence	Configures loopback to exist on a port by default.

When a port is up and port loopback detection takes effect, the command above is used to set whether loopback exists on this port. When a port is in shutdown state, this port is not suitable to set to have loopback, for the port in shutdown state cannot forward packets. The default settings is that loopback does not exist in a port.

39.1.3.8 Displaying the Configuration of Global Loopback Detection

Command	Purpose
show loopback-detection	Displays the configuration of global loopback detection.

This command is used to display the information about global loopback detection configuration, including global configuration, whether loopback exists on each port, and some ports' configurations.

39.1.3.9 Displaying the Configuration of Port Loopback Detection

Command	Purpose
show loopback-detection interface *intf*	Displays the configuration of port loopback detection.

This command is mainly used to display port loopback detection, including the port timer and the information about transmitted and received packets.

39.1.4 Configuration Example

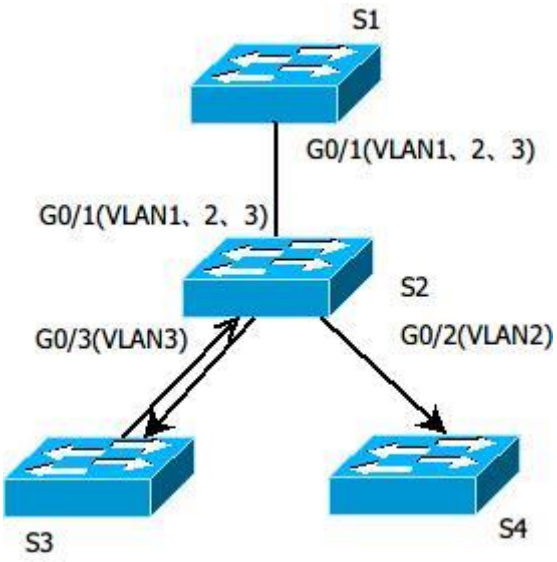


Figure 1.1 Loopback detection configuration

As shown in figure 1.1, the port of S1 conducts loopback detection to specified VLANs 1, 2 and 3. The corresponding configurations on all switches are shown below:

Switch S1:
Configuration of interface GigaEthernet0/1:
switchport trunk vlan-untagged 1-3
switchport mode trunk
loopback-detection enable
loopback-detection control block
loopback-detection vlan-control 1-5
Global Configuration
loopback-detection
vlan 1-3

Switch S2:
Configuration of interface GigaEthernet0/1:
switchport mode trunk
Configuration of interface GigaEthernet0/2:
switchport mode trunk
Configuration of interface GigaEthernet0/3:
switchport mode trunk
Global Configuration
vlan1-3

Switch S3:
Configuration of interface GigaEthernet0/1:
switchport pvid 3

If loopback exists in the network that S3 connects and the PVID of the interface, on which loopback exists, is 3, the packets will be transmitted to interface g0/1 of S1 and S1 will block interface g0/1 after finding loopback.

40. QoS Configuration

If you care to use your bandwidth and your network resources efficiently, you must pay attention to QoS configuration.

40.1 QoS Configuration

40.1.1 QoS Overview

40.1.1.1 40.1.1.1 QoS Concept

In general, the switch works in best-effort served mode in which the switch treats all flows equally and tries its best to deliver all flows. Thus if congestion occurs all flows have the same chance to be discarded. However in a real network different flows have different significances, and the QoS function of the switch can provide different services to different flows based on their own significances, in which the important flows will receive a better service.

As to classify the importance of flows, there are two main ways on the current network:

- The tag in the 802.1Q frame header has two bytes and 3 bits are used to present the priority of the packet. There are 8 priorities, among which 0 means the lowest priority and 7 means the highest priority.
- The DSCP field in IP header of the IP packet uses the bottom 6 bits in the TOS domain of the IP header.

In real network application the edge switch distributes different priorities to different flows based on their significance and then different services will be provided to different flows based on their priorities, which is the way to realize the terminal-to-terminal QoS.

Additionally, you can also configure a switch in a network, enabling the switch to process those packets with specific attributes (according to the MAC layer or the L3 information of packets) specially. This kind of behaviors are called as the one-leap behaviors.
The QoS function of the switch optimizes the usage of limited network bandwidth so that the entire performance of the network is greatly improved.

40.1.1.2 Terminal-To-Terminal QoS Model

The service model describes a group of terminal-to-terminal QoS abilities, that is, the abilities for a network to transmit specific network communication services from one terminal to another terminal. The QoS software supports two kinds of service models: Best-Effort service and Differentiated service.

1. Best-effort service

The best-effort service is a singular service model. In this service model, an application can send any amount of data at any necessary time without application of permits or network notification. As to the best-effort service, if allowed, the network can transmit data without any guarantee of reliability, delay or throughput. The QoS of the switch on which the best-effort service is realized is in nature this kind of service, that is, first come and first served (FCFS).

2. Differentiated service

As to the differentiated service, if a special service is to be transmitted in a network, each packet should be specified with a corresponding QoS tag. The switch uses this QoS rule to conduct classification and complete the intelligent queuing. The QoS of the switch provides Strict Priority (SP), Weighted Round Robin (WRR), Deficit Round Robin (DRR) and First-Come-First-Served (FCFS).

40.1.1.3 Queue Algorithm of QoS

Each queue algorithm is the important basis to realize QoS. The QoS of the switch provides the following algorithms: Strict Priority (SP), Weighted Round Robin (WRR), Deficit Round Robin (DRR) and First-Come-First-Served (FCFS).

1. Strict priority

This algorithm means to first provide service to the flow with the highest priority and after the highest-priority flow comes the service for the next-to-highest flow. This algorithm provides a comparatively good service to those flows with relatively high priority, but its shortage is also explicit that the flows with low priority cannot get service and wait to die.

2. Weighted round robin

Weighted Round Robin (WRR) is an effective solution to the defect of Strict Priority (SP), in which the low-priority queues always die out. WRR is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority. After the queue with highest priority has used up all its bandwidth, the system automatically provides service to those queues with next highest priority.

3. Weighted Fair Queuing

Weighted Round Robin (WRR) is an effective solution to the defect of Strict Priority (SP), in which the low-priority queues always die out. WRR is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority. After the queue with highest priority has used up all its bandwidth, the system automatically provides service to those queues with next highest priority.

4. First come first served

The First-Come-First-Served queue algorithm, which is shortened as FCFS, provides service to those packets according to their sequence of arriving at a switch, and the packet that first arrives at the switch will be served first.

40.1.1.4 Weighted Random Early Detection

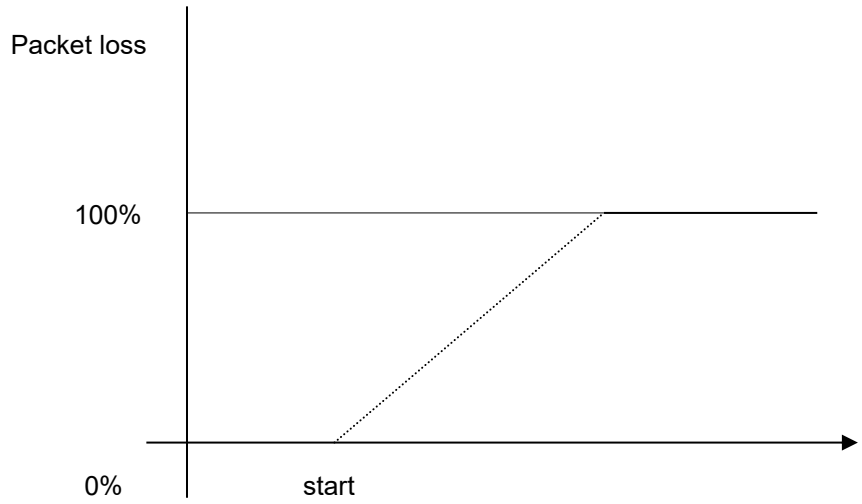
Congestion avoidance and traditional packet loss mechanism

Excessive congestion may inflict damage on network resources, so network congestion should be resolved through some measures. Congestion avoidance is a sort of flow control method of positively dropping packets and regulating network flows to solve network overload via network resource monitoring. The traditional way of resolving network congestion is to drop all incoming packets when the queue length reaches its threshold. But for TCP packets, heavy packet loss may cause TCP timeout and lead to slow TCP startup and congestion avoidance, which is called as TCP global synchronization.

WRED

The WRED algorithm is adopted to prevent TCP global synchronization. WRED helps users to set the queue threshold. When the queue length is less than the configured threshold, the packets will not be dropped; otherwise, the packets will be dropped randomly. Because WRED drops packets randomly, it is avoided for multiple TCP connections to slow down the transmission speed at the same time, which is the reason why TCP global synchronization is avoided. WRED enables other TCP connections to maintain a relatively high transmission speed when the packets of a certain TCP connection begin to be dropped and their transmission speed is slowed down. No matter what time it is, there are always some TCP connections to transmit packets with a high speed, which ensures effective bandwidth usability.

WRED cooperation is conducted when packets enter the outgoing queue and are checked for their size and packets in different ranges get different treatments. The key parameters include **Start**, **Slop** and **Drop priority**.



- When the queue length is less than start, packets will not be dropped.
- When the queue length is bigger than start, the incoming packets begin to be dropped randomly.The longer the queue is, the higher the dropping rate is.
- The rate for packet loss rises along with the increase of the queue length.

40.1.2 QoS Configuration Task List

In general, ONU will try its best to deliver each packet and when congestion occurs all packets have the same chance to be discarded. However, in reality different packets have different importance and the comparatively important packets should get the comparatively good service. QoS is a mechanism to provide different priority services to packets with different importance, in which the network can have its better performance and be used efficiently.

This chapter presents how to set QoS on ONU.

The following are QoS configuration tasks:

- Setting the Global CoS Priority Queue
- Setting the Bandwidth of the CoS Priority Queue
- Setting the Schedule Policy of the CoS Priority Queue
- Setting the Default CoS Value of a Port
- Setting the CoS Priority Queue of a Port
- Setting the CoS Priority Queue of a Port
- Establishing the QoS Policy Mapping
- Setting the Description of the QoS Policy Mapping
- Setting the Matchup Data Flow of the QoS Policy Mapping
- Setting the Actions of the Matchup Data Flow of the QoS Policy Mapping
- Applying the QoS Policy on a Port
- Displaying the QoS Policy Mapping Table

40.1.3 QoS Configuration Tasks

40.1.3.1 Setting the Global CoS Priority Queue

The task to set the QoS priority queue is to map 8 CoS values, which are defined by IEEE802.1p, to the priority queues in a switch. This series of switch has 8 priority queues. According to different queues, the switch will take different schedule policies to realize QoS.

If a CoS priority queue is set in global mode, the mapping of CoS priority queue on all ports will be affected. When priority queues are set on a L2 port, the priority queues can only work on this L2 port.

Enter the following privileged mode and run the following commands one by one to set DSCP mapping.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **cos map** *quid cos1..cosn*	Sets the CoS priority queue. **quid** stands for the ID of a CoS priority queue. **cos1…cosn** stands for the IEEE802.1p-defined CoS value.
exit	Goes back to the EXEC mode.
write	Saves the settings.

40.1.3.2 Setting the Bandwidth of the CoS Priority Queue

The bandwidth of priority queue means the bandwidth distribution ratio of each priority queue, which is set when the schedule policy of the CoS priority queue is set to WRR/DRR. This series of switches has 8 priority queues in total.

If this command is run, the bandwidth of all priority queues on all interfaces are affected. This command validates only when the queue schedule policy is set to WRR or DRR. This command decides the bandwidth weight of the CoS priority queue when the WRR/DRR schedule policy is used.

Run the following commands one by one to set the bandwidth of the CoS priority queue.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **scheduler weight bandwidth***weight1...weightn*	Sets the bandwidth of the CoS priority queue.. **weight1…weightn** stand for the weights of 8 CoS priority queues of WRR/DRR.
exit	Goes back to the EXEC mode.
write	Saves the settings.

40.1.3.3 Setting the Schedule Policy of the CoS Priority Queue

A switch has many output queues on each of its port. This series of switches has 8 priority queues. The output queues can adopt the following three schedule modes:

- SP (Sheer Priority): In this algorithm, only when the high-priority queue is null can the packets in the low-priority queue be forwarded, and if there are packets in the high-priority queue these packets will be unconditionally forwarded.
- In this mode, the bandwidth of each queue is distributed with a certain weight and then bandwidth distribution is conducted according to the weight of each queue. The bandwidth in this mode takes byte as its unit.
- The First-Come-First-Served queue algorithm, which is shortened as FCFS, provides service to those packets according to their sequence of arriving at a switch, and the packet that first arrives at the switch will be served first.

Enter the following configuration mode and set the schedule policy of CoS priority queue.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **scheduler policy** { **sp** | **wrr|wfq|fcfs** }	Sets the schedule policy of the CoS priority queue. **sp** means to use the SP schedule policy. **Wrr** means to use the WRR schedule policy. **Fcfs** to use the FCFS schedule policy. **drr** means to use the DRR schedule policy.
exit	Goes back to the EXEC mode.
write	Saves the settings.

40.1.3.4 Configuring the Minimum and Maximum Bandwidths of CoS Priority Queue

The minimum and maximum bandwidths of CoS priority queue can be modified through configuration. All the flows with a bandwidth less than the configured minimum bandwidth shall not be dropped, but the flows with a bandwidth bigger than the configured maximum bandwidth shall all be dropped.

Enter the privileged mode.

Command	Purpose
config	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **cos bandwidth** *quid*	**quid** stands for the priority queue.

min-bandwidth max-bandwidth	**min-bandwidth** means the minimum bandwidth. **max-bandwidth** means the maximum bandwidth.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

40.1.3.5 Configuring Weighted Random Early Detection

Enters the privileged mode.

Command	Purpose
config	Enters the global configuration mode.
scheduler wred [queue *quid* **{drop-level** *drop-level* **| low-limit** *limit-percent* **| slope** *slope***}]** **no scheduler wred [queue** *quid***]**	Sets WRED. quid stands for the queue. drop-level stands for the packet dropping level. limit-percent stands for the starting percent. Slop stands for the packet dropping trend.
exit	Goes back to the EXEC mode.
write	Saves the settings.

40.1.3.6 Setting the Default CoS Value of a Port

If the port of a switch receives a data frame without tag, the switch will add a default CoS priority to it. Setting the default CoS value of a port is to set the untagged default CoS value, which is received by the port, to a designated value.

Enter the privilege mode and run the following commands to set the default CoS value of a port:

Command	Purpose
config	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[no] cos default cos	Sets the CoS value of the received untagged frames. **cos** stands for the corresponding CoS value.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

40.1.3.7 Setting the CoS Priority Queue of a Port

When a priority queue is set on a L2 port, the priority queue will be used by the L2 port; otherwise, you should conduct the configuration of a global CoS priority queue.

Enter the privilege mode and run the following commands to set the default CoS value of a port:

Command	Purpose
config	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **cos map** *quid cos1..cosn*	Sets the CoS priority queue. **quid** stands for the ID of a CoS priority queue. **cos1…cosn** stands for the IEEE802.1p-defined CoS value.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.8 Setting the CoS Priority Queue of a Port

Based on the DSCP value, the COS queue is mapped again, the DSCP value is modified and the congestion bit is changed.

Enter the privilege mode and run the following commands to set the default CoS value of a port:

Command	Purpose
config	Enters the global configuration mode.
[**no**]**dscp map** *word* {**dscp***dscp-value* | **cos***cos-value* | **cng***cng-bit* }	**word** stands for the DSCP range table. **dscp-value** means to set the mapped DSCP value. **cos-value** means to set the mapped priority CoS. **Cng-bit** means the mapped congestion bit.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.9 Establishing the QoS Policy Mapping

Flow classification means to identify a class of packets with certain attributes by applying a certain regulation and take designated actions towards to these packets.

Enter the privileged mode and then run the following commands to establish a new QoS policy mapping.

Command	Purpose
config	Enters the global configuration mode.
[no]policy-map*name*	Enters the configuration mode of the QoS policy map. **name** stands for the name of the policy.
exit	Exits from the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.10 Setting the Description of the QoS Policy Mapping

Enter the privileged mode and run the following commands to set the description of a QoS policy mapping. This setting will replace the previous settings.

Command	Purpose
config	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. **name** stands for the name of the policy.
description description-text	Sets the description of the QoS policy. **description-text** stands for the text to describe the policy.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.11 Setting the Matchup Data Flow of the QoS Policy Mapping

The classification rule of the QoS data flow means the filtration rule configured by the administrator according to management requirements. It can be simple, for example, flows with different priorities can be identified by the ToS field of the IP packet's header, or complicated, for example, the packets can be classified according to the related information about the comprehensive link layer, the network layer and the transmission layer, such as the MAC address, the source address of IP, the destination address or the port ID of the application. In general, the classification standard is limited in the header of an encapsulated packet. It is rare to use the content of a packet as the classification standard.

Enter the policy configuration mode, set the match-up data flow of policy and replace the previous settings with this data flow according to the following steps:

Command	Purpose
config	Enters the global configuration mode.
[no]policy-map name	Enters the configuration mode of the QoS policy map. **name** stands for the name of the policy.
description description-text	Sets the description of the QoS policy. **description-text** stands for the text to describe the policy.
classify {**any** | **cos** *cos* | **icos***icos* | **vlan***vlanid* | **ivlan***ivlanid* | **ethernet-type***ethernet-type* | **precedence***precedence-value* | **dscp***dscp-value* | **tos***tos-value* | **diffserv***diffserv-value* | **ip***ip-access-list* | **ipv6** *ipv6-access-list* | **mac***mac-access-list* } **no classify** { **cos** | **icos** | **vlan** | **ivlan** | **ethernet-type** | **precedence** | **dscp** | **tos** | **diffserv** | **ip** | **ipv6**| **mac** }	Matches up with any packet. Configures the matched COS value which ranges between 0 and 7. **icos** stands for the matched inner COS value which ranges between 0 and 7. **vlanid** stands for the matched VLAN, which ranges from 1 to 4094. **ivlanid** stands for the matched inner VLAN, which ranges from 1 to 4094. **ethernet-type** stands for the matched packet type, which is between 0x0600 and 0xFFFF. **precedence-value** stands for the priority field in tos of IP packet, which ranges from 0 to 7. **dscp-value** stands for the dscp field in tos of IP packet, which ranges from 0 to 63. **tos-value** stands for latency, throughput, reliability and cost fields in tos of IP packet, which ranges from 0 to 15.

	diffserv-value stands for the entire tos field. **Ip-access-list** stands for the name of the matched IP access list. The name has 1 to 20 characters. **Ipv6-access-list** stands for the name of the matched IPv6 access list. The name has 1 to 20 characters. Configures the name of the matched MAC access list. The name has 1 to -20 characters.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.12 Setting the Actions of the Match-up Data Flow of the QoS Policy Mapping

The actions to define the data flow mean to take corresponding actions to a data flow with compliance of the filtration rule, which include bandwidth limit, drop, update, etc.

Enter the privileged mode and run the following commands to set the action of a policy, matching up the data flow. The action will replace the previous settings.

Command	Purpose
config	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. **name** stands for the name of the policy.
action{**bandwidth** *max-band* **|** {**cir** *commit-band* {**bc** *commit-burst-size*{**be** *peak-burst-size* **|** **pir** *pir-band* }} **|** **[conform** {**forward | dscp***dscp-value*} **|exceed** {**forward | drop | dscp** *dscp-value* **| discardable** {**green | yellow | red**}} **|violate**{**forward | drop | dscp** *dscp-value* **| discardable** {**green | yellow | red**}}**]**} **| cos** *cos* **| drop | dscp** *dscp-value* **| precedence** *precedence-value* **| forward | icos**	**max-band** stands for the occupied maximum bandwidth. Sets the policing: **cir commit-band** stands for the certified bandwidth. **bc commit-burst-size** stands for the size of burst packet, which ranges from 4 to 4096Kb. **be peak-burst-size** stands for the size of peak burst, which ranges from 4 to 4096Kb. **pir pir-band** stands for the peak bandwidth, which ranges from 1 to 163840. **conform {forward | dscp dscp-value}** stands

icos **| ivlan** {**add** *ivlanid* **| del** *ivlanid* **|** *ivlanid*}**| cpicos | mac** *mac-addr* **| monitor** *session-value* **| queue** *queue-value* **| redirect** *interface-id***| stat-packet | stat-byte | vlanID** { **add** *vlanid* | *vlanid* }} **no action** {**bandwidth | cir | cos | drop | dscp | precedence | forward | icos | ivlan | cpicos | mac | monitor | queue | redirect | stat-packet | stat-byte | vlanID**}	for a bandwidth guarantee action, among which **forward** means not to conduct any action and **dscp** means to change the dscp value. **drop** means to drop the matched packets. Sets the matched DSCP field to ***dscp-value*** **0~63**. **precedence-value** stands for the priority field of tos in ip packet.0-7. Conducts no operations to the matched packets. Sets the matched COS field to cos-value 0-7. **ivlanid** is used to replace, add or delete the inner VLAN ID. **cpicos** means to replace the outer cos with inner cos. **mac-addr** is used to set the destination MAC address. **session-value** is used to set mirroring, which ranges from 1 to 4. **queue-value** is used to set the mapping queue, which ranges from 1 to 8. Redirects the egress port of the matched flow. **stat-packet** stands for the number of packets under statistics. **stat-byte** means the number of bytes under statistics. **vlanID** is used to replace or add the outer vlan ID, which ranges from 1 to 4094.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.13 pplying the QoS Policy on a Port

The QoS policy can be applied to a port; multiple QoS policies can be applied to the same port and the same QoS policy can also be applied to multiple ports. On the same port, the priorities of the policies which are earlier applied than those of the policies which are later applied. If a packet is set to have two policies and the actions are contradicted, the actions of the firstly matched policies. After a QoS policy is applied on a port, the switch adds a policy to this port by default to block other data flows, which are not allowed to pass through. When all policies on a port are deleted, the switch will automatically remove the default blockage policy from a port.

Enter the following privileged mode and run the following commands to apply the QoS policy.

Command	Purpose
config	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **qos policy** *name* { **ingress**|**egress**}	Applies the QoS policy on a port. **name** stands for the name of QoS policy mapping. ***ingress*** means to exert an influence on the ingress. *egress* means to exert an influence on the egress.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

40.1.3.14 Displaying the QoS Policy Mapping Table

You can run the **show** command to display all or some designated QoS policy maps.

Run the following command in privileged mode to display the QoS policy mapping table.

Command	Purpose
show policy-map [*policy-map-name*]	Displays all or some designated QoS policy maps. **policy-map-name** stands for the name of QoS mapping table.

40.1.4 QoS Configuration Example

40.1.4.1 Example for Applying the QoS Policy on a Port

The following example shows how to set packet's cos to 2 on port g0/2:

```
ip access-list extended ipacl
permit ip 192.168.20.2 255.255.255.255 192.168.20.210 255.255.255.255
!
policy-map pmap
classify ip ipacl
action cos 2
!
interface g0/2
qos policy pmap ingress
!
```

41. DoS Attack Prevention Configuration

41.1 DoS Attack Prevention Configuration

41.1.1 DoS Attack Overview

41.1.1.1 Concept of DoS Attack

The DoS attack is also called the service rejection attack. Common DoS attacks include network bandwidth attacks and connectivity attacks. DoS attack is a frequent network attack mode triggered by hackers. Its ultimate purpose is to break down networks to stop providing legal users with normal network services.
DoS attack prevention requires a switch to provide many attack prevention methods to stop such attacks as Pingflood, SYNflood, Landattack, Teardrop, and illegal-flags-contained TCP. When a switch is under attack, it needs to judge which attack type it is and handles these attack packets specially, for example, sending them to CPU and drop them.

41.1.1.2 DoS Attack Type

Hackers will make different types of DoS attack packets to attack the servers. The following are common DoS attack packets:

41.1.1.3 Ping of Death

Ping of Death is the abnormal Ping packet, which claims its size exceeds the ICMP threshold and causes the breakdown of the TCP/IP stack and finally the breakdown of the receiving host.

41.1.1.4 TearDrop

TearDrop uses the information, which is contained in the packet header in the trusted IP fragment in the TCP/IP stack, to realize the attack. IP fragment contains the information that indicates which part of the original packet is contained, and some TCP/IP stacks will break down when they receive the fake fragment that contains the overlapping offset.

41.1.1.5 SYN Flood

A standard TCP connection needs to experience three hand-shake processes. A client sends the SYN message to a server, the server returns the SYN-ACK message, and the client sends the ACK message to the server after receiving the SYN-ACK message. In this way, a TCP connection is established. SYN flood triggers the DoS attack when the TCP protocol stack initializes the hand-shake procedure between two hosts.

41.1.1.6 Land Attack

The attacker makes a special SYN message (the source address and the destination address are the same service address). The SYN message causes the server to send the SYN-ACK message to the sever itself, hence this address also sends the ACK message and creates a null link. Each of this kinds of links will keep until the timeout time, so the server will break down. Landattack can be classified into IPland and MACland.

41.1.2 DoS Attack Prevention Configuration Task List

As to global DoS attack prevention configuration, you configure related sub-functions and then the switch drops corresponding DoS attack packets. Hence, the bandwidth of the switch is guaranteed not to be used up.

DoS attack prevention configuration tasks are shown below:

Configuring Global DoS Attack Prevention

Displaying All DoS Attack Prevention Configuration

41.1.3 DoS Attack Prevention Configuration Tasks

41.1.3.1 Configuring Global DoS Attack Prevention

Configuring global DoS attack prevention means configuring DoS attack prevention sub-functions in global mode and each sub-function can prevent a different type of DoS attack packets. The DoS IP sub-function can prevent the LAND attacks, while the DoS ICMP sub-function can prevent Ping of Death. You can set the corresponding sub-function according to actual requirements.

Configure the DoS attack prevention function in EXEC mode.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **dos enable {all | icmp** ***icmp-value*** **| ip | ipv4firstfrag | l4port | mac | tcpflags | tcpfrag** ***tcpfrag-value*****}**	Configures **all** to prevent all types of DoS attack packets. Configures **icmp** to prevent the ICMP packets, among which the **icmp-value** means the maximum length of the ICMP packet. Configures **ip** to prevent those IP packets whose source IPs are the same as the destination IPs. Configures **ipv4firstfrag** to check the first fragment of the IP packet. Configures **l4port** to prevent those TCP/UDP packets whose source port IDs are destination port IDs. Configures **mac** to prevent those packets whose source MACs are destination MACs. Configures **tcpflags** to prevent those TCP packets containing illegal TCP flags. Configures **tcpfrag** to prevent those TCP packets whose minimum TCP header is **tcpfrag-value**.
exit	Goes back to the EXEC mode.
write	Saves the settings.

41.1.3.2 Displaying All DoS Attack Prevention Configurations

You can display the Dos attack prevention configurations through the **show** command.

Run the following command in EXEC mode to display the configured DoS attack prevention functions.

Command	Purpose
show dos	Displays Dos attack prevention configuration.

41.1.4 DoS Attack Prevention Configuration Example

The following example shows how to configure to prevent the attacks of TCP packets, which have illegal flags, and then displays user's configuration.

config

dos enable tcpflags

show dos

The following example shows how to prevent the attacks of IP packets whose source IPs are destination IPs in global mode.

config

dos enable ip

The following example shows how to prevent in global mode the attacks of ICMP packets whose maximum length is more than 255.

config

dos enable icmp 255

42. Attack Prevention Configuration

42.1 Attack Prevention Configuration

42.1.1 Overview

To guarantee the reasonable usage of network bandwidth, our 6508 series switches provide the function to prevent vicious traffic from occupying lots of network bandwidth. In light of current attack modes, our 6508 series switches can limit the hosts that send lots of ARP, IGMP or IP message in a period of time and do not provide any service to these hosts. The function can prevent malicious message from occuping lots of network bandwidth. Therefore, the networkcan not be congested.

42.1.2 Attack Prevention Configuration Tasks

When the number of IGMP, ARP or IP message that is sent by a host in a designated interval exceeds the threshold, we think that the host attacks the network.

You can select the type of attack prevention (ARP, IGMP or IP), the attack prevention port and the attack detection parameter. You have the following configuration tasks:

- Configuring the attack prevention type
- Configuring the attack detection parameters

42.1.3 Attack Prevention Configuration

42.1.3.1 Configuraing the Attack Detection Parameters

Command	Description
filter period *time*	Sets the attack detection period to **time**, whose unit is second.
filter threshold *vlaue*	Sets the attack detection threshold to **value**. The parameter **value** represents the number of messge at the threshold.
filter block-time *time*	Sets the out-of-service time for the attack source when the attack source is detected. Its unit is second.

42.1.3.2 Configuring the Attack Prevention Type

Command	Description
filter igmp	Detects the igmp attack.
fileter ip source-ip	Detects the IP attack based on the source IP address.
interface f x/y	Enters interface configuration mode for interface y at slot X.
filter arp	Detects the arp attack.

The ARP attack takes the host's MAC address and the source port as the attack source, that is, message from the same MAC address but different ports cannot be calculated together. Both the IGMP attack and IP attack take the host's IP address and source port as the attack source.
Remember that the IGMP attack prevention and the IP attack prevention cannot be started up together.

42.1.3.3 Starting up the Attack Prevention Function

After all parameters for attack prevention are set, you can start up the attack prevention function. Note that small parts of processor source will be occupied when the attack prevention function is started.

Command	Description
filter enable	Starts up the attack prevention function.

Use the **no filter enable** command to disable the attack prevention function and remove the block to all attack sources.

42.1.3.4 Checking the State of Attack Prevention

After attack prevention is started, you can run the following command to check the state of attack prevention:

Command	Description
show filter	Checks the state of attack prevention.

42.1.4 Attack Prevention Configuration Example

To enable the IGMP attack prevention and the ARP attack prevention on port 1/2, consider any host that sends more than 1200 pieces of message within 15 seconds as the attack source and to cut off network service for any attack source.

filter period 15

filter threshold 1200

filter block-time 600

interface f1/2

filter arp

exit

filter enable

43. Network Protocol Configuration

43.1 Configuring IP Addressing

43.1.1 IP Introduction

43.1.1.1 IP

Internet Protocol (IP) is a protocol in the network to exchange data in the text form. IP has the functions such as addressing, fragmenting, regrouping and multiplexing. Other IP protocols (IP protocol cluster) are based on IP. As a protocol working on the network layer, IP contains addressing information and control information which are used for routing.

Transmission Control Protocol (TCP) is also based on IP. TCP is a connection-oriented protocol which regulates the format of the data and information in data transmission. TCP also gives the method to acknowledge data is successfully reached. TCP allows multiple applications in a system to communicate simultaneously because it can send received data to each of the applications respectively.

The IP addressing, such as Address Resolution Protocol, are to be described in section 1.3 “Configuring IP Addressing.” IP services such as ICMP, HSRP, IP statistics and performance parameters are to be described in Chapter 4 “Configuring IP Services.”

43.1.1.2 IP Routing Protocol

Our routing switch supports multiple IP routing dynamic protocols, which will be described in the introduction of each protocol.

IP routing protocols are divided into two groups: Interior Gateway Routing Protocol (IGRP) and Exterior Gateway Routing Protocol (EGRP). Our routing switch supports RIP, OSPF, BGP and BEIGRP. You can configure RIP, OSPF, BGP and BEIGRP respectively according to your requirements. Our switch also supports the process that is to configure multiple routing protocols simultaneously, a random number of OSPF processes (if memory can be distributed), a BGP process, a RIP process and a random number of BEIGRP processes. You can run the **redistribute** command to redistribute the routes of other routing protocols to the database of current routing processes, connecting the routes of multiple protocol processes.

To configure IP dynamic routing protocols, you must first configure relevant processes, make relevant network ports interact with dynamic routing processes, and then designate routing processes to be started up on the ports. To do this, you may check configuration steps in configuration command documents.

43.1.1.3 Choosing routing protocol

It is a complex procedure to choose routing protocol. When you choose the routing protocol, consider the following items:

- Size and complexity of the network
- Whether the length-various network need be supported
- Network traffic
- Safety requirements
- Reliability requirements
- Strategy
- Others

Details of the above items are not described in the section. We just want to remind you that your network requirements must be satisfied when you choose the routing protocols.

43.1.1.4 IGRP

Interior Gateway Routing Protocol (IGRP) is used for network targets in an autonomous system. All IP IGRPs must be connected with networks when they are started up. Each routing process monitors the update message from other routing switches in the network and broadcasts its routing message in the network at the same time. The IGRPs that our routing switches support include:

- RIP
- OSPF
- BEIGRP

43.1.1.5 EGRP

Exterior Gateway Routing Protocol (EGRP) is used to exchange routing information between different autonomonous systems. Neighbors to exchange routes, reachable network and local autonomonous system number generally need to be configured. The EGRP protocol that our switch supports is BGP.

43.1.2 Configuring IP Address Task List

An essential and mandatory requirement for IP configuration is to configure the IP address on the network interface of the routing switch. Only in this case can the network interface be activated, and the IP address can communicate with other systems. At the same time, you need to confirm the IP network mask.

To configure the IP addressing, you need to finish the following tasks, among which the first task is mandatory and others are optional.

For creating IP addressing in the network, refer to section 1.4 “IP Addressing Example.”

Followed is an IP address configuration task list:

- Configuring IP address at the network interface
- Configuring multiple IP addresses at the network interface
- Configuring address resolution
- Configuring routing process
- Configuring broadcast text management
- Detecting and maintaining IP addressing

43.1.3 Configuring IP Address

43.1.3.1 Configuring IP Address at Network Interface

The IP address determines the destination where the IP message is sent to. Some IP special addresses are reserved and they cannot be used as the host IP address or network address. Table 1 lists the range of IP addresses, reserved IP addresses and available IP addresses.

Type	Address or Range	State
A	0.0.0.0 1.0.0.0 to 126.0.0.0 127.0.0.0	Reserved Available Reserved
B	128.0.0.0 to 191.254.0.0 191.255.0.0	Available Reserved
C	192.0.0.0 192.0.1.0 to 223.255.254 223.255.255.0	Reserved Available Reserved
D	224.0.0.0 to 239.255.255.255	Multicast address
E	240.0.0.0 to 255.255.255.254 255.255.255.255	Reserved Broadcast

The official description of the IP address is in RFC 1166 “Internet Digit”. You can contact the Internet service provider.

An interface has only one primary IP address. Run the following command in interface configuration mode to configure the primary IP address and network mask of the network interface:

Run…	To…
ip address *ip-address mask*	Configure the main IP address of the interface.

The mask is a part of the IP address, representing the network.

Our switches only support masks which are continuously set from the highest byte according to the network character order.

43.1.3.2 Configuring Multiple IP Addresses on Network Interface

Each interface can possess multiple IP addresses, including a primary IP address and multiple subordinate IP addresses. You need to configure the subordinate IP addresses in the following two cases:

- If IP addresses in a network segment are insufficient.

For example, there are only 254 available IP addresses in a certain logical subnet, however, 300 hosts are needed to connect the physical network. In this case, you can configure the subordinate IP address on the switch or the server, enabling two logical subnets to use the same physical subnet. Most of early-stage networks which are based on the layer-2 bridge are not divided into multiple subnets. You can divide the early-stage network into multiple route-based subnets by correctly using the subordinate IP addresses. Through the configured subordinate IP addresses, the routing switch in the network can know multiple subnets that connect the same physical network.

- If two subnets in one network are physically separated by another network.

In this case, you can take the address of the network as the subordinate IP address. Therefore, two subnets in a logical network that are physically separated, therefore, are logically connected together.

If you configure a subordinate address for a routing switch in a network segment, you need to do this for other routing switches in the same network segment.

Run the following command in interface configuration mode to configure multiple IP addresses on the network interface.

Run…	To…
ip address*ip-address mask* **secondary**	Configure multiple IP addresses on the network interface.

When the IP routing protocol is used to send the route update information, subordinate IP addresses may be treated in different ways.

43.1.3.3 Configuring Address Resolution

IP can realize functions such as IP address resolution control. The following sections show how to configure address resolution:

1. Creating address resolution

An IP device may have two addresses: local address (local network segment or device uniquely identified by LAN) and network address (representing the network where the device is located). The local address is the address of the link layer because the local address is contained in the message header at the link layer, and is read and used by devices at the link layer. The professionalists always call it as the MAC address. This is because the MAC sub layer in the link layer is used to process addresses.

For example, if you want your host to communicate with a device on Ethernet, you must know the 48-bit MAC address of the device or the local address of the link layer. The process on how to obtain the local address of the link layer from the IP address is called as Address Resolution Protocol (ARP). The process on how to obtain the IP address from the local address of the link layer is called as Reverse Address Resolution (RARP).

Our system adopts address resolution in two types: ARP and proxy ARP. The ARP and proxy ARP are defined in RFC 860 and 1027 respectively.

ARP is used to map IP addresses to media or MAC address. When the IP address is known, ARP will find the corresponding MAC address. When the MAC address is known, the mapping relationship between IP address and MAC address is saved in ARP cache for rapid access. The IP message is then packaged in the message at the link layer and at last is sent to the network.

- Defining a static ARP cache

ARP and other address resolution protocols provide a dynamic mapping between IP address and MAC address. The static ARP cache item is generally not required because most hosts support dynamic address resolution. You can define it in global configuration mode if necessary. The system utilizes the static ARP cache item to translate the 32-bit IP address into a 48-bit MAC address. Additionally, you can specify the routing switch to respond to the ARP request for other hosts.

You can set the active period for the ARP items if you do not want the ARP item to exist permanently. The following two types show how to configure the mapping between the static IP address and the MAC address.

Run one of the following commands in global configuration mode:

Run…	To…
arp ip-address hardware-address	Globally map an IP address to a MAC address in the ARP cache.
arp ip-address hardware-address **alias**	Specify the routing switch to respond to the ARP request of the designated IP address through the MAC address of the routing switch.

Run the following command in interface configuration mode:

Run…	To…
arp timeout*seconds*	Set the timeout time of the ARP cache item in the ARP cache.

Run show interfaces to display the ARP timeout time of the designated interface. Run the show arp to check the content of the ARP cache. Run clear arp-cache to delete all items in the ARP cache.

- Activating proxy ARP

The system uses the proxy ARP (defined by RFC 1027) to obtain the host's MAC address on other networks for the hosts without corresponding routes. For example, when the routing switch receives an ARP request and finds that the source host and the destination host are not connected to the same interface and all the routes that the routing switch reaches the destination host are not through the interface that receives the ARP request, it will send a proxy ARP response that contains its address of the link layer. The source host then sends the message to the routing switch and the switch forwards it to the destination host. The proxy ARP is activates by default.

To activate the proxy ARP, run the following command in interface configuration mode:

Run…	To…
ip proxy-arp	Activate the proxy ARP on the interface.

- Configuring free ARP function

The switch can know whether the IP addresses of other devices collide with its IP address by sending free ARP message. The source IP address and the destination IP address contained by free ARP message are both the local address of the switch. The source MAC address of the message is the local MAC address.
The switch processes free ARP message by default. When the switch receives free ARP message from a device and finds that the IP address contained in the message collide with its own IP address, it will return an ARP answer to the device, informing the device that the IP addresses collide with each other. At the same time, the switch will inform users by logs that IP addresses collide.
The switch's function to send free ARP message is disabled by default. Run the following commands to configure the free ARP function on the port of the switch:

Run…	To…
arp send-gratuitous	Start up free ARP message transmission on the interface.
arp send-gratuitous interval*value*	Set the interval for sending free ARP message on the interface. The default value is 120 seconds.

2. Mapping host name to IP addres

Any IP address can correspond to a host name. The system stores a hostname-to-address mapping cache that you can telnet or ping.

Run the following command in global configuration mode to specify a mapping between host name and IP address:

Run…	To…
ip host*name address*	Statically map the host name to the IP address.

43.1.3.4 Configuring Routing Process

You can configure one or multiple routing protocols according to your actual network requirements. The routing protocol provides information about the network topology. The details about configuring IP routing protocols such as BGP, RIP and OSPF are shown in the following sections.

43.1.3.5 Configuring Broadcast Message Handling

The destination addresses of the broadcast message are all the hosts on a physical network. The host can identify the broadcast message through special address. Some protocols, including some important Internet protocols, frequently use the broadcast message. One primary task of the IP network administrator is to control the broadcast message. The system supports the directed broadcast, that is, the broadcast of designated network. The system does not support the broadcast of all subnets in a network.

Some early-stage IP's do not adopt the current broadcast address standard. The broadcast address adopted by these IP's is represented completely by the number "0". The system can simultaneously identify and receive message of the two types.

1. Allowing translating from directed broadcast to physical broadcast

The directed IP broadcast message will be dropped by default, preventing the switch from attacking by message "service rejected".

You can activate the function of forwarding directed IP broadcast on the interface where the directed broadcast is transformed to the physical message. If the forwarding function is activated, all the directed broadcast message of the network that connects the interface will be forwarded to the interface. The message then will be sent as the physical broadcast message.

You can designate an access table to control the forwarding of broadcast message. After the access table is specified, only IP message that the access table allows can be transformed from the directed broadcast to the physical broadcast.

Run the following command in interface configuration mode to activate the forwarding of the directed broadcast.

Run…	To…
ip directed-broadcast [*access-list-name*]	Allow the translation from the directed broadcast to the physical broadcast on the interface.

2. Forwarding UDP broadcast message

Sometimes, the host uses the UDP broadcast message to determine information about the address, configuration and name, and so on. If the network where the host is located has no corresponding server to forward the UDP message, the host cannot receive any of the UDP message. To solve the problem, you can do some configuration on the corresponding interface to forward some types of broadcast message to an assistant address. You can configure multiple assistant addresses for an interface.

You can designate a UDP destination port to decide which UDP message is to be forwarded. Currently, the default forwarding destination port of the system is port 137.

Run the following command in interface configuration mode to allow message forwarding and to specify the destination address:

Run…	To…
ip helper-address*address*	Allow to forward the UDP broadcast message and to specify the destination address.

Run the following command in global configuration mode to specify protocols to be forwarded:

Run…	To…
ip forward-protocol udp [*port*]	Specify which interfaces' UDP protocols will be forwarded.

43.1.3.6 Detecting and Maintaining IP Addressing

Perform the following operations to detect and maintain the network:

1. Clearing cache, list and database

You can clear all content in a cache, list or the database. When you think some content is ineffective, you can clear it.

Run the following command in management mode to clear the cache, list and database:

Run…	To…
clear arp-cache	Clear the IP ARP cache.

2. Displaying statistics data about system and network

The system can display designated statistics data, such as IP routing table, cache and database. All such information helps you know the usage of the systematic resources and solve network problems. The system also can display the reachability of the port and the routes that the message takes when the message runs in the network.

All relative operations are listed in the following table. For how to use these commands, refer to Chapter “IP Addressing Commands”.

Run the following commands in management mode:

Run…	To…
show arp	Display content in the ARP table.
show hosts	Display the cache table about hostname-to-IP mapping.
show ip interface [*type number*]	Display the interface state.
show ip route [*protocol*]	Display the current state of the routing table.
ping {**host	address**}	Test the reachability of the network node.

43.1.3.7 IP Addressing Example

The following case shows how to configure the IP address on interface VLAN 11.

interface vlan 11

ip address 202.96.2.3 255.255.255.0

43.2Configuring NAT

43.2.1 Introduction

The Internet faces two key problems: insufficient IP address space and route measurement. Network Address Translation (NAT) is an attribute. You can find that a group of IP networks with this attribute use different IP address spaces, but you cannot find the actual address space used by the group of networks. By transforming these addresses to the address spaces that can be globally routed, NAT permits an organization without global routing addresses to connect the Internet. NAT also permits good recoding strategy to change the service providers for the organizations or to automatically code to the CIDR module. NAT will be described in RFC 1631.

43.2.1.1 NAT Application

Main NAT applications are shown as follows:

- All hosts need to connect to the Internet, but no all hosts have a unique global IP address. NAT enables unregistered networks with private IP addresses to connect the Internet. NAT are always configured at the routing switch between inside network and Internet. Before sending message to the Internet, NAT transfers the inside local address to the unique global IP address.
- The inside address has to be modified. You can transform the address by using NAT without too much time.
- The basic TCP transmission load balance need be realized. You can map a single global IP address to multiple IP addresses using TCP load distribution characteristic.
- As a resolution for connection problems, NAT can be used when relatively few hosts in an inside network communicate with the Internet. In this case, the IP addresses of few hosts will be transformed to a unique global IP address when they communicate with the Internet. These addresses can be reused when they are not used any more.

43.2.1.2 NAT Advantage

An obvious advantage of NAT is that you can perform configuration without modifying host or switch. As said above, NAT is useless if many hosts in a single-connection domain communicate with the outside. What's more, the NAT device is not suitable to translate the embedded IP address. These applications cannot work transparently or completely (without translation) pass through a NAT device. NAT hides the identifier of the host, which may be an advantage or a shortcoming.

The router configured with NAT has at least one inside interface and one outside interface. In typical case, NAT is configured at the router between the single-connection domain and the backbone domain. When a message is leaving the single-connection domain, NAT transforms the effective local address to a unique global address. When the message reaches the domain, NAT transforms the unique global address to the local address. If multiple interfaces exist, each NAT must have the same the transfer table. If no address is available, the software cannot distribute an address and NAT will drop the message and returns an ICMP message indicating the host cannot be reached.

The switch with NAT configured should not publish the local network. However, the routing information that NAT receives from the outside can be published in the single-connection domain.

43.2.1.3 NAT Terms

As said above, the term "inside" means those networks which are possessed by organizations and have to be transformed. In this domain, the host has an address in one address space. At the outside, the host will possess an address in another address space when the NAT is configured. The first address space means the local address space, while the second address space means the global address space.

Similarly, the term "outside" means the network that the single network connects, generally out of control of an organization. The addresses of the hosts in the outside network need to translate a certain address and may be classified into two types of addresses: local address and global address.

NAT uses the following definitions:

- Inside local address: IP address that is allocated to a host in the inside network. The address may not be the legal IP address distributed by Network Information Center (NIC) or service provider (SP).
- Inside global address: legal IP address distributed by NIC or SP, describing one or multiple IP addresses for the outside network.
- Outside local address: IP address of the outside host that appears in the inside network. It may be illegal. It can be distributed through the routable address space in the inside network.
- Outside global address: IP address that the owner of the host distributes to the host in the outside network, which can be distributed from the global address space or the network space.

43.2.1.4 NAT Regulation Matching Order

When NAT translates message, the configured NAT regulations must first be matched. There are three classes of NAT regulations: inside source address mapping, outside source address mapping and inside destination address mapping. Each class has its own subclasses. The following case takes the inside source address mapping as an example to introduce the subclass order of the NAT matching regulations:

- Static TCP/UDP port mapping regulation
- Static single address mapping regulations
- Static network segment mapping regulations
- Dynamic POOL address mapping regulations
- PAT mapping regulations

The regulations in the same subclass in the same class and the three classes are matched according the sequence they are being added. When you run the **show running** command, the order to display the NAT regulations is the same as the actual matching order.

43.2.2 NAT Configuration Task List

Before configuring any NAT, you must know the range of the inside local address and inside global address. The NAT configuration task list is shown as follows:

- Translating inside source address
- Reloading inside global address
- Translating the overlapping address
- Providing TCP load balance
- Changing translation timeout time and limiting the number of connections
- Monitoring and maintaining NAT

43.2.3 NAT Configuration Task

43.2.3.1 Translating Inside Source Address

When the host communicates with the outside network, it uses the attribute (translating inside source address) to translate its IP address to the unique global IP address. You can configure the static or dynamic inside source address translation through the following method:

The static translation creates the one-to-one mapping between inside local address and inside global address. When an inside host is accessed by a fixed outside address, the static translation is useful.

The dynamic translation creates the mapping between inside local address and outside address pool.

The following figure shows a routing switch translates the source address inside a network to the source address outside the network.

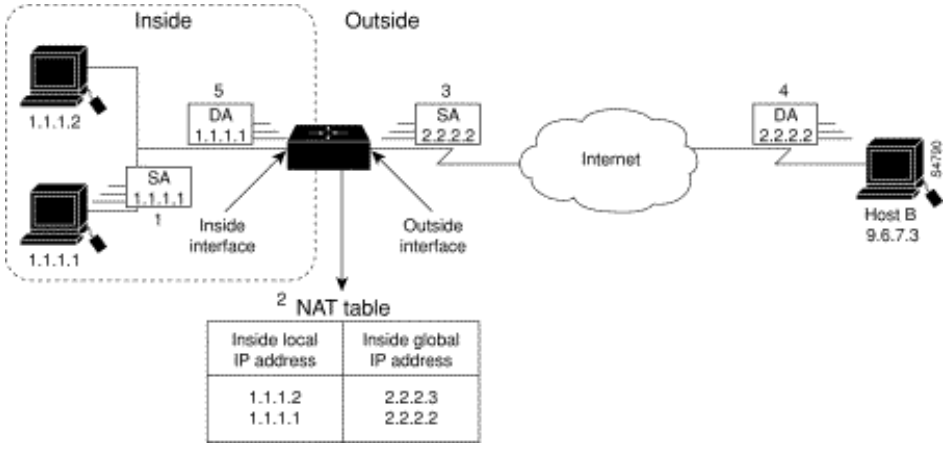


Figure 43-1 NAT Inside Source Address Transfer

The following steps show the inside source address translation.

(1) The user of host 1.1.1.1 creates a connection between host 1.1.1.1 and host B.

(2) The first packet received by the routing switch from host 1.1.1.1 makes the routing switch check the NAT table.

If a static translation item has been configured, the switch is to perform step 3.

If no translation exists, the switch decides that the source address (SA) 1.1.1.1 must be translated dynamically, then chooses a legal global address from the dynamic address pool, and finally generates a translation item. The type item is called as simple item.

(3) The routing switch replaces the inside local source address with the global address of the transfer item and forwards the message.

(4) Host B receives the message through inside global IP destination address (DA) 2.2.2.2 and responds to host 1.1.1.1.

(5) When the routing switch receives message of the inside global IP address, it takes the inside global address as a keyword to query the NAT table, translates the address to the inside local address of host 1.1.1.1, and forwards message to host 1.1.1.1.

(6) Host 1.1.1.1 receives the message and continues the session. The routing switch is to perform step 2 and step 5 for each message.

1. Configuring static transfer

Run the following commands in global configuration mode to configure static inside source address transfer:

Run…	To…
ip nat inside source static*local-ip global-ip*	Create a static transfer between inside local address and inside global address.
interface*type number*	Specify the inside interface.
ip nat inside	Label the interface as one to connect the inside network.
interface*type number*	Specify the outside interface.
ip nat outside	Label the interface as one to connect the outside network.

The above is the minimum configuration. You can configure multiple inside and outside interfaces.

2. Configuring dynamic transfer

Run the following commands in global configuration mode to configure dynamic inside source address translation.

Run…	To…
ip nat pool name start-ip end-ip netmask	Define a to-be-allocated global address pool according to your requirements.
ip access-list standard access-list-name permit source [source-mask]	Define a standard access list to permit which address can be transferred.
ip nat inside source list access-list-name **pool** name	Create dynamic source address transfer and specify the access list that is defined at the previous step.
interface type number	Specify the inside interface.
ip nat inside	Label the interface as one to connect the inside network.

interface type number	Specify the outside interface.
ip nat outside	Label the interface as one to connect the outside network.

Note

Only those transferable addresses can be contained in the access list (remember that an implicit item “deny all” exists at the end of each access list). The random access list may lead to unexpected results.
Refer to section 2.4.1 “Dynamic Inside Source Address Transfer Example” for details.

43.2.3.2 Reloading Inside Global Address

Multiple local addresses use one global address through the routing switch. All the addresses can be stored in the inside global address pool. When the reloading is configured, the routing switch maintains sufficient information from high-level protocols (such as TCP or UDP) and transfers the global address to the correct local address. When multiple local addresses are mapped to one global address, TCP or UDP port numbers of each inside host are used to label multiple local addresses.
The following figure shows the NAT operation when an inside global address represents multiple local addresses. TCP port number is used to label the local address.

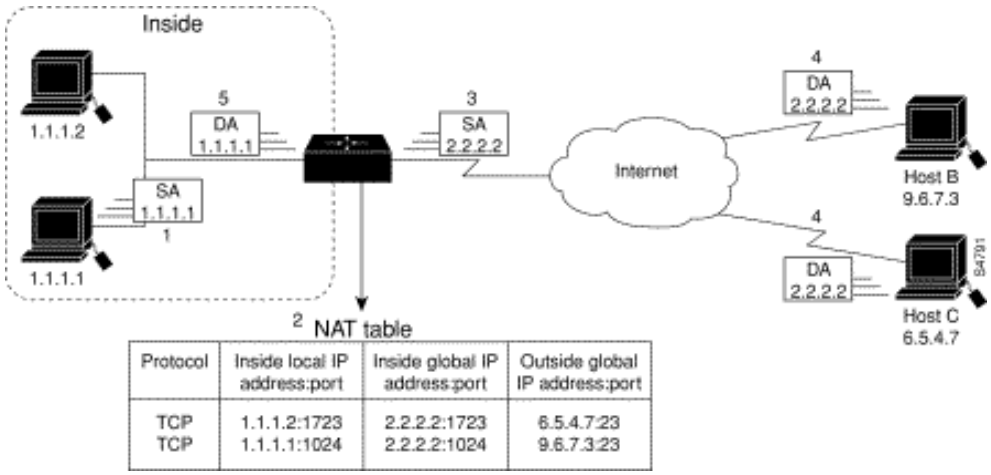


Figure 43-2 NAT Operation During the Reloading of Inside Global Address

The routing switch performs the following steps in the reloaded inside global address. Host B and host C think that they are communicating with host 2.2.2.2. However, they are communicating with different hosts in fact. The port number is the identifier. In fact, multiple inside hosts can share one inside global IP address using different port numbers.

(1) The user of host 1.1.1.1 creates a connection between host 1.1.1.1 and host B.

(2) The routing switch receives the first message from host 1.1.1.1 and then checks its NAT table.

If no transfer items exist, the switch decides that address 1.1.1.1 must be translated, and then creates a translation between inside local address 1.1.1.1 and legal global address. If the reloading is successful, another translation is started up. The switch reuses the global address in the previous translation and saves sufficient transferable information. The item is called as the expansion item.

(3) The routing switch replaces the inside local source address 1.1.1.1 with the selected global address, and then forwards a packet.

(4) Host B receives the packet and responds to host 1.1.1.1 using inside global IP address 2.2.2.2.

(5) When the routing switch receives the packet with the inside global IP address, it uses the protocol, inside global address, outside address and port as the keywords to search the NAT table. After that, it transfers the address to the inside local address 1.1.1.1 and forwards the packet to host 1.1.1.1.

(6) Host 1.1.1.1 receives the packet and continues the session. The routing switch performs step 2 and step 5 for each packet.

Run the following commands in global configuration mode to configure the reloading of the inside global address:

Run…	To…
ip nat pool name start-ip end-ip netmask	Define a to-be-distributed global address pool according to requirements.
ip access-list standard access-list-name **permit** source [source-mask]	Define a standard access list.
ip nat inside source list access-list-name **pool** name overload	Create dynamic inside source address transfer and decide the access list previously defined.
interface type number	Specify the inside interface.
ip nat inside	Label the interface as one to connect the inside network.
interface type number	Specify the outside interface.
ip nat outside	Label the interface as one to connect the outside network.

Only those transferable addresses can be contained in the access list (remember that an implicit item “deny all” exists at the end of each access list). The random access list may lead to unexpected results.

Refer to section 2.4.2 “Inside Global Address Reloading Example” for details.

43.2.3.3 Translating Overlapping Addresses

When an internal local address is the same as the to-be-connected outside address, address overlapping occurs. The following figure shows how NAT translates the overlapping addresses.

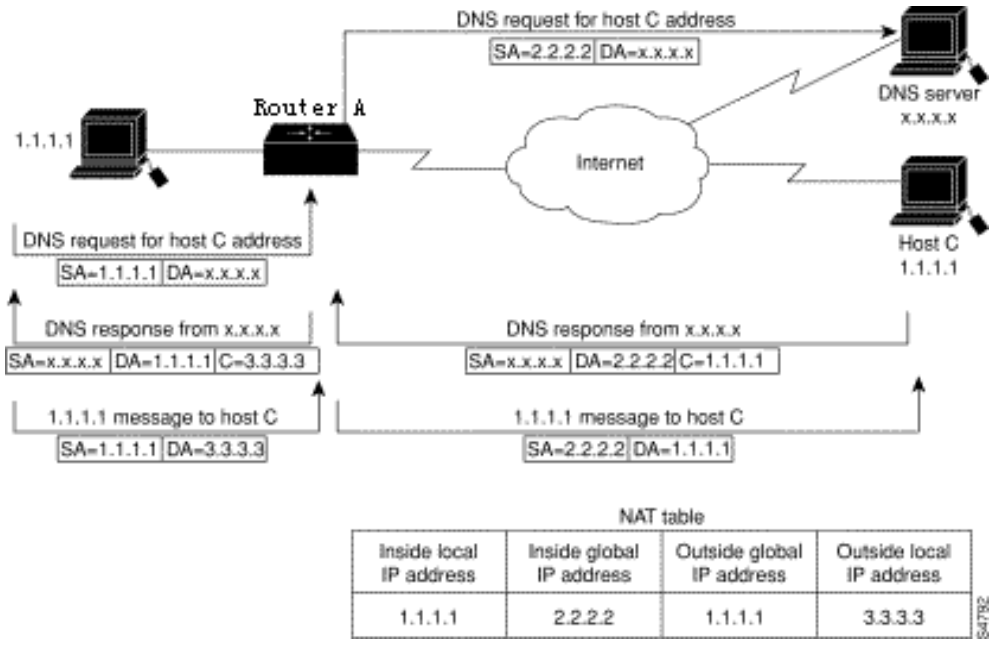


Figure 43-3 Network Condition Where NAT Translates Overlapping Addresses

The routing switch performs the following steps when translating the overlapping addresses:

(1) The user of host 1.1.1.1 uses domain name to send instructions for connecting host C. Host 1.1.1.1 requires DNS server to perform a checkup from domain name to address.

(2) The DNS server responds the request and returns the address 1.1.1.1 of host C. The routing switch intercepts the DNS response message and selects an outside local address from the outside local address pool to replace the source address. In this case, the source address 1.1.1.1 is replaced with address 3.3.3.3.

(3) The routing switch creates a mapping table about address transfer, where inside local addresses and inside global addresses map each other, outside global address and outside local address map each other.

(4) Host 1.1.1.1 sends message to host C . The destination IP address is the outside local address 3.3.3.3.

(5) When switch A receives message whose destination address is the outside local address, switch A transfers the local address to the global address.

(6) Host C receives the packet and continues the session.

1. Configuring static transfer

Run the following commands in global configuration mode to configure static source address translation:

Run…	To…
ip nat outside source static *global-ip local-ip*	Creates static translation between outside local address and outside global address.
interface *type number*	Specify the inside interface.
ip nat inside	Label the interface as one to connect the inside network.
interface*type number*	Specify the outside interface.
ip nat outside	Label the interface as one to connect the outside network.

2. Configuring dynamic transfer

Run the following commands in global configuration mode to configure dynamic outside source address transfer:

Run…	To…
ip nat pool*name start-ip end-ip netmask*	Define a to-be-distributed local address pool according to requirements.
ip access-list standard*access-list-name***permit** source [*source-mask*]	Define a standard access list.
ip nat outside source list*access-list-name* **pool***name*	Create dynamic outside source address transfer and decide the access list previously defined.
interfacetype*number*	Specify the inside interface.
ip nat inside	Label the interface as one to connect the inside network.
interface type *number*	Specify the outside interface.
ip nat outside	Label the interface as one to connect the outside network.

Only those transferable addresses can be contained in the access list (remember that an implicit item “deny all” exists at the end of each access list). The random access list may lead to unexpected results.

For details, refer to section“Overlapping Address Translation Example”.

43.2.3.4 Providing TCP Load Balance

Another fashion of using NAT is unrelated to the Internet address. Your organization may have multiple hosts to communicate with a frequently used host. In this case, you can use NAT technology to create a virtual host in the inside network, helping the load balance among actual hosts. You need to replace the destination address of the access list with the address in the cycle address pool. The distribution is complete in a cycle when a new connection from the outside to the inside is opened. The non-TCP communication need not be translated (unless other translations are effective). The following figure illustrates the attribute.

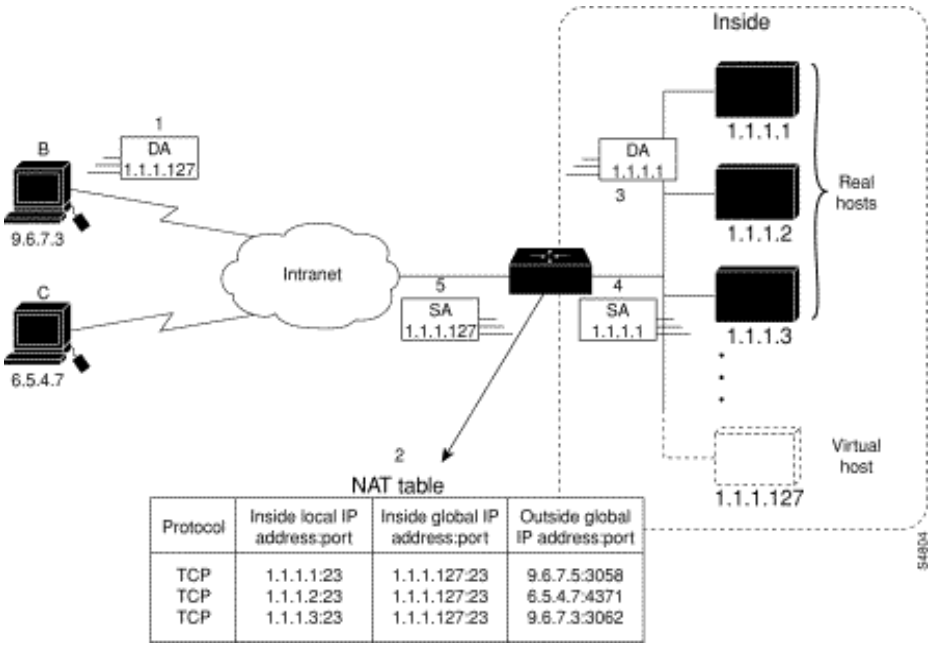


Figure 43-4 NAT TCP load balance

When translating the cycle address, the routing switch performs the following steps:

(1) The user of host B (9.6.7.3) sends instructions for connecting the virtual host 1.1.1.127 in the inside network.

(2) The routing switch receives the connection request and creates a new translation item to allocate the next host 1.1.1.1 for the inside local IP address.

(3) The routing switch replaces the destination address with the selected actual address of the host, and forwards the message.

(4) Host 1.1.1.1 receives the message and makes response.

(5) The routing switch receives the message and uses the inside local addresses and their port numbers, the outside address and port number as keywords to check the NAT table. The routing switch then transfers the source address to the address of the virtual host, and forwards the message.

(6) Next connection request invokes the routing switch to distribute address 1.1.1.2 for the inside local address. To configure the destination address transfer, run the following commands in global configuration mode. These commands permit to map one virtual host to multiple real hosts. Each TCP session with the virtual host will be transferred to the sessions with different real hosts.

Run...	To...
ip nat pool name start-ip end-ip netmask	Define an address pool containing the addresses of real hosts.
ip access-list standard access-list-name **permit** source [source-mask]	Define an access table permitting addresses of virtual hosts.
ip nat inside destination list access-list-name **pool** name	Create a dynamic inside target transfer mechanism and confirm the previously defined access list.
interface type number	Specify the inside interface.
ip nat inside	Label the interface as one to connect the inside network.
interface type number	Specify the outside interface.
ip nat outside	Label the interface as one to connect the outside interface.

Only those transferable addresses can be contained in the access list (remember that an implicit item “deny all” exists at the end of each access list). The random access list may lead to unexpected results.
For details, refer to section “TCP Load Configuration Example”.

43.2.3.5 Changing Translation Timeout Time and Limiting the Number of Connections

After a period of leisure, the dynamic Network Address Translation (NAT) is to time out by default. If the reloading is not configured, the simple translation item is to time out after one hour. You can run the following command to in global configuration mode to change the timeout value.

Run...	To...
ip nat translation timeout*seconds*	Change the timeout value of the dynamic NAT without reloading.

If the reloading is configured, the translation timeout will be better controlled because every translation item contains more contents. To change the timeout value of the expansible item, run one or most of the following commands in global configuration mode.

Run...	To...
ip nat translation udp-timeout *seconds*	Change the UDP timeout value (the default value is five seconds).
ip nat translation dns-timeout*seconds*	Change the DNS timeout value (the default value is one second).
ip nat translation tcp-timeout *seconds*	Change the TCP timeout value (the default value is one hour).
ip nat translation icmp-timeout*seconds*	Set the timeout time of the ICMP NAT (the default time is 60 seconds).
ip nat translation syn-timeout*seconds*	Set the timeout time of the NAT in the TCP SYN state (the default time is 60 seconds).
ip nat translation finrst-timeout *seconds*	Change the TCP FIN/RST timeout value (the default value is 60 seconds).

There are three methods to limit the NAT connections. Run the following commands in global configuration mode to realize the three methods.

Run...	To...
ip nat translation max-entries*numbers*	Set the maximum number of the translation items (the default value is 4000).
ip nat translation max-links A.B.C.D*numbers*	Limit the maximum number of the NAT connection items that the designated inside IP address creates. There is no default value.
ip nat translation max-links all *numbers*	Limit the maximum number of the NAT connection items that a single IP address creates. The default value is the same as max-entries.

43.2.3.6 Monitoring and Maintaining NAT

The dynamic NAT is to time out by default according to the time regulated by the NAT transfer table. You can run the following commands in management mode to clear up the timeout item before the timeout occurs.

Run...	To...
clear ip nat translation	Clear up all transfer items from the NAT transfer table.
clear ip nat translation inside *local-ip global-ip* [outside *local-ip global-ip*]	Clear up a simple dynamic translation item containing inside translation, outside translation or both.
clear ip nat translation outside*local-ip global-ip*	Clear up a simple dynamic translation item containing outside translation.
clear ip nat translation inside *local-ip local-port global-ip global-port* [outside *local-ip local-port global-ip global-port*]	Clear up expansible dynamic translation items.

Run one of the following commands in management mode to display the transfer information:

Run...	To...
show ip nat translations [verbose]	Display active translation.
show ip nat statistics	Display translation statistics.

43.2.4 NAT Configuration Example

43.2.4.1 Dynamic Inside Source Transfer Example

The following example shows how to transfer all source addresses (192.168.1.0/24) that matches access list a1 to one address in the net-208 pool whose address range is from 171.69.233.208 to 171.69.233.233.

```
ip nat pool net-208 171.69.233.208 171.69.233.233 255.255.255.240
ip nat inside source list a1 pool net-208
!
interface vlan10
 ip address 171.69.232.182 255.255.255.240
 ip nat outside
!
interface vlan11
 ip address 192.168.1.94 255.255.255.0
 ip nat inside
!
ip access-list    standard a1
 permit 192.168.1.0 255.255.255.0
!
```

43.2.4.2 Inside Global Address Reloading Example

An address pool named net-208 is created in the following example. The address pool contains all addresses from 171.69.233.208 to 171.69.233.233. The a1 access list permits all packets from source addresses from 192.168.1.0 to 192.168.1.255. If there is no transfer, packets matching the a1 access list are to be transferred to one address the net-208 address pool. The routing switch authorizes multiple local addresses (from 192.168.1.0 to 192.168.1.255) to use the same global address. The routing switch stores the port numbers to distinguish every connection.

```
ip nat pool net-208 171.69.233.208 171.69.233.233 255.255.255.240
ip nat inside source list a1 pool net-208 overload
!
interface vlan10
 ip address 171.69.232.182 255.255.255.240
 ip nat outside
!
interface vlan11
 ip address 192.168.1.94 255.255.255.0
 ip nat inside
!
ip access-list standard a1
 permit 192.168.1.0 255.255.255.0
!
```

43.2.4.3 Example to overlapping address transfer

The following example shows that other users in the Internet are legally using the address in the local network. Extra transfer is needed to access the outside network. The net-10 address pool is an outside local IP address pool. The sentence **ip nat outside source list 1 pool net-10** transfer the host addresses of the outside overlapping network to the address in the net-10 address pool.

```
ip nat pool net-208 171.69.233.208 171.69.233.223 255.2555.255.240
ip nat pool net-10 10.0.1.0 10.0.1.255 255.255.255.0
ip nat inside source list a1 pool net-208
ip nat outside source list a1 pool net-10
!
interface vlan10
ip address 171.69.232.192 255.255.255.240
ip nat outside
!
interface vlan11
ip address 192.168.1.94 255.255.255.0
ip nat inside
!
ip access-list standard a1
permit 192.168.1.0 255.255.255.0
!
```

43.2.4.4 TCP Load Distribution Example

The following example shows that the connections between a virtual address and a group of actual hosts are distributed. The address pool defines the addresses of actual hosts. The access list defines the virtual address. The TCP packet that matches the access list and is from serial port 1/0 (outside interface) is to be translated to the address in the pool.

```
ip nat pool real-hosts 192.168.15.2 192.168.15.15 255.255.255.240
ip nat inside destination list a2 pool real-hosts
!
interface vlan10
ip address 192.168.15.129 255.255.255.240
ip nat outside
!
interface vlan11
ip address 192.168.15.17 255.255.255.240
ip nat inside
!
ip access-list standard a2
permit 192.168.15.1 255.255.255.0
```

43.3Configuring DHCP

43.3.1 Introduction

The Dynamic Host Configuration Protocol (DHCP) provides some parameters of network configuration fro hosts in the Internet. DHCP will be described in RFC 2131. The most important function of DHCP is to distribute IP addresses on the interface. DHCP supports three mechanisms of distributing IP addresses.

- Automatic distribution

The DHCP server automatically distributes a permanent IP address to a client.

- Dynamic distribution

The DHCP server distributes an IP address for a client to use for a certain period of time or until the client does not use it.

- Manual distribution

The administrator of the DHCP server manually specifies an IP address and through the DHCP protocol sends it to the client.

43.3.1.1 DHCP Applications

DHCP has several kinds of applications. You can use DHCP in the following cases:

- You can distribute IP address, network segment and related sources (such as relevant gateway) to an Ethernet interface by configuring the DHCP client.
- When a switch that can access DHCP connects multiple hosts, the switch can obtain an IP address from the DHCP server through the DHCP relay and then distribute the address to the hosts.

43.3.1.2 DHCP Advantages

In current software version, the DHCP client or the DHCP client on the Ethernet interface is supported. The function to support the DHCP client has the following advantages:

- Reducing the configuration time
- Reducing configuration faults
- Controlling IP addresses of some device ports through the DHCP server

43.3.1.3 DHCP Terminology

DHCP is based on the Server/Client model. The DHCP-server and DHCP-client exist in the DHCP running conditions.

- DHCP-Server

It is a device to distribute and recycle the DHCP-related sources such as IP addresses and lease time.

- DHCP-Client

It is a device to obtain information from the DHCP server for devices of the local system to use, such as IP address information.

As described above, the lease time is a concept appearing in the procedure of DHCP dynamic distribution.

- Lease time

an effective period of an IP address since its distribution. When the effective period is over, the IP address is to be recycled by the DHCP server. To continuously use the IP address, the DHCP client requires re-applying the IP address.

43.3.2 Configuring DHCP Client

43.3.2.1 DHCP Client Configuration Tasks

- Obtaining an IP address
- Specifying an address for DHCP server
- Configuring DHCP parameters
- Monitoring DHCP

43.3.2.2 DHCP Client Configuration Tasks

1. Obtaining an IP address

Run the following command on the VLAN interface to obtain an IP address through the DHCP protocol for an interface.

Run...	To...
ip address dhcp	Specify the DHCP protocol to configure the IP address of the Ethernet interface.

2. Specifying an address for DHCP server

If the addresses of some DHCP servers are known, you can specify the addresses for these DHCP servers on the switch to reduce protocol interaction time. Run the following command in global configuration mode:

Run...	To...
ip dhcp-server *ip-address*	Specify the IP address of the DHCP server.

The command is optional when you perform operations to obtain an IP address.

3. Configuring DHCP parameters

You can adjust the parameters for the DHCP protocol interaction according to requirements. Run the following commands in global configuration mode:

Run...	To...
ip dhcp client minlease *seconds*	Specify the minimum lease time.
ip dhcp client retransmit *count*	Specify the times of resending protocol message.
ip dhcp client select *seconds*	Specify the interval for SELECT.

The command is optional when you perform operations to obtain an IP address.

4. Monitoring DHCP

To check information about DHCP-server currently found by switch, run the following command in management mode:

Run...	To...
show dhcp server	Display information about the DHCP server known by the routing switch.

Run the following command in management mode to check the IP address currently used by the routing switch:

Run...	To...
show dhcp lease	Display the IP address resources currently used by the routing switch and relevant information.

Additionally, if the DHCP protocol is used to distribute an IP address for an Ethernet interface, you can run **show interface** to check whether the IP address required by the Ethernet interface is successfully obtained.

43.3.2.3 DHCP Client Configuration Example

Obtaining an IP address

The following example shows Ethernet1/1 obtains an IP address through DHCP.

!

interface vlan 11

ip address dhcp

43.3.3 Configuring DHCP Server

43.3.3.1 DHCP Server Configuration Tasks

- Enabling DHCP server
- Disabling DHCP server
- Configuring ICMP detection parameter
- Configuring database storage parameter
- Configuring the address pool of DHCP server
- Configuring the parameter for the address pool of DHCP server
- Monitoring DHCP server
- Clearing information about DHCP server

43.3.3.2 Configuring DHCP Server

43.3.3.3 Enabling DHCP server

To enable the DHCP server and distribute parameters such as IP address for the DHCP client, run the following command in global configuration mode (the DHCP server also supports the relay operation. For the addresses that the DHCP server cannot distribute, the port where **ip helper-address** is configured is to forward the DHCP request):

Run...	To...
ip dhcpd enable	Enabling DHCP server.

43.3.3.4 Disabling DHCP server

To enable DHCP server and stop distributing parameters such as IP address parameter for the DHCP client, run the following command in global configuration mode:

Run...	To...
no ip dhcpd enable	Disable DHCP server.

43.3.3.5 Configuring ICMP detection parameter

You can adjust the parameter of the to-be-sent ICMP message when the server performs address detection. Run the following command in global configuration mode to configure the number of to-be-sent ICMP messages:

Run...	To...
ip dhcpd ping packets *pkgs*	Specify the times of address detection as the number of to-be-sent ICMP message.

Run the following command in global configuration mode to configure the timeout time of ICMP message response:

Run...	To...
ip dhcpd ping timeout *timeout*	Specify the timeout time of ICMP message response.

43.3.3.6 Configuring database storage parameter

To configure the interval when the address distribution information is stored in the agent database, run the following command in global configuration mode.

Run...	To...
ip dhcpd write-time *time*	Specify the interval at which the address distribution information is stored in the agent database.

43.3.3.7 Configuring DHCP server address pool

Run the following command in global configuration mode to add the address pool for the DHCP server:

Run...	To...
ip dhcpd pool *name*	Add the address pool of the DHCP server and enter the configuration mode of the DHCP address pool.

43.3.3.8 Configuring DHCP server address pool

You can run the following commands in DHCP address pool configuration mode to configure related parameters.

Run the following command to configure the network address of the address pool which is used for automatic distribution.

Run...	To...
network *ip-addr netsubnet*	Configure the network address of the address pool which is used for automatic distribution.

Run the following command to configure the address range that is used for automatic distribution.

Run...	To...
range *low-addr high-addr*	Configure the address range that is used for automatic distribution.

Run the following command to configure the default route that is distributed to the client:

Run...	To...
default-router *ip-addr …*	Configure the default route that is distributed to the client.

Run the following command to configure the DNS server address that is distributed to the client:

Run...	To...
dns-server *ip-addr …*	Configure the DNS server address that is distributed to the client.

Run the following command to configure domain that is distributed to the client:

Run...	To...
domain-name*name*	Configure domain that is distributed to the client.

Run the following command to configure the lease time of the address that is distributed to the client:

Run...	To...
lease {*days* [*hours*][*minutes*] | *infinite* }	Configure the lease time of the address that is distributed to the client.

Run the following command to configure the netbios server address that is distributed to the client:

Run...	To...
netbios-name-server*ip-addr…*	Configure the netbios server address that is distributed to the client.

You can run the following command to reject to distribute the IP address to the host whose MAC address is hardware-address.

Run…	To…
hw-access deny hardware-address	Reject to distribute IP addresses to the host whose MAC address is hardware-address.

43.3.3.9 Monitoring DHCP server

Run the following command in management mode to check current address distribution information about DHCP server.

Run…	To…
show ip dhcpd binding	Display current address distribution information about DHCP server.

Run the following command in management mode to check current message statistics information about DHCP server.

Run…	To…
show ip dhcpd statistic	Display current message statistics information about DHCP server.

43.3.3.10 Clearing up information about DHCP server

Run the following command in management mode to delete current address distribution information about DHCP server:

Run...	To...
clear ip dhcpd binding {*ip-addr*|*}	Delete the designated address distribution information.

Run the following command in management mode to delete current message statistics information about DHCP server.

Run...	To...
clear ip dhcpd statistic	Delete current message statistics information about DHCP server

43.3.3.11 DHCP Server Configuration Example

In the following example, the timeout time of the ICMP detection packet is set to 200ms; Address pool 1 is configured and the DHCP server is enabled.

```
ip dhcpd ping timeout 2
ip dhcpd pool 1
network 192.168.20.0 255.255.255.0
range 192.168.20.211 192.168.20.215
domain-name my315
default-router 192.168.20.1
dns-server 192.168.1.3 61.2.2.10
netbios-name-server 192.168.20.1
lease 1 12 0
!
ip dhcpd enable
```

43.4IP Service Configuration

It is to describe how to configure optional IP service. For the details of the IP service commands, refer to section “IP Service Commands”.

43.4.1 Configuring IP Service

Optional IP service configuration tasks are listed as follows:

- Managing IP connection
- Configuring performance parameters
- Configuring default gateway
- Detecting and maintaining IP network

The above operations are not mandatory. You can perform the operations according to your requirements.

43.4.1.1 Managing IP Connection

The IP protocol provides a series of services to control and manage IP connections. Most of these services are provided by ICMP. The ICMP message is sent to the host or other routing switches when the routing switch or the access server detects faults in the IP message header. ICMP is mainly defined in RFC 792. Perform the following different operations according to different IP connection conditions:

1. Sending ICMP unreachable message

If the system receives a message and cannot send it to the destination, such as no routes, the system will send an ICMP-unreachable message to the source host. The function of the system is enabled by default. If the function is disabled, you can run the following command in interface configuration mode to enable the function.

Run…	To…
ip unreachables	Enable the function to send an ICMP-unreachable message.

2. Sending ICMP redirection message

Sometimes the host selects an unfavorable route. After a routing switch on the route receives a message from the host, it is to check the routing table and then forward the message through the message-receiving interface to another routing switch that is in the same network segment as the host. In this case, the routing switch notifies the source host of directly sending the message with the destination to another routing switch without winding itself. The redirection message requires the source host to discard the original route and take more direct route suggested in the message. Many host's operating system adds a host route to its routing table. However, the routing switch is more willing to trust information obtained through the routing protocol. Therefore, the routing switch would not add the host route according to the information.

The function is enabled by default. If the hot standby routing switch protocol is configured on the interface, the function is automatically disabled. However, the function will not be automatically enabled even if the hot standby routing switch protocol is cancelled.

To enable the function, run the following command in interface configuration mode:

Run…	To…
ip redirects	Permit sending the ICMP redirection messafge.

3. Sending ICMP mask response message

Sometimes the host must know the network mask. To get the information, the host can send the ICMP mask request message. If the routing switch can confirm the mask of the host, it will respond with the ICMP mask response message. By default, the routing switch can send the ICMP mask response message.

To send the ICMP mask request message, run the following command in interface configuration mode:

Run…	To…
ip mask-reply	Send the ICMP mask response message.

4. Supporting route MTU detection

The system supports the IP route MTU detection mechanism defined by RFC 1191. The IP route MTU detection mechanism enables the host to dynamically find and adjust to the maximum transmission unit (MTU) of different routes. Sometimes the routing switch detects that the received IP message length is larger than the MTU set on the message forwarding interface. The IP message needs to be segmented, but the "unsegmented" bit of the IP message is reset. The message, therefore, cannot be segmented. The message has to be dropped. In this case, the routing switch sends the ICMP message to notify the source host of the reason of failed forwarding, and the MTU on the forwarding interface. The source host then reduces the length of the message sent to the destination to adjust to the minimum MTU of the route.

If a link in the route is disconnected, the message is to take other routes. Its minimum MTU may be different from the original route. The routing switch then notifies the source host of the MTU of the new route. The IP message should be packaged with the minimum MTU of the route as much as possible. In this way, the segmentation is avoided and fewer messagesare sent, improving the communication efficiency.
Relevant hosts must support the IP route MTU detection. They then can adjust the length of IP message according to the MTU value notified by the routing switch, preventing segmentation during the forwarding process.

5. Setting IP maximum transmission unit

All interfaces have a default IP maximum transmission unit (MTU), that is, the transmissible maximum IP message length. If the IP message length exceeds MTU, the routing switch segments the message.
Changing the MTU value of the interface is to affect the IP MTU value. If IP MTU equals to MTU, IP MTU will automatically adjust itself to be the same as new MTU as MTU changes. The change of IP MTU, however, does not affect MTU. IP MTU cannot bigger than MTU configured on the current interface. Only when all devices connecting the same physical media must have the same MTU protocol can normal communication be created.
To set IP MTU on special interface, run the following command in interface configuration mode:

Run…	To…
ip mtu*bytes*	Set IP MTU of the interface.

6. Authorizing IP source route

The routing switch checks the IP header of every message. The routing switch supports the IP header options defined by RFC 791: strict source route, relax source route, record route and time stamp. If the switch detects that an option is incorrectly selected, it will send message about the ICMP parameter problem to the source host and drop the message. If problems occur in the source route, the routing switch will send ICMP unreachable message (source route fails) to the source host.
IP permits the source host to specify the route of the IP network for the message. The specified route is called as the source route. You can specify it by selecting the source route in the IP header option. The routing switch has to forward the IP message according to the option, or drop the message according to security requirements. The routing switch then sends ICMP unreachable message to the source host. The routing switch supports the source route by default.
If the IP source route is disabled, run the following command in global configuration mode to authorize the IP source route:

Run…	To…
ip source-route	Authorizing IP source route.

7. Allowing IP fast exchange

IP fast exchange uses the route cache to forward the IP message. Before the switch forwards message to a certain destination, its system will check the routing table and then forward the message according to a route. The selected route will be stored in the routing cache of the system software. If latter message will be sent to the same host, the switch will forward latter message according to the route stored in the routing cache. Each time message is forwarded, the value of hit times of the corresponding route item is increasing by 1. When the hit times is equal to the set value, the software routing cache will be stored in the hardware routing cache. The following message to the same host will be forwarded directly by the hardware. If the cache is not used for a period of time, it will be deleted. If the software/hardware cache items reach the upper limitation, new destination hosts are not stored in the cache any more. The managed switch can hold 2074 hardware cache items and 1024 software cache items. To allow or forbid fast exchange, run the following command in interface configuration mode:

Run…	To…
ip route-cache	Allow fast exchange (use the routing cache to forward the IP message).
no ip route-cache	Forbid fast exchange.

To configure the hit times required when the software cache items are stored to the hardware cache, run the following command in global configuration.

Run…	To…
ip route-cache hit-numbers*hitnumber*	When the hit times of the routing item in the software cache reaches the value of the parameter **hitnumber**, the routing item in the software cache will be stored as a routing item in the hardware cache.

8. Supporting IP fast exchange on the same interface

You can enable the switch to support IP fast exchange by making the receiving interface the same as the transmitting interface. Generally, it is recommended not to enable the function because it conflicts with the redirection function of the router.

Run the following command in interface configuration mode to allow IP routing cache in the same interface:

Run…	To…
ip route-cache *same-interface*	Allow IP message with the same receiving/transmitting interfaces to be stored in the routing cache.

43.4.1.2 Configuring Performance Parameters

1. Setting the wait time for TCP connection

When the routing switch performs TCP connection, it considers that the TCP connection fails if the TCP connection is not created during the wait time. The routing switch then notifies the upper-level program of the failed TCP connection. You can set the wait time for TCP connection. The default value of the system is 75 seconds. The previous configuration has no impact on TCP connections that the switch forwards. It only affects TCP connections that are created by the switch itself.

Run the following command in global configuration mode to set the wait time for TCP connections:

Run…	To…
ip tcp synwait-time *seconds*	Set the wait time for TCP connection.

2. Setting the size of TCP windows

The default size of TCP windows is 2000 byte. Run the following command in global configuration mode to change the default window size:

Run…	To…
ip tcp window-size*bytes*	Set the size of TCP windows.

43.4.1.3 Detecting and Maintaining IP Network

1. Clearing cache, list and database

You can clear all content in a cache, list or database. Incorrect data in a cache, list or database need be cleared.

Run the following command to clear incorrect data:

Run…	To…
clear tcp statistics	Clear TCP statistics data.

2. Clearing TCP connection

To disconnect a TCP connection, run the following command:

Run…	To…
clear tcp {**local** host-name port **remote** host-name port | **tcb** address}	Clear the designated TCP connection. TCB refers to TCP control block.

3. Displaying statistics data about system and network

The system can display the content in the cache, list and database. These statistics data can help you know the usage of systematic sources and solve network problems.

Run the following commands in management mode. For details, refer to “IP Service Command”.

Run…	To…
show ip access-lists *name*	Display the content of one or all access lists.
show ip cache [prefix mask] [type number]	Display the routing cache that is used for fast IP message exchange.
show ip sockets	Display all socket information about the routing switch.
show ip traffic	Display statistics data about IP protocol.
show tcp	Display information about all TCP connection states.
show tcp brief	Briefly display information about TCP connection states.
show tcp statistics	Display TCP statistics data.
show tcp tcb	Display information about the designated TCP connection state.

4. Displaying debugging information

When problem occurs on the network, you can run **debug** to display the debugging information.

Run the following command in management mode. For details, refer to “IP Service Command”.

Run…	To…
debug arp	Display the interaction information about ARP.
debug ip icmp	Display the interaction information about ICMP.
debug ip raw	Display the information about received/transmitted IP message.
debug ip packet	Display the interaction information about IP.
debug ip tcp	Display the interaction information about TCP.
debug ip udp	Display the interaction information about UDP.

43.4.2 Configuring Access List

43.4.2.1 Filtering IP Message

Filtering message helps control the movement of packet in the network. The control can limit network transmission and network usage through a certain user or device. To make packets valid or invalid through the crossly designated interface, our routing switch provides the access list. The access list can be used in the following modes:

Controlling packet transmission on the interface

Controlling virtual terminal line access

Limiting route update content

The section describes how to create IP access lists and how to use them.

The IP access list is an orderly set of the **permit/forbid** conditions for applying IP addresses. The ROS software of our switch tests the address one by one in the access list according to regulations. The first match determines whether the ROS accepts or declines the address. After the first match, the ROS software terminates the match regulations. The order of the conditions is, therefore, important. If no regulations match, the address is declined.

Use the access list by following the following steps:

(1) Create the access list by designating the access list name and conditions.

(2) Apply the access list to the interface.

43.4.2.2 Creating Standard and Extensible IP Access List

Use a character string to create an IP access list.

The standard access list and the extensible access list cannot have the same name.

Run the following command in global configuration mode to create a standard access list:

Run…	To…
ip access-list standard*name*	Use a name to define a standard access list.
deny {*source [source-mask]* | **any**}[**log**] or **permit** {*source [source-mask]* | **any**}[**log**]	Designate one or multiple **permit/deny** conditions in standard access list configuration mode. The previous setting decides whether the packet is approved or disapproved.
Exit	Log out from the access list configuration mode.

Run the following command in global configuration mode to create an extensible access list.

Run…	To…
ip access-list extended *name*	Use a name to define an extensible IP access list.
{**deny	permit**} *protocolsourcesource-maskdestination destination-mask* [**precedence***precedence*] [**tos***tos*] [**established**] [**log**]{**deny	permit**} *protocol***any any**	Designate one or multiple **permit**/**deny** conditions in extensible access list configuration mode. The previous setting decides whether the packet is approved or disapproved. **precedence** means the priority of the IP packet; **TOS** means Type of Service.
Exit	Log out from the access list configuration mode.

After the access list is originally created, any part that is added later can be put at the end of the list. That is to say, you cannot add the command line to the designated access list. However, you can run **no permit** and **no deny** to delete items from the access list.

When you create the access list, the end of the access list includes the implicit deny sentence by default. If the mask is omitted in the relative IP host address access list, 255.255.255.255 is supposed to be the mask.
After the access list is created, the access list must be applied on the route or interface. For details, refer to section 4.2.3 “Applying the Access List to the Interface”.

43.4.2.3 Applying the Access List to the Interface

After the access list is created, you can apply it to one or multiple interfaces including the **in** interfaces and **out** interfaces.

Run the following command in interface configuration mode.

Run…	To…
ip access-group*name* **{in	out}**	Apply the access list to the interface.

The access list can be used on the **in** interfaces and the **out** interfaces. For the standard access list of the **in** interface, the soured address of the packet is to be checked according to the access list after the packet is received. For the extensible access list, the routing switch also checks the destination. If the access list permits the address, the software goes on processing the packet. If the access list does not permit the address, the software drops the packet and returns an ICMP unreachable message.

For the standard access list of the **out** interfaces, after a packet is received or routed to the control interface, the software checks the source address of the packet according to the access list. For the extensible access list, the routing switch also checks the access list of the receiving side. If the access list permits the address, the software will send the packet. If the access list does not permit the address, the software drops the packet and returns an ICMP unreachable message.

If the designated access list does not exist, all packets allows to pass.

43.4.2.4 Extensible Access List Example

In the following example, the first line allows any new TCP to connect the destination port after port 1023. The second line allows any new TCP to connect the SMTP port of host 130.2.1.2.

```
ip access-list extended aaa
permit tcp any 130.2.0.0 255.255.0.0 gt 1023
permit tcp any 130.2.1.2 255.255.255.255 eq 25
interface vlan 10
ip access-group aaa in
```

Another example to apply the extensible access list is given. Suppose a network connects the Internet, you expect any host in the Ethernet can create TCP connection with the host in the Internet. However, you expect the host in the Internet cannot create TCP connection with the host in the Ethernet unless it connects the SMTP port of the mail host.

During the connection period, the same two port numbers are used. The mail packet from the Internet has a destination port, that is, port 25. The outgoing packet has a contrary port number. In fact, the security system behind the routing switch always receives mails from port 25. That is the exact reason why the incoming service and the outgoing service can be uniquely controlled. The access list can be configured as the outgoing service or the incoming service.

In the following case, the Ethernet is a B-type network with the address 130.20.0.0. The address of the mail host is 130.20.1.2. The keyword **established** is only used for the TCP protocol, meaning a connection is created. If TCP data has the ACK or RST digit to be set, the match occurs, meaning that the packet belongs to an existing connection.

```
ip access-list aaa
permit tcp any 130.20.0.0 255.255.0.0 established
permit tcp any 130.20.1.2 255.255.255.255 eq 25
interface vlan 10
ip access-group aaa in
```

43.4.3 Configuring IP Access List Based on Physical Port

43.4.3.1 Filtering IP Message

43.4.3.2 Filtering IP Message

Filtering message helps control the movement of packet in the network. The control can limit network transmission and network usage through a certain user or device. To make packets valid or invalid through the crossly designated interface, our routing switch provides the access list. The access list can be used in the following modes:

Controlling packet transmission on the interface

Controlling virtual terminal line access

Limiting route update content

The section describes how to create IP access lists and how to use them.

The IP access list is an orderly set of the **permit**/**forbid** conditions for applying IP addresses. The ROS software of our switch tests the address one by one in the access list according to regulations. The first match determines whether the ROS accepts or declines the address. After the first match, the ROS software terminates the match regulations. The order of the conditions is, therefore, important. If no regulations match, the address is declined.

Use the access list by following the following steps:

(1) Create the access list by designating the access list name and conditions.

(2) Apply the access list to the interface.

43.4.3.3 Creating Standard and Extensible IP Access List

Use a character string to create an IP access list.

The standard access list and the extensible access list cannot have the same name.

Run the following command in global configuration mode to create a standard access list:

Run…	To…
ip access-list standard*name*	Use a name to define a standard access list.
deny {*source [source-mask]* | **any**}[**log**] or **permit** {*source [source-mask]* | **any**}[**log**]	Designate one or multiple **permit**/**deny** conditions in standard access list configuration mode. The previous setting decides whether the packet is approved or disapproved.
Exit	Log out from the access list configuration mode.

Run the following command in global configuration mode to create an extensible access list.

Run…	To…
ip access-list extended *name*	Use a name to define an extensible IP access list.
{**deny	permit**} *protocolsourcesource-maskdestination destination-mask* [**precedence***precedence*] [**tos***tos*] [**established**] [**log**]{**deny	permit**} *protocol***any any**	Designate one or multiple **permit**/**deny** conditions in extensible access list configuration mode. The previous setting decides whether the packet is approved or disapproved. **precedence** means the priority of the IP packet; **TOS** means Type of Service.
Exit	Log out from the access list configuration mode.

After the access list is originally created, any part that is added later can be put at the end of the list. That is to say, you cannot add the command line to the designated access list. However, you can run **no permit** and **no deny** to delete items from the access list.

When you create the access list, the end of the access list includes the implicit **deny** sentence by default. If the mask is omitted in the relative IP host address access list, 255.255.255.255 is supposed to be the mask.
After the access list is created, the access list must be applied on the route or interface. For details, refer to section 4.2.3 “Applying the Access List to the Interface”.

43.4.3.4 Applying the Access List to the Interface

After the access list is created, you can apply it to one or multiple interfaces including the **in** interfaces and **out** interfaces.

Run the following command in interface configuration mode.

Run…	To…
ip access-group*name* **{in	out}**	Apply the access list to the interface.

The access list can be used on the **in** interfaces and the **out** interfaces. For the standard access list of the **in** interface, the soured address of the packet is to be checked according to the access list after the packet is received. For the extensible access list, the routing switch also checks the destination. If the access list permits the address, the software goes on processing the packet. If the access list does not permit the address, the software drops the packet and returns an ICMP unreachable message.

For the standard access list of the **out** interfaces, after a packet is received or routed to the control interface, the software checks the source address of the packet according to the access list. For the extensible access list, the routing switch also checks the access list of the receiving side. If the access list permits the address, the software will send the packet. If the access list does not permit the address, the software drops the packet and returns an ICMP unreachable message.

If the designated access list does not exist, all packets allows to pass.

43.4.3.5 Extensible Access List Example

1. Port-based IP access list supporting TCP/UDP port filtration

{**deny | permit**} {tcp | udp}

sourcesource-mask [{ [src_portrange begin-port end-port] | [{gt | lt } port] }]

destination destination-mask [{ [dst_portrange begin-port end-port] | [{gt | lt } port] }]

[**precedence***precedence*] [**tos***tos*]

If you configure the access list by defining the port range, pay attention to the following:

- If you use the method of designating the port range to configure the access list at the source side and the destination side, some configuration may fail because of massive resource consumption. In this case, you need to use the fashion of designating the port range at one side, and use the fashion of designating the port at another side.
- When the port range filtration is performed, too many resources will be occupied. If the port range filtration is used too much, the access list cannot support other programs as well as before.

2. Port-based IP access list supporting TCP/UDP designated port filtration

In the following example, the first line allows any new TCP to connect the SMTP port of host 130.2.1.2.

```
ip access-list extended aaa
permit tcp any 130.2.1.2 255.255.255.255 eq 25
interface  f0/10
ip access-group aaa
```

44. IP ACL Application Configuration

44.1 Applying the IP Access Control List

44.1.1 Applying ACL on Ports

After an ACL is established, it can be applied on one or many slots or globally.

Run the following command in global or port configuration mode:

Command	Purpose
config	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **{ip | ipv6} access-group***name* **[egress | vlan {***word* **| add** *word* **remove** *word***|]**	Applies the established IP/IPv6 access list to an interface or cancels it on the interface. **Egress** means that the ACL is applied in an outbound direction. **Vlan** means that the ACL is applied in an inbound VLAN. **Word** stands for the VLAN range table. **Add** means to add the VLAN range table. **Remove** means to delete the VLAN range table.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

45. Routing Configuration

45.1 Configuring RIP

45.1.1 Overview

The section describes how to configure the RIP. For details about RIP commands, refer to the setion “RIP Commands” in “Network Protocol Command Reference”.

The routing information protocol (RIP) is still a commonly used interior gateway protocol (IGP), mainly applied to small-scale networks of the same type. RIP is a classical distance vector routing protocol, which appears in RFC 1058.

RIP uses the broadcast of the UDP packet to exchange the routing information. In the routing switch, the update of the routing information is performed every 30 seconds. If a switch does not receive the update information from the neighboring switches in 180 seconds, the switch is to label the route in the routing table from the neighboring switch as “unavailable”. If the update information is still not received in the following 120 seconds, the switch will delete the route from the routing table.

RIP uses the hop count to balance the weight of different routes. The hop count is the number of switches that a packet gets through from the information source and the information sink. The routing weight of the directly-connected network is **0**. The routing weight of the unreachable network is **16**. Because the range of RIP-using routing weight is small, it is not suitable for the large-scale network.

If the switch has a default route, the RIP declares the route to the pseudo-network 0.0.0.0. In fact, network 0.0.0.0 does not exist. It is just used in RIP to realize the default route. If RIP learns a default route, or the default gateway and the default weight are configured in a switch, the switch is to declare the default network.

RIP sends the routing update information to the designated network interface. If the network that the interface resides is not designated, the network cannot be declared in any RIP update information.

The RIP-2 of our switches supports plain text, MD5 authentication, routing summary, CIDR and VLSM.

45.1.2 Configuring RIP Task List

To configure RIP, the following tasks must be complete first. The task to activate RIP is mandatory, while other tasks are optional.

- Starting up RIP
- Allowing RIP routing to update the single program broadcast
- Applying the offset to the routing weight
- Adjusting the timer
- Specifying the RIP version number
- Activating RIP authentication
- Forbidding routing summary
- Forbidding the authentication of the source IP address
- Configuring the maximum number of routes
- Activating or forbidding horizon split.
- Monitoring and maintaining RIP

45.1.3 Configuring RIP Tasks

45.1.3.1 Starting up RIP

Run the following command in global configuration mode to activate RIP:

Command	Purpose
routerrip	Activates the RIP routing process and enters the switch configuration mode.
network*network-number*<network-mask>	Specifies the network number related to the RIP routing process.

45.1.3.2 Allowing RIP Routing to Update the Single-Program Broadcast

Normally, RIP is a broadcast protocol. To enable the RIP routing update to reach the non-broadcast network, you must configure the switch to enable it to exchange the routing information.

Run the following command in switch configuration mode to enable the routing information exchange:

Command	Purpose
neighbor*ip-address*	Defines a neighboring switch to exchange routing information with the known switch.

Additionally, you can run **ip rip passive** to specify ports to forbid sending the route update information.

45.1.3.3 Applying the Offset to the Routing Weight

The offset list is used to add an offset for the outgoing routes or the incoming routes learned by the RIP. It provides a local mechanism to add the routing weight. You also can use the access list or the interface to limit the offset list. Run the following command in switch configuration mode to add the routing weight.

Command	Purpose
offset { [interface-type number]|* } {**in**|**out**} access-list-name offset	Adds an offset for the routing weight.

45.1.3.4 Adjusting the Timer

The routing protocol uses several timers to judge the frequency of sending route update information, how much time is needed for the route to become ineffective and other parameters. You can adjust these timers to improve the performance of the routing protocol.

You also can adjust the routing protocol to speed up the convergent time of all IP routing arithmetic, rapidly backing up the redundancy switch and ensuring the minimum breakdown time in case of quick recovery.

Run the following command in switch configuration mode to adjust the timer:

Command	Purpose
timers holddown *value*	It means how much time is needed for a route to be deleted from the routing table.
timers expire*value*	It means what interval is needed for a route to be declared ineffective.
timers update*value*	It means the transmission frequency of the routing update information.

45.1.3.5 Specifying the RIP Version Number

The RIP-2 of our switches supports authentication, PIN management, routing summary, CIDR and VLSM. By default, the switch receives RIP-1 and RIP-2, but the switch only sends RIP-1. Through configuration, the switch can receive and send only the packet RIP-1, or only the packet RIP-2. To meet the previous demand, run the following command in switch configuration mode:

Command	Purpose
version {1 | 2}	The switch sends and receives only RIP-1 or only RIP-2.

The previous tasks control the default actions of the RIP. You also can configure a certain interface to change the default actions.

Run the following commands in VLAN configuration mode to control the interface whether to send RIP-1 or RIP-2.

Command	Purpose
ip rip send version 1	The configured interface only sends RIP-1.
ip rip send version 2	The configured interface only sends RIP-2.
ip rip send versioncompatibility	Sends the RIP-2 update message in the form of broadcast.

Run the following commands in interface configuration mode to control the interface whether to receive packet RIP-1 or packet RIP-2

Command	Purpose
ip rip receive version 1	The configured interface only receives RIP-1.
ip rip receive version 2	The configured interface only receives RIP-2.
ip rip receive version 1 2	The configured interface receives RIP-1 and RIP-2.

45.1.3.6 Activating RIP Authentication

RIP-1 does not support authentication. To receive and send the RIP-2 packet, you can activate the RIP authentication on the interface.

On the activated interface, two authentication modes are provided: plain text authentication and MD5 authentication. Each RIP-2 packet uses the plain authentication by default.

For the purpose of security, do not use the plain authentication in the RIP packet because the unencrypted authentication PIN is sent to each RIP-2 packet. You can use the plain authentication without security concern.

Run the following commands in VLAN configuration mode to configure the RIP plain text authentication.

Command	Purpose
ip rip authentication simple	Configures the interface to use the plain authentication.
ip rip password [string]	Configures the PIN of the plain authentication.

Run the following commands in interface configuration mode to configure the MD5 authentication of the RIP:

Command	Purpose
ip rip authentication message-digest	Configures the interface to use the MD5 authentication.
ip rip message-digest-key [*key-ID*] **md5** [*key*]	Configures the PIN and ID of the md5 authentication.

45.1.3.7 Forbidding Routing summary

RIP-2 supports the automatic routing summary by default. RIP-2 routes are collected when passing the boundaries of different networks. The RIP-1 automatic collection function is always in **positive** state.

If there is a separated subnet, you need to forbid the routing summary function to declare the subnet. If the routing summary function is disabled, the switch is to send the routing information of the subnet and the host when passing through the boundaries of different networks. Run the following command in switch configuration mode to disable the automatic routing summary function.

Command	Purpose
no auto-summary	Disables the automatic routing summary function.

45.1.3.8 Forbidding the Authentication of the Source IP Address

By default, the switch authenticates the source IP address in the RIP routing update information. If the address is illegal, the routing update is dropped.

When a switch wants to receive its own update information and the network and neighbor are not configured on the switch of the receiving side, you can forbid the authentication of the source IP address. Normally, you are not recommended to use the command.Run the following command in switch configuration mode to forbid authenticating the source IP address of the incoming routing information:

Command	Purpose
no validate-update-source	Forbids authenticating the source IP address of the incoming routing information.

45.1.3.9 Configuring the Maximum Number of Routes

By default, the local RIP routing table contains up to 1024 routes. When the route number exceeds the maximum number, you cannot add new routes to the routing table. At the same time, the system notifies you that the route number has already reached the maximum number set for the routing table.Run the following command in switch configuration mode to configure the maximum number of routes for the local RIP routing table:

Command	Purpose
maximum-count*number*	Configures the maximum number of routes for the local RIP routing table.
no maximum-count	Resumes the default maximum number of routes.

45.1.3.10 Aactivating or Forbidding Horizon Split

Normally, the switch that connects to the broadcast IP network and adopts the distance vector routing protocol adopts the horizon split to reduce the possibility of the routing loop. The information about the routing loop of horizon split declares itself to the interface that receives the routing information. In this way, the communication among multiple routing switches is improved, especially when the loop breaks. However, it is not so good as to the non-broadcast network. At this time, you may forbid the horizon split.

If the assistant IP address is configured on the interface and the horizon split is activated, the source IP address of the routing update may not conclude all assistant addresses. The source IP address of one routing update contains only one network number.

Run the following commands in VLAN configuration mode to activate or forbid the horizon split.

Command	Purpose
ip rip split-horizon	Activates the horizon split.
no ip rip split-horizon	Forbids the horizon split.

By default, the horizon split is activated on the point-to-point interface; the point-to-multiple interface is forbidden.

Foe details, refer to the section “Horizon Split Example”.

In normal case, do not change the default configuration unless you are sure that the programs need to change states. Remember that if the horizon split is forbidden in a serial port that connects a packet switching network, you must forbid the horizon split in the switches in relative multiple-program group of a network.

45.1.3.11 Monitoring and Maintaining RIP

Monitoring and maintaining RIP needs to display network statistics information, such as RIP parameter configuration, real-time network track. These information help you judge the network usage, solve network problem and the reachabilitiy of network nodes.

Run the following commands in management mode to display all routing statistics information:

Command	Purpose
show ip rip	Display the current state of the RIP protocol.
show ip rip database	Displays all RIP routes.
show ip rip protocol	Displays all RIP-relative information.

Run the following commands in management mode to track routing protocol information:

Command	Purpose
debug ip rip database	Tracks information about adding RIP route to the routing table, deleting route from the routing table and changing route.
debug ip rip protocol	Tracks RIP message.

45.1.4 RIP Configuration Example

Device A and device B are configured as follows:

Device A:

```
interface vlan 11
ip address 192.168.20.81 255.255.255.0
!
interface loopback 0
ip address 10.1.1.1 255.0.0.0
!
router rip
network 192.168.20.0
network 10.0.0.0
!
```

Device B:

```
interface vlan 11
ip address 192.168.20.82 255.255.255.0
interface loopback 0
ip address 20.1.1.1 255.0.0.0
!
router rip
network 192.168.20.0
network 20.0.0.0
!
```

45.2Configuring BEIGRP

45.2.1 Overview

Technologies used by BEIGRP are similar to the distance vector protocol:

- The router makes routing decision according to the information provided by the directly-connecting neighbor;
- The router provides its routing information to its directly-connecting neighbor.However, BEIGRP has more advantages compared with the distance vector protocol:
- BEIGRP saves all routes sent by all neighbors in the topology, not just saving the best route received up to now.
- BEIGRP can query neighbors when it cannot access the destination and has no replaceable route. Therefore, the convergence speed of BEIGRP is as fast as that of the best-link-state protocol.

Diffused Update Algorithm (DUAL) of BEIGRP is the core reason why BEIGRP is better than other traditional distance vector protocols. It always in **active** state and queries the neighbors when it cannot access the destination and there is no replaceable route. Therefore, the collection speed of BEIGRP is rapid.
BEIGRP is a special transmission protocol designed on the basis of EIGRP requirements. BEIGRP is created on the IP protocol. The following requirements are satisfied by BEIGRP:

- The disappearance of new or old neighbors is dynamically detected through the hello message.
- All data transmission is reliable.
- The transmission protocol allows the single-program or multiple-program transmission.
- The transmission protocol can adapt to the change of network conditions and neighbor response.
- BEIGRP can limit its bandwidth occupancy rate according to requirements.

45.2.2 BEIGRP Configuration Task List

The BEIGRP configuration includes the following tasks. Among the tasks, the task to activate the BEIGRP is mandatory; other tasks can be selectively performed according to requirements.

- Activating BEIGRP
- Configuring bandwidth occupancy percent
- Regulating account coefficient of BEIGRP compound distance
- Regulating the compound distance through offset
- Disabling automatic route summary
- Customizing route summary
- Configuring forwarding route
- Configuring other BEIGRP parameters
- Monitoring and maintaining the running of BEIGRP

45.2.3 BEIGRP Configuration Task

45.2.3.1 Activating BEIGRP

Perform the following operations to create a BEIGRP process:

Command	Purpose
router beigrp*as-number*	Adds a BEIGRP process in global configuration mode.
network*network-number network-mask*	Adds network segment to the BEIGRP process in route configuration mode.

After the above configuration is complete, BEIGRP starts to run on all interfaces of the network segment. BEIGRP finds new neighbors through hello message and interacts original routes through update information.

45.2.3.2 Configuring Bandwidth Occupancy Percent

In default state, BEIGRP occupies up to 50% of bandwidth. You can run the following command in VLAN interface configuration mode to adjust the bandwidth that can be used by BEIGRP.

Command	Purpose
ip beigrp bandwidth-percent*percent*	Configures the maximum bandwidth percent for the BEIGRP message.

45.2.3.3 Regulating Coefficient of BEIGRP Compound Distance

In some cases, the coefficient of BEIGRP compound distance need be regulated, which finally affects the routing strategy. Though the default coefficient used by BEIGRP is suitable for most network conditions, you need to regulate it in some special cases. The regulation may cause great change of the whole network. Be careful when you perform this regulation.

Run the following command in route configuration mode:

Command	Purpose
metric weights*k1 k2 k3 k4 k5*	Regulates the coefficient of the BEIGRP compound distance.

45.2.3.4 Regulating the Compound Distance Through Offset

You can add all incoming and outgoing routes purposively according to requirements using the offset table, or add compound distances of several suitable routes. The purpose is to affect the routing result of the router. In the configuration process, you can selectively specify the access list or the application interface in the offset list to further confirm routes which the offset is added to.

Command	Purpose
offset{type number | *} {**in** | **out**} access-list-name offset	Applies a offset table.

45.2.3.5 Disabling Automatic Route summary

The automatic collection of BEIGRP is different from that of other dynamic routing protocols. It complies with the following regulations:

- When multiple networks in a BEIGRP process are defined, a summary route of the defined network is generated if at least one subnet of the network is in the BEIGRP topology table.
- The created summary route is oriented to the Null0 interface has the minimum distance of all subnets. The summary route is also added to the main IP routing table. Its management distance is 5 (which cannot be configured).
- When the update information is sent to neighbors in different main IP networks, the subnet of the summary route of rule 1 and rule 2 is canceled. Only the summary route is sent.
- Subnets that do not belong to any network defined in the BEIGRP procedure are not be collected.

In some network conditions, you may hope to notify neighbors of each detailed route. In this case, you need run the following command:

Command	Purpose
no auto-summary	Disables the automatic routing summary.

45.2.3.6 Customizing Routing summary

When the automatic routing summary cannot meet the requirements, you can configure routing summary on every interface where BEIGRP runs, and specify the destination network segments that are to perform routing summary. The interfaces where routing summary is configured will not send any detailed routing update information that belongs to the routing summary network segment. Other interfaces do not get affected.

The routing summary operations comply with the following regulations:

- After a routing summary command is configured on an interface, a summary route of the defined network is generated if at least one subnet of the network is in the BEIGRP topology table.
- The created summary route is oriented to the Null0 interface has the minimum distance of all subnets. The summary route is also added to the main IP routing table. Its management distance is 5 (which cannot be configured).
- When the routing update information is sent on the interface where routing summary is configured, the detailed routes belonging to routing summary network segment are to cancelled. Other routing update information will not be affected.

Command	Purpose
ip beigrp summary-address *ip address address mask*	Configures routing summary on the interface.

45.2.3.7 Configuring Forwarding Route

When BEIGRP forwards other types of routes, BEIGRP complies with the following regulations:

- If the present route is static or directly-connected, the command **default-metric** need not be configured and other compound distance parameters (bandwidth, delay, reliability, effective load and MTU) are directly obtained from the current port.
- If the present routes are routes of other BEIGRP processes, the **default-metric** command need not be configured and its compound distance parameters are directly obtained from the BEIGRP process.
- The **default-metric** command must be configured when routes of other protocols such as rip and ospf are sent. The suitable distance of the route forwarding is determined by the configuration value. If the command is not configured, the route forwarding cannot function.

On the switch where BEIGRP and RIP simultaneously run, to make BEIGRP neighbors learn the routes learned by the RIP protocol in the local switch, run the following command.

Command	Purpose
default-metric bandwidth delay reliability loading mtu	Configures the default vector distance for route forwarding.
redistribute *protocol*[**route-map** *name*]	Forwards routes to the BEIGRP protocol.

45.2.3.8 Configuring Other BEIGRP Parameters

To adjust to different network conditions and make BEIGRP more efficient, you need modify the following parameters:

- Modify the interval for BEIGRP to send hello message and neighbor timeout time.
- Disable the horizon split.

45.2.3.8.1 Modify the interval for BEIGRP to send hello message and neighbor timeout time

The following objectives needed bythe BEIGRP hello protocol to perform correct BEIGRP operations are listed:

- It can find new accessible neighbor. The detection of neighbor is an automatic process without any manual configuration.
- It authenticates neighbor configuration and only allows communication between neighbors that are configured in compatible mode.
- It continuously monitors neighbor's usability and detects the disappearance of neighbors.

The router sends the hello multiple-program broadcast packet on the interfaces where BEIGRP runs. Each BEIGRP-supporting router receives these multiple-program broadcast packets. Therefore, all neighbors can be found.

The Hello protocol uses two timers to detect the disappearance of neighbors. The hello interval specifies the transmission frequency of the BEIGRP hello message on the interface of the router. **hold timer** specifies the time to declare the neighbor is dead when the router cannot receives data from the designated neighbor. After any type of the BEIGRP packet is received from the neighboring router, the value of **hold timer** needs to be reset.

Different network types or network bandwidth adopt different default values of the hello timer.

Interface Type Packaging		Hello Timer (second)	Hold Timer (second)
LAN Interface	Any	5	15

In the Hello protocol, different default values of the timer may cause BEIGRP neighbors that connect the same IP subnet to use different hello timers or hold timers. To prevent the problem from occurring, you need to specify the hold timer in the hello packet of each router. Each BEIGRP router uses the hold timer specified in the hello packet of the neighboring router to judge whether the neighbor times out. In this way, trouble-detecting timers of different neighbors appears in one WAN topology. In special cases, the default value of the timer cannot fulfill actual requirements. To modify the interval to send the hello message, run the following command:

Command	Purpose
ip beigrp hello-interval*seconds*	Modifies the interval to send the hello message on the interface.

To modify the timeout timer of the neighbor, run the following command:

Command	Purpose
ip beigrp hold-time*seconds*	Modifies the timeout time of the neighbor.

45.2.3.8.2 Disabling the horizon split

The horizon split function is normally adopted. It prevents a received routing information from broadcasting out from the same interface, avoiding route loop. In some cases, the horizon split function is not the best choice, so you can run the following command to disable the horizon split function:

Command	Purpose
no ip beigrp split-horizon	Disables the horizon split function.

45.2.3.9 Monitoring and Maintaining BEIGRP

Run the following command to clear the neighboring relationship.

Command	Purpose
clear ip beigrp neighbors [*interface*]	Clear the neighboring relationship.

Run the following commands to display all BEIGRP statistics information:

Command	Purpose
show ip beigrp interfaces [*interface*] *[as-number*]	Displays the information about BEIGRP interface.
show ip beigrp neighbors[*as-number* | *interface*]	Displays the information about BEIGRP neighbors.
show ip beigrp topology [*as-number* | all-link | summary | active]	Displays the information about BEIGRP topology table.

45.2.4 BEIGRP Configuration Example

In the following example, the summary route that sends network segment 10.0.0.0/8 on VLAN11 is configured. All subnet routs of the network segment will not be notified of the neighbor. At the same time, the automatic summary of the BEIGRP process is disabled.

interface vlan 11

ip beigrp summary-address 1 10.0.0.0 255.0.0.0

!

router beigrp 1

network 172.16.0.0 255.255.0.0

no auto-summary

45.3Configuring OSPF

45.3.1 Overview

The chapter describes how to configure the OSPF. For the details of OSPF commands, refer to relative sections about OSPF commands.

OSPF is a IGP routing protocol developed by the OSPF team of IETF. OSPF designed for the IP network supports IP subnets and exterior routing information identifier, message authentication and IP multicast. The OSPF function of our switches complies with the requirements of OSPF V2 (See RFC2328). The following table lists some key features in reality.

Key Feature	Description
Stub domain	Support the stub domain.
Rout forwarding	Routes that are learned by any routing protocol can be forwarded to other routing protocol domain, which means that OSPF can enter routes that RIP learned in the automatic domain. The routes that OSPF learns also can be exported to RIP. Among the automatic domains, OSPF can enter the routes that BGP learns; OSPF routes also can be exported to BGP.
Authentication	Among neighboring switches in a domain, the plain text and MD5 authentication are supported.
Routing interface parameters	The configurable interface parameters include the output cost, resending interval, interface output delay, the priority of the switch, the interval to judge the shutdown of the switch, the interval of the hello packet and the authentication PIN.
Virtual link	The virtual link is supported.
NSSA area	See RFC 1587.
OSPF in the on-demand circuit	See RFC 1793.

45.3.2 OSPF Configuration Task List

OSPF requires the routing data exchange among switches, ABR and ASBR in the whole domain. To simplify the configuration, you can make them run in the default settings without authentication. However, if you modify a certain parameter, make sure that the modified parameter is the same on all switches.

You need to complete the following tasks to configure OSPF. The task to activate OSPF is mandatory, while other configurations are optional.

- Starting up OSPF
- Configuring interface parameters of OSPF
- Configuring OSPF in different physical networks
- Configuring OSPF area parameters
- Configuring NSSA domain of OSPF
- Configuring routing summary in the OSPF area
- Configuring forwarded routing summary
- Generating default route
- Choosing route ID on the LOOPBACK interface
- Configuring the management distance of OSPF
- Configuring timer for route calculation
- Monitoring and maintaining OSPF

For route forwarding configuration, refer to relevant content about the IP routing protocol configuration

45.3.3 OSPF Configuration Task

45.3.3.1 Starting up OSPF

Similar to other routing protocols, before activating OSPF, you have to create the OSPF routing process. In the creation of the routing process, An IP address range related to the processing and a relevant domain ID need be distributed.

Run the following commands in global configuration mode to start up OSPF:

Command	Purpose
router ospf*process-id*	Activates the OSPF routing protocol and enters the switch configuration mode.
network*addressmask***area***area-id*	Configures the running interface of OSPF and the relevant interface domain ID.

45.3.3.2 Configuring Interface Parameters of OSPF

You are allowed to modify OSPF parameters of the interface according to actual requirements. When you modify a parameter, make sure that the parameter on all switches of the interconnected network is same. Run the following commands in interface configuration mode to configure the interface parameters:

Command	Purpose
ip ospf cost*cost*	Configures the value of the transmission packet on the OSPF interface.
ip ospf retransmit-interval *seconds*	Configures the seconds of LSA resending between neighbors on the same OSPF interface.
ip ospf transmit-delay*seconds*	Configures the time to send LSA on an OSPF interface (unit: second).
ip ospf priority*number*	Configures the priority number for the routing switch to become the OSPF DR routing switch.
ip ospf hello-interval*seconds*	Configures the interval to send the hello packet on the OSPF interface.
ip ospf dead-interval*seconds*	Configures the dead interval. In the prescribed interval, if the hello packet from neighbors is not received, the neighboring switch is considered to be in shutdown state.
ip ospf authentication-key*key*	Represents the authentication password of the neighboring route in a network segment. The OSPF authentication password is adopted.
ip ospf message-digest-key*keyid* md5 *key*	Requires OSPF to use the MD5 authentication.
ip ospf passive	Configures the state of the hello message on a port.

45.3.3.3 Configuring OSPF in Different Physical Networks

OSPF divides the physical media of the network into the following classes:

- Broadcast network (Ethernet, Token Ring, FDDI)
- Non-broadcast and multi-access network (SMDS, Frame Relay, X.25)
- Point-to-point network (HDLC, PPP)

The X.25 and frame-relay network provides optional broadcast capability. You can configure the OSPF to run in the broadcast network through the **map** command. For details of the map command, refer to the description of the map command in *WAN Command Reference*.

45.3.3.4 Configuring OSPF Network Type

No matter what physical media type your network belongs to, you can configure your network to be the broadcast network or the non-broadcast and multi-access network. This feature allows you configure the network flexibly. You can configure the broadcast network to the non-broadcast and multi-access network; you also can configure the non-broadcast network, such as X.25, Frame Relay and SMDS, to the broadcast network. The feature also eases the neighbor's configuration. For details, refer to contents about OSPF configuration of non-broadcast network.

Configuring the non-broadcast and multi-access network to a broadcast network or a non-broadcast network is to suppose that the virtual link exists between two random switches or to suppose that the network is a mesh network. The previous configuration is unreal because it costs too much. You may configure the non-broadcast and multi-access network to a partly meshed network. To save the expense, you can configure the non-broadcast and multi-access network to a point-to-multipoint network. The disconnected switches can exchange the routing information with each other through the virtual link.

The interface connecting the OSPF point to other points is defined as the point-to-multipoint network interface. It creates lots of host routes. Comparing with the non-broadcast and multi-access network or the point-to-point network, the OSPF point-to-multipoint network has the following advantages:

- The point-to-multipoint network is easy to configure. The configuration does not need the neighbor configuration commands. It only needs an IP address and there is no DR.
- The point-to-multipoint network does not need the wholly meshed network's topology, so the expense is smaller.
- It is more reliable. The connection can keep working even if the virtual link fails.

Run the following commands in interface configuration mode to configure the type of the OSPF network.

Command	Purpose
ip ospf network {broadcast | non-broadcast | {point-to-multipoint [non-broadcast] }}	Configures the network type of the OSPF.

The network of the switch is a broadcast network.

45.3.3.5 Configuring OSPF Area Parameters

The configurable area parameters include authentication, stub area and the value of the default routing summary. The authentication is based on the password protection.

Stub area is an area which exterior routes are not sent to. ABR generates a default exterior route to enter the stub area, enabling stub area to connect exterior networks out of the automatic area. To utilize the feature that OSPF stub supports, the default route must be used in the stub area. To further reduce the LSAs to enter the stub area, you need select the option **No Summary** in the ABR.

Run the following command in switch configuration mode to set area parameters:

Command	Purpose
area*area-id***authentication simple**	Activates the authentication of the OSPF area.
area*area-id***authentication message-digest**	Specifies the MD5 authentication as the authentication OSPF.
area*area-id***stub** [no-summary]	Defines a stub area.
area *area-id***default-cost** *cost*	Set the value of the default route in the stub area.

45.3.3.6 Configuring Routing Summary in the OSPF Area

The feature enables the ABR to broadcast a summary route to other areas. In OSPF, ABR is to broadcast every network to other areas. If the network number is distributed serially according to some method, you can configure ABR to broadcast a summary route to other areas. The summary route can cover all networks in a certain range.

Run the following command in switch configuration mode to set the address range:

Command	Purpose
area*area-id***range***address mask*	Sets the address range of the summary area.

45.3.3.7 Configuring Forwarded Routing Summary

When the routes are distributed from other areas to the OSPF area, each route will be uniquely broadcast in the exterior LSA method. However, you can configure the switch to broadcast a route, which can cover a certain address area. This method reduces the size of the OSPF link state database.

Run the following command in switch configuration mode to configure the summary route:

Command	Purpose
summary-address*prefixmask* [not advertise]	Describes the address and mask covering the distributed route. Only one summary route is broadcast.

45.3.3.8 Generating Default Route

ASBR requires generating a default route to enter the OSPF route area. When you configure the switch to distribute the route to the OSPF area, the route automatically becomes ASBR. However, default ASBR does not generate the default route to enter the OSPF routing area.

Run the following command in switch configuration mode to force ASBR to generate the default route.

Command	Purpose
default-information originate [always] [route-map *map-name*]	Forces ASBR to generate the default route.

45.3.3.9 Choosing Route ID Through the LOOPBACK Interface

OSPF takes the maximum IP address configured on the interface as the switch ID. If the interface connecting the IP address changes to the Down state, or the IP address is cancelled, the OSPF process is to recalculate the new switch ID and resend the routing information from all interfaces.

If a **loopback** interface is configured with the IP address, the switch takes its IP address as its ID. The **loopback** interface will never be at the **down** state. Therefore, the routing table is stable.

The switch preferentially takes the **loopback** interface as the switch ID. It also chooses the maximum IP address as the switch ID. If the loopback interface does not exist, the maximum IP address of the switch is taken as the switch ID. You cannot specify OSPF to use any special interface.

Run the following command in global configuration mode to configure the IP loopback interface:

Command	Purpose
interface loopback 0	Creates a loopback interface and enters the interface configuration mode.
ip address*ip-address mask*	Distributes an IP address for an interface.

45.3.3.10 Configuring OSPF Management Distance

The management distance stands for the credit level of the routing information source, such as the single switch or a group of switches. Generally, the management distance is an integer between 0 and 255. The bigger the number is, the lower the credit level is. If the management distance is 255, the routing information source is not trusted or should be omitted.

OSPF uses three kinds of different management distances: intra-area, inter-area and external. The routes in an area are called **intra-area** routes; routes to other areas are called **inter-area** routes; routes that are distributed from other routing protocol areas are called **external** routes. The default value of each type of routes is 110.

Run the following command in switch configuration mode to configure the distance vale of OSPF.

Command	Purpose
distance ospf [intra-area *dist1*] [inter-area *dist2*] [external *dist3*]	Modifies the management distance value of the intra-area routes, inter-area routes and external routes.

45.3.3.11 onfiguring Timer for Routing Calculation

You can configure the delay between when OSPF receives the topology change information and when the calculation is started. You also can configure the interval of continuously calculating SPF. Run the following command in switch configuration mode.

Command	Purpose
timersdelay*delaytime*	Sets the delay of routing calculation in an area.
timershold*holdtime*	Sets the minimum interval of routing calculation in an area.

45.3.3.12 onitoring and Maintaining OSPF

The network statistics information includes the content of IP routing table, cache and database. All information help you to judge the usage of network resources, solve network problems, learn the reachability of network nodes and to find routes where packets get through the network.

Run the following commands to display all routing statistics information:

Command	Purpose
Show ipospf [*process-id*]	Displays the general information of the OSPF process.
Show ip ospf [*process-id*] **database** **show ip ospf** [*process-id*] **database [router]** [*link-state-id*] **show ip ospf** [*process-id*] **database [router] [self-originate]** **show ip ospf** [*process-id*] **database [router] [adv-router** [*ip-address*]] **show ip ospf** [*process-id*] **database[network]** [*link-state-id*] **show ip ospf** [*process-id*] **database [summary]** [*link-state-id*] **show ip ospf** [*process-id*] **database [asbr-summary]** [*link-state-id*] **show ip ospf** [*process-id*] **database [external]** [*link-state-id*] **show ip ospf** [*process-id*] **database [database-summary]**	Displays the relative information about OSPF database.
show ip ospf border-routers	Displays internal items in the routing table between ABR and ASBR.

show ip ospf interface	Displays information about the OSPF interface.
show ip ospf neighbor	Displays information about neighbors of OSPF according to the interface.
debug ip ospf adj	Monitors the procedure of establishing OSPF adjacency.
debug ip ospf events	Monitors the OSPF interface and neighboring events.
debug ip ospf flood	Monitors the flooding of OSPF database.
debug ip ospf lsa-generation	Monitors the LSA generation of OSPF.
debug ip ospf packet	Monitors the OSPF message.
debug ip ospf retransmission	Monitors the message resending of OSPF.
debug ip ospf spf **debug ip ospf spf intra** **debug ip ospf spf inter** **debug ip ospf spf external**	Monitors the SPF calculation route of OSPF.
debug ip ospf tree	Monitors SPF tree establishment of OSPF.

45.3.4 OSPF Configuration Example

45.3.4.1 VLSM Configuration Example

OSPF and static routes support VLSMs. Through VLSMs, different masks on different interfaces can use the same network number. The IP address is thus saved and the address space is effectively utilized.

In the following example, a 30-digit subnet mask is used. A 2-digit address space is reserved for the host address of the serial port. Two host addresses are enough for the point-to-point serial link.

interface vlan 10

ip address 131.107.1.1 255.255.255.0

! 8 bits of host address space reserved for ethernets

interface vlan 11

ip address 131.107.254.1 255.255.255.252

! 2 bits of address space reserved for serial lines

! Router is configured for OSPF and assigned AS 107

router ospf 107

! Specifies network directly connected to the router

network 131.107.0.0 0.0.255.255 area 0.0.0.0

45.3.4.2 OSPF Route and Route Distribution Configuration Example

OSPF demands to exchange information among internal switches, ABR and ASBR. In the minimum configuration, the OSPF-based switch can work with default parameter settings. There is no authentication demand.

The following are three configuration examples:

The first example shows basic OSPF commands.

The second example shows how to configure internal routing switches, ABR and ASBR in an automatic system.

The third example shows how to use all kinds of OSPF tools.

45.3.4.2.1 Basic OSPF Configuration Example

The following example shows how to configure a simple OSPF. Activate the routing process 9; connect Ethernet interface 0 to area 0.0.0.0; meanwhile, send RIP to OSPF or send OSPF to RIP.

```
interface vlan 10
ip address 130.130.1.1 255.255.255.0
ip ospf cost 1
!
interface vlan 10
ip address 130.130.1.1 255.255.255.0
!
router ospf 90
network 130.130.0.0 255.255.0.0 area 0
redistribute rip
!
router rip
network 130.130.0.0
redistribute ospf 90
```

45.3.4.2.2 Example to Basic Configuration of Internal Routing Switch, ABR and ASBR

In the following example, four area Ids are distributed to four IP address ranges. The routing process 109 is activated. Four areas are area 10.9.50.0, area 0, area 2 and area 3. The masks of areas 10.9.50.0, 2 and 3 are designated with address range. Area 0 includes all networks.

```
router ospf 109
network 131.108.20.0 255.255.255.0 area 10.9.50.0
network 131.108.0.0 255.255.0.0 area 2
network 131.109.10.0 255.255.255.0 area 3
network 0.0.0.0 0.0.0.0 area 0
```

Interface vlan10 is in area 10.9.50.0:

interface vlan 10

ip address 131.108.20.5 255.255.255.0

Interface vlan11 is in area 2:

interface vlan 11

ip address 131.108.1.5 255.255.255.0

Interface vlan12 is in area 2:

interface vlan 12

ip address 131.108.2.5 255.255.255.0

Interface vlan13 is in area 3:

interface vlan 13

ip address 131.109.10.5 255.255.255.0

Interface vlan14 is in area 0:

interface vlan 14

ip address 131.109.1.1 255.255.255.0

Interface vlan 100 is in area 0:

interface vlan 100

ip address 10.1.0.1 255.255.0.0

The function of network area configuration command has its order, so the sequence of the commands is important. The switch matches the IP address/mask pair according to the order. For details, refer to section *OSPF Commands*.

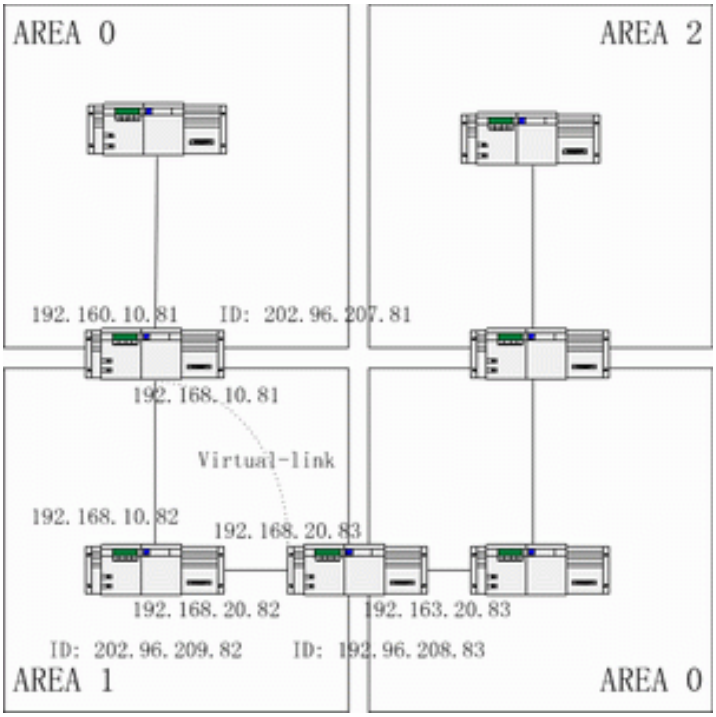
Check the first network area. The interface subnet 131.108.20.0 configured for area ID 10.9.50.0 is 131.108.20.0. The Ethernet interface is configured to 0. The interface is therefore in area 10.9.50.0.

In the second area, if the previous process is adopted to analyze other interfaces, interface 1 is matched. Therefore, interface 1 connects area 2.

Continue matching other network areas. Note that the last network area command is an exception, which means that all the remnant interfaces connect network area 0.

45.3.4.2.3 Complex Configuration of Interior Switches, ABR and ASBR

The following example shows how to configure multiple switches in a single OSPF automatic system. The following figure shows the network topology of the configuration example.



Configure switches according to the previous figure.

RTA:

interface loopback 0

ip address 202.96.207.81 255.255.255.0

!

interface vlan 10

ip address 192.168.10.81 255.255.255.0

!

interface vlan 10

ip address 192.160.10.81 255.255.255.0

!

router ospf 192

network 192.168.10.0 255.255.255.0 area 1

network 192.160.10.0 255.255.255.0 area 0

!

RTB:

interface loopback 0

ip address 202.96.209.82 255.255.255.252

!

interface vlan 10

ip address 192.168.10.82 255.255.255.0

!

interface vlan 11

ip address 192.160.20.82 255.255.255.0

!

router ospf 192

network 192.168.20.0 255.255.255.0 area 1

network 192.168.10.0 255.255.255.0 area 1

!

RTC:

interface loopback 0

ip address 202.96.208.83 255.255.255.252

!

interface vlan 10

ip address 192.163.20.83 255.255.255.0

!

interface vlan 11

ip address 192.160.20.83 255.255.255.0

!

router ospf 192

network 192.168.20.0 255.255.255.0 area 1

network 192.163.20.0 255.255.255.0 area 0

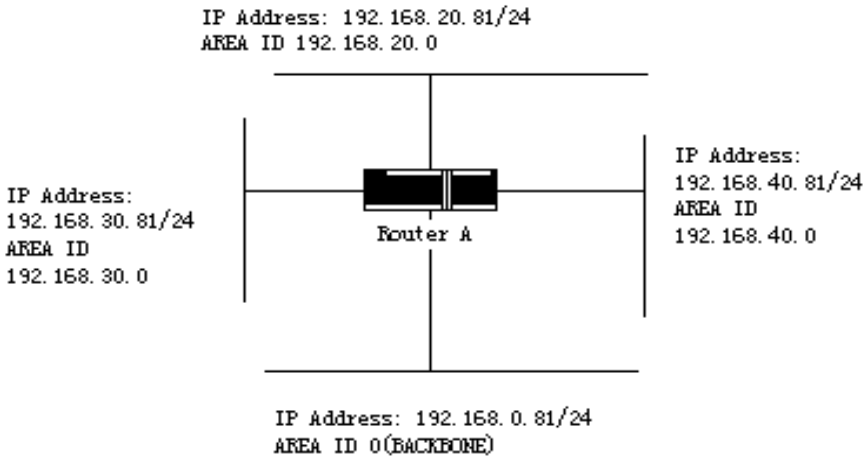
!

45.3.4.3 Configuring Complex OSPF on ABR Switch

The following case describes ABR configuration tasks.

- Configuring basic OSPF
- Distributing routes

The following figure shows the address range and area distribution.



The following are basic configuration tasks:

(1) Configuring the address range for Ethernets 0 to 3

(2) Activating OSPF on every interface

(3) Setting the authentication password for each area and network

(4) Setting the link state value and other interface parameters

Note

Use one **area** command respectively to set authentication parameters and stub area. You can use one command to set these parameters.

- Set backbone area (Area 0).

The configuration tasks relative with the distribution are listed in the following:

- Distribute IGRP routes and RIP routes to enter OSPF parameter setting (including metric-type, metric, tag and subnet).
- Distribute IGRP routes and OSPF routes to RIP.

The following is an OSPF configuration example.

```
interface vlan 10
ip address 192.168.20.81 255.255.255.0
ip ospf password GHGHGHG
ip ospf cost 10
!
```

```
interface vlan 11
ip address 192.168.30.81 255.255.255.0
ip ospf password ijklmnop
ip ospf cost 20
ip ospf retransmit-interval 10
ip ospf transmit-delay 2
ip ospf priority 4
!
interface vlan 12
ip address 192.168.40.81 255.255.255.0
ip ospf password abcdefgh
ip ospf cost 10
!
interface vlan 13
ip address 192.168.0.81 255.255.255.0
ip ospf password ijklmnop
ip ospf cost 20
ip ospf dead-interval 80
!
router ospf 192
network 192.168.0.0 255.255.255.0 area 0
network 192.168.20.0 255.255.255.0 area 192.168.20.0
network 192.168.30.0 255.255.255.0 area 192.168.30.0
network 192.168.40.0 255.255.255.0 area 192.168.40.0
area 0 authentication simple
area 192.168.20.0 stub
area 192.168.20.0 authentication simple
area 192.168.20.0 default-cost 20
area 192.168.20.0 authentication simple
area 192.168.20.0 range 36.0.0.0 255.0.0.0
area 192.168.30.0 range 192.42.110.0 255.255.255.0
area 0 range 130.0.0.0 255.0.0.0
area 0 range 141.0.0.0 255.0.0.0
redistribute rip
```

RIP is in network 192.168.30.0.

```
router rip
network 192.168.30.0
redistribute ospf 192
!
```

45.4Configuring BGP

The chapter describes how to configure the Boundary Gateway Protocol (BGP). For details about BGP commands, refer to section “BGP Commands”. BGP is an Exterior Gateway Protocol (EGP) defined in RFC1163, 1267 and 1771. BGP allows to create a routing selection mechanism among the autonomous systems. The routing selection mechanism can ensure automatic exchange of routing selection information among the auto-managed system without loop.

45.4.1 Overview

45.4.1.1 BGP Introduction

In BGP, each route contains a network number, auto-managed system list that the route passes (as-path) and other attribute lists. Our switch software supports version 4 BGP defined in RFC1771. The basic function of BGP is to exchange network reachable information with other BGP systems, including information about the AS routing table. The information about AS routing table can be used to construct the AS connection figure and apply AS-level routing strategy through the AS connection figure. BGP Version 4 supports CIDR. CIDR reduces the size of the routing table by creating the summary route. The super network, therefore, is generated. CIDR cancels the notion of BGP network class and supports IP prefix broadcast. The CIDR can be transmitted through OSPF, enhanced IGRP, ISIS-IP and RIP2.

EGP is different from IGP with its enhanced control capability. BGP provides multiple optional methods to control the routes.

- Use neighbor-based access-list, aspath-list and prefix-list to filter the route. Or use port-based access-list and prefix-list to filter the route or the **Nexthop** attribute of the route.
- Use route-map to modify BGP route's attributes such as MED, Local Preference and Weight.
- To interact with dynamic IGRPs such as ospf and rip, you can use the **distribute** command to redistribute the route. The BGP routing information is thus automatically generated. The BGP route can be generated by manually configuring **network** and **aggregate**. When the BGP route is generated, you can use **route-map** to set the attribute of the route.
- To control the priority of BGP routes in the system, run the distance command to set the management distance of the BGP route.

45.4.1.2 BGP Route Selection

The decision procedure of BGP is based on route attribute comparing. When there are multiple routes to reach the same network, BGP selects the optimal route. The procedure of BGP selecting the optimal route is shown as follows:

- If the next hop cannot be reached, the optimal route is considered.
- If the route is an internal one and synchronization is activated, the optimal route is not considered when the route is not in IGP.
- The route with maximum weight is preferentially selected.
- If all routes have the same weight, the route with maximum local priority is preferentially selected.
- If all routes have the same local priority, the route generated by the local router is preferentially selected. For example, routes may be generated when the local router runs the **network** command or the **aggregate** command or the IGP routes are forwarded.
- If the local priority is same, or if the routes are not generated by the local router, the route with the shortest AS path is first selected.
- If the AS paths are same, the route with the smallest Origin attribute value (IGP < EGP < INCOMPLETE) is first selected.
- If the Origin attribute values is the same, the route with the smallest MED value is first selected. The MED value compare is for the routes from the same neighboring AS unless **bgp always-compare-med** is activated.
- If all routes have the same MED, the EBGP is first selected. All paths in the autonomous system are taken as IBGP.

If each route has the same connection attribute, the route with the smallest **router-id** is first selected.

45.4.2 BGP Configuration Task

45.4.2.1 Configuring Basic BGP Characteristic

BGP configuration tasks can be classified into two groups: basic tasks and advanced tasks. The first two items of basic tasks are mandatory for BGP configuration. Other items in basic tasks and advanced tasks are optional.

45.4.2.1.1 Activating BGP Routing Choice

Run the following commands in global configuration mode to activate BGP route selecting:

Command	Purpose
router bgp *autonomous-system*	Activates the BGP routing process in router configuration mode.
network*network-number/masklen* *[route-map route-map-name]*	Marks the network as the local autonomous system and adds it to the BGP table.

(1) For EGP, when you use the router configuration command **network** to configure an IP network, you can control which network can get notification. It is contrary for IGP. For example, The RIP protocol uses the **network** command to decide where the update is sent.

(2) You can use the **network** command to add the IGP route to the BGP routing table. The router resources, such as the configured RAM, decide the upper limit of the available **network** command. As an additional choice, you also can run the **redistribute** command.

45.4.2.1.2 Configuring BGP Neighbor

To exchange routing information with the outside, the BGP neighbor must be configured.

BGP supports two neighbors: IBGP and EBGP. The interior neighbors are in the same AS. The exterior neighbors are in a different AS. In general, exterior neighbors are closely adjacent and share a subnet; interior neighbors are in anyplace of the same AS.

Run the router configuration command to configure the BGP neighbors:

Command	Purpose
neighbor {*ip-address* } **remote-as***number*	Designates a BGP neighbor.

For details, refer to the section “BGP Neighbor Configuration Example”.

45.4.2.1.3 Configuring BGP Soft Reconfiguration

In general, BGP neighbors exchange all routes only when the connection is created; they then exchange only the changed routes later. If the configured routing policy is changed, you must clear the BGP sessions before you apply the changed routing policy to the received routes. However, clearing the BGP session can disable the high-speed cache and seriously undermine network running. You are recommended to adopt the soft reconfiguration function because it helps to configure and activate policy without clearing BGP sessions. Currently, the new soft reconfiguration function can be applied to each neighbor. The new soft reconfiguration is applied to the incoming update generated by neighbors, it is called incoming soft reconfiguration. When the new soft reconfiguration is used to send the outgoing update to the neighbor, it is called outgoing soft reconfiguration. After the incoming soft reconfiguration is run, new input policies validates. After the outgoing soft reconfiguration is run, the new local output policy validates without resetting BGP session.

In order to generate the incoming update without resetting BGP session, the router of the local BGP session should restore the received incoming update without modification. Whether the incoming update is received or declined by the current incoming policy is not in the consideration. In this case, the memory will be badly occupied. The outgoing reconfiguration has no extra memory cost, so it is always valid. You can trigger the outgoing soft reconfiguration on the other side of the BGP session to validate the new local incoming policy. To permit the incoming soft reconfiguration, you need to configure BGP to restore all received routing update. The outgoing soft reconfiguration does not require pre-configuration.

Run the following command to configure BGP soft reconfiguration:

Command	Purpose
Neighbor { ip-address } soft-reconfiguration [inbound]	Configures BGP soft reconfiguration.

45.4.2.1.4 Resetting BGP Connection

Once two routers are defined as BGP neighbors, they will create a BGP connection and exchange route choice information. If the BGP routing policy is modified afterwards, or if other configuration is changed, you must reset the BGP connection to validate the changed configuration. Run one of the following commands to reset the BGP connection.

Command	Purpose
clear ip bgp *	Resets all BGP connections.
clear ip bgp *address*	Resets a special BGP connection.

45.4.2.1.5 Configuring Synchronization Between BGP and IGPs

If an AS sends information at the third AS through your AS, the internal routing state of your AS must be the same as the routing information that the AS broadcasts to other ASs. For example, before all routers in your AS learn the routes through IGP, your AS may receive routing information from your BGP that some routers cannot route. The synchronization between BGP and IGP is that the BGP does not broadcast the routing information until all IGP routers in the AS learn the routing information. The synchronization is activated by default.

In some cases, you need not to perform the synchronization between BGP and IGP. If other ASs are not allowed to send data through your AS, or if all routers in your AS run BGP, the synchronization will be cancelled. After the synchronization is cancelled, your IGP can carry a few routes and BGP will aggregate more rapidly.

Run the following command to cancel the synchronization:

Command	Purpose
no synchronization	Cancel the synchronization between BGP and IGP.

When cancelling the synchronization, you need to run the command **clear ip bgp** to clear BGP sessions. For details, refer to the section “Example for Neighbor-Based BGP Path Filtration”.

In general, only one or two routes are forwarded to your IGP and become the exterior routes in IGRP or the BGP session sponsor generates a default AS route. When the routes are forwarded from BGP to IGP, only the routes obtained through EBGP can be forwarded. In most cases, your IGP is not redistributed to BGP; the networks in the AS are listed by running the router configuration command **network**; your network, therefore, will be broadcast. The network listed in this way is called as the local network; BGP has the origin attribute of IGP. These routes, such as directly-connected routes, static routes or routes learned from IGP, must be in the main IP routing table and be valid. In BGP routing process, the main IP routing table is scanned periodically to detect whether local network exists and the BGP routing table is updated afterwards. Be careful when the BGP forwards the routes. Routes in IGP may be forwarded by other routers through BGP. BGP potentially sends information to IGP and IGP then sends the information back to BGP.

45.4.2.1.6 Configuring BGP Route Weight

BGP route weight is a number that is endowed to BGP route for controlling route choice process. The weight is local for the router. The weight ranges from 0 to 65535. The default weight of the local BGP routes is 32768. The route weight obtained from the neighbor is 0. The administrator can carry out the routing policy by modifying the route weight.

Run the following command to configure the route weight:

Command	Purpose
neighbor {*ip-address* } **weight** *weight*	**Designates a weight for all neighbor's routes.**

You can also modify the route weight through the route map.

45.4.2.1.7 Configuring Neighbor-Based BGP Routing Filtration

The router software provides the following methods to filter the BGP routes of the designated neighbor:

(1) Use the Aspath list filter with the commands ip aspath-list and neighbor filter-list.

Command	Purpose
ip aspath-list*aspaths-list-name* {permit | deny} *as-regular-expression*	Defines a BGP-related access table.
router bgp*autonomous-system*	Enters the router configuration mode.
neighbor {*ip-address* } filter-list*aspath-list-name* {in | out }	Establishes a BGP filter.

(2) Use the access list with the commands ip access-list and neighbor distribute-list.

Command	Purpose
ip access-liststandard*access-list-name*	Defines an access list.
router bgp*autonomous-system*	Enters the router configuration mode.
neighbor {*ip-address* } distribute-list*access-list-name* {in | out }	Establishes a BGP filter.

(3) Use the prefix list with the commands ip prefix-list and neighbor prefix-list.

Command	Purpose
ip prefix-list*prefixs-list-name* |*sequence number* { permit |deny } A.B.C.D/n ge x le y	Defines a prefix list.
router bgp*autonomous-system*	Enters the router configuration mode.
neighbor {*ip-address* } prefix-list*prefix-list-name* {in | out}	Establishes a BGP filter.

(4) Use the route mapping with the commands route-map and neighbor route-map.

Route mapping can filter and change the routing attribute.

For details, refer to the section "Example for Neighbor-Based BGP Path Filtration".

45.4.2.1.8 Configuring Port-Based BGP Route Filtration

You can use the access list or the prefix list to configure the port-based BGP route filtration. You can filter the network number or the gateway address of the route. You can designate the **access-list** option to use the access list, or designate the **prefix-list** option to use the prefix list to filter the network number of the route. You also can designate the **gateway** option to use the access list to filter the **Nexthop** attribute of the route. The **access-list** option and the **prefix-list** option cannot be used together. The asterisk mark (*) can be designated to filter routes on all ports.

Run the following command in BGP configuration mode to configure the port-based BGP route filtration.

Command	Purpose
filter interface {**in** | **out**}〔**access-list** access-list-name〕〔**prefix-list** prefix-list-name〕〔**gateway** access-list-name〕	Configures the port-based BGP route filtration.

For details, refer to the section “Example for Port-Based BGP Route Filtration”.

45.4.2.1.9 Cancelling BGP-Updated Next Hop Processing

You can cancel the next hop processing for the neighbor's BGP update. The configuration is useful in the non-broadcast networks such as frame relay or X.25. In frame relay or X.25, BGP neighbors cannot directly access all other neighbors in the same IP subnet. The following methods can cancel the next hop processing:

- The local IP address that uses the BGP connection replaces the next-hop address of the outgoing route.
- Use the route map to designate the next-hop address of the outgoing route or the incoming route.

Run the following command to cancel the next-hop processing:

Command	Purpose
neighbor {*ip-address* } **next-hop-self**	Cancels the next-hop processing when BGP neighbors update.

When the previous command is used, the current router notifies itself to take as the next hop of the route. Therefore, other BGP neighbors will send packets to the current router. It is useful in the non-broadcast network because a path from the current router to the designated neighbor. However, it is useless in the broadcast network because unnecessary extra hops will occur.

45.4.2.2 Configuring Senior BGP Characteristics

45.4.2.2.1 Filtering and Modifying Route Update Through Route Map

The route map can be used on each neighbor to filter the route update and modify the parameter's attributes. The route map can be applied in both the incoming update and the outgoing update. Only the routes that pass the route map are processed when the route update is sent or received.

The route map supports that the incoming update and the outgoing update are based on the AS path, community and network number. The **aspath-list** command requires be used for the AS matching. The community matching requires the **community-list command. The network matching requires the ip access-list command** .

Run the following command to filter and modify the route update through the route map.

Command	Purpose
neighbor {*ip-address* } **route-map** *route-map-name* **{in | out}**	Applies the route map to the incoming or outgoing route.

For details, refer to the section "BGP Route Map Example".

45.4.2.2.2 Configuring Aggregation Addres

The non-type inter-field route can create the aggregation route (and super network) to minimize the routing table. You can configure the aggregation route by redistributing the aggregation route to BGP or by using the aggregation attribute described in the following table. If the BGP table has at least one more detailed record, add the aggregation address to the BGP table.

Use one or several of the following command to create the aggregation address in the routing table:

Command	Purpose
aggregate network/len	Creates the aggregation address in the routing table.
aggregate network/len **summary-only**	Broadcasts only the summary address.
aggregate network/len **route-map** map-name	Generates the designated aggregation address through the route map.

Refer to the section "BGP Route Aggregation Example".

45.4.2.2.3 Configuring BGP Community Attribute

The routing policy that BGP supports is based one of the following three values for BGP routing information:

- Routing network number
- Value of the **AS_PATH** attribute
- Value of the **COMMUNITY** attribute

Routes can be classified into the community through the COMMUNITY attribute and the community-based routing policy can be applied to routes. Therefore, the configuration of routing information control is simplified. Community is a group of routes having the same attributes. Each route may belong to multiple communities. The AS administrator can decide which community a route belongs to.

The COMMUNITY attribute is an optional, transmissible and global, which ranges from 1 to 4,294,967,200.

The famous communities that are predefined in the Internet are listed in the following table:

Community	Description
no-export	Does not broadcast the route to the EBGP peers, including the EBGP peers in the autonomous system.
no-advertise	Does not broadcast the route to any peer.
local-as	Does not broadcast the route to the outside of the autonomous system.

When generating, receiving or forwarding the route, the BGP session sponsor can set, add or modify the route community attributes. After the routes are aggregated, the aggregation contains the COMMUNITY attribute from all original routes.

The COMMUNITY attribute is not sent to neighbors by default. Run the following command to send the COMMUNITY attribute to the designated neighbor.

Command	Purpose
neighbor {*ip-address* } **send-community**	Sends the COMMUNITY attribute to the designated neighbor.

Perform the following operations to set the community attribute:

Command	Purpose
route-map *map-name sequence-number* **{deny | permit}**	Configures the route map.
set community *community-value*	Configures the setup regulations.
router bgp*autonomous-system*	Enters the router configuration mode.
neighbor {*ip-address* } **route-map***access-list-name* {**in | out** }	Applies the route map.

Perform the following operations to configure the community-attribute–based routing information filtration:

Command	Purpose
ip community-list standard | expended*community-list-name* {**permit | deny**} *communtiy-expression*	Defines the community list.
route-map *map-name sequence-number* **{deny | permit}**	Configures the route map.
match *community-list-name*	Configures the matching regulations.
router bgp*autonomous-system*	Enters the router configuration mode.
neighbor {*ip-address* } **route-map***route-map-name* {**in | out** }	Applies the route map.

Refer to the section “Example for Route Map Through BGP Community Attribute”.

45.4.2.2.4 Configuring Autonomous System Alliance

The method to reduce IBGP connections is to divide one AS into multiple sub ASs and classify them into an autonomous system alliance. As to the outside, the alliance seems like an AS. As to the inside of the alliance, each sub AS is full-connected and connects other sub ASs in the same alliance. Even if the EBGP session exists in the peers of different sub AS, they still exchange route choice information as IBGP peers do. That is, they save the next hop, MED and local priority information.

To configure a BGP autonomous system alliance, you must designate the alliance identifier. The alliance identifier is an AS number. As to the outside, the AS looks like a single AS which takes the alliance identifier as the AS number.

Run the following command to configure the identifier of the autonomous system alliance:

Command	Purpose
bgp confederation0 identifier *autonomous-system*	Configures the identifier of the autonomous system alliance.

Run the following command to designate the autonomous system number belonging to the autonomous system alliance:

Command	Purpose
bgp confederation peers autonomous-system [autonomous-system ...]	Designates the AS belonging to the autonomous system alliance.

Refer to the section “BGP Autonomous System Alliance Example”.

45.4.2.2.5 Configuring Route Reflector

Another method to reduce IBGP connections is to configure the route reflector.

The peers in the route reflector are divided into two groups: client peers and other routers in the AS (non-client peers). The route reflector reflects the routes between the two groups. The route reflector and the client peers consists of a cluster. The non-client peers must be fully connected. The client peers need not be fully connected. The clients in the cluster do not communicate with the IBGP session sponsors in the different cluster.

When the route reflector receives the routing infotmation, it will perform the following tasks:

- Broadcast the routes from the external BGP session sponsors to all clients and non-client peers.
- Broadcast the routes from the non-client routes to all clients.
- Broadcast the routes from the client to all client peers and non-client peers. The client peers need not be fully connected.

Run the following command to set the local router as the reflector and designate the neighbor as the client:

Command	Purpose
neighbor *ip-address***route-reflector-client**	Sets the local router to the reflector and designate the neighbor as the client.

One AS has multiple route reflectors. The route reflector handles other route reflectors as it handles IBGP session sponsors. In general, the clients in the same cluster has only one route reflector. The cluster is identified by the router ID of the route reflector. To add redundancy and avoid the failure of the single node, one cluster may have several route reflectors. In this case, all route reflectors in the cluster must be set to a 4-bit cluster ID, enabling the route reflector to identify the update information of other route reflectors in the same cluster. All the route reflectors in the same cluster must be fully connected and have the same client peers and non-client peers.

If several route reflectors exists in a cluster, run the following command to configure the cluster ID:

Command	Purpose
bgp cluster-id *cluster-id*	Configures the cluster ID.

Refer to the section “BGP Route Reflector Configuration Example”.

45.4.2.2.6 Shutting down peers

Run the following command to shut down the BGP neighbors:

Command	Purpose
neighbor {ip-address } **shutdown**	Shuts down the BGP neighbor.

Run the following command to activate the neighbor:

Command	Purpose
no neighbor {ip-address } **shutdown**	Activates the BGP neighbor.

45.4.2.2.7 Configuring multihop external peers

The external peers must be in the directly-connected networks by default. Run the following command to configure multihop external peers:

Command	Purpose
neighbor {ip-address } **ebgp-multihop** ttl	Sets the BGP neighbor to the multihop external peers.

45.4.2.2.8 Setting BGP route management distance

The management distance is a unit to measure the priority of routing protocols. BGP uses three kinds of management distance: external distance, internal distance and local distance. The route learned from the external BGP shows the external distance. The route learned from the internal BGP shows the internal distance. The local route shows the local distance. Run the following command to set BGP route management distance:

Command	Purpose
distance bgp external-distance internal-distance local-distance	Sets BGP route management distance.

It is dangerous to modify the management distance of the BGP routes. You are not recommended to do it. The external distance should be shorter than the distance of any dynamic routing protocol. The internal distance should be longer than the distance of any dynamic routing protocol.

45.4.2.2.9 Modifying BGP timer

Run the following command to modify BGP **keepalive** and **holdtime** timer:

Command	Purpose
neighbor *[ip-address | peer group-name]* **timers** *keepalive holdtime*	Sets the **keepalive** and **holdtime** timer for the designed peers or the peer group (unit: second).

Run the command **no neighbor timers** to resumes the timer of the BGP neighbor or the peer group to the default value.

45.4.2.2.10 omparing MED of the routes from different ASs

MED is a parameter that is considered when an optimal route needs to be selected from multiple available paths. The path with comparatively small MED value is first considered.

By default, when the best route is being chosen, the MED compare is performed only among the routes from the same AS. You can configure to allow the MED compare during route choice, no matter which AS the routes come from.

Run the following command to perform the MED compare among routes from different ASs:

Command	Purpose
bgp always-compare-med	Performs the MED compare among routes from different ASs.

45.4.3 Monitoring and Maintaining BGP

The administrator can browse and delete the content in the routing table or other databases in BGP. The value of the detailed statistics information can be displayed.

45.4.3.1 Clearing BGP routing table and database

Run the following command in management mode to perform relative tasks about clearing high-speed cache, table or BGP database.

Command	Purpose
clear ip bgp *	Resets all BGP connections.
clear ip bgp *as-number*	Resets the BGP connection of the designated autonomous system.
clear ip bgp *address*	Resets the BGP connection of the designated neighbor.
clear ip bgp *address* **soft** { **in|out** }	Clears the incoming or outgoing database of the designated neighbor.
clear ip bgp *aggregates*	Clears the routes generated during route aggregation.
clear ip bgp *networks*	Clears the routes generated by the **network** command.
clear ip bgp *redistribute*	Clears the routes generated in the forwarding process.

45.4.3.2 Displaying routing table and system statistics information

The detailed statistics information such as the BGP routing table and the database content can be displayed. These statistics information helps you to fully use network resources and resolve network problems.
Run the following command to display different kinds of statistics information:

Command	Purpose
show ip bgp	Displays the BGP routing table in the system.
show ip bgp prefix	Displays the routs that match the prefix-matched list.
show ip bgp community	Displays the statistics information about the community attribute.
show ip bgp regexp	Displays the routes that match the

regular-expression	regular expression.
show ip bgp *network*	Displays the designated BGP route.
show ip bgp neighbors *address*	Displays the detailed information about the TCP connection and BGP connection of the designated neighbor.
show ip bgp neighbors *[address]* [received-routes | routes | advertised-routes]	Displays the routes learned from a special BGP neighbor.
show ip bgp paths	Displays all BGP path information in the database.
show ip bgp summary	Displays the state of all BGP connections.

45.4.3.3 Tracking BGP information

To locate the fault and resolve the problem, you need to observe the BGP connection establishment, route receiving and route forwarding by tracking the BGP information. Perform the following operations:

Command	Purpose
debug ip bgp *	Tracks common BGP information.
debug ip bgp all	Tracks all BGP information.
debug ip bgp fsm	Tracks the BGP state machine.
debug ip bgp keepalive	Tracks the BGP **keepalive** message .
debug ip bgp open	Tracks the BGP **Open** message.
debug ip bgp update	Tracks the BGP **Update** message.

45.4.4 BGP Configuration Example

45.4.4.1 BGP route map example

The following example shows how to modify the attributes of the incoming route from neighbors by using the route map. Set the weight of any route that is received from neighbor 140.222.1.1 and matches the ASPATH access list **aaa** to **200**. Set the local priority to **250**. If the route is declined, other routes are declined.

```
router bgp 100
!
neighbor 140.222.1.1 route-map fix-weight in
neighbor 140.222.1.1 remote-as 1
!
route-map fix-weight permit 10
match as-path aaa
set local-preference 250
set weight 200
!
ip aspath-list aaa permit ^690$
ip aspath-list aaa permit ^1800
```

In the following example, the first item of route map **freddy** sets the MED attribute of all routes starting from autonomous system 690 to **127**. The second item enables the routes that do not satisfy the previous conditions to be sent to neighbor 1.1.1.1:

```
router bgp 100
neighbor 1.1.1.1 route-map freddy out
!
ip aspath-list abc permit ^690_
ip aspath-list xyz permit .*
!
route-map freddy permit 10
match as-path abc
set metric 127
!
route-map freddy permit 20
match as-path xyz
```

The following example shows how to modify the routes that are generated in route forwarding through the route map:

```
router bgp 100
redistribute rip route-map rip2bgp
!
route-map rip2bgp
```

match ip address rip

set local-preference 25

set metric 127

set weight 30000

set next-hop 192.92.68.24

set origin igp

!

ip access-list standard rip

permit 131.108.0.0 255.255.0.0

permit 160.89.0.0 255.255.0.0

permit 198.112.0.0 255.255.128.0

45.4.4.2 BGP neighbor configuration example

In the following example, the BGP router belongs to AS109. AS109 establishes two networks. The router has three neighbors: an external neighbor (in a different AS), an internal neighbor (with the same AS number) and an external neighbor.

router bgp 109

network 131.108.0.0

network 192.31.7.0

neighbor 131.108.200.1 remote-as 167

neighbor 131.108.234.2 remote-as 109

neighbor 150.136.64.19 remote-as 99

45.4.4.3 Example for neighbor-based BGP path filtration

The following is an example for neighbor-based BGP path filtration. The route that gets through the access list **test1**of **as-path** obtains a weight value **100**. Only the route that gets through the access list **test2** of **as-path** can be sent to neighbor 193.1.12.10. Similarly, the route that gets through the access list test3 can be accepted by neighbor 193.1.12.10:

router bgp 200

neighbor 193.1.12.10 remote-as 100

neighbor 193.1.12.10 filter-list test1 weight 100

neighbor 193.1.12.10 filter-list test2 out

neighbor 193.1.12.10 filter-list test3 in

ip aspath-list test1 permit _109_

ip aspath-list test2 permit _200$

ip aspath-list test2 permit ^100$

ip aspath-list test3 deny _690$

ip aspath-list test3 permit .*

45.4.4.4 Example for port-based BGP route filtration

The following example shows that the routes from port e1/0 are filtered through access list acl:

router bgp 122

filter vlan10 in access-list acl

The following example shows how to filter the routes from port e1/0 simultaneously using the access list **filter-network** and the access list **filter-gateway** to respectively filter the network number and the gateway address.

router bgp 100

filter vlan100 in access-list filter-network gateway filter-gateway

The following example shows how to filter routes from all ports simultaneously using the prefix list **filter-prefix** and the prefix list **filter-gateway** to respectively filter the network number and the gateway address.

router bgp 100

filter * in prefix-list filter-prefix gateway filter-gateway

45.4.4.5 Example for prefix-list-based route filtration configuration

The following example shows that the default route 0.0.0.0/0 is declined:

ip prefix-list abc deny 0.0.0.0/0

The following example shows that the route which matches the prefix 35.0.0.0/8 is allowed:

ip prefix-list abc permit 35.0.0.0/8

In the following example, only the prefixes with the length from /8 to /24 are accepted in the BGP process:

router bgp

network 101.20.20.0

filter * in prefix max24

!

ip prefix-list max24 seq 5 permit 0.0.0.0/0 ge 8 le 24

!

In the following example, the router filters all the routes and only accepts the routes whose prefix length ranges from 8 to 24:

router bgp 12

filter * in prefix-list max24

ip prefix-list max24 seq 5 permit 0.0.0.0/0 ge 8 le 24

The following example shows that route whose prefix length is no more than 24 is permitted in network 192/8:

ip prefix-list abc permit 192.0.0.0/8 le 24

The following example shows that route whose prefix length exceeds 25 is permitted in network 192/8:

ip prefix-list abc deny 192.0.0.0/8 ge 25

The following example shows that routes whose prefix length is larger than 8 and smaller than 24 are permitted:

ip prefix-list abc permit 0.0.0.0/0 ge 8 le 24

The following example shows that routes whose prefix length exceeds 25 are denied:

ip prefix-list abc deny 0.0.0.0/0 ge 25

The following example shows that all routes from network 10/8 are denied. If the mask of A-class network 10.0.0.0/8 is less than or equal to 32 bits, all routes are denied:

ip prefix-list abc deny 10.0.0.0/8 le 32

The following example shows that all routes are denied because the mask length of network 204.70.1/24 exceeds 25:

ip prefix-list abc deny 204.70.1.0/24 ge 25

The following example shows that all routes are permitted:

ip prefix-list abc permit any

45.4.4.6 BGP route aggregation example

The following example shows how to create the aggregation route in BGP through route forwarding or the conditional route aggregation function:

In the following example, the command **redistribute static** is used to forward the aggregation route 193. * . * . * :

```
ip route 193.0.0.0 255.0.0.0 null 0
!
router bgp 100
redistribute static
```

If at least one route in the routing table belongs to the designated range, an aggregation route is created in the BGP routing table according to the following configuration. The aggregation route is considered to be from your AS and has the **atomic** attribute which may be lost in the indication information:

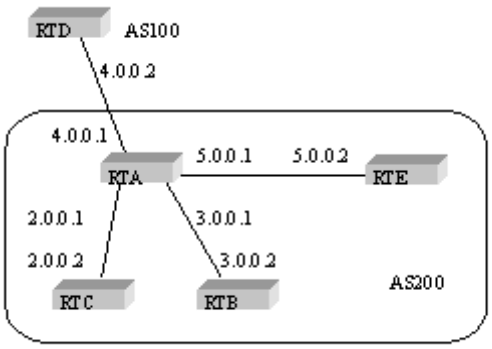
```
router bgp 100
aggregate 193.0.0.0/8
```

The following example shows how to create the aggregation route 193.*.*.* and how to constrain more detailed routes from broadcasting to all neighbors:

```
router bgp 100
aggregate 193.0.0.0/8 summary-only
```

45.4.4.7 BGP route reflector configuration example

The following is an example for the route reflector configuration. RTA, RTB, RTC and RTE belongs to the same autonomous system AS200. RTA functions as the route reflector, while RTB and RTC function as the clients of the route reflector. RTE is a common IBGP neighbor. RTD belongs to AS100 and establishes an EBGP connection with RTA. The configuration is shown as follows:



RTA configuration:

interface vlan110

ip address 2.0.0.1 255.0.0.0

!

interface vlan111

ip address 3.0.0.1 255.0.0.0

!

interface vlan112

ip address 4.0.0.1 255.0.0.0

!

interface vlan113

ip address 5.0.0.1 255.0.0.0

!

router bgp 200

neighbor 2.0.0.1 remote-as 200 /*RTC IBGP*/

neighbor 2.0.0.1 route-reflector-client

neighbor 3.0.0.1 remote-as 200/*RTB IBGP*/

neighbor 3.0.0.1 route-reflector-client

neighbor 5.0.0.1 remote-as 200 /*RTE IBGP*/

neighbor 4.0.0.2 remote-as 100 /*RTD EBGP*/

network 11.0.0.0/8

!

ip route 11.0.0.0 255.0.0.0 2.0.0.12

RTB configuration:

```
interface vlan110
ip address 3.0.0.2 255.0.0.0
!
router bgp 200
neighbor 3.0.0.1 remote-as 200 /*RTA IBGP*/
network 13.0.0.0/8
!
ip route 13.0.0.0 255.0.0.0 3.0.0.12
```

RTC configuration:

```
interface vlan110
ip address 2.0.0.2 255.0.0.0
!
router bgp 200
neighbor 2.0.0.1 remote-as 200 /*RTA IBGP*/
network 12.0.0.0/8
!
ip route 12.0.0.0 255.0.0.0 2.0.0.12
```

RTD configuration:

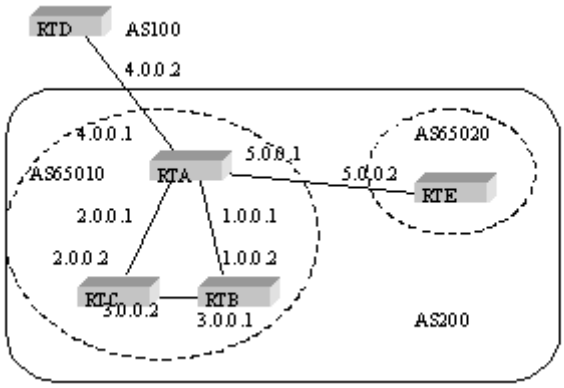
```
interface vlan110
ip address 4.0.0.2 255.0.0.0
!
router bgp 100
neighbor 4.0.0.1 remote-as 200 /*RTA EBGP*/
network 14.0.0.0/8
!
ip route 14.0.0.0 255.0.0.0 4.0.0.12
```

RTE configuration:

```
interface vlan110
ip address 5.0.0.2 255.0.0.0
!
router bgp 200
neighbor 5.0.0.1 remote-as 200 /*RTA IBGP*/
network 15.0.0.0/8
!
ip route 15.0.0.0 255.0.0.0 5.0.0.12
```

45.4.4.8 BGP autonomous system alliance example

The following figure shows an autonomous system alliance configuration. RTA, RTB and RTC create the IBGP connection. RTA, RTB and RTC belong to the private autonomous system 65010. RTE belongs to the private autonomous system 65020. RTE and RTA establish the EBGP connection in the autonomous system alliance. AS65010 and AS65020 make up of an autonomous system alliance. The number of the autonomous system alliance is AS200. RTD belongs to AS100. An EBGP connection is established between RTD and AS200 through RTA.



RTA configuration:

interface vlan110

ip address 1.0.0.1 255.0.0.0

!

interface vlan111

ip address 2.0.0.1 255.0.0.0

!

interface vlan112

ip address 4.0.0.1 255.0.0.0

!

interface vlan113

ip address 5.0.0.1 255.0.0.0

!

router bgp 65010

bgp confederation identifier 200

bgp confederation peers 65020

neighbor 1.0.0.2 remote-as 65010 /*RTB IBGP*/

neighbor 2.0.0.2 remote-as 65010 /*RTC IBGP*/

neighbor 5.0.0.2 remote-as 65020 /*RTE EBGP*/

neighbor 4.0.0.2 remote-as 100 /*RTD EBGP*/

RTB configuration:

```
interface vlan110
ip address 1.0.0.2 255.0.0.0
!
interface vlan111
ip address 3.0.0.1 255.0.0.0
!
router bgp 65010
bgp confederation identifier 200
bgp confederation peers 65020
neighbor 1.0.0.1 remote-as 65010 /*RTA IBGP*/
neighbor 3.0.0.2 remote-as 65010/*RTC IBGP*/
```

RTC configuration:

```
interface vlan110
ip address 2.0.0.2 255.0.0.0
!
interface vlan111
ip address 3.0.0.2 255.0.0.0
!
router bgp 65010
bgp confederation identifier 200
bgp confederation peers 65020
neighbor 2.0.0.1 remote-as 65010 /*RTA IBGP*/
neighbor 3.0.0.1 remote-as 65010 /*RTB IBGP*/
```

RTD configuration:

```
interface vlan110
ip address 4.0.0.2 255.0.0.0
!
router bgp 100
neighbor 4.0.0.1 remote-as 200 /*RTA EBGP*/
```

RTE configuration:

```
interface vlan110
ip address 5.0.0.2 255.0.0.0
!
router bgp 65020
bgp confederation identifier 200
bgp confederation peers 65010
neighbor 5.0.0.1 remote-as 65010 /*RTA EBGP*/
```

45.4.4.9 Example for route map using BGP community attribute

In the following example, the command **route map set-community** is used to update the outgoing routes of neighbor 171.69.232.50. The special community attribute value **no-export** can be set through the route of the access list **aaa**. Other routes perform normal broadcast. The special community attribute value automatically prevents the BGP session sponsor in AS200 from broadcasting the route to the outside of the autonomous system.

```
router bgp 100
neighbor 171.69.232.50 remote-as 200
neighbor 171.69.232.50 send-community
neighbor 171.69.232.50 route-map set-community out
!
route-map set-community 10 permit
match ip address aaa
set community no-export
!
 route-map set-community 20 permit
```

In the following example, the command **route map set-community** is used to update the outgoing routes of neighbor 171.69.232. 90. Set the current value to the community attribute value **200**. Other routes performs normal broadcast.

```
route-map bgp 200
neighbor 171.69.232.90 remote-as 100
neighbor 171.69.232.90 send-community
neighbor 171.69.232.90 route-map set-community out
!
route-map set-community 10 permit
match as-path test1
set community-additive 200 200
!
route-map set-community 20 permit
match as-path test2
!
ip aspath-list test1 permit 70$
ip aspath-list test2 permit .*
```

In the following example, Set the MED and the local priority of the route from neighbor 171.69.232.55 according to the community attribute value. Set MED of all routes that match the community list **com1** to **8000**. These routes may contain routes with community value “100 200 300” and “900 901”. These routes may have other attribute values.

Set the local priority of the routes which send the community list **com2** to **500**.

Set the local priority of other routes to **50**. Therefore, all the local priority value of all remaining routes of neighbor 171.69.232.55 is **50**.

```
router bgp 200
neighbor 171.69.232.55 remote-as 100
neighbor 171.69.232.55 route-map filter-on-community in
!
route-map filter-on-community 10 permit
match community com1
set metric 8000
!
route-map filter-on-community 20 permit
match community com2
set local-preference 500
!
route-map filter-on-community 30 permit
set local-preference 50
!
ip community-list com1 permit 100 200 300
ip community-list com1 permit 900 901
!
ip community-list com2 permit 88
ip community-list com2 permit 90
!
```

46. IP Hardware Subnet Routing Configuration

46.1 IP Hardware Subnet Configuration Task

46.1.1 Overview

IP hardware subnet routing is similar to IP fast exchange.

When the IP hardware subnet routing is not enabled, before forwarding message containing the IP address A at the next hop, the switch first checks whether the item of destination A exists in the IP cache of hardware. If the item exists, the message will be forwarded through hardware. If the item does not exist, the message is sent to CPU and then processed through software. IP hardware subnet routing items include the destination subnet, mask, IP address of the next hop, interface and so on. When the IP hardware subnet routing is enabled, after the IP cache fails to be matched, the system is to check the IP hardware subnet routing items. If the matched item is found, the message will be directly forwarded through the next-hop IP address and the interface designated in the matched item. If the IP hardware subnet routing item is not found, the message will be sent to CPU for processing.

The IP hardware subnet routing has two modes: automatic and manual. In manual mode, you need to manually configure all routing items required by the IP hardware subnet routing. Note that routing items having longer mask of destination subnet should be configured earlier. In automatic mode, the system automatically addes the known routes to the hardware subnet routing. All the procedure is automatic after the hardware subnet routing is started.

46.1.2 Configuring IP Hardware Subnet Routing

Perform the following steps to configure the IP hardware subnet routing:

Step	Command	Description
1	[**no**] **ip exf** {**default** | *destination mask*} {**cpu**| *nexthop* vlan *vlanid*}	Add or delete a hardware subnet route. Deleting a hardware subnet route requires to specify the destination network and mask. Replace **destination** and **mask** in the command line with **default** when you delete a route. In this case, The next hop is not CPU. The command is effective only in manual configuration mode.
2	[**no**] **ip exf**	Enable or disable the IP hardware subnet routing.

46.1.3 Checking the State of IP Hardware Subnet Routing

Command	Description
show ip exf	Displays the current state of the IP hardware subnet routing.

46.2Configuration Example

Pay attention to the following content when you configure the routing items:

- As to the direct-connecting routing, the next hop is CPU. If the next hop is a routing interface not an IP address, do as in the direct-connecting routing.
- When the number of the routing items in the system is bigger than that of the IP hardware subnet routing items, the default routing cannot be the IP hardware subnet routing. Two or several routes, which are prefix to each other, must be used together when IP hardware subnet routing is adopted. For other items, advise to add heavy-traffic items to the hardware subnet routing table. Our 3224 series switches support 15 hardware subnet routes, including the default subnet route.
- The ARP of the next-hop IP address does not exist, the system will send an ARP request and temporarily designate the next-hop routing item as CPU. After the system receives the ARP response, the system then update the next hop to the user-designating address. If the VLAN interface where the next hop resides is found different from the configured interface during the ARP response, the next hop of the route is designated as CPU. Users then need to correct the configuration.
- If the next-hop interface or the interface protocol does not exist, the item will not be added to the hardware subnet routing table.

Suppose a switch has the following routing items:

(1) 192.168.0.0/16 next hop 192.168.26.3/vlan1

(2) 192.168.20.0/24 next hop 192.168.26.1/vlan1

(3) 192.168.1.0/24 direct-connecting routing

(4) 192.168.26.0/24 direct-connecting routing

(5) 10.0.0.0/8 next hop 192.168.1.4/vlan2

(6) 0.0.0.0/0 next hop 192.168.1.6/vlan2

The destination subnet of route item 1 is the prefix of subnet 2, 3 and 4. Therefore,these items should be added to the hardware subnet routing table together. Item 3 and 4 are direct-connecting routing and the next hop is CPU.

The relative configuration is as follows:

ip exf 192.168.20.0 255.255.255.0 nexthop 192.168.26.1 vlan 1

ip exf 192.168.1.0 255.255.255.0 cpu

ip exf 192.168.26.0 255.255.255.0 cpu

ip exf 192.168.0.0 255.255.0.0 nexthop 192.168.26.3 vlan 1

ip exf 10.0.0.0 255.0.0.0 nexthop 192.168.1.4 vlan 2

ip exf 0.0.0.0 0.0.0.0 nexthop 192.168.1.6 vlan 2

47. IP-PBR Configuration

47.1 IP-PBR Configuration

IP-PBR realizes software PBR functions through the hardware of switch chip.

PBR stands for Policy Based Routing. PBR enables users to rely on a certain policy not on routing protocol for routing. Software based PBR supports multiple policies and rules and also load balance. You can designate the next hop's IP address or port for those packets that are in line with policy. PBR supports load balance and applies multiple next-hop IP addresses or ports on those policy-supported packets.

Only when the next-hop egress ARP designated by route map is already learned can IP-PBR regard that this egress is valid and then the corresponding rule is effective. When a packet satisfies IP-PBR policy, the hardware directly forwards this packet to the next-hop egress that the rule specifies. This process is finished by the hardware without the operation of CPU. The packets forwarded by IP-PBR have the highest priority and only those packets unmatched with IP-PBR rule are forwarded to CPU.

The current IP-PBR supports the IP ACL policy and the next-hop IP address policy. When multiple next hops are configured, the first effect next hop is chosen. IP-PBR also supports equivalent routing that is realized by the switch chip. Hardware equivalent routing needs no extra configuration.

IP-PBR supports the following policy routing commands:

route-map*WORD*

match ip address*WORD*

set ip next-hop*X.X.X.X* [**load-balance**]

ip policy route-map *WORD*

IP-PBR is a little different from router's policy routing. IP-PBR chooses an effective next hop as the egress and drops packets if no valid next hop available, while router's policy routing selects an effective next hop but packet loss happens if this next hop has not learned ARP. Once multiple sequences are set, one difference between IP-PBR and software policy routing must be noted. Software policy routing always chooses high-priority sequence routes no matter whether IP address matched by high-priority sequences overlaps with that matched by low-priority sequences and whether these routes are effective, while IP-PBR chooses low-priority sequence routes when high-priority sequence routes invalidate.

47.1.1 Enabling or Disabling IP-PBR Globally

Run the following commands in global configuration mode.

Command	Purpose
ip pbr	The IP-PBR function is disabled by default.
no ip pbr	Resumes the default settings.

IP-PBR is disabled by default.

47.1.2 ISIS Configuration Task List

To configure IP-PBR, do as follows:

Create ACL;

Create a route map;

Apply the route map on a port;

To create an ACL, run the following command globally:

Command	Remarks
ip access-list standard *net1*	Enters the ACL configuration mode and defines ACL.

To create a route map, run the following commands globally:

Command	Remarks
route-map *pbr*	Enters the route map configuration mode.
match ip address*access-list*	Configures the match-up policy.
set ipnext-hop *A.B.C.D*	Configures the next-hop address of IP packet.

To apply policy routing on an IP-receiving port, run the following commands:

Command	Remarks
interface *interface_name*	Enters the interface configuration mode.
ip policy route-map *route-map_name*	Applies policy routing on the port.

47.1.3 Monitoring and Maintaining MVC

Run the following commands in EXEC mode:

Command	Operation
show ip pbr	It is used to display the information about RIP configuration.
show ip policy	Shows the port on which IP-PBR is applied.
show ip pbr policy	It is used to display the information about IP-PBR equivalent routing.
debug ip pbr	It is used to enable or disable the debugging switch of IP-PBR.

The information that IP-PBR is not running is shown:

```
switch#show ip pbr

IP policy based route state: disabled



No pbr apply item

No equiv exf apply item
```

All data related about IP-PBR running are shown below:

```
switch#show ip pbr
IP policy based route state: enabled

No equiv exf apply item

VLAN3 use route-map ddd, and has 1 entry active.
------------------
Entry sequence 10, permit
  Match ip access-list:
  ac1
  Set Outgoing nexthop
  90.0.0.3
```

The IP-PBR policy routing information is shown below:

```
switch#show ip pbr policy
IP policy based route state: enabled

VLAN3 use route-map ddd, and has 1 entry active.
------------------
Entry sequence 10, permit
  Match ip access-list:
  ac1
  Set Outgoing nexthop
  90.0.0.3
```

The equivalent routing information is shown below:

```
switch#show ip pbr exf
IP policy based route state: enabled

Equiv EXF has 1 entry active.
------------------
Entry sequence 1, handle c1f95b0
   Dest ip: 1.1.0.0/16
   90.0.0.3
      192.168.213.161
```

47.1.4 IP-PBR Configuration Example

Switch configuration:

```
!
ip pbr
!
interface vlan1
ip address 10.1.1.3 255.255.255.0
no ip directed-broadcast
ip policy route-map pbr
!
ip access-list standard ac1
permit 10.1.1.21 255.255.255.255
!
ip access-list standard ac2
permit 10.1.1.2 255.255.255.255
!
route-map pbr 10 permit
match ip address ac1
set ip next-hop 13.1.1.99
!
route-map pbr 20 permit
match ip address ac2
set ip next-hop 13.1.1.99 14.1.1.99load-balance
!
```

Configuration Description

The switch is to apply policy routing on the packets that are received from VLAN1.As to the packets whose source IPs are 10.1.1.21, their next hop is 13.1.1.99.As to the packets whose source IPs are 10.1.1.2, they are applied on **route-map pbr 20**; because **set ip next-hop** has the **load-balance** parameter, the switch chip will automatically choose 13.1.1.99 or 14.1.1.99 as the egress according to destination IP address.

48. Multi-VRF CE Configuration

48.1 Multi-VRF CE Introduction

48.1.1 Overview

The Virtual Private Network (VPN) provides a secure method for multiple client networks to share the ISP-supplied bandwidth. In general, one VPN comprises a team of client networks that share a public routing table on the ISP's routers. Each client network is connected to the interface of the network devices of ISP, while ISP's device will relate each interface to a VPN routing table. One VPN routing table is also called as a VRF (VPN Routing /Forwarding table).

VRF is usually deployed on a Provider Edge (PE) device, such as MPLS VRF VPN. A PE supports multiple VPNs, and each VPN has its independent IP address space among which IP addresses can be overlapped. The VPN of a different client connects a different interface of PE, while PE differentiates the to-be-checked routing tables according to the incoming port of the packet.

Multi-VRF CE is to remove the task of connecting multiple client networks from PE to CE, which only requires a physical link to connect CE and PE. In this way, the port resource of PE is saved. CE also maintains the VRF routing table for each VPN. The packets from the client network are first forwarded on CE and then transmitted to PE after the packets pass through the ISP network.

The switch which serves as MCE connects different client networks through different ports and then relates these ports to a VPN routing table. The switch only supports VRF settings on the VLAN port.

The MCE function is usually deployed at the edge of the large-scale MPLS-VRF VPN network. The three functions, Multi-VRF CE, MPLS label switching and the function of MPLS control layer, are independent.

Figure 1.1 shows an MPLS-VRF VPN network.

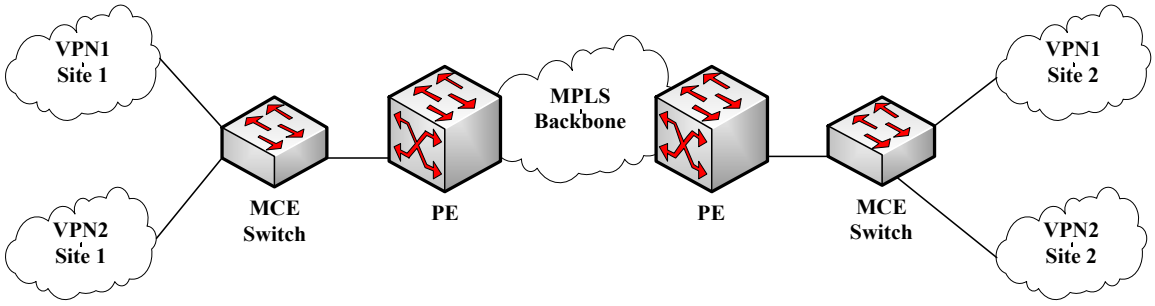


Figure 1.1 MCE in the MPLS-VRF VPN network

48.1.1.1 Establishing Routes with CE

The Multi-VRF CE switch can establish routes with CE through multiple dynamic routing protocols. CE can be routers or the Ethernet switches. The routing protocols which are supported include OSPF, RIP and BEIGRP. The MCE switch also supports static routing configuration.

The MCE switch generally needs different VLAN ports to connect CEs that belong to different VPNs. The VLAN ports that are used to connect the VPNs require to be related to a VRF. CE does not need to support VRF.

48.1.1.2 Establishing Routes with PE

The MCE switch (MCE) can connect one or multiple PEs, but both MCE and the connected PEs have to get VRF configured. MCE will provide PE the routes which MCE learns from CE and learns the routes of remote client networks from PE.

The VRF route can be established between MCE and PE through dynamic routing protocols such as BGP, OSPF, RIP and BEIGRP. Of course, the VRF route can also be established statically.

In general, MCE and PE belong to different autonomous systems. Hence, the method to establish the VRF route between MCE and PE by using EBGP is the key point in this document.

48.2 Multi-VRF CE Configuration

48.2.1 Default VRF Configuration

Function	Default Configuration
VRF	There is no configuration. All routes are added to the default routing table.
VPN expansibility of VRF	There is no Routing Distinguisher (RD). There is no input/output Routing Target (RT).
Maximum number of VRF routes	10240
VRF port	N/A. None of VLAN ports is related with VRF, and the routes of ports are added to the default routing table.
IP Express Forwarding	The hardware IP routing is not enabled.

48.2.2 MCE Configuration Tasks

- Configuring VRF
- Configuring a VPN Route
- Configuring BGP Route Between PE and CE
- Testifying the VRF Connectivity between PE and CE

48.2.3 MCE Configuration

48.2.3.1 **Configuring VRF** Refer to the following steps to configure one or multiple VRFs.

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config# ip vrf *vrf-name*	Creates VRF and enters the VRF configuration mode. vrf-name: VRF name with up to 31 characters
Switch_config_vrf# rd *route-distinguisher*	Sets the route distinguisher of VRF. route-distinguisher: Stands for the distinguisher of the route. It consists of autonomous domain ID and random numbers, or IP and random numbers.
Switch_config_vrf# route-target { export | import | both } *route-target-extened-community*	Creates the expanded VPN attributes of input/output VRF objects. route-target-extended-community: It consists of autonomous domain ID and random numbers, or IP and random numbers.
Switch_config_vrf# interface *intf-name*	Enters the interface configuration mode. intf-name: Stands for the name of an interface.
Switch_config_intf# ip vrf forwarding *vrf-name*	Relates the L3 interface with VRF. vfi-name: Means the name of VRF.
Switch_config_intf# exit	Exits from interface configuration mode.
Switch_config# ip exf	Enables ip hardware routing .
Switch_config# show ip vrf [brief | detail | interface] [*vrf-name*]	Browses the VRF information.
Switch_config#no ip vrf *vrf-name*	Deletes the configured VRF and the relation between VRF and the L3 interface. vfi-name: Means the name of VRF.
Switch_config_intf# no ip vrf forwarding [*vrf-name*]	Deletes the relation between the L3 interface and VRF.

48.2.3.2 Configuring VPN Route

The route can be established between MCE and customer device through the configuration of BGP, OSPF, RIP, BEIGRP or static route. The following takes OSPF configuration as an example, which is similar to other routes' configurations.

When a route is configured on MCE to connect the client network, the VRF attributes of the routing protocol need be specified. VRF need not be configured on the customer device.

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config# router ospf *process-id* vrf *vrf-name*	Starts the OSPF-VRF route and enters the configuration mode.
Switch_config_ospf# network*network-number* *network-mask*area*area-id*	Defines the OSPF network, mask and area ID.
Switch_config_ospf# redistribute bgp *ASN*	Forwards the designated BGP network to the OSPF network.
Switch_config_ospf# exit	Exits from the OSPF configuration mode.
Switch_config# show ip ospf	Browses the information about the OSPF protocol.
Switch_config# no router ospf*process-id*	Deletes the OSPF-VRF routing configuration.

48.2.3.3 Configuring the BGP Route Between PE and CE

Refer to the following configuration commands:

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config# router bgp *autonomous-system-number*	Starts the BGP protocol by designating autonomous system number and enters the BGP configuration mode.
Switch_config_bgp# bgp log-neighbor-changes	Starts the record about BGP neighbor change.
Switch_config_bgp# address-family ipv4 vrf *vrf-name*	Enters the configuration mode of VRF address-family.
Switch_config_bgp_af# redistribute ospf	Forwards the OSPF routing information to the BGP network.

ospf-process-id	
Switch_config_bgp_af#network*network-number/prefix-length*	Configures the network number and the mask's length that are distributed by BGP.
Switch_config_bgp_af# neighbor*address* remote-as*ASN*	Configures the BGP neighbor and the autonomous system number of a neighbor.
Switch_config_bgp_af# exit-address-family	Exits from the configuration mode of address-family.
Switch_config_bgp# exit	Exits from the BGP configuration mode.
Switch_config# show ip bgp vpnv4 [all | rd | vrf]	Browses the BGP-VRF routing information.
Switch_config# no router bgp *ASN*	Deletes the BGP routing configuration.

48.2.3.4 Testifying the VRF Connectivity Between PE and CE

Use the PING command with the VRF option to testify the VRF connectivity of PE and CE.

Command	Purpose
Switch# ping –vrf*vrf-name**ip-address*	Conducts the PING operation to the addresses in VRF.

48.3MCE Configuration Example

Figure 2.1 shows a simple VRF network. Both S1 and S2 are the Multi-VRF CE switches. S11, S12 and S13 belong to VPN1, S21 and S22 belong to VPN2, and all of them are customer devices. The OSPF route should be configured between CE and customer device, while the BGP route is configured between CE and PE.

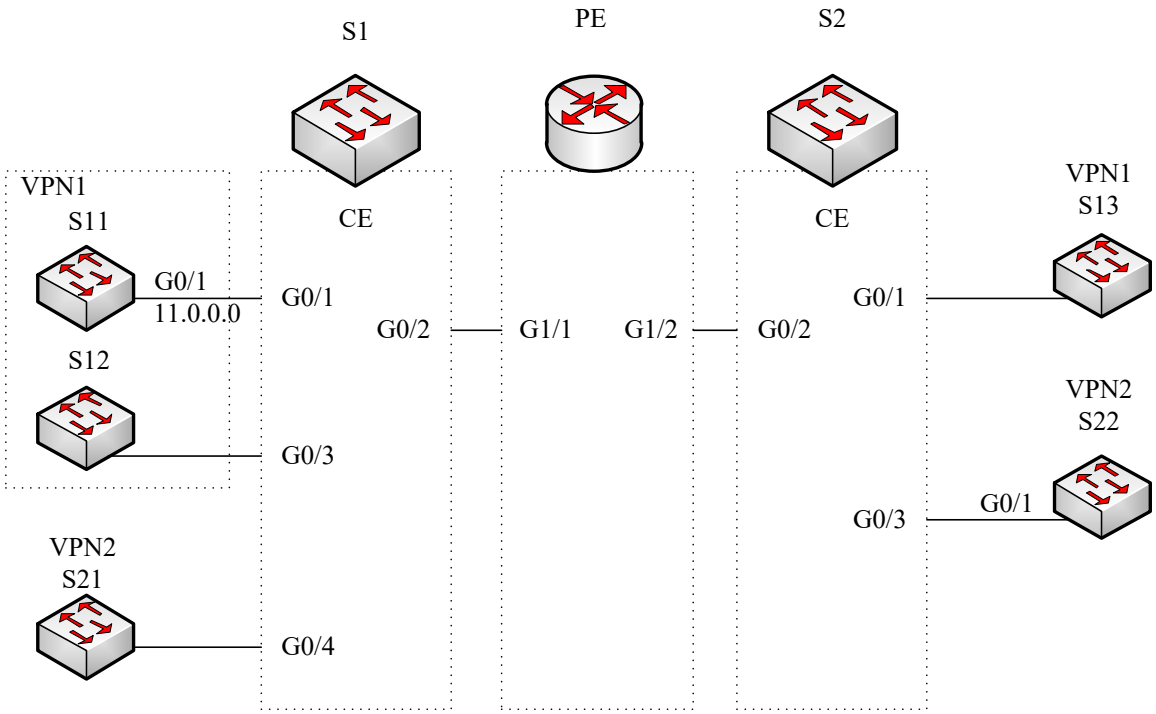


Figure 2.1 MCE configuration example

48.3.1 Configuring S11

Set the VLAN attributes of the physical interface that connects CE:

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport pvid 11

Switch_config_g0/1# exit

Sets the IP address and the VLAN interface.

Switch_config# interface VLAN11

Switch_config_v11# ip address 11.0.0.2 255.0.0.0

Switch_config_v11# exit

Set the routing protocol between CE and customer's device:

Switch_config# router ospf 101

Switch_config_ospf_101# network 11.0.0.0 255.0.0.0 area 0

Switch_config_ospf_101# exit

48.3.2 Configuring MCE-S1

Configures VRF on the Multi-VRF CE device.

```
Switch#config
Switch_config# ip vrf vpn1
Switch_config_vrf_vpn1# rd 100:  1
Switch_config_vrf_vpn1# route-target export 100:  1
Switch_config_vrf_vpn1# route-target import 100:  1
Switch_config_vrf_vpn1# exit

Switch_config# ip vrf vpn2
Switch_config_vrf_vpn2# rd 100:  2
Switch_config_vrf_vpn2# route-target export 100:  2
Switch_config_vrf_vpn2# route-target import 100:  2
Switch_config_vrf_vpn2# exit
```

Configure the loopback port and the physical port, and use the address of the loopback port as the router ID of the BGP protocol.

```
Switch_config# interface loopback 0
Switch_config_l0# ip address 101.0.0.1 255.255.255.255
Switch_config_l0# exit
```

S1 connects S11 through the F0/1 port, S21 through the G0/4 port and PE through the G0/2 port.

```
Switch_config# interface gigaEthernet 0/1
Switch_config_g0/1# switchport pvid 11
Switch_config_g0/1# exit

Switch_config# interface gigaEthernet 0/4
Switch_config_g0/4# switchport pvid 15
Switch_config_g0/4# exit

Switch_config# interface gigaEthernet 0/2
Switch_config_g0/2# switchport mode trunk
Switch_config_g0/2# exit
```

Set the L3 VLAN port of a switch, bind the VRF to the VLAN port and set the IP address. S1 connects PE through two logical ports, VLAN21 and VLAN22. The two ports, VLAN11 and VLAN15, connect VPN1 and VPN2 respectively.

Switch_config# interface VLAN11
Switch_config_v11# ip vrf forwarding vpn1
Switch_config_v11# ip address 11.0.0.1 255.0.0.0
Switch_config_v11# exit

Switch_config# interface VLAN15
Switch_config_v15# ip vrf forwarding vpn2
Switch_config_v15# ip address 15.0.0.1 255.0.0.0
Switch_config_v15# exit

Switch_config# interface VLAN21
Switch_config_v21# ip vrf forwarding vpn1
Switch_config_v21# ip address 21.0.0.2 255.0.0.0
Switch_config_v21# exit

Switch_config# interface VLAN22
Switch_config_v22# ip vrf forwarding vpn2
Switch_config_v22# ip address 22.0.0.2 255.0.0.0
Switch_config_v22# exit

Configure the OSPF route between CE and customer device.

Switch_config# router ospf 1 vrf vpn1
Switch_config_ospf_1# network 11.0.0.0 255.0.0.0 area 0
Switch_config_ospf_1# redistribute bgp 100
Switch_config_ospf_1#exit

Switch_config# router ospf 2 vrf vpn2
Switch_config_ospf_2# network 15.0.0.0 255.0.0.0 area 0
Switch_config_ospf_2# redistribute bgp 100
Switch_config_ospf_2#exit

Configure the EBGP route between PE and CE.

Switch_config# router bgp 100
Switch_config_bgp# bgp log-neighbor-changes

Switch_config_bgp# address-family ipv4 vrf vpn1

Switch_config_bgp_vpn1# no synchronization

Switch_config_bgp_vpn1# redistribute ospf 1

Switch_config_bgp_vpn1# neighbor 21.0.0.1 remote-as 200

Switch_config_bgp_vpn1# exit-address-family

Switch_config_bgp# address-family ipv4 vrf vpn2

Switch_config_bgp_vpn2# no synchronization

Switch_config_bgp_vpn2# redistribute ospf 2

Switch_config_bgp_vpn2# neighbor 22.0.0.1 remote-as 200

Switch_config_bgp_vpn2# exit-address-family

Switch_config_bgp# exit

Create VLAN.

Switch_config# vlan 1,11-12,21-22

Enables the forwarding of subnet route of the switch.

Switch_config# ip exf

48.3.3 Configuring PE

Set VRF on PE:

```
Switch#config
Switch_config# ip vrf vpn1
Switch_config_vrf_vpn1# rd 200:  1
Switch_config_vrf_vpn1# route-target export 200:  1
Switch_config_vrf_vpn1# route-target import 200:  1
Switch_config_vrf_vpn1# exit

Switch_config# ip vrf vpn2
Switch_config_vrf_vpn2# rd 200:  2
Switch_config_vrf_vpn2# route-target export 200:  2
Switch_config_vrf_vpn2# route-target import 200:  2
Switch_config_vrf_vpn2# exit
```

Set the loopback interface as the router identifier:

```
Switch_config# interface loopback 0
Switch_config_l0# ip address 102.0.0.1 255.255.255.255
Switch_config_l0# exit
```

Set the physical interface which connects PE and CE: G1/1 and G1/2 connect S1 and S2 respectively:

```
Switch_config# interface gigaEthernet 1/1
Switch_config_g1/1# switchport mode trunk
Switch_config_g1/1# interface gigaEthernet 1/2
Switch_config_g1/2# switchport mode trunk
Switch_config_g1/2# exit
```

Set the L3 VLAN interface of PE, which connects S1:

```
Switch_config# interface VLAN21
Switch_config_v21# ip vrf forwarding vpn1
Switch_config_v21# ip address 21.0.0.1 255.0.0.0
Switch_config_v21# exit

Switch_config# interface VLAN22
Switch_config_v22# ip vrf forwarding vpn2
Switch_config_v22# ip address 22.0.0.1 255.0.0.0
Switch_config_v22# exit
```

Set the L3 VLAN interface of PE, which connects S2:

```
Switch_config# interface VLAN31
Switch_config_v31# ip vrf forwarding vpn1
Switch_config_v31# ip address 31.0.0.1 255.0.0.0
Switch_config_v31# exit

Switch_config# interface VLAN32
Switch_config_v32# ip vrf forwarding vpn2
Switch_config_v32# ip address 32.0.0.1 255.0.0.0
Switch_config_v32# exit
```

Set the EBGP of PE:

```
Switch_config# router bgp 200
Switch_config_bgp# bgp log-neighbor-changes
Switch_config_bgp# address-family ipv4 vrf vpn1
Switch_config_bgp_vpn1# no synchronization
Switch_config_bgp_vpn1# neighbor 21.0.0.2 remote-as 100
Switch_config_bgp_vpn1# neighbor 31.0.0.2 remote-as 300
Switch_config_bgp_vpn1# exit-address-family

Switch_config_bgp# address-family ipv4 vrf vpn2
Switch_config_bgp_vpn2# no synchronization
Switch_config_bgp_vpn2# neighbor 22.0.0.2 remote-as 100
Switch_config_bgp_vpn2# neighbor 32.0.0.2 remote-as 300
Switch_config_bgp_vpn2# exit-address-family
Switch_config_bgp# exit
```

Set VLAN and enable the subnet routing forwarding.

```
Switch_config# vlan 1,21-22,31-32
Switch_config# ip exf
```

48.3.4 Configuring MCE-S2

Configures VRF:

```
Switch#config
Switch_config# ip vrf vpn1
Switch_config_vrf_vpn1# rd 300:  1
Switch_config_vrf_vpn1# route-target export 300:  1
Switch_config_vrf_vpn1# route-target import 300:  1
Switch_config_vrf_vpn1# exit

Switch_config# ip vrf vpn2
Switch_config_vrf_vpn2# rd 300:  2
Switch_config_vrf_vpn2# route-target export 300:  2
Switch_config_vrf_vpn2# route-target import 300:  2
Switch_config_vrf_vpn2# exit
```

Configure the loopback port and the physical port, and use the address of the loopback port as the router ID of the BGP protocol.

```
Switch_config# interface loopback 0
Switch_config_l0# ip address 103.0.0.1 255.255.255.255
Switch_config_l0# exit
```

S2 connects S13 through the F0/1 port, S22 through the G0/3 port and PE through the G0/2 port.

```
Switch_config# interface gigaEthernet 0/1
Switch_config_g0/1# switchport pvid 41
Switch_config_g0/1# exit

Switch_config# interface gigaEthernet 0/3
Switch_config_g0/3# switchport pvid 46
Switch_config_g0/3# exit

Switch_config# interface gigaEthernet 0/2
Switch_config_g0/2# switchport mode trunk
Switch_config_g0/2# exit
```

Set the L3 VLAN port of a switch, bind the VRF to the VLAN port and set the IP address. S2 connects PE through two logical ports, VLAN31 and VLAN32. The two ports, VLAN41 and VLAN46, connect VPN1 and VPN2 respectively.

```
Switch_config# interface VLAN41
Switch_config_v41# ip vrf forwarding vpn1
```

Switch_config_v41# ip address 41.0.0.1 255.0.0.0

Switch_config_v41# exit

Switch_config# interface VLAN46

Switch_config_v46# ip vrf forwarding vpn2

Switch_config_v46# ip address 46.0.0.1 255.0.0.0

Switch_config_v46# exit

Switch_config# interface VLAN31

Switch_config_v31# ip vrf forwarding vpn1

Switch_config_v31# ip address 31.0.0.2 255.0.0.0

Switch_config_v31# exit

Switch_config# interface VLAN32

Switch_config_v32# ip vrf forwarding vpn2

Switch_config_v32# ip address 32.0.0.2 255.0.0.0

Switch_config_v32# exit

Configure the OSPF route between CE and customer device.

Switch_config# router ospf 1 vrf vpn1

Switch_config_ospf_1# network 41.0.0.0 255.0.0.0 area 0

Switch_config_ospf_1# redistribute bgp 300

Switch_config_ospf_1#exit

Switch_config# router ospf 2 vrf vpn2

Switch_config_ospf_2# network 46.0.0.0 255.0.0.0 area 0

Switch_config_ospf_2# redistribute bgp 300

Switch_config_ospf_2# exit

Configure the EBGP route between PE and CE.

Switch_config# router bgp 300

Switch_config_bgp# bgp log-neighbor-changes

Switch_config_bgp# address-family ipv4 vrf vpn1

Switch_config_bgp_vpn1# no synchronization

Switch_config_bgp_vpn1# redistribute ospf 1

Switch_config_bgp_vpn1# neighbor 31.0.0.1 remote-as 200

Switch_config_bgp_vpn1# exit-address-family

Switch_config_bgp# address-family ipv4 vrf vpn2

Switch_config_bgp_vpn2# no synchronization

Switch_config_bgp_vpn2# redistribute ospf 2

Switch_config_bgp_vpn2# neighbor 32.0.0.1 remote-as 200

Switch_config_bgp_vpn2# exit-address-family

Switch_config_bgp# exit

Create VLAN.

Switch_config# vlan 1,31-32,41,46

Enables the forwarding of subnet route of the switch.

Switch_config# ip exf

48.3.5 Setting S22

Set the VLAN attributes of the physical interface of CE, and connect S22 and S2 through interface f0/1:

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport pvid 46

Switch_config_g0/1# exit

Sets the IP address and the VLAN interface.

Switch_config# interface VLAN46

Switch_config_v46# ip address 46.0.0.2 255.0.0.0

Switch_config_v46# exit

Set the routing protocol between CE and customer's device:

Switch_config# router ospf 103

Switch_config_ospf_103# network 46.0.0.0 255.0.0.0 area 0

Switch_config_ospf_103# exit

48.3.6 TestifyingVRF Connectivity

Run the PING command on S1 to testify the connectivity of VPN1 between S1 and S11:

Switch# ping -vrf vpn1 11.0.0.2

!!!!!

--- 11.0.0.2 ping statistics ---

5 packets transmitted, 5 packets received, 0% packet loss

round-trip min/avg/max = 0/0/0 ms

Testify the connectivity between S1 and PE:

Switch# ping -vrf vpn1 21.0.0.1

!!!!!

--- 21.0.0.1 ping statistics ---

5 packets transmitted, 5 packets received, 0% packet loss

round-trip min/avg/max = 0/0/0 ms

49. Reliability Configuration

49.1 Configuring Port Backup

This chapter discusses how to back up the interface, describes the backup functions on the asynchronism serial interface, synchronism serial interface or ISDN interface.
For details about interface backup commands, refer to *Interface Backup Command Reference*.

49.1.1 Overview

Interface backup functions can enabled Backup interface or disabled it according to statement or flux information of Primary interface .If primary interface is down because of lines and etc., backup interface will enabled auto and data can send or receive through it instead of primary interface. It can add reliability from source router to destination. If flux of primary interface is crowded, it can activate backup interface also, share the data transportations to speed up data transportations. If primary interface is between “down” and “up” or flux of primary interface and backup interface are both small, backup interface can be activated but not transporting data. This can save cost of lines .The listing interfaces can be primary interface:

- asynchronism serial port
- ISDN
- synchronism serial port

Except above types, backup interfaces include Dialer logic interface also.

49.1.2 Backup InterfaceConfigratoin Task List

If you want to configure interface backup in above interfaces ,you should do as follows in interface configure mode.

- Enabling backup and choosing the backup interface

You can also do these tasks. These tasks are optional, can provide many uses and enforce interface backup functions.

- enabling interface backup rejection
- enabling flux equalization backup

49.1.3 Backup InterfaceConfigratoin Task

49.1.3.1 Enabling Backup and Choosing the Backup Interface

To realize interface backup functions, you should configure backup interface of this interface first. You can use instructions as follows in interface configuration mode.

Command	Purpose
backup interface*slot/port*	choose backup interface of this interface.

49.1.3.2 Enabling Backup Interface Rejection

Set delaying of enabled and disabled backup interface .To realize time gap between primary interface state changing and the result of state of backup interface changing.

1. choose backup interface
2. enabled interface backup delaying in this interface .

choose backup interface,You can use instructions as follows in interface configuration mode.

Command	Purpose
Backup interface*slot/port*	Choose backup interface of this port.

Enabled interface backup delaying , You can use instructions as follows in interface configuration mode.

Command	Purpose
backup delay {enable-delay | never } {disable-delay | never }	Difine backup interface activation and deactivation delaying.

49.1.3.3 Enabling Flux Equlization Backup

Flux equlization backup function will work if real flux of primary interface pass the percentage limit, backup interface will be activated to work state. If real flux of primary interface and backup interface is less than percentage limit to primary band width , backup interface will be activated to backup state.

Enabled flux equalization backup, you should execute tasks as follows:

- choosing the backup interface
- enabling flux equalization of this interface

49.1.3.3.1 Choosing backup interface.

You can use instructions as follows in interface configuration mode.

Command	Purpose
Backup interface*slot/port*	Choose backup interface of this interface

49.1.3.3.2 Enabling flux equalization of this interface.

You can use instructions as follows in interface configuration mode.

Command	Purpose
Backup load [enable-threshold|never][disable-threshold|never]	Configure interface backup flux to activate or deactivate backup interface limit.

49.1.4 Examples of Port Backup Configuration

Enable the backup interface on serial interface 1/0,and choose serial interface 1/1 as his backup interface. The time of backup interface activation and deactivation is both 5 seconds. Flux equalization setting is when true flux of primary interface pass 60% of band width , activate backup interface, while flux through both interfaces is less than 30% of band width of primary interface, activate backup interface.

configure routers

interface s1/0

backup interface int s1/1

backup delay 5 5

backup load 70 30

It is enabled when the primary interface is “down”, while the dialing backup interface is always connected. If the backup interface is a normal dialing interface, when the primary interface is down and the backup interface does not need to send data, the backup interface will not dial initiative, only dial when sending data .After enabled this ,regardless of transporting data, when primary interface is “down”, backup interface will dial at once to connect.(if you take slow dial interface as backup interface ,it is fit).

Enabled flux equlization backup, you must execute tasks as follows:

- Choose backup interface
- enabled backup interface dial at once when primary interface is “down”.

1. Choose backup interface. You can use instructions as follows in interface configuration mode.

Command	Purpose
backup interface slot/port	Choose backup interface of this interface .

2. Enabled backup interface dial at once when primary interface is “down”.

You can use instructions as follows in interface configuration mode.

Command	Purpose
backup always	When primary interface is down, backup Interface is always connected.

For an example(a0/0 as a dial interface)

configure router

interface s1/0

backup interface a0/0

backup always

49.2Configuring HSRP protocol

49.2.1 Overview

HSRP is a standard method of providing high network availability by providing first-hop redundancy for IP hosts on an IEEE 802 LAN configured with a default gateway IP address. HSRP routes IP traffic without relying on the availability of any single router. It enables a set of router interfaces to work together to present the appearance of a single virtual router or default gateway to the hosts on a LAN. When HSRP is configured on a network or segment, it provides a virtual Media Access Control (MAC) address and an IP address that is shared among a group of configured routers. HSRP allows two or more HSRP-configured routers to use the MAC address and IP network address of a virtual router.The virtual router does not exist; it represents the common target for routers that are configured to provide backup to each other. One of the routers is selected to be the active router and another to be the standby router, which assumes control of the group MAC address and IP address should the designated active router fail.

HSRP detects when the designated active router fails, and a selected standby router assumes control of the Hot Standby group's MAC and IP addresses. A new standby router is also selected at that time.Devices running HSRP send and receive multicast UDP-based hello packets to detect router failure and to designate active and standby routers. When HSRP is configured on an interface, Internet Control Message Protocol (ICMP) redirect messages are disabled by default for the interface.

HSRP is supported on VLAN-based or routed uplink interfaces only. Legacy media types are not supported.

49.2.2 HSRP protocol Configuration tast list

- Enabling HSRP Protocol
- Configuring HSRP Group Property

49.2.3 HSRP protocol Configuration tast

49.2.3.1 Enabling HSRP Protocol

To enable hsrp protocol in interface, you should configure the below command in interface configure model :

Command	Purpose
standby [*group-number*] ip [*ip-address* [secondary]]	Enable hsrp protocol

49.2.3.2 Configuring HSRP Group Property

To configure HSRP group property ，you should configure one or more command list below in interface configure model:

Command	Purpose
standby [*group-number*] timershellotime *holdtime*	Configure HSRP timer parameter.
standby [*group-number*] mac-address*mac-address*	Configure HSRP group virtual mac address.
standby [*group-number*] priority*priority*	Configure hsrp priority level.(To vote in active/standby router)
standby [*group-number*] preempt [delay*delay*]	Configure hsrp preempt. If local router's priority is larger than active router, local router should try to replace the active router. Configure hsrp preempt delay timer.Local router should replace active router after preempt delay timer.
standby [*group-number*] track*type number* [*interface-priority*]	Configure hsrp group tracking interface list.If the tracking interface is failed ,HSRP priority value decreased.
standby [*group-number*] authentication*string*	Configure the HSRP group authentication string to authenticate hsrp packet validation.

49.2.4 Example of Hot Standby Configuration

The following is a typical HSRP configuration example. The host in network segment 171.16.6.0/24 access server 1 and server 2 through R1/R2/R3. R1 and R2 backups each other in network segment 172.16.2.0/24. Both R1 and R2 realize the load-share function.

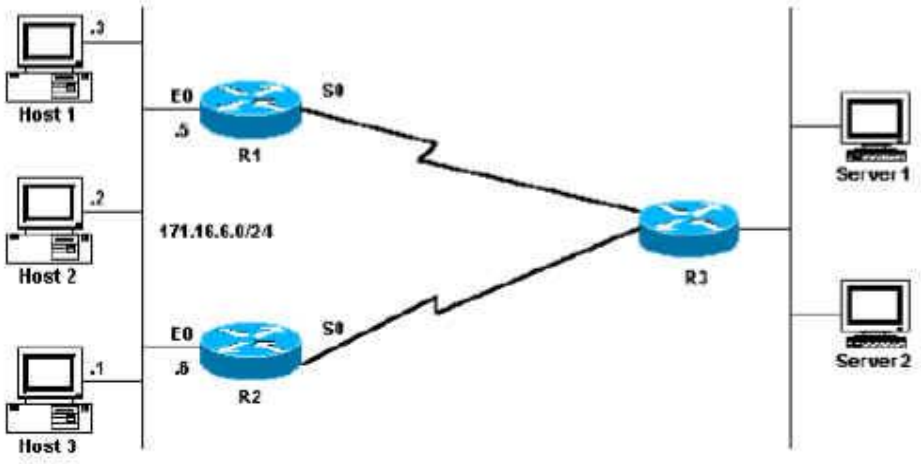


Figure 2-1 HSRP configuration

The following is R1 configuration:

First configure two HSRP groups on port Ethernet0, of which the virtual IP of group 1 is 171.16.6.100. The value of the default privilege level is 100, while the value of the privilege of group1 on R2 is 95. Therefore, R1 is the active router of group1. If the s0 protocol is down, the privilege of group 1 decreases to 90 by 10. In this case, the privilege of group1 on R2 is higher than that of group1 on R1. Because group1 on R2 has the occupation mechanism, group 1 on R2 then automatically switches to the active state and group1 of R1 switches to the standby state.

The virtual IP of group2 is 171.16.6.200 and the privilege of group 2 is 95. Because the default value of the privilege of group 2 on R2 is 100, group 2 of R2 is then the standby router.

R1 HSRP Configuration
Interface Ethernet0
ip address 171.16.6.5 255.255.255.0
standby 1 preempt
standby 1 ip 171.16.6.100 255.255.255.0
standby 1 trackl Serial0
standby 2 preempt
standby 2 ip 171.16.6.200 255.255.255.0
standby 2 track Serial0
standby 2 priority 95

The following is the R2 configuration:

Configure two HSRP groups on interface Ethernet 0. The virtual IP of group 1 is 171.16.6.100 and the privilege of group1 is 100, so R2 is the standby router of group1.

The virtual IP of group 2 is 171.16.6.200 and the default privilege of group2 is 100. Because the privilege of group2 on R2 is 95, R2 is then the active router of group2.

R2 HSRP Configuration
Interface Ethernet0
ip address 171.16.6.6 255.255.255.0
standby 1 preempt
standby 1 ip 171.16.6.100 255.255.255.0
standby 1 trackl Serial0
standby 1 priority 95
standby 2 preempt
standby 2 ip 171.16.6.200 255.255.255.0
standby 2 track Serial0

Then set the gateways of the host in network segment 172.16.6.0/24 to 172.16.6.100 and 172.16.6.200 respectively. In this case, the load balance then functions.

49.3Configuring VRRP

49.3.1 VRRP Overview

The Virtual Router Redundant Protocol (VRRP) can take several routers as a router backup group, providing network users a virtual-gateway router. It is useful to users when the router detection protocol is not supported. This is because it cannot automatically switch to a new NMS router when the selected router is reinstalled or breaks down.

VRRP provides a virtual MAC address and a virtual IP which is shared by a group of VRRP-running routers. VRRP will select a router from this router group to server as a main router. The main router receives and forwards the packets whose destination address is the virtual MAC address of the backup group. When VRRP detects the invalidity of the main router, the VRRP routers will select one as a new main router to obtain the MAC and the IP of the backup group.

The VRRP-running main router transmits the Advertise packets based on the Sock Raw multicast, while the standby routers receive these packets. The standby routers can serve as the main router through their Timer out mechanism and the Preempt mechanism. You can configure multiple hot standby groups on an interface to fully use the router.

Currently, VRRP is supported on routed uplink or VLAN interfaces. Legacy media types such as Token Ring are not supported.

VRRP is designated by IETF VRRP working group which is defined in RFC2338.

49.3.1.1 VRRP Application

Line backup

You can back up a link through VRRP.

For example, if a node in a company or in a bank wants to connect the outside network through the VRRP group, another router will automatically take over the jobs when one router invalidates.

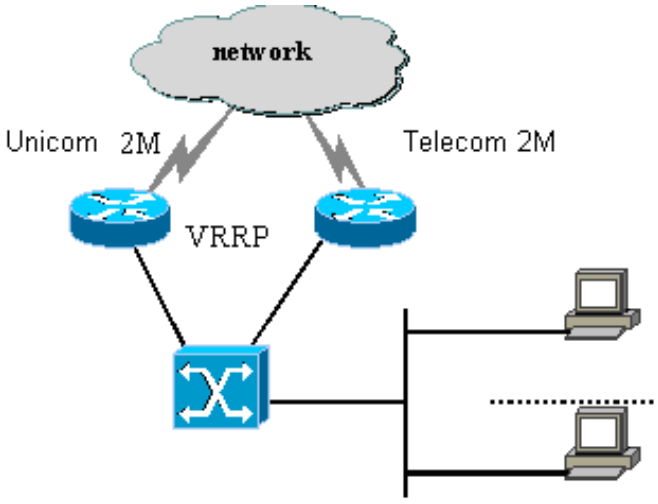


Figure 3-1 VRRP application

49.3.1.2 VRRP Terms

VRRP	Virtual Router Redundancy Protocol
VIP	Virtual IP
VMAC	Virtual MAC address
VRRP Router	A router which runs VRRP
Virtual Router	a VRRP group which is viewed by other parts in the network as a virtual router
IP Address Owner	A VRRP router that sets a real IP of an interface to VRRP VIP
VirtualRouter Master	Active router that forwards the data in the current VRRP group
Primary IP Address	An IP address selected from the addresses of an interface according to a certain regulation, which is normally the first IP address
Virtual Router Backup	A standby router which will be selected to serve as a data-forwarding router when the master router invalidates

49.3.2 VRRP Configuration Task List

- Enabling VRRP
- Configuring the time for vrrp
- Configuring the vrrp learning mode
- Configuring the description string for VRRP
- Configuring the privilege for VRRP hot backup
- Configuring the preemption mode
- Configuring the privilege for tracking other interfaces
- Configuring the authentication string
- Monitoring and maintaining VRRP

49.3.3 VRRP Configuration Tasks

49.3.3.1 Enabling VRRP

Command	Purpose
[no] vrrp*group-number*ip*[ip-address netmask* [secondary]]	Enables or disables VRRP.

49.3.3.2 Configuring the Time of VRRP

Command	Purpose
[no] vrrp*group-number*timers advertise <*1-255*>|<dsec<*5-360*>>	Sets the time of VRRP whose unit is second or 0.1 second.

49.3.3.3 Setting the VRRP Learning Mode

Command	Purpose
[no] vrrp *group-number* timers learn	Sets the VRRP learning mode.

49.3.3.4 Configuring the Description String of VRRP

Command	Purpose
[no] vrrp*group-number*description *TEXT*	Configures the description string for VRRP.

49.3.3.5 Configuring the Privilege for VRRP Hot Backup

Command	Purpose
[no] vrrp *group-number* priority<*1-255*>	Sets the hot standby privilege level in the VRRP router for selecting the primary router and the standby router.

49.3.3.6 Configuring the Preemption Mode

Command	Purpose
[no] vrrp *group-number*preempt [delay<*1-254*>]	Sets the preemption mode.

49.3.3.7 Configuring the Privilege for Tracking Other Ports

Command	Purpose
[no] vrrp*group-number*track type*number* [*interface-priority*]	Configures the privilege for tracking other ports, enabling the VRRP privilege to vary with the state change of the tracked port. When the tracked port invalidates, the VRRP privilege decreases; when the tracked port resumes effective, the VRRP privilege increases.

49.3.3.8 Configuring the Authentication String

Command	Purpose
[no] vrrp*group-number*authentication*string*	Selects an authentication string, which is used to authenticate other routers in the same group when the backup protocol packet exchanges.

49.3.3.9 Monitoring and Maintaining VRRP

Command	Purpose
show vrrp [interface*interface-number*] brief | detail	Displays the running state of the current VRRP.
debug vrrp [interface *interface-numbergroup-number*] all | packets | events | errors	Debugs three kinds of VRRP events.

49.3.4 VRRP Configuration Example

In the following network topology, two subnets in a same network use their own gateways (gateway A and gateway B) respectively to access the Internet, but gateway A and gateway B are standby ones each other. When one gateway (one router) breaks down, the other will work for the two subnets.

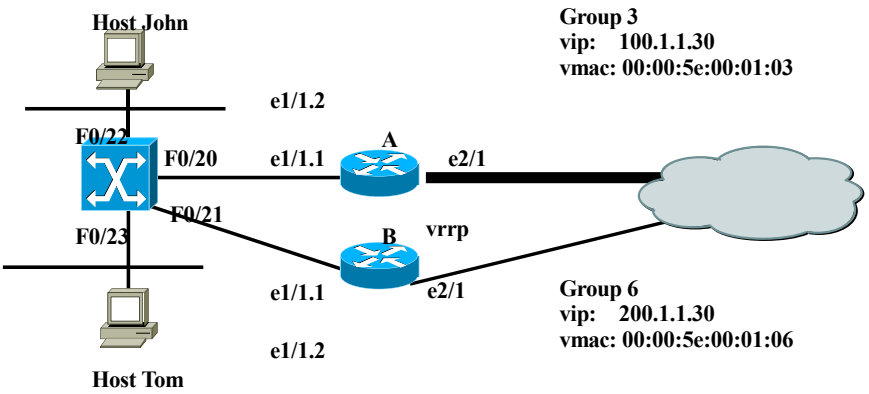


Figure 3-2 Simple VRRP application topology

The configuration is shown as follows:

Router A:

```
----------------------------------
interface Ethernet1/1.1
encapsulation dot1Q 2
ip address 100.1.1.5 255.255.255.0
vrrp 3 associate 100.1.1.30 255.255.255.0
   vrrp 3 priority 120
   vrrp 3 description line1-master
   vrrp 3 authentication line1pwd
vrrp 3 preempt
   vrrp 3 timers advertise dsec 15
----------------------------------
interface Ethernet1/1.2
encapsulation dot1Q 3
ip address 200.1.1.5 255.255.255.0
vrrp 6 associate 200.1.1.30 255.255.255.0
   vrrp 6 priority 110
   vrrp 6 description line2-backup
   vrrp 6 authentication line2pwd
vrrp 6 preempt
   vrrp 6 timers advertise dsec 15
----------------------------------
```

RouterB:

```
-----------------------------------
interface Ethernet1/1.2
encapsulation dot1Q 2
ip address 100.1.1.6 255.255.255.0
vrrp 3 associate 100.1.1.30 255.255.255.0
   vrrp 3 priority 110
   vrrp 3 description line1-backup
   vrrp 3 authentication line1pwd
vrrp 3 preempt
   vrrp 3 timers advertise dsec 15
-----------------------------------
interface Ethernet1/1.2
encapsulation dot1Q 3
ip address 200.1.1.6 255.255.255.0
vrrp 6 associate 200.1.1.30 255.255.255.0
   vrrp 6 priority 120
   vrrp 6 description line2-master
   vrrp 6 authentication line2pwd
vrrp 6 preempt
   vrrp 6 timers advertise dsec 15
-----------------------------------
SwitchA
-----------------------------------
interface FastEthernet0/20
 switchport trunk vlan-allowed (2,3)
!
interface FastEthernet0/21
 switchport trunk vlan-allowed (2,3)
!
interface FastEthernet0/22
 switchport pvid 2
!
interface FastEthernet0/23
 switchport pvid 3
!
interface VLAN2
 ip addr 100.1.1.8 255.255.255.0
 no ip directed-broadcast
!
interface VLAN3
 ip addr 200.1.1.8 255.255.255.0
 no ip directed-broadcast
-----------------------------------
```

50. Multicast Configuration

50.1 Multicast Overview

The chapter describes how to cofigure the multicast routing protocol. For the details of the multicast routing commands, refer to the part “Multicast Routing Commands”.

The traditional IP transmission allows only one host to communicate with a single host (unicast communication) or to communicate with all hosts (broadcast communication). The multicast technology allows one host to send message to some hosts. These hosts are called as group members.

The destination address of the message sent to the group member is a D-class address (224.0.0.0~239.255.255.255). The multicast message is transmitted like UDP. It does not provide reliable transmission and error control as TCP does.

The sender and the receiver make up of a multicast application. The sender can send the multicast message without joining in a group. However, the receiver has to join in a group before it receives the message from the group.

The relationship between group members is dynamic. The host can join in or leave a group at any time. There is no limitation to the location and number of the group member. If necessary, a host can be a member of multiple groups. Therefore, the state of the group and the number of group members varies with the time.

The router can maintain the routing table for forwarding multicast message by executing the multicast routing protocol such as PIM-DM and PIM-SM. The router learns the state of the group members in the directly-connected network segment through IGMP. The host can join in a designated IGMP group by sending the **IGMP Report** message.

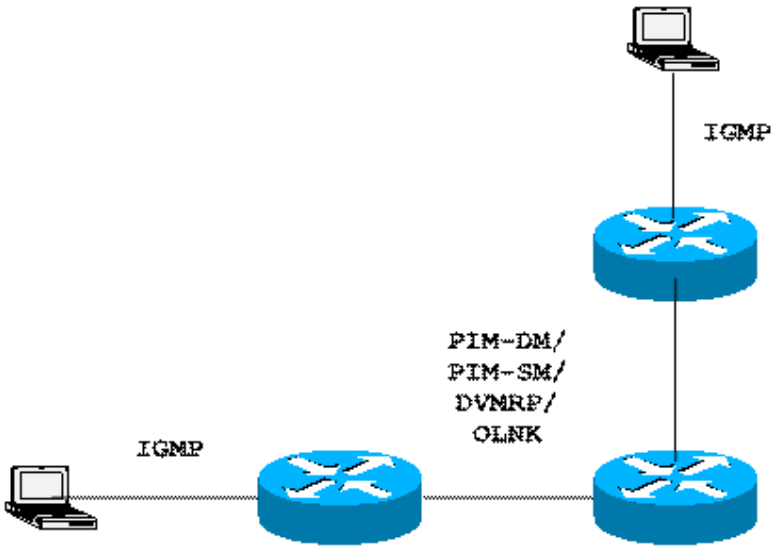
The IP multicast technology is suitable for the one-to-multiple multimedia application.

50.1.1 Multicast Routing Realization

In the router software of our router, the multicast routing includes the following regulations:

- IGMP runs between the router and the host in the LAN, which is used to track the group member relationship.
- OLNK is a static multicast technology, which is used in the simple topology. It realizes the multicast forwarding and effectively saves CPU and bandwidth.
- PIM-DM, PIM-SM and DVMRP is dynamic multicast routing protocols. They run between routeres and realizes the multicast forwarding by creating the multicast routing table.

The following figure shows the multicast protocols used in the IP multicast applications:



50.1.2 Multicast Routing Configuration Task List

50.1.2.1 Basic Multicast Configuration Task List

- Starting up the multicast routing (mandatory)
- Configuring TTL threshold (optional)
- Canceling rapid multicast forwarding (optional)
- Configuring static multicast route (optional)
- Configuring multicast boundary (optional)
- Configuring multicast helper (optional)
- Configuring Stub multicast route (optional)
- Monitoring and maintaining multicast route (optional)

50.1.2.2 IGMP Configuration Task List

- Modifying the current version of IGMP
- Configuring the IGMP query interval
- Configuring IGMP Querier interval
- Configuring the maximum response time of IGMP
- Configuring the query interval of the last IGMP group member
- Static IGMP configuration
- Configuring the IGMP **Immediate-leave** list

50.1.2.3 PIM-DM Configuration Task List

- Regulating the timer
- Designate the PIM-DM version
- Configuring the state refreshment
- Configuring the filtration list
- Setting the DR priority
- Clearing (S,G) information

50.1.2.4 PIM-SM Configuration Task List

- Configuring static RP
- Configuring standby BSR
- Configuring standby RP
- Displaying PIM-SM multicast routing
- Clearing multicast routes learned by PIM-SM

50.2Basic Multicast Routing Configuration

50.2.1 Starting up Multicast Routing

To allow the router software to forward the multicast message, you must start up the multicast routing. Run the following command in global configuration mode to start up the multicast message forwarding:

Command	Purpose
ip multicast-routing	Starts up the multicast routing.

50.2.2 Starting up the Multicast Function on the Port

When the multicast routing protocol runs on a port, the IGMP is activated on the port. The multicast routing protocols include OLNK, PIM-DM, PIM-SM and DVMRP. Only one multicast routing protocol is allowed to run on the same port. When the router connects multiple multicast domains, different multicast protocols can be run on different ports.

Although the router software can function as the multicast boundary router (MBR). If possible, do not simultaneously run multiple multicast routing protocols on the same router for some multicast routing protocols may be badly affected. For example, when PIM-DM and BIDIR PIM-SM simultaneously run, confusion is to occur.

50.2.2.1 Starting up PIM-DM

Run the following command to run PIM-DM on a port and then activate the multicast dense mode function:

Command	Purpose
ip pim-dm	Enters the port where PIM-DM is running and then activates PIM-DM multicast routing process in port configuration mode.

50.2.2.2 Starting up PIM-SM

To run PIM-DM on a port and activate the PIM-DM multicast, perform the following operation:

Command	Purpose
ip pim-sm	Enters a port where PIM-SM needs to run and then activates the PIM-SM multicast routing process in port configuration mode.

50.2.3 Configuring TTL Threshold

Run the command **ip multicast ttl-threshold** to configure the TTL threshold of the multicast message that is allowed to pass the port. Run the command **no ip multicast ttl-threshold** to use the default threshold value **1**.

Command	Purpose
ip multicast ttl-threshold*ttl-value*	Configures the TTL threshold on the port.

Example

The following example shows how the administrator configures the TTL threshold on a port:

interface ethernet 1/0

ip multicast ttl-threshold 200

50.2.4 Cancelling Rapid Multicast Forwarding

Run the command **ip multicast mroute-cache** to configure the rapid multicast forwarding function on a port. Run the command **no ip multicast mroute-cache** to cancel the rapid multicast forwarding function.

Command	Purpose
ip multicast mroute-cache	Enables the rapid multicast forwarding function on a port.

Example

The following example shows how the administrator cancels the rapid multicast forwarding function on a port:

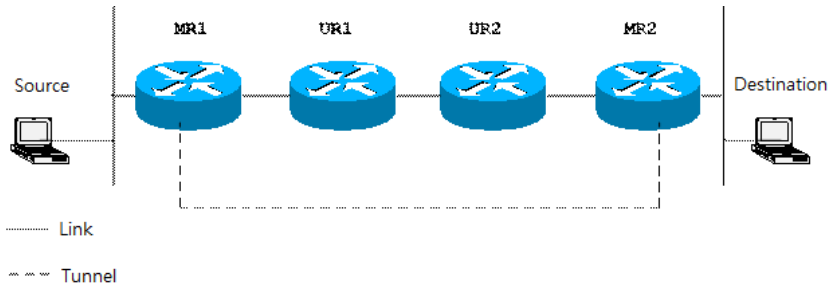
interface ethernet 1/0

no ip mroute-cache

50.2.5 Configuring Static Multicast Route

The static multicast route allows that the multicast forwarding path is different from the unicast path. RPF check is performed when the multicast message is forwarded. The actual port receiving the message is the expected receiving port. That is, the port is the next-hop port of the unicast route that reaches the sender. If the unicast topology is same to the multicast topology, RPF check is reasonable. In some cases, the unicast path requires to be different from the multicast path.

Take the tunnel technology as an example. When a router in a path does not support the multicast protocol, the resolution is to configure the GRE tunnel between two routeres. In the following figure, each unicast router supports only the unicast message; each multicast router supports only the multicast message. The source host sends the multicast message to the destination host through MR1 and MR2. MR2 forwards the multicast message only when it is received through the tunnel. When the destination host sends the unicast message to the source host, the tunnel is also used. When the tunnel technology is adopted, the message transmission speed is slower than that of the direct message transmission.



After the static multicast routing is configured, the router can perform the RPF check according to the configuration information. The RPF check is not based on the unicast routing table any more. Therefore, the multicast message goes through the tunnel, while the unicast message does not go through the tunnel. The static multicast route only exists in the local place. It will not be announced or forwarded.

Run the following command in global configuration mode to configure the static multicast route:

Command	Purpose
ip mroute*source-address mask rpf-address***type***number*[**distance**]	Configures the static multicast route.

50.2.6 Configuring IP Multicast Boundary

Run the command **ip multicast boundary** to configure the multicast boundary for the port. Run the command **no ip multicast boundary** to cancel the configured boundary. The commands used in the second configuration will replace the commands used in the first configuration.

Command	Purpose
ip multicast boundary *access-list*	Configures the multicast boundary for the port.

Example

The following example shows how to configure the management boundary for a port:

interface ethernet 0/0

ip multicast boundary acl

ip access-list standard acl

permit 192.168.20.97 255.255.255.0

50.2.7 Configuring IP Multicast Rate Control

Run the command **ip multicast rate-limit** to limit the rate of receiving and sending the multicast message in a source/group range. Run the command **noip multicastrate-limit** to cancel the rate limitation.

Run the following command to limit the input rate of a multicast flow to n kbps.

Command	Purpose
ip multicast rate-limit in group-list *access-list*1 source-list *access-list*2 nkbps	Configures the maximum input rate limitation of the multicast flow in a certain range.

Run the following command to limit the output rate of a multicast flow to n kbps

Command	Purpose
ip multicast rate-limit out*group-listaccess-list*1 *source-list access-list*2 kbps	Configures the maximum output rate limitation of the multicast flow in a certain range.

50.2.8 Configuring IP Multicast Helper

Run the command **ip multicast helper-map** to use the multicast route to connect two broadcast networks in the multicast network. Run the command **no ip multicast helper-map** to cancel the command.

Command	Purpose
interface*type number*	Enters the interface configuration mode.
ip multicast helper-map broadcast*group-address access-list*	Configures the command **ip multicast helper** to convert the broadcast message to the multicast message.
ip directed-broadcast	Allows the directional broadcast.
ip forward-protocol [*port*]	Configures the port number allowing to forward the message.

On the last-hop router connecting the destination broadcast network, perform the following operations:

Command	Purpose
interface *type number*	Enters the interface configuration mode.
ip directed-broadcast	Allows the directional broadcast.
ip multicast	Configures the command **ip multicast**

helper-map*group-address broadcast-address access-list*	**helper** to convert the multicast message to the broadcast message.
ip forward-protocol [port]	Configures the port number allowing to forward the message.

Example

The following example shows how to configure the command ip multicast helper.

The configuration of the router is shown in the following figure. Configure the command ip directed-broadcast on the e0 port of the first-hop router to handle the directional message. Configure ip multicast helper-map broadcast 230.0.0.1 testacl1, allowing to convert the UDP broadcast message with port number 4000 that is sent from the source address 192.168.20.97/24 to the multicast message with the destination address 230.0.0.1.

Configure the command ip directed-broadcast on the e1 port of the last-hop router to handle the directional message. Configure ip multicast helper-map 230.0.0.1 172.10.255.255 testacl2, allowing to convert the multicast message with port number 4000 and the destination address 230.0.0.1 that is sent from the source address 192.168.20.97/24 to the broadcast message with the destination address 172.10.255.255.

In the first-hop router connecting the source broadcast network, perform the following operations: (the router is configured on the VLAN port)

```
interface ethernet 0
ip directed-broadcast
ip multicast helper-map broadcast 230.0.0.1 testacl
ip pim-dm
!
ip access-list extended testacl  permit udp 192.168.20.97 255.255.255.0 any
ip forward-protocol udp 4000
```

In the last-hop router connecting the destination broadcast network, perform the following operations:

```
interface ethernet 1
ip directed-broadcast
ip multicast helper-map 230.0.0.1 172.10.255.255 testacl2
ip pim-dm
!
ip access-list extended testacl2  permit udp 192.168.20.97 255.255.255.0 any
ip forward-protocol udp 4000
```

50.2.9 Configuring Stub Multicast Route

Run the commands **ip igmp helper-address** and **ip pim-dm neighbor-filter** to configure the Stub multicast route.

On the port where the stub router and the host are connected, perform the following operations:

Command	Purpose
interface*type number*	Enters the interface configuration mode.
ip igmp helper-address *destination-address*	Configures the command **ip igmp helper-address** to forward the multicast message to the central router.

On the port where the central router and the stub router are connected, perform the following operations:

Command	Purpose
interface *type number*	Enters the interface configuration mode.
ip pim neighbor-filter *access-list*	Filters all **pim** messages on the stub router.

Example

The configuration of router A and B is shown as follows:

Stub Router A Configuration

ip multicast-routing

ip pim-dm

ip igmp helper-address 10.0.0.2

Central Router B Configuration

ip multicast-routing

ip pim-dm

ip pim-dm neighbor-filter stubfilter

ip access-list stubfilter

deny 10.0.0.1

50.2.10 Monitoring and Maintaining Multicast Route

50.2.10.1 Clearing the multicast cache and the routing table

If special caches or the routing table is invalid, you need to clear its content. Run the following commands in management mode:

Command	Purpose
clear ip igmp group [*type number*] [*group-address* | <*cr*>]	Clears the items in the IGMP cache.
clear ip mroute*[* | group-address | source-address]*	Clears the items in the multicast routing table.

50.2.10.2 Displaying the multicast routing table and system statistics information

The detailed information about the IP multicast routing table, cache or database helps to judge how the resources are used and to resolve network problems.

Run the following commands in management mode to display the statistics information about the multicast route:

Command	Purpose
show ip igmp groups [*type number* | *group-address*] [detail]	Displays the information about the multicast group in the IGMP cache.
show ip igmp interface [*type number*]	Displays the IGMP configuration information on the interface.
show ip mroute mfc	Displays the multicast forwarding cache.
show ip rpf [ucast | mstatic | pim-dm | pim-sm | dvmrp] *source-address*	Displays the RPF information.

50.3IGMP Configuration

50.3.1 Overview

50.3.1.1 IGMP

Internet Group Management Protocol (IGMP) is a protocol used to manage multicast group members. IGMP is an asymmetric protocol, containing the host side and the switch side. At the host side, the IGMP protocol regulates how the host, the multicast group member, reports the multicast group it belongs to and how the host responds to the query message from the switch. At the switch side, the IGMP protocol regulates how the IGMP-supported switch learns the multicast group member ID of the hosts in the local network and how to modify the stored multicast group member information according to the report message from the host.
Since our switches support the IGMP Router protocol, the multicast routing protocol can be provided with the information about the multicast group members in the current network and the switch decides whether to forward the multicast message. In a word, to enable the switch support the multicast process of the IP message, the switch need be configured to support the multicast routing protocol and the IGMP Router protocol. Currently, MY COMPANY' switches support the IGMP Router protocol and version 3 IGMP, the latest version.
There is no independent startup commands for IGMP. The function of the IGMP-Router protocol is started up through the multicast routing protocol.

50.3.1.2 OLNK

Strictly speaking, the IGMP only-link protocol (OLNK) is not a multicast routing protocol because it has no interaction process as other protocols. However, in some special cases, running OLNK in the simple topology will get nice results. Similar to the PIM-DM protocol which also has no negotiation process, OLNK can handle the change of IGMP group members and promptly adjust the RPF interface according to the topology change. In this way, OLNK ensures the multicast forwarding and prevents the control messages of the multicast routing protocol from occupying the bandwidth.

50.3.2 IGMP Configuration

The commands to configure the attributes of the IGMP-Router mainly are the commands to adjust the IGMP parameters. The following is to describe these commands. For details about these commands, refer to explanation documents relative to the IGMP commands.

50.3.2.1 Changing Current IGMP Version

Up to now, the IGMP protocol has three formal versions. The corresponding RFCs are RFC1112, RFC2236 and RFC3376. IGMP V1 supports only the function to record the multicast group members. IGMP V2 can query the designated multicast group member, generates the leave message when an IGMP host leaves a multicast group, and shortens the change delay of the group member. IGMP V3 has additional functions to update and maintain the multicast group member IDs which correspond to the source host addresses. The IGMP Router protocol of IGMP V3 is fully compatible with the host side of IGMP V1 and IGMP V2. MY COMPANY's switch software supports the IGMP Router protocols of the three IGMP versions.

You can configure the IGMP-Router function at different interfaces (the multicast routing protocol configured on different interfaces can start up the IGMP-Router function) and different versions of IGMP can be run on different interfaces.

Note that a multicast switch can start up the IGMP-Router function on only one of the ports that connect the same network.

Run the following command in interface configuration mode to change the version of the IGMP-Router protocol on a port:

Command	Purpose
ip igmp version*version_number*	Changes the IGMP version running on the current port.

50.3.2.2 Configuring IGMP Query Interval

No matter what version number of the current IGMP-Router protocol is, the multicast switch can send the IGMP General Query message every a certain time on the port where the IGMP-Router function is started. The transmission address is 224.0.0.1. The purpose of the multicast switch is to get the report message from the IGMP host and therefore know which multicast group each IGMP host in the network belongs to. The interval to send the General Query message is called as IGMP Query Interval. If the parameterIGMP Query Interval is set to a big value, the switch cannot immediately receive the information about which multicast group the current IGMP host belongs to. If the parameter IGMP Query Interval is set to a small value, the flow of the IGMP message is to increase in the current network.

Run the following command in interface configuration mode to modify the IGMP query interval on a port:

Command	Purpose
ip igmp query-interval*time*	Modifies the IGMP query interval on the current interface (unit: second).

50.3.2.3 Configuring IGMP Querier Interval

As to version 2 and version 3 of the IGMP-Router protocol, if another switch that runs the IGMP-Router protocol exists in the same network, you need to choose a querier. Querier stands for a switch that can send the query message (In fact, it is a port of the switch where the IGMP-Router protocol is enabled). Normally, one network has only one querier, that is, only one switch sends the IGMP Query message. There is no querier choice for IGMP-Router V1 because the multicast routing protocol decides which switch to send the IGMP Query message in IGMP-Router V1.

IGMP-Router V2 and IGMP-Router V3 have the same querier choice mechanism, that is, the switch with the minimum IP address is the querier in the network. The switch that is not the querier needs to save a clock to record the existence of the querier. If the clock times out, the non-querier switch turns to be the querier until it receives the IGMP Query message from the switch with a smaller IP address.

For IGMP-Router V2, you can configure other querier intervals using the following command:

Command	Purpose
ip igmpquerier-timeout*time*	Configures the interval for other queriers (unit: second).

For IGMP-Router V1, the interval of other queriers is useless. For IGMP-Router V3, the interval cannot be configured because it is decided by the protocol itself.

50.3.2.4 Configuring Maximum IGMP Response Time

For IGMP-Router V2 and IGMP-Router V3, special data field in the transmitted IGMP General Query message regulates the maximum response time of the IGMP host. That is, the IGMP host has to send the response message before the regulated maximum response time expires, indicating that the General Query message is received. If the maximum response time is set to a big value, the change of multicast group members delays. If the maximum response time is set to a small value, the flow of the IGMP message will be increased in the current network.

The maximum IGMP response time must be shorter than the IGMP query interval. If the value of the maximum response time is bigger than the query interval, the system will automatically set the maximum response time to **query-interval – 1**.

For IGMP-Router V2 and IGMP-Router V3, run the following command in interface configuration mode to set the maximum IGMP response time:

Command	Purpose
ip igmp query-max-response-time*time*	Configures the maximum IGMP response time (unit: second).

For IGMP-Router V1, the maximum IGMP response time is decided by the protocol itself. Therefore, the previous command is useless to IGMP-Router V1.

50.3.2.5 Configuring IGMP Query Interval for the Last Group Member

For IGMP-Router V2 and IGMP-Router V3, When the Group Specific Query message for a specific multicast group is sent, the query interval of the last group member will be used as the maximum response time of the host. That is, the IGMP host has to send the response message before the maximum response time of the last group member expires, indicating that the Group Specific Query message is received. If the IGMP host finds that it need not respond to the query message, it will not respond to the message after the interval. In this case, the multicast switch is to update the saved multicast group member information. If the query interval of the last group member is set to a big value, the change of the multicast group member delays. If the query interval of the last group member is set to a small value, the flow of the IGMP message is to increase in the current network.

For IGMP-Router V2 and IGMP-Router V3, run the following command in interface configuration mode to configure the IGMP query interval of the last group member:

Command	Purpose
ip igmp last-member-query-interval*time*	Configures the IGMP query interval of the last group member (unit: ms).

The previous command is useless for IGMP-Router V1.

50.3.2.6 Static IGMP Configuration

Besides the functions regulated by the IGMP-Router protocol, BODCOM's switches support the static multicast group configuration on the port. For the IGMP host, its multicast group member relationship may vary. Suppose the IGMP host only belongs to the multicast group **group1**, it receives the multicast message from and sends the multicast message to the multicast group **group1**. After a period of time, it may belong to the multicast group **group2**, and receives the multicast message from and sends the multicast message to the multicast group **group2**. After another period of time, the IGMP host may not belong to any multicast group. Therefore, the multicast group assignment information varies.

Different the above "dynamic multicast group", if a port is configured to belong to a static multicast group, the multicast routing protocol then takes the port as one that always receives and sends the multicast message of the multicast group. To be better compatible with IGMP-Router V3, the static multicast group can be configured to receive the multicast message from the designated source address, that is, the source-filter function is added when the multicast message is received.

Run the following command in interface configuration mode to configure the static multicast group for a port:

Command	Purpose
ip igmp static-group { * | *group-address*} {**include***source-address* | <*cr*> }	Configures the static multicast group attribute for a port.

50.3.2.7 Configuring the IGMP Immediate-leave List

If IGMP V2 is started up on a port of the switch and the network that the port connects has only one IGMP host, you can realize the Immediate Leave function of the IGMP host by configuring the **IGMP Immediate-leave** list. According to the regulations of IGMP V2, when a host leaves a specific multicast group, the host will send the Leave message to all multicast switches. After receiving the Leave message, the multicast switches send the Group Specific message to confirm whether any multicast message to be received from or sent to the multicast group by the host exists on the port. If the Immediate Leave function is configured, no message need be interacted between the IGMP host and the multicast switch, the change of the multicast group member IDs will not be delayed.

The command can be configured both in global configuration mode and in interface configuration mode. The priority of the command configured in global configuration mode is higher than that configured in interface configuration mode. If the command is first configured in global configuration mode, the command configured in interface configuration mode will be omitted. If the command is first configured in interface configuration mode, the command configured in global configuration mode will delete the command configured in interface configuration mode.

For IGMP-Router V2, run the following command in interface configuration mode to configure the IGMP Immediate-leave list:

Command	Purpose
ip igmp immediate-leave group-list*list-name*	Configures the access list that realizes the function to immediately leave the multicast group for the IGMP host.
ip access-list standard*list-name*	Creates a standard IP access list named **list-name**.
permit*source-address*	Configures the IP address for the IGMP host that will realize the immediate-leave function in standard access-list configuration mode.

The previous command is invalid to IGMP-Router V1 and IGMP-Router V3.

50.3.3 IGMP Characteristic Configuration Example

All configurations about the IGMP characteristics are performed in VLAN port.

50.3.3.1 Example for changing the IGMP version

The IGMP-Router protocol of latter version is compatible with the IGMP host of low version, but cannot be compatible with the IGMP-Router protocol of the earlier version. Therefore, if, there are switches running the IGMP-Router protocol of the earlier version in the current network, you need to change the IGMP-Router protocol of latter version to the IGMP-Router protocol of earliest version in the same network segment. Suppose the administrator knows that switches running IGMP-Router V1 and IGMP-Router V2 exist in a network that the local switch connects, the administrator needs to change the version of the IGMP-Router protocol from version 2 to version 1 on a port of the switch that runs IGMP-Router V2.

interface ethernet 1/0

ip igmp version 1

50.3.3.2 IGMP query interval configuration example

The following example shows how to modify the IGMP query interval to 50 seconds on the interface **ethernet 1/0**:

interface ethernet 1/0

ip igmp query-interval 50

50.3.3.3 IGMP Querier interval configuration example

The following example shows how to modify the IGMP Querier interval to 100 seconds on the interface **ethernet 1/0**:

interface ethernet 1/0

ip igmp querier-timeout 100

50.3.3.4 Maximum IGMP response time example

The following example shows how to modify the maximum IGMP response time to 15 seconds on the interface **ethernet 1/0**:

interface ethernet 1/0

ip igmp query-max-response-time 15

50.3.3.5 Example for configuring IGMP query interval for the last group member

The following example shows how to modify the IGMP query interval of the last group member to 2000 ms on the interface ethernet 1/0:

interface ethernet 1/0

ip igmp last-member-query-interval 2000

50.3.3.6 Static IGMP configuration example

The configuration command of the static multicast group can define different classes of static multicast groups by adopting different parameters. The following examples shows the results of running different command parameter.

interface ethernet 1/0

ip igmp static-group *

The previous configuration command configures all static multicast groups on the interface ethernet 1/0. The multicast routing protocol is to forward all IP multicast messages to the interface ethernet 1/0.

interface ethernet 1/0

ip igmp static-group 224.1.1.7

The previous configuration command configures the static multicast group 224.1.1.7 on the interface ethernet 1/0, that is, the interface belongs to the multicast group 224.1.1.7. The multicast routing protocol is to forward all IP multicast messages that are finally sent to the multicast group 224.1.1.7 to the interface ethernet 1/0.

interface ethernet 1/0

ip igmp static-group 224.1.1.7 include 192.168.20.168

The previous configuration command configures the static multicast group 224.1.1.7 on the interface ethernet 0/0, and defines source-filter of the multicast group as 192.168.20.168. That is, the interface belongs to the multicast group 224.1.1.7, but it only receives the IP multicast messages from 192.168.20.168. The multicast routing protocol is to forward IP multicast messages that are received from 192.168.20.168 and finally sent to the multicast group 224.1.1.7 to the interface ethernet 0/0.

Run the following command in interface configuration mode to receive the IP multicast message that is from 192.168.20.169 and finally sent to the multicast group 224.1.1.7:

ip igmp static-group 224.1.1.7 include 192.168.20.169

The previous command can be executed for many times to define different source addresses.

In a multicast group, the multicast group information cannot be simultaneously configured both for a specific source address and for all source addresses. The command used in the later configuration will be omitted. For example, If you run the command **ip igmp static-group 224.1.1.7 include 192.168.20.168** after the command **ip igmp static-group 224.1.1.7** is executed, the command **ip igmp static-group 224.1.1.7 include 192.168.20.168** will be omitted.

50.3.3.7 IGMP Immediate-leave list configuration example

The following example shows how to set the access list to **imme-leave** on the interface ethernet 1/0 with the **immediate-leave** function and to add the IP address 192.168.20.168 of the IGMP host to the access list. The configuration ensures that the IGMP host with IP address 192.168.20.168 realizes the **immediate-leave** function.

interface ethernet 1/0

ip igmp immediate-leave imme-leave

exit

ip access-list standard imme-leave

permit 192.168.20.168

50.4PIM-DM Configuration

50.4.1 PIM-DM Introduction

Protocol Independent Multicast Dense Mode (PIM-DM) is a multicast routing protocol in dense mode. By default, when the multicast source starts to send the multicast data, all network nodes in the domain receive the data. Therefore, PIM-DM forwards the multicast packets in broadcast-pruning mode. When the multicast source starts to send data, the switches alongside forward the multicast packets to all PIM-activated interfaces except the RPF interface. In this way, all network nodes in the PIM-DM domain can receive these multicast packets. To finish the multicast forwarding, the switches alongside need create the corresponding multicast routing item (S,G) for group G and its source S. The routing item (S,G) includes the multicast source address, multicast group address, incoming interface, outgoing interface list, timer and logo.

If there is no multicast group member in a certain network segment, PIM-DM will send the pruning information, prune the forwarding interface connecting the network segment and then establish the pruning state. The pruning state corresponds to the timeout timer. When the timer times out, the pruning state turns to be the forwarding state again and the multicast data can be forwarded along these branches. Additionally, the pruning state contains information about the multicast source and the multicast group. When the multicast group member appears in the pruning area, PIM-DM actively sends the graft message to the upper field without waiting for the pruning state of the upper field to time out, turning the pruning state to the forwarding state.

As long as source S still sends information to group G, the first-hop switch will periodically send the refreshing information of the routing item (S,G) to the nether original broadcast tree to finish refreshing. The state refreshing mechanism of PIM-DM can refresh the state of the downstream, ensuring that the pruning of the broadcast tree does not time out.

In the multi-access network, besides the DR selection, PIM-DM also introduces the following mechanisms:

- Use the assertion mechanism to select the unique forwarder to prevent the multicast packet from being repeatedly forwarded.
- Use the add/prune restraint mechanism to reduce redundant add/prune information.
- Use the pruning deny mechanism to deny improper pruning actions.

In the PIM-DM domain, the switches that run PIM-DM periodically send the Hello information to achieve the following purposes:

- Discover neighboring PIM switches.
- Judge leaf networks and leaf switches.
- Select the designated router (DR) in the multi-access network.

To be compatible with IGMP v1, PIM-DM is in charge of the DR choice. When all PIM neighboring routers on the interface support DR Priority, the neighboring router with higher priority is selected as the DR. If the priority is the same, the neighboring router with the maximum interface IP value is selected as the DR. If the priority is not shown in the Hello message of multiple routers, the router whose interface has the biggest IP value is selected as the DR.

The PIM-DM v2 of DBCOM's switches supports the neighbor filtration list, CIDR, VLSM and IGMP v1-v3.

50.4.2 Configuring PIM-DM

50.4.2.1 Modifying Timer

The routing protocol adopts several timers to judge the transmission frequency of Hello message and state-refresh control message. The interval to transmit the Hello message affects whether the neighbor relationship can correctly created.

Run the following commands in switch configuration mode to regulate the timer:

Command	Purpose
ip pim-dm hello-interval	Sets the interval (unit: second) to send the Hello message from the interface and the neighbor.
Ippim-dm state-refresh rigination-interval	For the first-hop switch directly connecting the source, the interval to send the state-refresh message is only valid to the configurations at the upstream ports. For the following switches, the interval is the period to receive and handle the state-refresh message.

50.4.2.2 Configuring State-Refresh

The state-refresh control information of the PIM-DM is forwarded in management mode by default. The configuration commands in interface configuration mode are effective only to the configurations at the upstream ports when the first-hop switch directly connecting the source sends the state-refresh message periodically. For the following switches, the interval is the period to receive and handle the state-refresh message.

Command	Purpose
no ip pim-dm state-refresh disable	Allows to send and receive the state-refresh message on the port.
ip pim-dm state-refresh origination-interval	Configures the interval to send and receive the state-refresh message on the port.

50.4.2.3 Configuring Filtration List

PIM-DM does not set the filtration list by default. The referred filtration list includes the neighbor filtration list and the multicast boundary filtration list. The filtration list requires to be configured in interface configuration mode.

To forbid a switch or switches at a network segment to join in the PIM-DM negotiation, the neighbor filtration list need be configured. To forbid or permit some groups to pass the local region, the multicast boundary filtration list need be configured.

Command	Purpose
ip pim-dm neighor-filter	Configures the neighbor filtration list.
ip multicast boundary	Configures the multicast boundary filtration list.

50.4.2.4 Setting DR Priority

To be compatible with IGMP v1, the DR choice is required. By default, the priority of the DR is set to **1**. When all PIM neighboring routers on the interface support DR Priority, the neighboring router with higher priority is selected as the DR. If the priority is the same, the neighboring router with the maximum interface IP value is selected as the DR. If the priority is not shown in the Hello message of multiple routers, the router whose interface has the biggest IP value is selected as the DR.

Run the following command in interface configuration mode:

Command	Purpose
ip pim-dm dr-priority	Configures the priority for the local DR on the designated port.

50.4.2.5 Clearing Item (S,G)

Normally, item (S,G) in the local MRT or the statistics value of the multicast message number forwarded through item (S,G) need be cleared. Run the following commands in management mode.

Command	Purpose
clear ip mroute pim-dm {***** | *group* [*source*]}	Clears the item (S,G) in the local MRT. The operation is to delete all or part items of the local multicast routing table. Multicast message forwarding may be affected. The command is used to delete only the (S,G) items created by the PIM-DM multicast routing protocol on the upstream ports.
clear ip pim-dm interface	Resets the statistics value of multicast message forwarded by (S,G) on the PIM-DM port. The command is used to reset only the (S,G) items created by the PIM-DM multicast routing protocol on the upstream ports.

50.4.3 PIM-DM State-Refresh Configuration Example

Refer to section 4.2.2 “Configuring State-Refresh”.

50.5Configuring PIM-SM

50.5.1 PIM-SM Introduction

Protocol Independent Multicast Spare Mode (PIM-SM) is a multicast routing protocol in sparse mode. In the PIM-SM domain, the switches that run PIM-SM periodically send the Hello information to achieve the following purposes:

- Discover neighboring PIM-SM switches.
- Select the designated router (DR) in the multi-access network.

As shown in the following figure, the DR sends the join/prune message to the directly-connected group members at the direction of multicast distribution tree, or sends the data of the directly-connected multicast source to the multicast distribution tree.

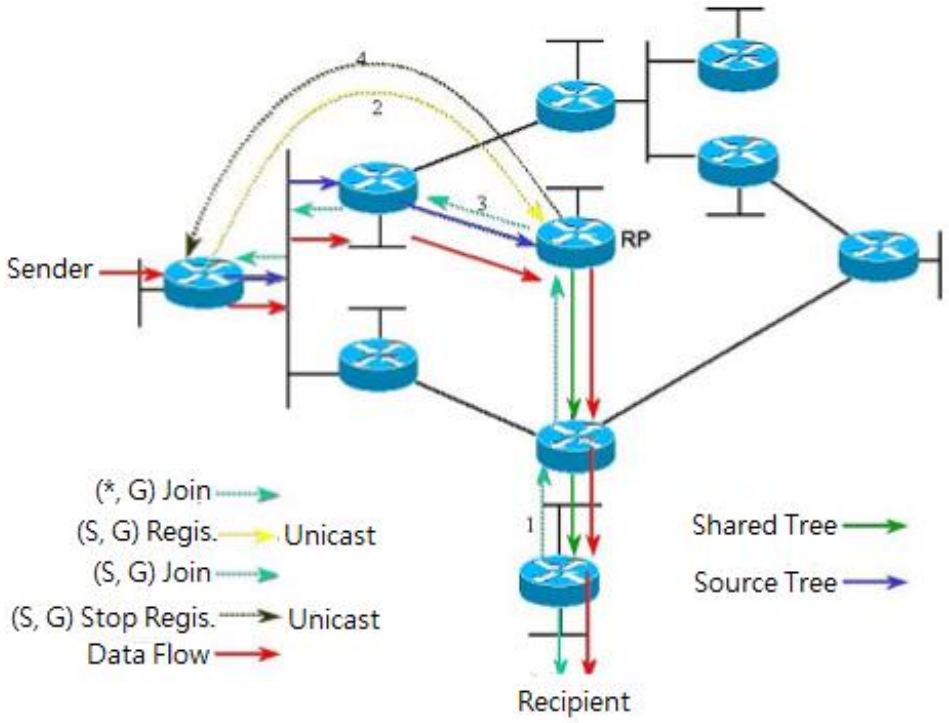


Figure 5-1 Join-in mechanism of PIM-SM

PIM-SM forwards the multicast packet by creating the multicast distribution tree. The multicast distribution tree can be classified into two groups: Shared Tree and Shortest Path Tree. Shared Tree takes the RP of group G as the root, while Shortest Path Tree takes the multicast source as the root. PIM-SM creates and maintains the multicast distribution tree through the displayed join/prune mode. As shown in Figure 5-1, when the DR receives a Join message from the receiving side, it will multicast a (*, G)-join message at each hop towards the RP of group G to join in the shared tree. When the source host sends the multicast message to the group, the packet of the source host is packaged in the registration message and unicast to the RP by the DR; The RP then sends the unpackaged packet of the source host to each group member along the shared tree; The RP sends the (S,G)-join message to the first-hop switch towards the source's direction to join in the shortest path tree of the source; In this way, the packet of the source will be sent to the RP along the shortest path tree without being packaged; When the first multicast data arrives, the RP sends the registration-stop message to the DR of the source and the DR stops the registration-packaged process. Afterwards, the multicast data of the source is not packaged any more, but it will be sent to the RP along the shortest path three of the source and then sent to each group member by the RP along the shared tree. When the multicast data is not needed, the DR multicasts the Prune message hop by hop towards the RP of group G to prune the shared tree.

PIM-SM also deals with the RP choice mechanism. One or multiple candidate BSRs are configured in the PIM-SM domain. You can select a BSR among candidate BSRs according to certain regulations. Candidate RPs are also configured in the PIM-SM domain. These candidate RPs unicast the packets containing RP's address and multicast groups to the BSR. The BSR regularly generates the Bootstrap message containing a series of candidate RPs and corresponding group addresses. The Bootstrap message is sent hop by hop in the whole domain. The switch receives and stores the Bootstrap message. After the DR receives a report about a group member's relationship from the directly-connected host, if the DR has no the routing item of the group, the DR will map the group address to a candidate RP through the Hash algorithm. The DR then multicasts the Join/prune message hop by hop towards the RP. Finally, the DR packages the multicast data in the registration message and unicasts it to the RP.

50.5.2 Configuring PIM-SM

50.5.2.1 Starting up PIM-SM

Run the following command to run PIM-SM on the interface to activate the multicast function in sparse mode:

Command	Purpose
ip pim-sm	Enters the interface where PIM-SM needs to be run and activates the PIM-SM multicast routing process in interface configuration mode.

50.5.2.2 Configuring Static RP

If the network scale is small, you can configure the static RP to use PIM-SM. The RP configuration of all routers in the PIM-SM domain must be same, ensuring the PIM-SM multicast route is correct.

If some router in the PIM-SM domain runs the BSR, the RP check follows the order: the static RP with override configured is preferred. If the override is not configured for the static RP, the RP in the RP mapping list distributed by the BSR is preferred.

Run the following command in global configuration mode:

Command	Purpose
ip pim-sm rp-address rp-add [**override**|**acl-name**] **no ip pim-sm rp-address** rp-add	Configures the static RP for the local switch.

50.5.2.3 Configuring Candidate BSR

The configuration of the candidate RP can generate the unique global BSR in the PIM-SM domain. The global BSR collects and distributes the RP in the domain, ensuring the RP mapping is unique.

Run the following command in global configuration mode:

Command	Purpose
ip pim-sm bsr-candidate*type number* [*hash-mask-length*] [**priority**] **no ip pim-sm bsr-candidate** *type number*	Configures the local switch as the candidate BSR, and competes the global BSR by learning the BSM message.

50.5.2.4 Configuring Candidate RP

Configure the candidate RP to enable it to be sent to the BSR periodically and then be diffused to all PIM-SM routers in the domain, ensuring the RP mapping is unique.

Run the following command in global configuration mode:

Command	Purpose
ip pim-sm rp-candidate [**type***number*] [**interval**|*group-list acl-name*] **no ip pim-sm rp-candidate** [**type***number*]	Configures the local switch as the candidate RP. After the candidate RP is configured, it will be sent to the BSR periodically. The BSR then broadcasts all PIM-SM routers in the PIM-SM domain.

50.5.2.5 Displaying PIM-SM Multicast Route

Run the following command to check the multicast route information learned by PIM-SM:

Command	Purpose
show ip mroute pim-sm [*group-address*] [*source-address*] [**type***number*] [**summary**] [**count**] [**active** *kbps*]	Displays the PIM-SM multicast route information.

50.5.2.6 Clearing Multicast Routes Learned by PIM-SM

Run the following command to clear multicast routes learned by PIM-SM:

Command	Purpose
clear ip mroute pim-sm [* | group-address] [source-address]	Clears information about the PIM-SM multicast routes.

50.5.3 Configuration Example

50.5.3.1 PIM-SM Configuration Example (The switch is configured on the VLAN port)

The following examples show how two switches learn and forward the PIM-SM multicast routes.

Device A:

```
!
ip multicast-routing
!
interface Loopback0
ip address 192.166.100.142 255.255.255.0
ip pim-sm
!
interface Ethernet1/1
ip address 192.166.1.142 255.255.255.0
ip pim-sm
ip pim-sm dr-priority 100
!
interface Serial2/0
ip address 192.168.21.142 255.255.255.0
physical-layer speed 128000
ip pim-sm
!
router rip
network 192.168.21.0
network 192.166.1.0
network 192.166.100.0
version 2
!
ip pim-sm bsr-candidate Loopback0 30 201
ip pim-sm rp-candidate Loopback0
!
```

Device B:

```
!
ip multicast-routing
!
interface Ethernet0/1
ip address 192.168.200.144 255.255.255.0
ip pim-sm
ip pim-sm dr-priority 200
!
interface Serial0/0
ip address 192.168.21.144 255.255.255.0
ip pim-sm
!
```

50.5.3.2 BSR Configuration Example (The switch is configured on the VLAN port)

The following example shows the BSR configuration of two switches.

Device A:

```
!
ip multicast-routing
!
interface Loopback0
ip address 192.166.100.142 255.255.255.0
ip pim-sm
!
interface Ethernet1/1
ip address 192.166.1.142 255.255.255.0
ip pim-sm
!
interface Serial2/0
ip address 192.168.21.142 255.255.255.0
physical-layer speed 128000
ip pim-sm
!
router rip
network 192.168.21.0
network 192.166.100.0
!
ip pim-sm bsr-candidate Loopback0 30 201
!
```

Device B:

```
!
ip multicast-routing
!
interface Loopback0
ip address 192.168.100.144 255.255.255.0
ip pim-sm
!
interface Ethernet0/1
ip address 192.168.200.144 255.255.255.0
ip pim-sm
!
interface Serial0/0
ip address 192.168.21.144 255.255.255.0
ip pim-sm
!
ip pim-sm bsr-candidate Loopback0 30
!
```

51. IPv6 Configuration

51.1 IPv6 Protocol's Configuration

The configuration of the IPv6 address of the router only takes effect on the VLAN interface, not on the physical interface.

The IPv6 protocol is disabled in default state. If the IPv6 protocol need be used on a VLAN interface, this protocol should be first enabled in VLAN interface configuration mode. To enable the IPv6 protocol, users have to set the IPv6 address. If on a VLAN interface at least one IPv6 address is set, the VLAN interface can handle the IPv6 packets and communicates with other IPv6 devices.

To enable the IPv6 protocol, users should finish the following task:

- Setting at least one IPv6 address in VLAN interface configuration mode

51.2Enabling IPv6

51.2.1 Setting the IPv6 Address

The IPv6 address is used to determine the destination address to which the IPv6 packets can be sent. There are three kinds of IPv6 addresses.

Kind	Referred Format	Remarks
Unicast address	2001: 0: 0: 0: 0DB8: 800: 200C: 417A/64	**2001: 0: 0: 0: 0DB8: 800: 200C: 417A** stands for a unicast address, while **64** stands for the length of the prefix of this address.
Multicast address	FF01: 0: 0: 0: 0: 0: 0: 101	All multicast addresses begin with FF.
Any address	2002: 0: 0: 0: 0DB8: 800: 200C: 417A/64	The format of this address is the same as that of the unicast address. Different VLAN interfaces can be set to have the same address, no matter it is a unicast/broadcast/multicast address.

For the further details of the IPv6 address, see RFC 4291.

In order to enable IPv6, users must set a unicast address in VLAN interface configuration mode. The set unicast address must be one or multiple addresses of the following type:

- IPv6 link-local address
- Global IPv6 address

To set an IPv6 link-local address in VLAN interface configuration mode, run the following commands.

Command	Purpose
ipv6 enable	Sets a link-local address automatically.
ipv6 address fe80: : x link-local	Sets a link-local address manually.

Note

The link-local address must begin with fe80.The default length of the prefix is 64 bit.At manual settings only the values at the last 64 bits can be designated.

On a VLAN interface can only one link-local address be set.

After IPv6 is enabled through the configuration of the link-local address, IPv6 only takes effect on the local link.

To set a global IPv6 address in VLAN interface configuration mode, run the following commands.

Command	Purpose
ipv6 address autoconfig	Sets a global address automatically.
ipv6 address [ipv6-address/prefix-length | prefix-name sub-bits/prefix-length] | [eui-64]	Sets a global address.
ipv6 address X: X: X: X: : X/<0-128> anycast	Sets an address of unicast/broadcast/multicast.

Note

- When IPv6 is enabled through the configuration of a global address, all interconnected IPv6 device can be handled by IPv6.
- If a link-local address has not been set before the configuration of the global address, the system will set a link-local address automatically.

51.3Setting the IPv6 Services

51.3.1 Setting the IPv6 Services

After IPv6 is enabled, all services provided by IPv6 can be set. The configurable IPv6 service is shown below:

Managing the IPv6 Link

51.3.1.1 Managing the IPv6 Link

IPv6 provides a series of services to control and manage the IPv6 link. This series of services includes:

(1) Setting the transmission frequency of the ICMPv6 packet

(2) Setting the source IPv6 route

(3) Setting the MTU of IPv6

(4) Setting IPv6 redirection

(5) Setting IPv6 destination unreachability

(6) Setting IPv6 ACL

(7) Setting IPv6 Hop-Limit

1. Setting the transmission frequency of the ICMPv6 packet

If you want to limit the transmission frequency of the ICMPv6 packet, run the command in the following table. If the ICMPv6 transmission frequency is larger than the set value, the transmission frequency will be limited. The default transmission frequency is 1000us. If you want to modify the transmission frequency, run the following command in global mode:

Command	Purpose
ipv6 icmp6-ratelimit *ratelimit*	Sets the transmission frequency of the ICMPv6 packet.

2. Setting the source IPv6 route

IPv6 allows a host to designate the route of an IPv6 network, that is, the source route. The host can realize the source route through using the routing header in the IPv6 packets. The router can forward packets according to the routing header, or desert this kind of packets considering security.

The router supports the source route by default. If the source route is closed, users can run the following command in global configuration mode to open the source route.

Command	Purpose
ipv6 source-route	Allows the source IPv6 route.

3. Setting the MTU of IPv6

All interfaces have a default IPv6 MTU. If the length of an IPv6 packet exceeds MTU, the router will fragment this IPv6 packet.

To set IPv6 MTU on a specific interface, run the following command in interface configuration mode:

Command	Purpose
ipv6 mtu *bytes*	Sets IPv6 MTU on an interface.

4. Setting IPv6 redirection

Sometimes, the route selected by the host is not the best one. In this case, when a switch receives a packet from this route, the switch will transmit, according to the routing table, the packet from the interface where the packet is received, and forward it to another router which belongs to the same network segment with the host. Under this condition, the switch will notify the source host of sending the packets with the same destination address to another router directly, not by way of the switch itself. The redirection packet demands the source host to replace the original route with the more direct route contained in the redirection packet. The operating system of many hosts will add a host route to the routing table. However, the switch more trusts the information getting from the routing protocol and so the host route will not be added according to this information.

IPv6 redirection is opened by default. However, if a hot standby router protocol is configured on an interface, IPv6 redirection is automatically closed. If the hot standby router protocol is canceled, this function will not automatically opened.

To open IPv6 redirection, run the following command:

Command	Purpose
ipv6 redirects	Allows IPv6 to transmit the redirection packets.

5. Setting IPv6 destination unreachability

In many cases, the system will automatically transmit the destination-unreachable packets. Users can close this function. If this function is closed, the system will not transmit the ICMP unreachable packets.

To enable this function, run the following command:

Command	Purpose
ipv6 unreachables	Allows IPv6 to transmit the destination unreachable packets.

6. Setting IPv6 ACL

Users can use ACL to control the reception and transmission of packets on a VLAN interface. If you introduce ACL on a VLAN interface in global configuration mode and designate the filtration's direction, the IPv6 packets will be filtered on this VLAN interface.

To filter the IPv6 packets, run the following command in interface configuration mode.

Command	Purpose
ipv6 traffic-filter *WORD* { in | out }	Filters the IPv6 packets in the reception or transmission direction (in: receive; out: transmit) on a VLAN interface.

7. Setting IPv6 Hop-Limit

Users can designate a router to transmit the value of the hop-limit field in the packets (except those forwarded packets). All those packets that this router transmits out, if the upper-level application does not apparently designate a hop-limit value, use the set value of hop-limit. At the same time, the value of the hop-limit field is added to the RA packets that this router transmits.

The default hop-limit value is 64. If you want to change this value, you can run the following command in interface configuration mode.

Command	Purpose
ipv6 cur-hoplimit *value*	Designates a router to transmit the hop-limit field of the packets.

52. ND Configuration

52.1 ND Overview

A node (host and router) uses ND (Neighbor Discovery protocol) to determine the link-layer addresses of the connected neighbors and to delete invalid cache rapidly. The host also uses the neighbor to discover the packet-forwarding neighboring routers. Additionally, the node uses the ND mechanism to positively trace which neighbors are reachable or unreachable and to test the changed link-layer address. When a router or the path to a router has trouble, the host positively looks for another working router or another path.

IPv6 ND corresponds to IPv4 ARP, ICMP router discovery and ICMP redirect.

ND supports the following link types: P2P, multicast, NBMA, shared media, changeable MTU and asymmetric reachability. The ND mechanism has the following functions:

(1) To discover routers: how the host to locate the routers on the connected links.

(2) To discover prefixes: how the host to find a group of address prefixes, defining which destinations are on-link on the connected links.

(3) To discover parameters: how the node to know the link-related or network-related parameters of the transmission interface.

(4) To automatically set addresses: how the node to set the address of an interface automatically.

(5) Address solution: When the IP of a destination is given, how a node determines the link-layer address of the on-link destination.

(6) To determine the next hop: it is an algorithm to map the IP address of a destination to the neighboring IP. The next hop can be a router or destination.

(7) To test unreachable neighbors: how a node to determine unreachable neighbors; if neighbor is a router, the default router can be used.

(8) To test repeated address: how a node to determine whether a to-be-used address is not used by another node.

(9) Redirect: how a router to notify the host of the best next hop.

52.1.1 Address Resolution

Address resolution is a procedure of resolving the link-layer address through node's IP. Packet exchange is realized through ND request and ND notification.

- Configuring a static ND cache

In most cases, dynamic address resolution is used and static ND cache configuration is not needed. If necessary, you can set static ND cache in global mode and the system will use it to translate IP into the link-layer address. The following table shows how to set a static-IP-to-link-layer-address mapping.

Run the following relative command in global mode:

Command	Purpose
ipv6 neighbor ipv6address **vlan** vlanid hardware-address	Sets a static ND cache and translates IPv6 address into a link-layer address.

52.1.2 ND Configuration

The ND protocol is used not only for address resolution but for other functions such as neighbor solicitation, neighbor advertisement, router solicitation, router advertisement and redirect.

The following commands are all run in port configuration mode:

- Setting the number of transmitted NSs when ND performs DAD on a local port

Before the IPv6 port is started, it should send the NS information to the local machine to find if there is any duplicate IPv6 address existing on links through DAD.

Command	Purpose
ipv6 nd dad attempts num	Sets the number of transmitted NSs when the local port performs DAD.

- Setting the M flag in the RA message transmitted by the local port

The M flag indicates that the RA message host should obtain addresses through on-status automatic configuration. To set the M flag in the RA message transmitted by the local port to 1, run the following command.

Command	Purpose
ipv6 nd managed-flag	Sets the M flag in the RA message transmitted by the local port.

- Setting the NS transmission interval of the local port and the retrans-timer field in the RA message

This command can be used to set the NS transmission interval of the local switch on the local port and at the same time the **retrans-timer** field in the RA message on the local port.

The host sets its **retrans-timer** variable according to the retrans-timer field in RA.

Command	Purpose
ipv6 nd ns-interval milliseconds	Means the NS retransmission interval in the local port and the retrans-timer field in the RA message.Its default value is 1000ms.

- Setting the O flag in the RA message transmitted by the local port

The O flag indicates that the RA message host should obtain other information through on-status automatic configuration. To set the O flag in the RA message transmitted by the local port to 1, run the following command:

Command	Purpose
ipv6 nd other-flag	Sets the O flag in the RA message transmitted by the local port.

- Setting the prefix of the RA message

The router releases address prefixes to the network host via RA message. The address prefix plus the host address is the entire unicast address. The prefix option is carried by the RA message, and the host obtains the IPv6 address prefix and related parameter from this option.

Command	Purpose
ipv6 nd prefix {ipv6-prefix/prefix-length | **default**} [**no-advertise** | [valid-lifetime preferred-lifetime [**off-link** | **no-autoconfig**]]]	Means that the local port transmits the prefix option's content in the RA message.

- Setting the RA transmission interval

The following command is used to set the range of RA transmission interval. The RA transmission interval is in general an indefinite value but a random value in a fixed range, which can avoid abrupt flow surge in the network.

Command	Purpose
ipv6 nd ra-interval-range max min	Sets the range of RA transmission interval. The maximum RA transmission interval is 600s and the minimum RA transmission interval is 200s.

The interval for the local port to transmit the first three messages cannot be more than 16 seconds, while that to transmit the following messages varies between the maximum interval (600 seconds) and the minimum interval (200 seconds).

- Setting a specific RA transmission interval

RA packets are transmitted in an interval configured by **ra-interval-range**, but if users want to use a specific transmission interval, they can set this value through the following command:

Command	Purpose
ipv6 nd ra-interval interval	Sets a specific RA transmission interval, which is not set by default.

- Setting the router-lifetime field in the RA message transmitted by the local port

The **router-lifetime** field in the RA message is the triple of the maximum value of **ipv6 nd ra-interval-range**.

Command	Purpose
ipv6 nd ra-lifetime seconds	Sets the router-lifetime field in the RA message transmitted by the local port.

- Setting the reachable-time field of the RA message

reachable-time means the time to reach a neighbor, which is 0 by default.

Command	Purpose
ipv6 nd reachable-time milliseconds	Sets the **reachable-time** field in the RA message transmitted by the local port. Its default value is 0ms.

- Setting the value of the router preference in the RA message

router-preference means the router's priority, which accounts for two bits in the **flags** domain in the RA message.The router's priority can be high, medium and low. The medium priority is the default settings.

Command	Purpose
ipv6 nd router-preference preference	Sets the **router-preference** field in the RA message transmitted by the local port.It is medium by default.

- Stopping a port to be the notification port of a switch

Only the notification port can transmit RA packets. The notification port supports multicast and is set to have at least one unicast IP address. Its AdvSendAdvertisment flag is TRUE in value.

The configuration of **ipv6 nd suppress-ra** in the VLAN port means shutdown the notification port. This command is not set by default.

Command	Purpose
ipv6 nd suppress-ra	Means the value of the AdvSendAdvertisment flag on the local port. 0

53. RIPNG Configuration

53.1 Configuring RIPNG

53.1.1 Overview

Routing Information Protocol of next generation (RIPng) is the RIP of version 6. In the equipment RIPng and RIP are two completely independent modules that are in charge of the learning and management of the routing information in version 6 and version 4 respectively.

RIPng is same to RIP in the internal working mechanism. RIPng switches the routing information through the UDP broadcast. In a router the update of the routing information is transmitted every 30 seconds. If a router has not received the routing update from its neighboring router in 180 seconds, the router will label this route unavailable in its routing table. And in the following 120 second this router will remote this route from its routing table.

RIPng can also be applied in small-scale networks. It uses the hop count to weigh the weights of different routes. This hop count means the number of routers that a packet has passed from a signal source to another signal source. The routing weight of the directly connected network is 0 and that of the unreachable network is 16. Since the route weight used by RIPng has a small range, it is unsuitable for the large-scale networks.

If a router has a default route, RIPng declares the route to the fake network 0: : 0/0. In fact, network **0: : 0/0** does not exist and it is just used to realize the default route in RIPng. If RIPng learns a default route or a router sets the default gateway and the default weight, the router will declare the default network.

RIPng sends the route update to the interface that is covered by instances. If an interface is not set to be an IPv6 interface, it will not be covered by an RIPng instance.

The RIPng protocol in our routers supports multiple instances. On an interface up to four instances can be set and one instance can cover up to 4 interfaces.

53.1.2 Setting RIPng Configuration Task List

Before setting RIPng, you have finished the following tasks. Among these tasks, you have to activate RIPng, but to other tasks, you can choose to do them according actual requirements.

- Allowing to Set the Unicast Routing Protocol
- Enabling RIPng
- Allowing the RIPng route to update the unicasting broadcast of a packet
- Applying the Offset on the Routing Weight
- Filtering the received or transmitted routes
- Setting the Management Distance
- Adjusting the Timer
- Redistributing the Routes of an Unlocal Instance
- Summarizing the Routes Manually
- Maximum Number of Routes
- Activating or Forbidding Horizontal Fragmentation
- Monitoring and Maintaining RIPng

53.1.3 RIPng Configuration Tasks

53.1.3.1 Allowing to Set the Unicast Routing Protocol

To set the RIPng, you must first run the following command to allow setting the switch of a unicast route.

Command	Purpose
Ipv6 unicast-routing	Enables to set the unicast routing protocol on a device.

53.1.3.2 Enabling a RIPng Case

To enable the RIPng instance, run the following command in interface configuration mode:

Command	Purpose
ipv6 rip *instance-name* **enable**	Enables RIPng on an interface.

To enter the RIPng instance, run the following command in global configuration mode:

Command	Purpose
router ripng *instance-name*	Enters the RIPng instance and its configuration mode.

Users can enable a RIPng instance on an interface. If the RIPng instance does not exist, a RIPng instance will be generated. The system can directly enter the RIPng instance in global configuration mode and a RIPng instance will be generated if this RIPng instance does not exist.

Users can enable up to 4 RIPng instances on an interface and a RIPng instance can cover up to 4 interfaces.

53.1.3.3 Redistributing the Routes of an Unlocal Instance

RIPng can redistribute the routing information of an unlocal instance to the routing information database of the local instance, and then conducts route interaction with other devices through the routes in the routing database of this instance. To reach the aim above, run the following command in RIPng configuration mode:

Command	Purpose
Redistribute *protocol [instance-name | process-id]*	Redistributes static routes, other ospfv6 processes, and other RIPng instances.

53.1.3.4 Allowing the RIPng Route to Update the Unicasting Broadcast of a Packet

RIPng is generally a multicast protocol. To enable RIPng routing updates to reach the non-broadcast network, users must make configuration on a router to allow the switching of routing information. To reach the aim above, run the following command in RIPng configuration mode:

Command	Purpose
neighbor*ipv6-address*	Defines a neighboring router and switches the routing information with this neighboring router.

53.1.3.5 Applying the Offset on the Routing Weight

The offset list is used to add an offset for an incoming or outgoing route which RIPng learns. In this case, a local mechanism is provided to add the routing weight. Additionally, you can also use the access list or an interface to limit the offset list. To add the routing weight, run the following command in RIPng configuration mode:

Command	Purpose
offset { [interface-type number]|* } {**in**|**out**} *access-list-name* offset *value*	Adds an offset to a routing weight.

53.1.3.6 Filtering the Received or Transmitted Routes

Through settings the RIPng instance can filter the received or transmitted routes on the corresponding interface, in which flexible configuration policies can be flexibly realized. Run the following command in RIPng configuration mode:

Command	Purpose
filter*interface-type interface-number* **{in | out}** access-list | gateway | prefix-list	Filters the received or transmitted routing information.

53.1.3.7 Setting the Management Distance

Trough setting the management distance, you can change the credibility of the route of RIPng instance. In general, the bigger the value is, the more incredible the value is. To set the management distance, run the following command in RIPng configuration mode:

Command	Purpose
distance *weight*[*X: X: X: X: : X/*<0-128> [Acc-list_name]	Sets the management distance of the RIPng instance's route.

53.1.3.8 Adjusting the Timer

The routing protocol needs several timers to judge the transmission frequency of routing updates and how long it takes for a route to become invalid. You can adjust these timers to make the performance of a routing protocol more suitable for the requirements of network interconnecting.

You can also adjust the routing protocols to speed up the convergence time of the IPv6 algorithm and make fast backup of the redundancy router, guaranteeing a maximum breakup for a terminal user when quick recovery is needed. To adjust the timer, run the following command in RIPng configuration mode:

Command	Purpose
timers holddown *value*	Means how long it takes for a route to be removed from the routing table.
timers garbage*value*	Means how long it takes for a route to be declared invalid.
timers update*value*	Means the transmission frequency of routing updates, whose unit is second.

53.1.3.9 Summarizing the Routes Manually

RIPng must summarize the routing information manually to reduce the number of the routes that interact with neighbors. To summarize the routing information, run the following command in the RIPng configuration mode:

Command	Purpose
aggregate-address *ipv6-prefix/prefixlen*	Summarizes the routing information.

53.1.3.10 Activating or Forbidding Horizontal Fragmentation

In normal cases, a router that connects the broadcast IPv6 network and uses the distance vector routing protocol takes the horizontal fragmentation to reduce the possibility of route loopback. The horizontal fragmentation blocks the routing information from being declared to the interface that receives this routing information. In this way the communication between multiple routers can be optimized, especially when the loopback is broken. However, this solution is not so good to those un-broadcast networks. In these networks, you have to forbid horizontal fragmentation.

To activate or disable horizontal fragmentation, run the following commands in VLAN configuration mode:

Command	Purpose
Ipv6 rip split-horizon	Activates horizontal fragmentation.
no ipv6 rip split-horizon	Forbids horizontal fragmentation.

By default, horizontal fragmentation is activated on those point-to-point interfaces and forbidden on those point-to-multipoint interfaces.

In normal cases, you are not recommended to change the default state unless you are sure that the routes can be correctly declared after the state of your application program is changed. If horizontal fragmentation is forbidden on a serial interface that connects a packet switching network, you have to disable horizontal fragmentation on routers of any related multicast group on a network.

53.1.3.11 **Monitoring and Maintaining RIPng**

Through monitoring and maintaining RIPng, you can get the statistic information of a network, including the parameters of RIPng, the network usage information and the real communication-tracing information. This kind of information can help users to judge the usage of network resources and solve network problems. From the statistics information, you can also know the reachablity of a network node.

To display all kinds of statistics information, run the following commands in EXEC mode:

Command	Purpose
show ipv6 rip *instance-name* summary	Displays the total routing information about a RIPng instance.
show ipv6 rip *instance-name* database	Displays all routes of a RIPng instance.
show ipv6 rip *instance-name* interface	Displays all interfaces that a RIPng instance covers.

To trace the information about the routing protocols, run the following commands in EXEC mode:

Command	Purpose
debug ipv6 rip *instance-name* database	Traces that a route of a RIPng instance is added to removed from or changed in a routing table.
debug ipv6 rip *instance-name* event	Traces the abnormity that occurs in the running of a RIPng instance and the whole process of redistributing a RIPng instance.
debug ipv6 rip *instance-name* send	Traces the process that a RIPng instance transmits packets.
debug ipv6 rip *instance-name* recv	Traces the process that a RIPng instance receives packets.
debug ipv6 rip *instance-name* msg	Traces the important events that lead to the termination of the startup of a RIPng instance.
debug ipv6 rip *instance-name* all	Traces all the information about a RIPng instance.

53.1.4 RIPng Configuration Example

This section shows some RIPng configuration example:

Connect device A and device B directly and make the following settings:

Device A:

```
interface VLAN2
no ip address
no ip directed-broadcast
ipv6 address 4444:  :  4444/64
ipv6 enable
ipv6 rip dang2 enable
ipv6 rip dang2 split-horizon
!
router ripng dang2
redistribute static
exit
!
!
```

Device B:

```
interface Ethernet1/1
no ip address
no ip directed-broadcast
duplex half
ipv6 address 4444:  :  2222/64
ipv6 enable
ipv6 rip dang enable
ipv6 rip dang split-horizon
!
router ripng dang
redistribute static
exit
!
```

In this way both device A and device B learns the static routing information from each other.

54. OSPFv3 Configuration

54.1 Overview

OSPFv3 is an IGP routing protocol developed by the OSPF working group of IETF for the IPv6 network. OSPFv3 supports the IPv6 subnet, the mark of the external routing information and the packet's authentication.

OSPFv3 and OSPFv2 have a lot in common:

- Both router ID and area ID are 32 bit.
- The following are the same type of packets: Hello packets, DD packets, LSR packets, LSU packets and LSAck packets.
- Having the same neighbor discovery mechanism and the same neighborhood generation mechanism
- Having the same LSA expansion mechanism and the same LSA aging mechanism

The main differences of both OSPFv3 and OSPFv2 are shown below:

- OSPFv3 is running on the basis of link, while OSPFv2 is running on the basis of network segment.
- OSPFv3can run multiple instances on the same link.
- OSPFv3 labels its neighbor through router ID, while OSPFv2 labels its neighbor through IP.
- OSPFv3 defines 7 classes of LSAs.

The following table shows some key functions in the realization of the OSPFv3 functions.

Key attributes	Description
Stub domain	Supports the stub domain.
Route forwarding	Means that routes that are learned or generated by any routing protocol can be forwarded to the domains of other routing protocols.In the autonomous domain, it means that OSPFv3 can input the RIPng learned routes. The routes learned by OSPFv3 can also be exported to RIPng.Between the autonomous domains, OSPFv3 can import the BGP-learned routes; OSPFv3 routes can also be exported to the BGPs.
Parameters of a routing interface	The following are configurable interface parameters: output cost, retransmission interval, interface's transmission delay, router's priority, interval for judging the shutdown of a router, hello interval, and authentication key.
Virtual link	Supports the virtual link.

54.2OSPFv3 Configuration Task List

OSPFv3 demands the switchover of routing data between in-domain router, ABR and ASBR. In order to simplify the settings, you can make related configuration to enable them to work under the default parameters without any authentication; if you want to change some parameters, you must guarantee that the parameters on all routers are identical.

To set OSPFv3, you must perform the following tasks. Except that the task of activating OSPFv3 is mandatory, other settings are optional.

- Enabling OSPFv3
- Setting the parameters of the OSPFv3 interface
- Setting OSPFv3 on different physical networks
- Setting the parameters of the OSPFv3 domain
- Configuring the NSSA Domain of OSPFv3
- Setting the Route Summary in the OSPFv3 Domain
- Setting the Summary of the Forwarded Routes
- Generating a Default Route
- Choosing the route ID on the loopback interface
- Setting the management distance of OSPFv3
- Setting the Timer of Routing Algorithm
- Monitoring and Maintaining OSPFv3

54.3OSPFv3 Configuration Tasks

54.3.1 Enabling OSPFv3

Before OSPFv3 is enabled, the function to forward the IPv6 packets must be enabled.

Run the following commands in global configuration mode:

Command	Purpose
router ospfv3*process-id*	Activates OSPFv3 and enters the router configuration mode.
router-id*router-id*	Sets the router ID of a router on which OSPFv3 is running.

Run the following command in interface configuration mode:

Command	Purpose
ipv6 ospf *process-id* **area** *area-id* **[instance** *instance-id***]**	Enables OSPFv3 on an interface.

If the OSPFv3 process is still not created before OSPFv3 is enabled on an interface, the OSPFv3 process will be automatically created.

54.3.2 Setting the Parameters of the OSPFv3 Interface

During OSPFv3 realization, related OSPFv3 parameters on an interface are allowed to be modified according to actual requirements. Of cause you have no need to change every parameter, but you have to make sure that some parameters are consistent on all routers in the connected networks.

Run the following commands in interface configuration mode to do relevant configurations:

Command	Purpose
ipv6 ospf cost*cost*	Sets the cost of the packet that is transmitted from the OSPFv3 interface.
ipv6 ospf retransmit-interval *seconds*	Sets the LSA retransmission interval between neighbors.
ipv6 ospf transmit-delay*seconds*	Sets the delay time for transmitting LSA on an OSPFv3 interface.
ipv6 ospf priority*number*	Sets a router to be the priority of the OSPFv3 DR router.
ipv6 ospf hello-interval*seconds*	Sets the interval for the OSPFv3 interface to transmit the Hello packets.
ipv6 ospf dead-interval*seconds*	Means that in a regulated interval if the OSPFv3 packets are not received from a neighboring router, this neighboring router is viewed to be shut down.

54.3.3 Setting OSPFv3 on Different Physical Networks

OSPFv3 divides physical network media into the following three kinds:

- Broadcast networks (Ethernet, Token Ring, FDDI)
- Non-broadcast and multi-access networks (SMDS, Frame Relay, X.25)
- Point-to-point networks (HDLC, PPP)

54.3.4 Setting the OSPF Network Type

No matter what physical media type the network is, you can configure your network to be a broadcast network, a non-broadcast network or a multi-access network. So you can set your network flexibly and your network can be set to be a non-broadcast and multi-access one, or a broadcast network such as the X.25, Frame Relay or SMDS network. Also the neighbor's settings will be simplified.

To set an un-broadcast and multi-access network is to suppose that every two routers have a virtual link or suppose a full-mesh network. It is unrealistic due to unbearable cost. But you set this network to be a point-to-multipoint one. Between those routers which are not adjacent the routing information can be switched through the virtual link.

The OSPFv3 point-to-multipoint interface can be set to be multipoint-to-point interface, through which multiple routes of a host can be established. The OSPFv3 point-to-multipoint network, comparing with the non-broadcast and multi-access network or the point-to-point network, has the following advantages:

- The point-to-multipoint network is easy to be set without generating DR.
- This kind of network do not require the full-mesh topology, so the construction cost is relatively low.
- This kind of networks are more reliable. Even if its virtual link fails, the connection can be maintained.

The network type of the routers is the broadcast type.

54.3.5 Setting the Parameters of the OSPFv3 Domain

The configurable domain parameters include: authentication, designating a stub area and specifying a weight for a default summary route. Its authentication is based on password protection.

The stub area means that external routes cannot be distributed to this area. Instead, ABR generates a default external route that enters the stub area, enabling the stub area to communicate with external networks of an autonomous area. In order to make use of the attributes supported by the OSPF stub, the default route must be used in the stub area. To further reduce LSAs that are forwarded to the stub area, you can forbid the summary function on ABR.

Run the following command in router configuration mode to set the domain's parameters:

Command	Purpose
area*area-id***stub** [no-summary]	Defines a stub area.
area *area-id***default-cost** *cost*	Sets the weight of the default route of the stub area.

As to those areas that are not backbone areas and do not connect the backbone areas directly or as to those discontinuous areas, the OSPFv3 virtual link can be used to establish a logic connectivity. In order to create a virtual link, you have to perform configuration at the two terminals of the virtual link. If only one terminal is configured, the virtual link cannot work.

Run the following command in router configuration mode to set the domain's parameters:

Command	Purpose
area*area-id***virtual-link** *neighbor-ID* [**dead-interval***dead-value*][**hello-interval***hello-value*][**retransmit-interval***retrans-value*][**transmit-delay***dly-value*]	Establishes the virtual link.

54.3.6 Setting the Route Summary in the OSPFv3 Domain

With this function ABR can broadcast a summary route to other areas. In OSPFv3 ABR will broadcast each network to other areas. If network IDs are distributed to be continuous, you can set ABR to broadcast a summary route to other areas. The summary route can cover all networks in a certain range.

Run the following command in router configuration mode to set the address' range:

Command	Purpose
area*area-id***range** *ipv6-prefix /prefix-length*	Sets the address' range of the summary route.

54.3.7 Setting the Summary of the Forwarded Routes

When routes are distributed from other routing areas to the OSPFv3 routing area, each route is singularly broadcasted as an external LSA. However, you can set a route on a router to make this route cover an address range. In this way, the size of the OSPFv3 link-state database can be reduced.

Run the following command in router configuration mode to set a summary route:

Command	Purpose
summary-prefix*ipv6-prefix /prefix-length*	Broadcasts only one summary route.

54.3.8 Generating a Default Route

ASBR should generate a default route to enter the OSPFv3 routing area. Whenever it is, you make configuration to enable a router to distribute a route to the OSPFv3 routing area and this route becomes ASBR automatically. However, ASBR does not generate a default route by default to enter the OSPFv3 routing area.

54.3.9 Choosing the Route ID on the Loopback Interface

OSPFv3 uses the maximum IPv4 address as its router ID. If the interface that connects the IPv4 address is down or the IPv4 address is deleted, the OSPF process will recalculate the ID of this new router and retransmit the routing information from all interfaces.

If an IPv4 address is configured on a loopback interface, the router will first use the IPv4 address of loopback as its ID. Because the loopback interface will never be down, the routing table is greatly stable.

The router can first select the loopback interface as its ID or select the maximum IPv4 address in all loopback interfaces as its ID. If there is no loopback interface, the IPv4 address of a router will be used as the router ID. You cannot specify OSPFv3 to use any specific interface.

Run the following commands in global configuration mode to set the IP loopback interface:

Command	Purpose
interface loopback *num*	Creates a loopback interface and enters the interface configuration mode.
ip address*ip-address mask*	Distributes an IPv4 address for an interface.

54.3.10 Setting the Management Distance of OSPFv3

The management distance means the trust level of the routing information source. Generally speaking, the management distance is an integer between 0 and 255. The bigger its value is, the lower the trust level is. If the management distance is 255, the routing information source will be distrusted and omitted.

OSPFv3 uses three different kinds of management distances: inter-domain, inner-domain and exterior. The routes in a domain are called inner-domain routes; the routes to other domains are called inter-domain routes; the routes transmitted from other routing protocols are called the exterior routes. The default value of each kind of routes is 110.

54.3.11 Setting the Timer of Routing Algorithm

You can set the delay between receiving the topology change information and calculating SPF. You can also set the interval between two continuous SFP algorithm.

Run the following command in router configuration mode:

Command	Purpose
timersdelay*delaytime*	Set a delay for routing algorithm in an area.
timershold*holdtime*	Sets a minimum interval for routing algorithm in an area.

54.3.12 Monitoring and Maintaining OSPFv3

The network statistics information which can be displayed includes the content of the IP routing table, caching and database. This kind of information can help users to judge the usage of network resources and solve network problems.

You can run the following commands to display all kinds of routing statistics information:

Command	Purpose
show ipv6ospf [*process-id*]	Displays the general information about the OSPFv3 routing process.
show ipv6 ospf [*process-id*] **database** **show ipv6 ospf** [*process-id*] **database [router] [adv-router** *router-id***]** **show ipv6 ospf** [*process-id*] **database[network] [adv-router** *router-id***]** **show ipv6 ospf** [*process-id*] **database [inter-prefix][adv-router** *router-id***]** **show ipv6 ospf** [*process-id*] **database [inter-router][adv-router** *router-id***]** **show ipv6 ospf** [*process-id*] **database [external][adv-router** *router-id***]** **show ipv6 ospf** [*process-id*] **database [link][adv-router** *router-id***]** **show ipv6 ospf** [*process-id*] **database [intra-prefix][adv-router** *router-id***]**	Displays the information about the OSPFv3 database.
show ipv6 ospf interface	Displays the information about the OSPFv3 interface.
show ipv6 ospf neighbor	Displays the information about

	OSPFv3 neighbors.
show ipv6 ospf route	Displays the routing information about OSPFv3.
show ipv6 ospf topology	Displays the OSPFv3 topology.
show ipv6 ospf virtual-links	Displays the virtual links of OSPFv3.
debug ipv6 ospf	Monitors all OSPFv3 behaviors.
debug ipv6 ospf events	Monitors the OSPFv3 events.
debug ipv6 ospf ifsm	Monitors the state machine of the OSPFv3 interface.
debug ipv6 ospf lsa	Monitors related behaviors about OSPFv3 LSA.
debug ipv6 ospf nfsm	Monitors the state machine of the OSPFv3 neighbors.
debug ipv6 ospf nsm	Monitors the information of which the management module notifies OSPFv3.
debug ipv6 ospf packet	Monitors the OSPFv3 packets.
debug ipv6 ospf route	Monitors the routing information about OSPFv3.

54.4OSPFv3 Configuration Example

54.4.1 Example for OSPFv3 Route Learning Settings

OSPFv3 requires switching information among many internal routers, ABR and ASBR. In the minimum settings, the OSPFv3-based router works under the case that all its parameters take their default values and there is no authentication.

The following are three configuration examples:

The first example shows the commands for basic OSPFv3 settings.

The second example shows multiple OSPFv3 processes can be set on a router.

The third example shows how to use OSPFv3 to learn routes.

The fourth example shows how to set the OSPFv3 virtual link.

1. Basic OSPFv3 Configuration Example

The following example shows a simple OSPFv3 settings. In this example, you have to activate process 90, connect Ethernet interface 0 to area 0.0.0.0, distribute RIPng to OSPFv3 and OSPFv3 to RIPng.

```
ipv6 unicast-routing
!
interface vlan 10
ipv6 address 2001:  :  1/64
ipv6 enable
ipv6 rip aaa enable
ipv6 rip aaa split-horizon

ipv6 ospf 90 area 0
ipv6 ospf cost 1
!
router ospfv3 90
router-id 1.1.1.1
redistribute rip
!
router ripng aaa
redistribute ospf 90
```

2. Configuring multiple OSPFv3 processes

The following example shows that two OSPFv3 processes are created.

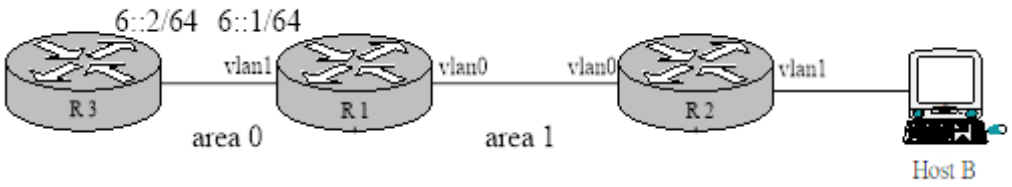
```
ipv6 unicast-routing
!
!
```

```
interface vlan 10
ipv6 address 2001:    :    1/64
ipv6 enable

ipv6 ospf 109 area 0 instance 1
ipv6 ospf 110 area 0 instance 2
!
!
interface vlan 11
ip address 2002:    :    1/64
ipv6 enable

ipv6 ospf 109 area 1 instance 1
ipv6 ospf 110 area 1 instance 2
!
!
router ospfv3 109
router-id 1.1.1.1
redistribute static
!
router ospfv3 110
router-id 2.2.2.2
!
```

Each interface can belong to many OSPFv3 processes, but if an interface belongs to multiple OSPFv3 processes each OSPFv3 process must correspond to different instances.

3. Complicated configuration example

The following example shows how to configure multiple routers in a single OSPFv3 autonomous system. The following figure shows the network topology of the configuration example:



Configure the router according to the above-mentioned figure:

R1:

```
interface vlan 0
ipv6 enable

 ipv6 ospf 1 area 1
!
interface vlan 1
ipv6 enable

 ipv6 ospf 1 area 0
!
ipv6 route 2001:  :  /64 6:  :  2
!
router ospfv3 1
router-id 1.1.1.1
 redistribute static
!
```

R2:

```
interface vlan 0
ipv6 enable

 ipv6 ospf 1 area 1
!
!
router ospfv3 1
router-id 2.2.2.2
!
```

Browsing the routing table of R2:

R2#show ipv6 route

O 6: : /64[1]

[110,20] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

O 2001: : /64[1] (forwarding route)

[110,150] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

C fe80: : /10[1]

is directly connected, L,Null0

C fe80: : /64[1]

is directly connected, C, VLAN0

C fe80: : 2e0: fff: fe26: a8/128[1]

is directly connected, L, VLAN0

C ff00: : /8[1]

is directly connected, L,Null0

From the command sentences above, we can see that R2 has learned route forwarding.

Setting area 1 to be the stub area:

R1:

interface vlan 0

ipv6 enable

ipv6 ospf 1 area 1

!

interface vlan 1

ipv6 enable

ipv6 ospf 1 area 0

!

ipv6 route 2001: : /64 6: : 2

!

router ospfv3 1

router-id 1.1.1.1

area 1 stub

redistribute static

!

R2:

interface vlan 0

ipv6 enable

ipv6 ospf 1 area 1

!

!

router ospfv3 1

router-id 2.2.2.2

area 1 stub

!

Browsing the routing table of R2:

R2#show ipv6 route

O : : /0[1]

[110,11] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

O 6: : /64[1]

[110,20] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

C fe80: : /10[1]

is directly connected, L,Null0

C fe80: : /64[1]

is directly connected, C, VLAN0

C fe80: : 2e0: fff: fe26: a8/128[1]

is directly connected, L, VLAN0

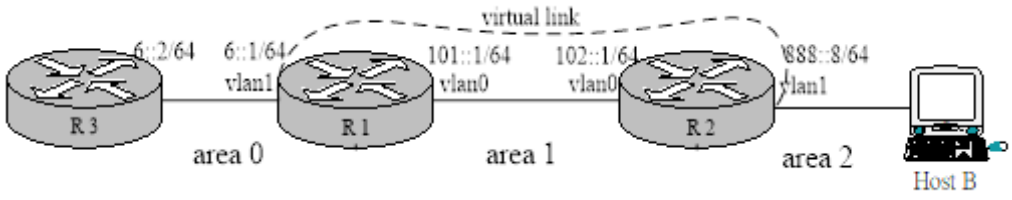
C ff00: : /8[1]

is directly connected, L,Null0

It can be judged that ABR in the stub area can generate a default route normally and notify other routers in this area without importing ASE LSA into the stub area.

4. Configuring the virtual link

The following example shows how to configure a virtual link in a single autonomous OSPFv3 system. The following figure shows the network topology of the configuration example:



Configure the router according to the above-mentioned figure:

R1:

```
interface vlan 0
 ipv6 address 101:   :   1/64
ipv6 enable

 ipv6 ospf 1 area 1
!
interface vlan 1
 ipv6 address 6:   :   1/64
ipv6 enable

 ipv6 ospf 1 area 0
!
ipv6 route 2001:   :   /64 6:   :   2
!
router ospfv3 1
router-id 200.200.200.1
area 1 virtual-link 200.200.200.2
redistribute static
!
```

R2:

```
interface vlan 0
 ipv6 address 101:   :   2/64
ipv6 enable

 ipv6 ospf 1 area 1
!
interface vlan 1
 ipv6 address 888:   :   8/64
ipv6 enable

 ipv6 ospf 1 area 2
!
!
router ospfv3 1
router-id 200.200.200.2
area 1 virtual-link 200.200.200.1
!
```

Browsing the state of the OSPFv3 neighbor:

R1#show ipv6 ospf neighbor

OSPFv3 Process (1)

Neighbor ID Pri State Dead Time Interface Instance ID

200.200.200.2 1 Full/DR 00: 00: 35 VLAN0 0

200.200.200.2 1 Full/ - 00: 00: 36 VLINK1 0

R2#show ipv6 ospf neighbor

OSPFv3 Process (1)

OSPFv3 Process (1)

Neighbor ID Pri State Dead Time Interface Instance ID

200.200.200.1 1 Full/Backup 00: 00: 36 VLAN0 0

200.200.200.1 1 Full/ - 00: 00: 37 VLINK1 0

Browsing the information in the routing table:

R1#show ipv6 route

C 6: : /64[1]

is directly connected, C,VLAN1

C 6: : 1/128[1]

is directly connected, L, VLAN1

C 101: : /64[2]

is directly connected, C, VLAN0

C 101: : 1/128[2]

is directly connected, L, VLAN0

O 101: : 2/128[2]

[110,10] via fe80: 4: : 2e0: fff: fe26: a8(on VLAN0)

O 888: : /64[2]

[110,20] via fe80: 4: : 2e0: fff: fe26: a8(on VLAN0)

S 2001: : /64[1]

[1,0] via 6: : 2(on VLAN1)

C fe80: : /10[2]

is directly connected, L,Null0

C fe80: : /64[2]

is directly connected, C, VLAN0

C fe80: : 2e0: fff: fe26: 2d98/128[2]

is directly connected, L, VLAN0

C fe80: : /64[1]

is directly connected, C, VLAN1

C fe80: : 2e0: fff: fe26: 2d99/128[1]

is directly connected, L, VLAN1

C ff00: : /8[2]

is directly connected, L,Null0

R2#show ipv6 route

O 6: : /64[1]

[110,20] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

C 101: : /64[1]

is directly connected, C, VLAN0

O 101: : 1/128[1]

[110,10] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

C 101: : 2/128[1]

is directly connected, L, VLAN0

C 888: : /64[1]

is directly connected, C, VLAN1

C 888: : 8/128[1]

is directly connected, L, VLAN1

O 2001: : /64[1]

[110,150] via fe80: 4: : 2e0: fff: fe26: 2d98(on VLAN0)

C fe80: : /10[1]

is directly connected, L,Null0

C fe80: : /64[1]

is directly connected, C, VLAN0

C fe80: : 2e0: fff: fe26: a8/128[1]

is directly connected, L, VLAN0

C fe80: : /64[1]

is directly connected, C, VLAN1

C fe80: : 2e0: fff: fe26: a9/128[1]

is directly connected, L, VLAN1

C ff00: : /8[1]

is directly connected, L,Null0

55. BFD Configuration

55.1 Overview

BFD (Bidirectional Forwarding Detection) is a set of all-net uniform detection mechanism used for rapid detection and monitoring of link or IP routing forwarding connectivity. To improve the performance of existing networks, communication troubles can be detected rapidly between neighboring protocols so that a standby communication channel can be quickly established.

BFD can establish sessions between two machines to monitor bidirectional forwarding paths between the two machines and serve upper-level protocols. The served upper-level protocol notifies BFD of the one with which the session is established. After the session is established through the three-handshake mechanism, no reception of BFD control packets from the peer within the detection time or the number of dropped echo packets outnumbering the allowed threshold causes trouble. This case is then reported to the upper-level protocol for corresponding processing.

55.2 BFD Configuration Tasks

55.2.1 Activating Port BFD

Port BFD is not activated by default.

After port BFD is enabled, BFD configured through dynamic protocols takes effect.

Run the following command to achieve the previous purpose:

Command	Purpose
bfd enable <cr> | [min_tx_interval <tx_value> min_rx_interval <rx_value> multiplier <m_value>]	Activates port BFD.

Before the BFD session is established, the BFD control packets are transmitted in an interval of no less than 1 second so as to narrow down traffic. After the session is established, the BFD control packets are transmitted in a negotiated interval so as to realize rapid detection. During the establishment of BFD session, the transmission interval and detection time of BFD control packets are also determined via packet exchange. In an effective BFD session, these timers can be modified through negotiation at any time without affecting the session status. The timer negotiations at different BFD session directions are conducted independently and the bidirectional timers can be different. The transmission interval for BFD control packets is the maximum value between local **min_tx_interval** and peer **min_rx_interval**, that is to say, the comparatively slow part decides the transmission frequency.

The detection time is **Detect Mult** in peer BFD control packets multiplied the negotiated transmission interval of peer BFD control packets. If you increase **min_tx_interval** of the local end, the actual transmission interval of BFD control packets on the local end cannot be modified until the packets reset by the peer's F field are received, which ensures that the detection time is lengthened on the peer before the increase of the transmission interval of BFD control packets on the local end. Otherwise, the detection timer on the peer may time out.

If **min_rx_interval** on the local end is decreased, the local detection time cannot be modified until the packets reset by the peer's F field are received, which ensures that the transmission interval of BFD control packets on the peer has been decreased before the decrease of local detection time. However, if **min_tx_interval** is decreased, the local transmission interval of BFD control packets may decrease immediately; if **min_rx_interval** is increased, the local detection time will increase immediately.

55.2.2 Activating the Port BFD Query Mode

The port BFD query mode is not activated by default.

In query mode, we suppose that each system has an independent method to confirm its connection with other systems. Once a BFD session is established, the system stops transmitting BFD control packets unless a certain system requires explicit connectivity checkup. In a system where explicit connectivity checkup is required, the system transmits short-sequence BDF control packets and claims the session is down if it doesn't receive the response packets in the checkup period. If the response packets are received from the peer in the checkup period, it means the forwarding path is normal and the BFD control packets then stop being transmitted.

Run the following command to achieve the previous purpose:

Command	Purpose
bfd demand enable	Activates the BFD query mode.

The system supports to activate or deactivate the BFD query mode.

55.2.3 Activating Port BFD Echo

Port BFD echo is not activated by default.

After the BFD echo is activated, if the neighbor supporting BFD echo is up, the control packets are transmitted according to the interval configured by slow-timers. The connectivity detection is finished by the echo packets and the transmission interval of echo packets is the time configured by **min_echo_rx_interval**.

Run the following command to achieve the previous purpose:

Command	Purpose
bfd echo enable<*cr*>|<*number*>	Activates BFD echo.

The activation and shutdown of echo functionality on an already “up” neighbor has no impact on this neighbor’s status, but the transmission interval of control packets is affected.

55.2.4 Enabling Port BFD Authentication

Port BFD authentication is not activated by default.

Authentication configuration takes immediate effect before BFD neighbor is up, and the two terminals of a link on which BFD detection is conducted can be up only when their BFD authentication configurations are same. But if authentication configuration is modified after BFD neighbor is up, the same configurations or different configurations on the two terminals have no any impact on the BFD neighbor’s status.

Run the following command to achieve the previous purpose:

Command	Purpose
bfd authentication-mode [md5 | meticulous md5 | simple] <key id><key>	Enables the BFD authentication function.

Displaying the BFD Statistics Information

You can run the following commands to display all kinds of BFD statistics information:

Command	Purpose
show bfd interfaces *[details]*	Displays the ports in the system on which BFD is activated.
show bfd neighbors *[details]*	Displays BFD neighbors in the system.

55.3BFD Configuration Example

You need to set related protocols for BFD detection and activate the BFD function on the corresponding port before configuring BFD.

The following example shows how BFD provides BGP with bidirectional detection:

Establish the EBGP relationship between A and B, and check the link through BFD.

A:

```
interface vlan1
ip address 1.1.1.1 255.255.255.0
bfd enable
no ip directed-broadcast
!
router bgp 100
no synchronization
bgp log-neighbor-changes
neighbor 1.1.1.2 remote-as 200
neighbor 1.1.1.2 fall-over bfd
!
```

B:

```
interface vlan1
ip address 1.1.1.2 255.255.255.0
bfd enable
no ip directed-broadcast
!
router bgp 200
no synchronization
bgp log-neighbor-changes
neighbor 1.1.1.1 remote-as 100
neighbor 1.1.1.1 fall-over bfd
!
```

56. SNTP Configuration

56.1 Overview

56.1.1 Stipulations

56.1.1.1 Format Stipulation in the Command Line

Syntax	Definition
Bold	Stands for the keyword in the command line, which stays unchanged and must be entered without any modification. It is presented as a bold in the command line.
{italic}	Stands for the parameter in the command line, which must be replaced by the actual value. It must be presented by the italic in the brace.
<*italic*>	Stands for the parameter in the command line, which must be replaced by the actual value. It must be presented by the italic in the point bracket.
[ ]	Stands for the optional parameter, which is in the square bracket.
{ x | y | ... }	Means that you can choose one option from two or more options.
[x | y | ...]	Means that you can choose one option or none from two or more options.
{ x | y | ... } *	Means that you has to choose at least one option from two or more options, or even choose all options.
[x | y | ...] *	Means that you can choose multiple options or none from two or more options.
&<1-n>	Means that the parameter before the “&” symbol can be entered *n* times.
#	Means that the line starting with the “#” symbol is an explanation line.

56.2SNTP Configuration

56.2.1 Overview

Simple Network Time Protocol (SNTP) is currently an important method to realize time synchronization on the Internet.

SNTP adopts the client-server mode. The server obtains its own time by receiving the GPS signals or takes its own atomic clock as its time standard, while the client, by regularly accessing the time service provided by the server, gets the correct time information and regulates its own clock to synchronize with the time on the Internet. The UDP protocol and port 123 are used for the communication between the client and the server.

56.2.2 SNTP Configuration Task List

SNTP settings can be divided into two parts: one part is for the local switch to take as the SNTP server, and the other is for the local switch to take as the SNTP client.

The local switch takes as the SNTP server:

- Setting the Grade of the SNTP Server
- Enabling the SNTP Server

The local switch takes as the SNTP client:

- Setting the IP Address of the SNTP Server
- Setting the Interval of Browsing the SNTP Server
- Disabling the SNTP Server

56.2.3 SNTP Configuration

56.2.3.1 Setting the Grade of the SNTP Server

Configuration mode: Global

Command	Purpose
sntp master [Stratum]	Sets the grade of the SNTP server.

56.2.3.2 Enabling the SNTP Server

Configuration mode: Global

Command	Purpose
sntp master	The SNTP server is enabled by default.

56.2.3.3 Setting the IP Address of the SNTP Server

Configuration mode: Global

Command	Purpose
sntp server<A.B.C.D> [sntp-version]	Sets the IP address and version of the SNTP server.

56.2.3.4 Setting the Interval of Browsing the SNTP Server

Configuration mode: Global

Command	Purpose
sntp query-interval< minutes>	Sets the interval for the SNTP client to browse the SNTP server.

56.2.3.5 Disabling the SNTP Server

Configuration mode: Global

Command	Purpose
no sntp master	Closes the SNTP server.

57. Cluster Management Configuration

57.1 Overview

The switch cluster is a group of switches which can be managed as a single entity. In the cluster, there must be a switch worked as the command switch, which allows up to 255 switches simultaneously to join the cluster as member switches. As the single access node in the cluster, the command switch is used to configure, manage and monitor member switches. One switch belongs to only one cluster at a certain moment.

57.2Cluster Management Configuration Task List

- Planning cluster
- Creating cluster
- Configuring cluster
- Monitoring the state of standby group
- Using SNMP to manage cluster
- Using Web to manage cluster

57.3Cluster Management Configuration Task

57.3.1 Planning Cluster

A. VLAN

To manage the switch through the cluster, the command switch, the member switch and candidate switch of a cluster must have the default VLAN. The interface of the default VLAN of these switches has already existed.

B. Automatically discovering member switches and candidate switches

The command switch uses the BDP protocol to find the member switch, candidate switch and other clusters. The command switch also uses the BDP protocol to find the network topology. Therefore, you need to run the BDP protocol on the member switch, candidate switch and other clusters and activate BDP on the interconnected interfaces.

C. IP address

If the management station accesses the cluster through the TCP/IP management mode, such as telnet, http and snmp, you need configure the IP address of the command switch that the management station can access. You need not configure the IP address for the member switch of the cluster.

After the member switch joins in the cluster, the command switch distributes an IP address to each member switch. These IP addresses are selected from the IP pool of the cluster configured on the command switch. When planning the address pool, pay attention that the service addresses cannot be the same as those in the address pool; note that the address number in the address pool cannot be smaller than the maximum number of member switches in the cluster (including the command switch).

57.3.2 Creating Cluster

A. Activating command switch

Run the following command in global configuration mode to set the current switch to the command switch:

Command	Description
cluster mode commander*cluster-name*	Sets the current switch to the command switch.

B. Activating standby switch

Run the following command in global configuration mode to set the current switch to the standby switch:

Command	Description
cluster mode commander *member*	Sets the current switch to the standby switch.

C. Adding member switch

Run the following command in global configuration mode to add the standby switch with the designated MAC address to the cluster:

Command	Description
cluster member [**id***member-id*] **mac-address***H.H.H* [**password** *enable-password*]	Adds member switch.

57.3.3 Configuring Cluster

A. Configuring IP pool

Run the following command in global configuration mode to configure the IP address pool for cluster management:

Command	Description
cluster address-pool *A.B.C.D A.B.C.D*	Configures the IP address pool.

B. Configuring hellotime

You can modify the interval to send the handshake message between the command switch and the member switch by configuring hellotime (unit: second).

Run the following command in global configuration mode to configure the cluster's hellotime:

Command	Description
cluster hellotime*<1-300>*	Configures the interval of sending hello message between the command switch and the member switch.

C. Configuring holdtime

If the member switch and the command switch do not receive the handshake message from the peer in an interval, they think the peer is in **down** state. You can configure **holdtime** to change the interval value

Run the following command in global configuration mode to configure the cluster's hellotime:

Command	Description
cluster holdtime<*1-300*>	Configures the interval of sending handshake message between the command switch and the member switch.

D. Configuring hop number of the discovery protocol

The cluster uses the hop number to measure the distance of switches in the cluster. The hop number of the discovery protocol configured on the command switch equals the distance between the cluster verge and the candidate switch which is farthest to the cluster verge.

Run the following command in global configuration mode to configure the hop number of the discovery protocol for the cluster:

Command	Description
cluster discovery *hop-count*	Configures the PDP hop number of the discovery protocol.

57.3.4 Monitoring the State of Standby Group

Run the following command in privileged mode to monitor the configuration and state of cluster:

Command	Description
show cluster	Monitors the state of the standby group.
show cluster *member*	Checks the cluster member.
show cluster candidate	Checks the cluster candidate.
show cluster topo	Checks the cluster topology.
show address-pool	Checks the address pool the cluster.

57.3.5 Using SNMP to Manage Cluster

After the cluster is created, the snmp message can be transmitted between the member switch and the snmp application through the command switch. The detailed process is shown as follows:

To access No. N member switch in snmp mode, specify the destination IP address as the address of the switch in an snmp application.

Set **community string**to**community string + @esN**, which belongs to the corresponding right of the command switch. If **community string** on the command switch is **public, community string** of No.6 member switch is **public@es6**.

57.3.6 Using Web to Manage Cluster

After the cluster is created, the http message can be transmitted between the member switch and the browser through the command switch. The detailed operation is to add prefix like “esN/” before the url.

Suppose the IP of the command switch is 192.168.20.1, the url of the No.6 member switch is http: //192.168.20.1/es6/.

58.GPON ONU Registration Management Configuration Commands

58.1 ONU Authentication Registration Configuration Commands

58.1.1.1 gpon onu-authen-method

Syntax

gpon onu-authen-method {disable | sn | pass | sn-pass | loid | hybrid} no gpon onu-authen-method

To set the authentication mode of the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
disable	If you don't do the certification, the registration will be automatically certified
sn	SN certification is performed
pass	Use PLOAM Password authentication
sn-pass	Use SN and PLOAM Password authentication
loid	Use China Telecom LOID certification
hybrid	Hybrid authentication using China Telecom LOID and SN

Default Value

If the ONU is not authenticated, the registration will be automatically authenticated.

Command Mode

GPON Port Configuration Mode

Usage Guidelines

disable: The ONU is not authenticated, that is, the registration is automatically authenticated.

sn: The ONU authentication of the existing SN binding configuration gpon bind-onu sn is passed. Otherwise, the ONU will not enter the activation online registration process.

pass: The ONU authentication of the existing password binding and gpon bind-onu password is passed. Otherwise, the ONU will be deactivated immediately after the activation of the online verification password fails. It should be noted that the corresponding binding is a separate password bind, and the password configuration gpon bind-onu sn serial-number password password-string cannot be authenticated in this mode.

sn-pass: For SN-bound and password, gpon bind-onu sn serial-number password is configured correctly password- string ONU authentication passed; If the SN is not bound, the ONU will not enter the activation and online registration process, and if the ONU fails to activate the online verification password, it will be deactivated immediately. It should be noted that configuring SN bindings and separate Password bindings cannot make this mode authentication pass.

loid: The ONU authentication for which the LOID binding configuration exists, or the LOID can pass the ONU authentication of the AAA authentication rules configured by the OLT. Otherwise, after the ONU completes the OMC channel establishment and obtains the CTC LOID information and fails to authenticate the ONU, the OLC will send an OMCI with the failed CTC LOID authentication to notify the ONU that the registration is rejected and deactivate the ONU.

hybrid: Authenticates to an ONU with an SN binding configuration, an ONU with an LOID binding configuration, or an ONU that can pass an AAA authentication rule configured with an OLT. Otherwise, after the ONU completes the OMC channel establishment and obtains the CTC LOID information and the authentication fails, the OLT will send an OMCI with the failed CTC LOID authentication to notify the ONU that the registration is rejected and deactivate the ONU.

When the authentication mode is switched, the OLT shuts down the PON port to provide the configuration personnel with the opportunity to configure the ONU authentication binding entries. The configuration personnel should complete the necessary modifications to the configuration before opening the port to avoid a large number of ONU authentication failures under the PON port.

Example

Change the ONU authentication mode of port gpon0/0/1 to SN authentication.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon onu-authen-method sn

58.1.1.2 gpon bind-pon-mode

Syntax

gpon bind-pon-mode {gpon | xgpon | xgspon} sequence *seq-range*

no gpon bind-pon-mode sequence *seq-range*

To bind the ONU serial number of the PON designated range and the PON mode, run the above commands.

Parameter Description

Parameter	Parameter Description
gpon	GPON port and ONU sequence number are bound to GPON
xgpon	The XG(S) PON port and the ONU sequence number are bound to the XGPON
xgspon	XGSPON port, the ONU sequence number is bound to XGSPON
seq-range	The sequence number range of the bound ONU

Default Value

None, all ONU serial numbers are not bound to PON mode.

Command Mode

GPON Port Configuration Mode

Usage Guidelines

The sequence number of the ONU bound to PON mode will only allow the ONU of that PON mode to be bound (the pon-mode parameter corresponding to gpon bind-onu must be the PON mode). The SN bindings automatically added during the ONU discovery process will also be preferentially assigned according to the PON mode reported by the ONU, and the serial number of the PON mode will be assigned if the serial number of the PON mode is bound.

Adding the PON mode binding to the PON port ONU serial number will change the PON mode of the ONU that has been bound to the serial number to the same PON mode .

Example

Bind the sequence numbers 1-100 of the ONU in ports 0/0/1 to XGPON.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon bind-pon-mode xgpon sequence 1-100

58.1.1.3 gpon bind-onu

Syntax

gpon bind-onu sn *serial-number* [password {hex *hex-sn-password* | *sn-pasword*}] [pon-mode gpon] [*onu-sequence*]

gpon bind-onu sn *serial-number* [regid {hex *hex-sn-regid* | *sn-regid*}] [pon-mode {xgpon | xgspon}] [*onu-sequence*]

Set the binding relationship between the SN serial number, password, and PON mode of the ONU and the GPON port and the serial number of the ONU (for the XG(S) PON port, the registration ID is the password).

gpon bind-onu password {hex *hex-sn-password-only* | *sn-pasword-only*} [pon-mode gpon] [*onu- sequence*]

gpon bind-onu regid {hex *hex-sn-regid-only* | *sn-regid-only*} [pon-mode {xgpon | xgspon}] [*onu- sequence*]

Set the password and PON mode of the ONU to be bound to the GPON port and the ONU serial number (for the XG(S) PON port, the registration ID is the password).

gpon bind-onu loid *loid-string* [password *loid-password-string*] [pon-mode {gpon | xgpon | xgspon}] [*onu-sequence*]

Set the LOID information and PON mode of the ONU to be bound no gpon bind-onu sn *serial-number*

no gpon bind-onu password {hex *hex-sn-pasword-only* | *sn-pasword-only*} no gpon bind-onu regid {hex *hex-sn-regid-only* | *sn-regid-only*}

no gpon bind-onu loid *loid-string*

no gpon bind-onu sequence *onu-sequence*

Delete the relationship between the SN or password or LOID information of the ONU and the GPON port and the sequence number of the ONU.

Parameter Description

Parameter	Parameter Description
serial-number	ONU serial number in one of two formats: XXXX: XXXXXXXX - The first 4 characters are VendorID displays, The colon is separated by a hexadecimal representation of the 4-byte vendor serial number, representing one byte for every 2 characters; XXXXXXXXXXXXXXXX - A hexadecimal representation of a full 8-byte serial number, representing one byte per 2 characters.

sn-pasword	GPON port, specify the PLOAM password information of 1-10 characters when binding the ONU serial number
hex-sn-pasword	GPON port, specify the PLOAM password when binding the ONU serial number It is configured in hexadecimal bytes, representing one byte for every 2 characters, and 1-10 bytes need to be configured, and the part less than 10 bytes will be filled with 0x00
sn-pasword- only	GPON port, bind PLOAM password separately, 1-10 characters
hex-sn-pasword- only	GPON port, bind the PLOAM password separately It is configured in hexadecimal bytes, representing one byte for every 2 characters, and 1-10 bytes need to be configured, and the part less than 10 bytes will be filled with 0x00
sn-regid	XG(S) PON port, specify the PLOAM password information, 1-36 characters, when binding the ONU serial number
hex-sn-regid	XG(S) PON port, specify the PLOAM password when binding the ONU serial number It is configured in hexadecimal bytes, representing one byte for every 2 characters, and 1-36 bytes need to be configured, and the part less than 36 bytes will be filled with 0x00
sn-regid- only	XG(S) PON port, bind PLOAM password separately, 1-36 characters
hex-sn-regid-only	XG(S) PON port, bind a PLOAM password separately It is configured in hexadecimal bytes, representing one byte for every 2 characters, and 1-36 bytes need to be configured, and the part less than 36 bytes will be filled with 0x00
loid-string	LOID string, 1-24 characters in length
loid-password- string	LOID password string, 1-12 characters in length
gpon	GPON port, specify the ONU PON mode as GPON when binding the ONU
xgpon	XG(S) PON port, specify the ONU PON mode as XGPON when binding the ONU
xgspon	XGSPON port, specify the ONU PON mode as XGSPON when binding the ONU
onu-sequence	The sequence number of the ONU port ranges from 1 to 128 (GPON port) or 1 to 256 (XG(S) PON port)

Default Value

No binding configuration

Command Mode

GPON Port Configuration Mode

Usage Guidelines

Only ONUs with bound configurations can save the configuration on their ONU interfaces. The added binding configurations are static bindings and will not be deleted when ONU is offline.

Add pon-modeParameter and onu-sequenceParameter for binding. If neither pon-modeParameter nor onu-sequenceParameter are configured, *onu-sequence assigns the lowest sequence number to the ONU sequence number that is not bound to PON mode (the ONU sequence number that is not configured with gpon bind-pon-mode). When only pon-modeParameter is configured, onu-sequence will preferentially assign the ONU sequence number bound to the PON mode*If the sequence number of the PON mode is assigned, the sequence number of the unbound PON mode is assigned. If only the onu-sequenceParameter is configured, if the onu sequence number has been bound to the PON mode, the pon-modeParameter is automatically configured to the PON mode. When both pon-modeParameter and onu-sequenceParameter are configured, if the ONU sequence number has been bound to PON mode, you need to ensure that the configured PON mode is the same as that of the ONU.

After pon-mode parameter is configured, authentication fails if the PON mode reported by the ONU is incorrect.

The PLOAM password attached to the ONU serial number takes effect only when the authentication mode is set to sn-pass. Only a separate PLOAM password is bound and will only take effect when the authentication mode is pass. For LOID information binding, only if the authentication mode is set to loid | hybrid.

The PLOAM password attached to the ONU serial number is optional, but if no password is configured, the ONU will always fail authentication when the authentication mode is sn-pass.

If no password string is configured, the authentication mode is set to loid | In hybrid case, the LOID password of the ONU can be authenticated if the value is arbitrary.

When binding the serial number of the ONU, the PLOAM password sn-pasword-only, and the LOID, you need to ensure that the corresponding information is unique on the OLT, otherwise the corresponding binding is added by the None method.

Existing binding configurations can add or modify the optional PLOAM password in the serial number binding, the optional password string in the LOID binding, and the PON mode, and adding or modifying these parameters will deactivate the ONU.

If gpon onu-auto-bind enable is enabled (default), the OLT will automatically add its static SN binding configuration after the ONU is activated and authenticated.

If gpon onu-auto-move enable is enabled (default), if the ONU of the same SN is migrated to another PON port to enter the discovery process, the static SN binding configuration of the original PON port is deleted.

If LOID authentication or individual password authentication is enabled to replace the overwritten static binding non-online SN function gpon loid-overwrite-static-sn | password-overwrite-static-sn (non-default), if the ONU is online, it passes LOID authentication or a separate password authentication pass If you find that the same ONU port has been bound to other SNs and the ONU that was originally bound to the SN is offline, the original static SN binding configuration is deleted.

If LOID/Password binding and SN binding configurations exist at the same time and correspond to different port serial numbers when LOID or Password authentication or separate password authentication is enabled, the ONU authentication will be migrated to the port sequence number bound to LOID/Password and the original static SN binding configuration will be deleted.

Example

Bind the sequence number 1 of the ONU port in the gpon0/0/1 port to the ONU PLNT:11111111.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon bind-onu sn PLNT:11111111 1

58.1.1.4 gpon onu-auto-bind

Syntax

gpon onu-auto-bind {enable | disable}

To enable or disable auto add ONU SN binding, run the above command.

Parameter Description

None

Default Value

Enable automatic addition of ONU SN bindings

Command Mode

GPON Port Configuration Mode

Usage Guidelines

If you enable Automatic Add SN Binding, static SN binding configurations are automatically added to the authenticated ONU. If you turn off Auto Add Binding, even if the ONU authentication is passed, the binding will still maintain the dynamic binding, once the ONU is offline, the corresponding relationship between the SN and the ONU port will be dissolved, and if there is no other binding configuration to maintain the ONU port, the ONU port will also be released.

Disabling automatic addition of bound SNs can be used in the following two scenarios:

1. If you do not perform LOID authentication or AAA authentication, you expect the ONU to be re-configured from the configuration template every time you go online, and release the ONU port after you go offline. Do not retain any mapping between ONUs and configurations.

2. Separate Password authentication or LOID-related authentication, create an ONU port by binding Password or LOID information, and configure the ONU port, the ONU is migrated to the corresponding ONU port after passing the Password or LOID authentication online, and the corresponding relationship between SN and ONU port or configuration is not retained. LOID is the same as ONU, and OLT does the same configuration processing.

Example

Configure the gpon0/0/1 port to disable and automatically add ONU SN bindings.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon onu-auto-bind disable

58.1.1.5 gpon reject-silence

Syntax

gpon reject-silence [*silence-time* | forever] no gpon reject-silence

To configure the ONU quiescence period after authentication fails, run the above commands.

Parameter Description

Parameter	Parameter Description
silence-time	Silience time 10-86400 in seconds
forever	Permanently silence, which needs to be lifted manually

Default Value

60s

Command Mode

GPON Port Configuration Mode

Usage Guidelines

After the ONU authentication fails or the activation fails, the deactivation silent state will be maintained, and after the quiescent period configured in this command expires, the OLT will try to activate the ONU online authentication again.

Example

The silence period is 30 seconds after the ONU authentication fails on port gpon0/0/1.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon reject-silence 30

58.1.1.6 gpon onu description

Syntax

gpon onu description *string*

To add a description string to the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
string	The description of the ONU, up to 32 in length

Default Value

None

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

Set the description string of the ONU on port gpon0/0/1:1 to PLANET-4F.

OLT(config-gpon0/0/1:1)# gpon onu description PLANET-4F

58.1.1.7 gpon disable-onu

Syntax

[no] gpon disable-onu *SerialNumber*

To enable/disable the designated SN by the specified PON port of the ONU, run the command.

Parameter Description

Parameter	Parameter Description
SerialNumber	ONU serial number in one of two formats: XXXX: XXXXXXXX - The first 4 characters are VendorID displays, The colon is separated by a hexadecimal representation of the 4-byte vendor serial number, representing one byte for every 2 characters; XXXXXXXXXXXXXXXX - A hexadecimal representation of a full 8-byte serial number, representing one byte per 2 characters.

Default Value

None

Command Mode

GPON Port Configuration Mode

Usage Guidelines

Disabling the ONU is achieved by PLOAM operation, and the ONU should enter the O7 state according to the standard and completely turn off its optical module emitting light. The ONU will always be discovered or activated unless the ONU is configured to be turned on, or the ONU is powered off and rebooted.

The disable command can be used to troubleshoot long-lit ONUs or disable abnormal ONUs from accessing the system.

Parameter	Parameter Description

The enable command takes effect only when the ONU is disabled and the ONU is connected to the original PON port link. If the ONU is not connected to the link, the PLOAM ONUNone method delivered by the enabling command operation will not be discontinued. In this case, you need to restart the ONU after power-off. Enabling the ONU does not guarantee that it will be activated, and the ONU will enter the normal discovery and authentication activation process.

If there is an ONU port corresponding to the SN under the PON port, after the gpon disable-onu SerialNumber is configured on the PON port, the gpon onu disable configuration will also be generated on the ONU port. After no gpon disable-onu SerialNumber is configured on the PON port, the gpon onu disable configuration on the ONU port disappears.

This command implements the ONU blacklist function.

Example

Disable ONU under port gpon0/0/1 with SN for PLNT:F79D62E5:

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon disable-onu PLNT:F79D62E5

Enable an ONU with SN number PLNT:F79D6100 on port gpon0/0/1:

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# no gpon disable-onu PLNT:F79D6100

58.1.1.8 gpon deactivate-onu

Syntax

gpon deactivate-onu interface *onu-intf-name*

To activate the designated ONU, run the command.

Parameter Description

onu-intf-name	Deactivate the ONU corresponding to the specified port, and the ONU port format is gpon *chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

This command takes effect only when the ONU is active. After the ONU is deactivated, the ONU should re-enter the discovery and activation online process.

Example

Deactivate the ONUs registered on port gpon0/0/1:1.

OLT# gpon deactivate-onu interface gpon0/0/1:1 Are you sure to deactivate the ONU(y/n)?y

58.1.1.9 gpon onu-auto-unbind

Syntax

gpon onu-auto-unbind [*value* | never] no gpon onu-auto-unbind

Enable or disable automatic aging of ONU SN bindings.

Parameter Description

Parameter	Parameter Description
value	Aging time, range 1000-10000000000, in seconds
never	No aging

Default Value

No aging

Command Mode

GPON Port Configuration Mode

Usage Guidelines

The OLT automatically clears the SN binding of the ONU that has been offline continuously for more than the configured aging time, and if the corresponding ONU port does not have the Password binding and LOID binding configuration, the corresponding ONU port will be released.

This command is usually used to ensure that the ONU that has been removed from the line no longer occupies the corresponding port resources.

Example

Configure the gpon0/0/1 port to automatically age the ONU SN binding time to 1,209,600 seconds (14 days).

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon onu-auto-unbind 1209600

58.1.1.10 gpon loid-overwrite-static-sn

Syntax

[no] gpon loid-overwrite-static-sn

To specify whether to allow the static SN binding to replace the LOID-authenticated and offline ONU, run the above command.

Parameter Description

None

Default Value

Not allowed

Command Mode

GPON Port Configuration Mode

Usage Guidelines

For LOID authentication in LOID information binding mode, users can replace different SNs but the same LOID ONU and keep the ONU port configuration The method that does not need to be reconfigured is to turn off gpon onu-auto-bind, keep the SN binding information not recorded, and migrate to the corresponding ONU port after each ONU goes online After LOID authentication is passed, the other is to keep gpon onu-auto-bind on. When the LOID points to an ONU port that has been offline and has other static SN bindings, the OLT will automatically delete the original static SN bindings and add a new static SN binding, and when the ONU is not replaced, the SN does not change, and the ONU uses the ONU bound ONU port to go online for LOID authentication, and the authentication is completed after the LOID authentication is passed, and no additional port migration is required and simplified onboarding process.

For LOID authentication in AAA mode, to realize that users can replace different SNs but the same LOID ONU and maintain the ONU port configuration without reconfiguring, you must keep gpon onu-auto-bind enabled and enable this loid-overwrite-static-mac switch to ensure that there is a static SN binding in the ONU so that the ONU port will not be released when the ONU is offline, and the configuration is retained.

Example

Configuring the gpon0/0/1 ports allows the static SN binding to replace the LOID-authenticated and offline ONU.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon loid-overwrite-static-sn

58.1.1.11 gpon password-overwrite-static-sn

Syntax

[no] gpon password-overwrite-static-sn

To specify whether to allow static SN bindings to replace ONUs that have passed Password authentication and are offline, run the above command.

Parameter Description

None

Default Value

Not allowed

Command Mode

GPON Port Configuration Mode

Usage Guidelines

For the authentication of a separate password binding mode, the user can replace the ONU with different SNs but the same password and keep the ONU port configuration without reconfiguration, one is to turn off gpon onu-auto-bind, keep the SN binding information not recorded, and go online on each ONU. The other is to keep gpon onu-auto-bind enabled and enable the password-overwrite-static-sn switch, when the password points to an ONU port bound to other static SNs that are offline during the ONU Password authentication process. The OLT automatically deletes the original static SN binding and adds a new static SN binding, and when the ONU is not replaced, the SN does not change, and the ONU uses the ONU port bound by the SN to go online for password authentication, and the authentication is completed after passing the password, which does not require additional port migration actions, simplifying the online processing process.

Example

Configure port gpon0/0/1 to replace the static SN binding of an ONU that has passed password authentication and is offline.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon password-overwrite-static-sn

58.1.1.12 gpon onu-config-migrate-with-sn-mode

Syntax

[no] gpon onu-config-migrate-with-sn-mode

To configure the ONU port configuration to enable and disable the ONU SN migration function, run the above command.

Parameter Description

None

Default Value

Disabled

Command Mode

Global Configuration Mode

Usage Guidelines

If the SN of the ONU is migrated to another PON port, the configuration on the corresponding ONU port will be automatically migrated to the new ONU port. It is mainly used when the ONU is migrated to a new PON port after the on-site cutover line.

Example

Enable the ONU port configuration to follow the ONU SN migration function.

OLT(config)# gpon onu-config-migrate-with-sn-mode

58.1.1.13 gpon configuration-move

Syntax

gpon configuration-move from *src-pon-intf-name* to *dst-pon-intf-name*

To migrate the PON port configuration, ONU binding, and all ONU ports under the PON port to the new PON port, run the above commands.

Parameter Description

Parameter	Parameter Description
src-pon-intf-name	Configure the PON port of the migration source in the following format: gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

dst-pon-intf-name	Configure the target PON port in the following format: gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

It is used to cut over lines in the field and migrate the entire main fiber to the new PON port. After the migration is complete, the source port will be restored to its default configuration, and the destination port will be enabled or closed according to the original enabled state of the source port.

When you perform a cutover on site, ensure that when you use this command, the migration destination port will not be connected to other None lines that are not migrated. The transferred line can be switched to the destination port first and then use the command to migrate the configuration while ensuring that the destination port is closed, or you can use the command to migrate the configuration and then cut over the line to the destination port after the configuration is migrated.

Example

Migrate the gpon0/0/1 configuration to gpon0/0/2.

OLT# gpon configuration-move from gpon0/0/1 to gpon0/0/2

58.1.1.14 gpon onu-sn-display-format

Syntax

gpon onu-sn-display-format {type-1 | type-2} no gpon onu-sn-display-format

To configure the ONU GPON SN display format, run the above command.

Parameter Description

Parameter	Parameter Description
type-1	Format: XXXX: XXXXXXXX The first four bytes of the vendor ID are displayed as characters, and the last four bytes are displayed in hexadecimal data
type-2	Format: XXXXXXXXXXXXXXXX All eight bytes are displayed in hexadecimal data

Default Value

type-1

Command Mode

Global Configuration Mode

Usage Guidelines

This command configuration will affect the output format of GPON ONU SN in all commands such as show run, show gpon onu-information, show gpon active-onu, and show gpon inactive-onu.

Example

Configure ONU GPON SN to display 8 bytes in hexadecimal data.

OLT(config)# gpon onu-sn-display-format type-2

58.1.1.15 gpon default-db-onu

Syntax

gpon default-db-onu interface { *onu-intf-name* | *pon-intf-name* [*seq-range*]}

To clear the ONU configuration database and unregisters the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf- name	Confirm the ONU per its port. The ONU port format is: gponchassis/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU port sequence number
pon-intf- name	Chek the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Restart the specified ONU sequence number range.

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

This command is used when you want to clear the existing database configuration of the ONU and make the ONU re-deliver the configuration according to the existing configuration template.

Example

The ONU registered on port gpon0/0/1:1 clears the configuration database and deregisters it.

OLT(config)# gpon default-db-onu interface gpon0/0/1:1

58.1.1.16 show gpon onu-information

Syntax

show gpon onu-information [{interface *pon-intf-name* [*seq-range*] | sn *serial-num* | loid *loid-string*}]

To display the ONU status information, run the above command.

Parameter Description

Parameter	Parameter Description
pon-intf- name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq- range	Check the ONU port serial number range
serial- num	Check the ONU serial number in one of two formats: XXXX: XXXXXXXX - The first 4 characters are VendorID displays, The colon is separated by a hexadecimal representation of the 4-byte vendor serial number, representing one byte for every 2 characters; XXXXXXXXXXXXXXXX - A hexadecimal representation of the full 8-byte serial number, representing one byte per 2 characters.
loid- string	LOID string, 1-24 characters in length

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

Use this command to display the interface name, PON mode, vendor name, device number, SN, LOID, activation status, configuration status, and activation time of the ONU.

In addition, SN and LOID filtering support fuzzy matching, and uncertain characters can be replaced by '*'. Note that the VendorID part of the first representation of SN does not support fuzzy matching and is case-sensitive. For example, an ONU with SN of 4244434DF79D62E5 can be ambiguously matched in the following ways: "**4443", "4*4*4*4", "PLNT:**9d".

Example

Display the binding information of all ONUs on gpon0/0/1 ports.

OLT# show gpon onu-information interface gpon0/0/1 Interface gpon0/0/1 has bound 1 ONUs:

IntfName	ModelID	SN	Status	Config Status	Active Time
gpon0/0/1:1	PLNT	PLNT:6B61B7CC	active	success	1970-01-02 16:25:06

58.1.1.17 show gpon active-onu

Syntax

show gpon active-onu [{interface *pon-intf-name* [*seq-range*] | sn *serial-num* | loid *loid-string*}]

Display information about the active ONU.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Check the ONU port serial number range

serial- num	Check the ONU serial number in one of two formats: XXXX: XXXXXXXX - The first 4 characters are VendorID displays, The colon is separated by a hexadecimal representation of the 4-byte vendor serial number, representing one byte for every 2 characters XXXXXXXXXXXXXXXX - A hexadecimal representation of the full 8-byte serial number, representing one byte per 2 characters

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Display information about all active ONUs under port gpon0/0/1.

OLT# show gpon active-onu interface gpon0/0/1 Interface gpon0/0/1 has bound 1 active ONUs:

IntfName	SN	Active Time	Active Duration	Distance(m)
gpon0/0/1:1	PLNT:F79D62E5	2021-08-08 00:51:41	0000d:00:08:23	77.2

58.1.1.18 show gpon inactive-onu

Syntax

show gpon inactive-onu [{interface *pon-intf-name* [*seq-range*] | sn *serial-num* | loid *loid-string*}]

To display information about inactive ONUs, run the above command.

Parameter Description

pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port.* chassis is the chassis number, slot is the slot number, and port is the GPON port number
Parameter	Parameter Description
seq-range	Check the ONU port serial number range
serial- num	Check the ONU serial number in one of two formats: XXXX: XXXXXXXX - The first 4 characters are VendorID displays, The colon is separated by a hexadecimal representation of the 4-byte vendor serial number, representing one byte for every 2 characters XXXXXXXXXXXXXXXX - A hexadecimal representation of the full 8-byte serial number, representing one byte per 2 characters
loid-string	LOID string, 1-24 characters in length

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Display information about all inactive ONUs under port gpon0/0/1.

OLT# show gpon inactive-onu interface gpon0/0/1 Interface gpon0/0/1 has bound 1 inactive ONUs:

IntfName SN Status Deactive Time Deactive Reason

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gpon0/0/1:1 PLNT:F79D62E5 disabled 2021-08-08 01:07:44 Admin control

58.1.1.19 show gpon onu-updown-information

Syntax

show gpon onu-updown-information [{interface *pon-intf-name* [*seq-range*] | sn *serial-num* | loid *loid-string*}]

Display the online/offline time information of ONUs in batches.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Check the ONU port serial number range
serial- num	Check the ONU serial number in one of two formats: XXXX: XXXXXXXX - The first 4 characters are VendorID displays, The colon is separated by a hexadecimal representation of the 4-byte vendor serial number, representing one byte for every 2 characters XXXXXXXXXXXXXXXX - A hexadecimal representation of the full 8-byte serial number, representing one byte per 2 characters
loid-string	LOID string, 1-24 characters in length

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Display the online and offline time of ONUs on port gpon0/0/1 in batches.

OLT# show gpon onu-updown-information interface gpon0/0/1 Interface gpon0/0/1 has bound 1 ONUs:

IntfName Description Status Active Time Deactive Time OMCC-

--- --- --- --- --- ---

gpon0/0/1:1 N/A off-line 2021-08-08 01:07:16 2021-08-08 01:07:44 2021-

58.1.1.20 show gpon onu-description

Syntax

show gpon onu-description [{interface *pon-intf-name* [*seq-range*] | find-by-description *desc*}]

To display ONU descriptions in batches, run the above command.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number.

seq-range	Check the ONU port serial number range
desc	Check ONU description information string

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Display the description of the ONUs on the gpon0/0/1 ports in batches.

OLT# show gpon onu-description interface gpon0/0/1 Interface gpon0/0/1 display 1 ONUs:

IntfName Description SN Status Config Status

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gpon0/0/1:1 PLANET-4F PLNT:F79D62E5 disabled N/A

58.1.1.21 show gpon onu-disable-information

Syntax

show gpon onu-disable-information [interface *pon-intf-name*]

To show the disabled ONU online information, run the command.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

The ONUs that are prohibited from going online usually include those that fail to activate, those that fail to authenticate, and those that are disabled. Except for the GPON port with gpon disable-onu disabled and the ONU port configured with gpon onu disable, other entries that are disabled will be automatically deleted after the silent period configured by the gpon reject-silence command, and the online authentication will be activated again.

For ONUs that fail to authenticate, the information of the ONU that is prohibited from going online also contains the ONU authentication information corresponding to the PON port configuration authentication mode of the ONU, and the necessary authentication item configuration can be adjusted according to the corresponding information to complete the authentication online of the ONU.

Example

Display information about all ONUs that have been banned from going online.

OLT# show gpon onu-disable-information

Interface Time Serial Number Disable Reason Loid(Password) OnuPassw

OnuPassword

---

gpon0/0/1 1970-01-02 15:06:57 PLNT:6B61B7CC Disable manual

58.1.1.22 show gpon onu-rejected-information

Syntax

show gpon onu-rejected-information [interface *pon-intf-name*]

To displaysONU SN information for which the authentication is denied, run the above command.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

For SN+Password authentication, password authentication, and LOID authentication, the authentication information is not recorded in this table. This table is valid only for SN certifications.

Example

Display ONU SN information for which the authentication was rejected.

OLT# show gpon onu-rejected-information

ONU rejected to register on the olt

NO. Interface Reject Time Serial Number Loid(Password) OnuPassword

----- ------------ ------------------- --------------- --------------- -----------------

1 gpon0/0/1 1970-01-02 15:06:57 PLNT:6B61B7CC

58.1.1.23 show gpon onu-status-count

Syntax

show gpon onu-status-count

To display statistics on the number of ONUs in various statuses, run the above command.

Parameter Description

None

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Display statistics on the number of ONUs in various statuses.

OLT# show gpon onu-status-count ONU STATUS COUNT

Offline: 73

Disable: 0

Activating: 0

Active: 2

MIB Syncing: 0

MIB Ready: 2

Authenticating: 0

Authenticated: 2

Not Configured: 0

Config Waiting: 0

Configuring: 0

Config Success: 2

Config Failed: 0

Template Failed: 0

58.1.1.24 show gpon onu-seq-id-map

Syntax

show gpon onu-seq-id-map interface *pon-intf-name*

To check the sequence number and ONUID information of the ONU in the PON port in batches, run the above command.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the PON port. The PON port format is gpon *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

In the case of LOID authentication and password authentication, the ONU may be migrated to another ONU port after the authentication is passed, resulting in no direct correspondence between the ONU port sequence number and the ONUID used on the actual GPON channel. You can use this command when you need to check the relationship between the ONU port sequence number and the ONUID. Note that the information in the ID column is the actual GTC ONUID plus 1.

Example

Display the serial numbers of all ONUs on GPON0/0/1.

OLT# show gpon onu-seq-id-map interface gpon0/0/1 Interface gpon0/0/1 has bound 2 ONUs:

IntfName	SEQ	ID	ITU-ONU-ID	Serial Number
gpon0/0/1:1	1	1	0	4244434D732FB42C
gpon0/0/1:2	2	2	1	4244434DF79D62E5

59. GPON ONU Service Management Configuration Commands

59.1 Global ONU Service Preset Configuration Commands

59.1.1 gpon omci-mib

Syntax

[**no**] **gpon omci-mib reset-on-active**

To configure whether to execute mib reset when ONU is online (the configuration must be redelivered after the ONU is online), run the above command.

[**no**] **gpon omci-mib** { **keep-alive** | **mib-audit** | **alarm-audit** }

To configure whether to enable keep-alive/mib-audit/alarm-audit mechanism, run the above command.

Parameter Description

None

Default Value

gpon omci-mib reset-on-active

no gpon omci-mib keep-alive

no gpon omci-mib mib-audit

no gpon omci-mib alarm-audit

Command Mode

Global Configuration Mode

Usage Guidelines

The **gpon omci-mib** command configures some of the working mechanisms of the OMCI of the GPON OLT.

If the synchronization number is consistent, it is considered that the configuration corresponding to the ONU recorded by the ONU is consistent with the actual configuration of the ONU, and there is no need to re-issue the ONU configuration, if the synchronization number is inconsistent, the actual configuration of the ONU is considered to be inconsistent with the OLT record, and the OLT must initiate the OMCI MIB Reset operation to clear the default state required by the ONU configuration recovery protocol. The number of configuration synchronization recorded by the OLT and ONU is cleared to zero, and then the OLT delivers the complete ONU configuration recorded by the ONU port through OMCI, and each configuration operation is delivered, the OLT and ONU increase the number of configuration synchronization maintained by 1 for subsequent check whether the configuration of the OLT and ONU is synchronized.

reset-on-active: This switch is used to control whether the OMCI MIB Reset operation is always performed after the ONU is activated and the ONU configuration is delivered. The MIB Reset delivery configuration is always executed during configuration, and the MIB Reset delivery configuration is executed only when the synchronization number is inconsistent during the no configuration.

keep-alive: This switch is used to control whether the OML sends OMCI packets periodically after the ONU goes online to check that the OMCI channel is working properly, and if the ONU is found to be not responding to the OMCI, the ONU is automatically deactivated. Perform periodic checks when configuring, but not when configuring. mib-audit: This switch is used to control whether the OLT interacts with the OMCI after the ONU configuration is completed, and if the configuration synchronization number is inconsistent, execute the MIB Reset and deliver the configuration again. Perform periodic checks when configuring, but not when configuring.

alarm-audit: This switch is used to control whether the OLT periodically obtains all ME alarms after the ONU configuration is complete. Obtain alarms periodically when configured and obtain alarms periodically when no is configured.

Example

After the ONU goes online, the ONU configuration is delivered again only if the synchronization number is inconsistent.

OLT(config)# no gpon omci-mib reset-on-active

After the ONU goes online, the OMCI channel status is not checked, and the number of synchronization is not checked periodically.

OLT(config)# no gpon omci-mib keep-alive OLT(config)# no gpon omci-mib mib-audit

59.1.2 gpon onu-uni-link-status-on

Syntax

[**no**] **gpon onu-uni-link-status-on**

To enable or disable onu uni port link status notification, run the command.

Parameter Description

None

Default Value

Disable

Command Mode

GPON Port Configuration Mode

Usage Guidelines

None

Example

To enable ONU uni port link status notification on the gpon0/0/1 port, run the following command.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon onu-uni-link-status-on

59.1.3 gpon broadcast-gem-port

Syntax

gpon broadcast-gem-port *gem-port-id*

no gpon broadcast-gem-port

To configure OLT GPON port downlink broadcast GEM port, run the commands above.

Parameter Description

Parameter	Parameter Description
gem-port-id	Broadcast GEM Port. The range is 384-4095. The default value is 4094.

Default Value

4094

Command Mode

GPON Port Configuration Mode

Usage Guidelines

The OLT will send downlink broadcasts, unknown multicasts, and unknown unicasts on the GPON port through the broadcast GEM port. The configured broadcast GEM port value will be used for all PON ports to forward broadcast, unknown multicast, and unknown unicast packets on the GEM port channel identified as the corresponding value. The OLT notifies the ONU to create a broadcast GEM port through the OMCI channel and connect to the corresponding forwarding service.

Example

The following example shows how to configure the downlink broadcast GEM Port of OLT gpon0/0/1 port to 3500:

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon broadcast-gem-port 3500

59.1.4 gpon position

Syntax

gpon position longitude *long* **latitude** *lat* **elevation** *elev* **horizonal-error** *horiz-er* **altitude-error** *alti-er* **area-code** *area-co* **timestamp** *timesta* **digest** *dig* **check** *ch*

To set OLT geolocation information, run the above commands.

Parameter Description

Parameter	Parameter Description
long	Longitude value
lat	Latitude value
elev	Height value
horiz-er	Horizontal error value
alti-er	Vertical error value
area-co	The value of the district's district code
timesta	Measure time
dig	Measure the signature checksum value
ch	Checksum value

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

The OLT geolocation information configuration is based on the "YD/T 3059-2016 Technical Requirements for Fixed Client Equipment for Broadband Universal Service". After this parameter is configured, the ONU of all OLTs will be notified of the geographic location where the OLT is located. The corresponding configuration data is generated by the corresponding BUAPP software. If the verification fails, the configuration data input is incorrect, and you need to reconfirm whether the data is consistent with the BUAPP display.

Example

The longitude value of setting OLT location information is 121.59266, the latitude value is 31.21400, the height value is 18, the horizontal error value is 12, the vertical error value is 0, the regional division code value is 310115125025, the measurement time is 1571830640, the measurement signature check value is 16853DB39A6C4D50, and the check value is 158C.

OLT(config)# gpon position longitude 12159266 latitude 3121400 elevation 18

horizonal-error 12 altitude-error 0 area-code 310115125025 timestamp 1571830640 digest 16853DB39A6C4D50 check 158C

59.2 ONU Information Check Commands

59.2.1 show gpon interface onu basic-info

Syntax

show gpon interface *onu-intf-name* **onu basic-info**

To show the ONU basic information, run the above command.

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

Parameter Description

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

Some information cannot be displayed until the ONU is registered.

Example

Display gpon0/0/1:1 ONU basic information.

```
OLT_config # show gpon int gpon0/0/1:1 onu basic-info
Serial number                    PLNT:F79D62E5 (4244434DF79D62E5)
VendorID                          PLNT (4244434D)
Version                          A0                  (41300000000000000000000000000000)
Traffic management option        Priority and rate (2)
Battery backup                   Disable monitoring (0)
Admin state                      Unlock (1)
Operational state                Enabled (1)

Model ID                          0000
OMCC version                      ITU-T G.988 (2010)(Baseline only)
Vendor product code              0
Security capability              AES-128 (1)
Security mode                     AES-128 (1)
Total priority queue number      103
Total traffic scheduler number 31
Total GEM port number             127
Total ethernet UNI number        4
Total VEIP UNI number             0
Total IpHost UNI number          3
Total POTS UNI number             0
Total CATV UNI number             0
Total Private CATV UNI number    1
Total other UNI number           0
Total general UNI number         4
Total private POE port number    0
Image #0 version                 10.0.23B.519     (31302E302E3233422E3531390000)
Image #0 status                  valid/active/committed
Image #1 version                 10.0.23A.B014    (31302E302E3233412E4230313400)
Image #1 status                  invalid/inactive/uncommitted
Piggyback DBA reporting          Mode 0 only (0)
Whole ONU DBA reporting           Not supported (0)
Distance                         77.8 m
Image update state               None (0)
Operator ID                      CTC
CTC SpecVersion                   0
CTC Onu Type                      SFU (0)
```

```
TxPowerControl                  Tx & Rx (2)
ONU Config Status               Success (2, 0)
Mib reset count                 2
Latest mib reset                2021-08-10 18:51:06
Applied template                onu-template-default
ONU Description                 N/A

Online Duration                 21h 19m 40s
 ----------------------------------------------------------------------

The current time: 2021-8-11 16:10:30
Seq   Active Time          Deactive Time        Deactive Reason
01    2021-08-10 18:50:49
```

59.3 ONU Remote Reboot Configuration Commands

59.3.1 gpon reboot onu

Syntax

gpon reboot onu interface {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**noconfirm**]

To reboot ONU, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Restart the ONU corresponding to the specified ONU port in the following format: **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf-name	Restart the ONU in the specified PON port in the format of gponchassis/slot/port chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Restart the specified ONU port sequence range, and restart all ONUs under the PON port if not specified
noconfirm	Do not wait for a prompt to confirm the execution of the command

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

This command is effective only if the ONU has established an OMCI channel with the OLT normally.

Example

Reboot gpon0/0/1:1 port corresponding ONU.

OLT# gpon reboot onu interface gpon0/0/1:1

59.3.2 gpon clear-onu-config

Syntax

gpon clear-onu-config interface {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**noconfirm**]

To remotely clear the local configuration of the ONU from the OLT, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Clear the local configuration of the ONU corresponding to the specified ONU port in the following format: **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf-name	Clear the local configuration of the ONU under the specified PON port in the format of gponchassis/slot/port chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Clear the specified ONU port sequence number range, and if not specified, clear the local configuration of all ONUs under the PON port
noconfirm	Do not wait for a prompt to confirm the execution of the command

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

This feature is implemented using the private extension OMCI. The definition of the local configuration of the ONU cleared by this command is determined by the ONU. This usually refers to clearing the configuration of the ONU that is not managed by the OMCI, and the configuration managed by the OMCI should be synchronized with the configuration of the ONU port application of the OLT, and no additional clearing is required. This operation is generally used after the ONU completes the version upgrade, and the ONU may have problems loading local configurations of different versions after the version is upgraded.

Example

The following example shows how to clear ONU local configuration on the gpon0/0/1:1 port.

OLT# gpon clear-onu-config interface gpon0/0/1:1

59.3.3 gpon reboot-onu at

Syntax

gpon reboot-onu at *time-of-day* **sequence** *seq-range*

no gpon reboot-onu at *time-of-day* [**sequence** *seq-range*]

To restart the ONU in the sequence number range of the corresponding ONU at a fixed time, run the above commands.

Parameter Description

Parameter	Parameter Description
time-of-day	The time needs to reboot the ONU. The time format is hour: minute. hour means hour and minute means minute.
seq-range	Reboot the specified ONU port serial number range.

Default Value

None

Command Mode

GPON Port Configuration Mode

Usage Guidelines

This command has an effect only if the ONU has been properly established with the OLT, causing the ONU in the range of the ONU port in the seq-range to restart the ONU at the time-of-day time.

You can configure multiple ONUs with different sequence numbers at the same restart time to spread out the ONUs to restart at different points in time. An ONU with the same sequence number can only be configured with one restart time, and if the configured sequence number is configured to a new restart time, the ONU will only restart at the new specified time.

Note that you need to configure NTP time synchronization or manually use the date command to calibrate the time of the OLT, otherwise the time when the OLT restarts the ONU may be inconsistent with the expected time.

Example

When the time is 15 ： 20, reboot gpon0/0/1:1-gpon0/0/1:9 corresponding ONU.

OLT# config

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon reboot-onu at 15:20 sequence 1-9

59.3.4 gpon mib-reset-onu

Syntax

gpon mib-reset-onu interface {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**noconfirm**]

Parameter	Parameter Description
onu-intf- name	Run MIB reset on the ONU corresponding to the specified ONU port in the following format: **gpon**} *chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf- name	Run a MIB reset on the ONU under the specified PON port in the following format: **gpon** *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the

	GPON port number
seq-range	Perform MIB reset for the specified ONU port sequence number range, and MIB reset for all ONUs under the PON port if not specified
noconfirm	Do not wait for a prompt to confirm the execution of the command

To manually execute the ONU MIB reset, run the above command.

Parameter Description

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

This command initiates the OMCI MIB reset operation, so that the ONU clears the default state required by the configuration recovery protocol, the configuration synchronization number recorded by the OLT and the ONU is cleared, and then the OLT delivers the complete ONU configuration recorded by the ONU port through the OMCI, and the configuration applied by the ONU port locally by the OLT will not be cleared, and the configuration managed by the ONU managed by the ONU MIB reset process will be resynchronized with the configuration applied by the ONU port of the OLT. When the ONU is offline, the number of configuration synchronizations will be cleared to zero, and a MIB reset will be forced once after the ONU goes online.

Example

Perform MIB reset on gpon0/0/1:1 corresponding ONU.

OLT# gpon mib-reset-onu interface gpon0/0/1:1

59.4 ONU Remote Upgrade Commands

59.4.1 gpon update-onu

Syntax

gpon update-onu *image_name* **interface** {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**image** {**instance0** | **instance1**}] [**noconfirm**]

To remotely update the software version of the ONU from the OLT, run the command.

Parameter Description

Parameter	Parameter Description
Image_name	Upgrade the file name of the ONU version used.
onu-intf-name	Upgrade the specified ONU port in the following format: gponchassis/slot/port:sequence chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf-name	Upgrade the ONU in the specified PON port format: gponchassis/slot/port chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Upgrade the specified ONU port sequence range, if not specified, upgrade all ONUs under the PON port
instance0	Specify partition 0 of the software version to be upgraded to the ONU
instance1	Specify partition 1 of the software version to be upgraded to the ONU
noconfirm	Do not wait for a prompt to confirm the execution of the command

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

Updating the software version takes effect only for the ONU that is currently online.

The OLT itself does not verify the ONU version, and the verification of the ONU version is completed by the ONU side, and the ONU should ensure that the update software can only be successfully updated when the update software matches the corresponding ONU type.

The ONU should maintain two software version partitions and load versions from the partition that identifies the committed by default. Maintaining the two version partitions can ensure that when the software version is written incorrectly, the ONU will not start due to the absence of a software version. If the ONU encounters a problem loading a newly written software version, the ONU will automatically restart to still reload the version from the committed default partition.

If the software version partition of the upgraded ONU is not specified, the OLT will perform version write operations on the partition that is not currently active in the version, that is, the partition that is not mounted by default.

If you write to the currently active version partition, the ONU will return an error to avoid destroying both versions of the ONU. Generally, the function of specifying the upgrade software version partition is not used.

If the version is successfully written to ONU, the ONU will restart and switch to the new updated version, at this time, the ONU should be in a different state from the current active version partition and the committed partition, and then the OLT will automatically submit an action to the ONU to confirm the upgrade result, so that the submitted partition will be switched to the current active version partition. At this point, the upgrade process ends.

If the corresponding data packet is lost during the upgrade, the OLT attempts to retransmit the packet. If an error is returned by the ONU, or if the ONU is disconnected during the upgrade, the upgrade process is terminated immediately. If the ONU does not enter a different state from the currently activated version partition and the committed partition after the version writing process is completed, the OLT will not automatically submit the default loading partition and the upgrade will fail.

Example

Update the software version of the ONU with sequence numbers 1-32 on port gpon0/0/1.

OLT# gpon update-onu onu_bin interface gpon0/0/1 1-32

59.4.2 gpon activate-image

Syntax

gpon activate-imge interface {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**image** {**instance0** | **instance1**}] [**noconfirm**]

The command is used to activate the ONU software version, the ONU will automatically reboot and then load the software version from the specified partition to boot.

Parameter Description

Parameter	Parameter Description
onu-intf- name	Activate the software version for the specified ONU port operation, and the ONU port format is: **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf-name	Activate the software version for the ONU operation under the specified PON port, and the PON port format is **gpon***chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Perform the operation of activating the software version to specify the ONU port sequence number range. If this is not specified, activate the software version for all ONUs under the PON port.
instance0	Specify partition 0 of the software version to activate the ONU
instance1	Specify the software version partition 1 to activate the ONU
noconfirm	Do not wait for a prompt to confirm the execution of the command

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

This function can be used to check whether the software version of another partition of the ONU is available. If the ONU reboot correctly loads the software version of another partition, it can be considered usable. The user can then choose to submit the partition that switches the default loading software, so that the ONU will then start from another partition loading the software by default.

If no active software version partition is specified, the OLT will activate the currently inactive version partition.

Specifying the Activation to Load a Specific Software Version Partition is usually used to perform ONU activation under the PON port in batches, and it is expected that all ONUs will be switched to load software from the specified sequence number partition. If you specify that a specific software version partition is the same as the partition of the currently activated software version of the ONU, it will not take effect.

If loading a software version requiring activation fails after an ONU reboot, the ONU will automatically reboot and still reload the version from the committed default partition. Maintainers should run the **show gpon onu-image-information** command to confirm that the ONU has been loaded after rebooting.

Example

Activate the version in another software version partition of the ONU under the gpon0/0/1:1 port：

OLT# gpon activate-image interface gpon0/0/1:1

59.4.3 gpon commit-image

Syntax

gpon commit-imge interface {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**image** {**instance0** | **instance1**}] [**noconfirm**]

The command is used to submit the software version, and the ONU will use the specified partition as the default partition to start loading the software version.

Parameter Description

Parameter	Parameter Description
onu-intf- name	Submit the software version to the specified ONU port in the following format: **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf- name	Submit the software version to the ONU operation under the specified PON port in the following format: gponchassis/slot/port chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Perform the software version submission operation to specify the ONU port sequence number range.
instance0	Specify partition 0 of the software version to which the ONU is submitted
instance1	Specify partition 1 of the software version to which the ONU is submitted
noconfirm	Do not wait for a prompt to confirm the execution of the command

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

If the committed software version partition is not specified, the OLT will commit the currently activated version partition and then start tacitly from the currently activated software version partition.

After the ONU upgrade command **gpon update-onu** is executed, if the ONU automatically activates the newly written version, the OLT automatically delivers the submit version operation.

In practice, it is not allowed to perform the commit operation on the partition of the ONU software version that is not currently activated, so as to avoid submitting the version that cannot be started, resulting in the start of the ONUNone method. Specifying the submission of a specific software version partition is usually used to perform ONU submissions under the PON port in batches, and it is expected that all ONUs will be switched to load software from the specified sequence number partition. Use the **gpon activate-image interface image** command to activate the version from the specified partition, and then submit the **gpon commit-image interface image** to the specified partition version to start by default.

Example

Submit the current software version of the ONU under the gpon0/0/1:1 port:

OLT# gpon commit-image interface gpon0/0/1:1

59.4.4 gpon onu-auto-upgrade

Syntax

gpon onu-auto-upgrade { **vendorID** *vendor* | **modelID** *model* | **onuFwVer** *old_version* }* **onuFwVerExp** *exp_version image_name* [**at** *time-of-day*]

no gpon onu-auto-upgrade [**vendorID** *vendor*] [**modelID** *model*] [**onuFwVer** *old_version*] [**at** *time-of-day*]

To configure the OLT automatically updates the software version of the ONU that matches the upgrade rule, run the above commands.

Parameter Description

Parameter	Parameter Description
Image_name	The name of the ONU version used for the automatic upgrade
exp_version	The expected software version number of the ONU after the upgrade
vendor	The name of the ONU manufacturer must be matched
model	A matching ONU model is required
old_version	The matching ONU software version number is required

time-of-day	Specify the time at which the upgrade operation is automatically updated, for example, at 03:44

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If atParameter is not configured, after this command is configured, the OLT will check whether the ONU matches the corresponding upgrade rule every hour and needs to be updated. When atParameter is configured, the OLT detects whether the ONU matches the corresponding upgrade rule at a specified time and needs to be updated.

The OLT updates the version of a maximum of 64 ONUs for each OLT slot according to the rules, and if there are other ONUs that match the conditions, the OLT will wait for the next test (if the AT is not configured, it will be the next hour, and when the AT is configured, it will be the corresponding time of the next day). After the ONU downloads the software version and activates the new software, the OLT verifies the software version number after the ONU restarts according to the parameter configured by expSwVer, and if the verification is successful, it will automatically submit the version to the ONU, otherwise, it will not submit the ONU and consider that the upgrade has failed and automatically restart the ONU to restore the original software version.

Example

The ONU with vendor PLNT and model 0020 is automatically upgraded at 10:10 every day, and the ONU image file used for the upgrade is named onu_bin and the expected software version is 1016.

OLT(config)# gpon onu-auto-upgrade vendorID PLNT modelID 0020 onuFwVerExp 1016 onu_bin at 10:10

59.4.5 show gpon onu-image-information

Syntax

show gpon onu-image-information [**interface** {*onu-intf-name* | *pon-intf-name*}]

To show ONU software version information, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	The software version of the specified ONU port is displayed, and the ONU port format is **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf-name	Display all ONU software versions in the specified PON port format: **gpon***chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

The software information displayed in this command is the information obtained by the OLT through the OMCI after the OMCI channel was established when the ONU was last online, and is not obtained when the command is entered, and cannot be used to determine whether the OMCI interaction with the ONU is normal. If the ONU has been offline or the OMCI channel has not been established, the corresponding information may be inaccurate.

Example

Display all ONU software version information on gpon0/0/1 port.

OLT# show gpon onu-image-information interface gpon0/0/1 Image information of gpon0/0/1:1:

Image #0	10.0.23B.519	valid	active	committed
Image #1	10.0.23A.B014	invalid	inactive	uncommitted

Image information of gpon0/0/1:2:

Image #0	10.0.25A.1002	valid	inactive	uncommitted
Image #1	10.0.25A.1046	valid	active	committed

59.4.6 show gpon onu-update-state

Syntax

show gpon onu-update-state [**interface** *onu-intf-name*]

To display ONU software version update state, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Only the software version update status of the specified ONU port is displayed, and the ONU port format is **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number.

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

Lists the update status of the ONU that initiated the software version update. If the ONU port information is not specified, the global ONU update statistics are additionally displayed.

Example

Display the update status of all ONU software versions.

OLT# show gpon onu-update-state

Image state of gpon0/0/1:1 is Downloading 5%:

Image#0 10.0.23B.744 valid inactive uncommitted Image#1 10.0.23B.932 valid active committed

------Counters------ None: 0

Downloading: 1

Activating: 0

Activate OK: 0

Activate error: 0

Committing: 0

Commit error: 0

Retry: 0

Failed: 0

Complete: 0

59.4.7 show gpon onu-auto-upgrade-state

Syntax

show gpon onu-auto-upgrade-state [**interface** {*onu-intf-name* | *pon-intf-name*}|**waiting**|**processing**|**retry**|**failed**|**failed-unExpVer**|**complete**]*

To display the automatic upgrade status of the ONU, run the command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Display the automatic upgrade status of the specified ONU port in the following format: **gpon***chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf-name	Display the automatic upgrade status of all ONUs under the specified PON port in the format of gponchassis/slot/port chassis is the chassis number, slot is the slot number, and port is the GPON port number
waiting	Display the ONUs that are waiting to be upgraded
processing	Display the ONU that is being upgraded
retry	Display the ONU that failed to retry
failed	Display the ONU that failed to upgrade
failed-unExpVer	Display the ONU whose upgrade is complete but whose startup version information is inconsistent
complete	Display the ONU that is successfully upgraded

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

To diagnose the cause of the ONU upgrade failure, run the command **show gpon onu-update-state interface** to analyze the problem.

Example

Display the automatic upgrade status of all ONUs

OLT# show gpon onu-auto-upgrade-state

------Counters-------- Waiting: 1 Updating: 0

Retry: 0

Failed: 0

Complete: 0

Failed unExpVer: 0 Next update: 00:46:57

IntfName VendorID ModelID SN PreImageVer

ExpImageVer state

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gpon0/0/1:1 PLNT 0000 PLNT:F79D62E5 10.0.23B.744

10.0.23B.932 Waiting

59.5 ONU Traffic Mapping Configuration Commands

59.5.1 gpon profile onu-flow-mapping

Syntax

gpon profile onu-flow-mapping *flowmap-prof-name*

To create an ONU traffic mapping profile and enter the traffic mapping profile configuration mode, run the above command.

no gpon profile onu-flow-mapping *flowmap-prof-name*

To delete ONU traffic mapping template, run the above command.

Parameter Description

Parameter	Parameter Description
*flowmap-prof-**name*	Name of the traffic mapping template.

Default Value

By default, there are two ONU traffic mapping profiles: flow-mapping-default-hgu and flow-mapping-default. flow-mapping-default maps all Ethernet UNI ports to virtual port 1, and flow-mapping-default-hgu maps all virtual Ethernet access points to virtual port 1, without cos and vlan mapping, and the other traffic mapping template configurations remain the default.

Command Mode

Global Configuration Mode

Usage Guidelines

When the template named flowmap-prof-name does not exist, create a template and enter the ONU traffic mapping template configuration mode, otherwise you can directly enter the configuration mode of the traffic mapping template.

The ONU traffic mapping template contains the mapping rules between basic ONU service traffic and virtual ports (GEM ports), and implements the configuration of multiple service models described in ITU G.988 8.2.2 Layer 2 functions. At the same time, the traffic mapping template also includes some basic configurations for the Layer 2 forwarding feature of the ONU.

The implementation of the OLT service model configuration is basically based on the description of ITU G.988 Figure II.1.3.1.2-1 -- Multi-UNI L2-OCM with multicast, with necessary deletions and minor changes, and supports the delivery of service models such as N:1, N:M, N:P, N:MP, etc.

In the traffic mapping template, each entry is configured to map a service port to a virtual port in some filter conditions. When multiple entries point to the same virtual port, the service ports in these entries will be merged under the same MAC Bridge Service, and these service ports will form the N part of the N:X mapping. If the entry contains a filter condition for CoS, an N:M mapping will be formed if the entry contains a VLAN filter, and an N:MP mapping will be formed if the entry contains both a filter condition for both CoS and VLANs. It should be noted that a service port can only be associated with a MAC Bridge Service, that is, only one service model can be used. At the same time, multiple entries with different filter conditions on a service port should correspond to different virtual ports. If there is no overlap between the corresponding virtual ports in all related entries, the service ports will be sorted under different MAC Bridge Services.

Example

Create or configure the ONU traffic mapping template flowmap-test.

OLT(config)# gpon profile onu-flow-mapping flowmap-test

59.5.2 gpon-profile entry uni

Syntax

gpon-profile entry *index* **uni type** {**eth-uni** | **ip-host** | **veip**} {**all** | *port-list*}

To configure the service port of the user corresponding to the ONU traffic mapping entry, run the above command.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
eth-uni	The traffic mapping port type is an Ethernet user port
ip-host	The traffic mapping port type is IP host
veip	The traffic mapping port type is a virtual Ethernet access point
all	The traffic is mapped for all ports of the specified type
port-list	A list of port sequence numbers of a specified type, such as 1, 3, 5-7, for which traffic mapping is required

Default Value

None

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

A valid traffic map entry must contain this designation for the user's service port.

The eth-uni port (G.988 Physical path termination Ethernet UNI) is generally the user-side Ethernet port corresponding to the ONU.

The ip-host port (G.988 IP host config data) is generally the IP service provided by the corresponding ONU, such as TR069 terminal, VOIP terminal, etc.

The veip port (G.988 Virtual Ethernet interface point) is generally an unmanageable OLT non-OMCI-managed service Ethernet access service, such as an Internet service for an HGU ONU managed by TR069 or ONU WEB.

Example

In the ONU traffic mapping profile flowmap-test, the entries with index 2 are mapped to the Ethernet user ports with sequence numbers 1, 2, and 5.

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile# gpon-profile entry 2 uni type eth-uni 1,2,5

59.5.3 gpon-profile entry vlan

Syntax

gpon-profile entry *index* **vlan** *vid-list* [**cos** *cos-list*]

no gpon-profile entry *index* **vlan**

To configure VLAN filtering for ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
vid-list	A list of VLAN IDs corresponding to traffic mapping entries, such as 1, 3, 5-7
cos-list	A list of CoS priorities for traffic mapping entries, such as 0, 1, 3, and 5-7

Default Value

None

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

The VLAN filtering function corresponds to the VLAN tagging filter data of ITU G.988 and points it to the MAC bridgeport config data corresponding to the GEM port to form an N:P service model.

A maximum of 12 VLANs can be used in the VLAN ID list.

Example

In the flowmap-test ONU traffic mapping profile, VLAN 1 and 10-20 are set to VLAN 1 and 10-20 for entries with index 2.

OLT(config)# gpon profile onu-flow-mapping flowmap-test config-gpon-profile# gpon-profile entry 2 vlan 1,10-20

59.5.4 gpon-profile entry step-vlan-step

Syntax

gpon-profile entry *index* **step-vlan-step** *step*

no gpon-profile entry *index* **step-vlan-step**

To configure VLAN filtering for ONU traffic mapping entries based on the step value of the ONU port sequence number, run the above commands.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
step	The step value based on the sequence number of the ONU port ranges from 1 to 4094

Default Value

If the stepper function based on the sequence number of the ONU port is not enabled, the step can also be considered to be 0.

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

The gpon-profile entry vlan command configures the function of the VLAN corresponding to the traffic mapping entry, and in some application scenarios, the VLAN ID is required to be independent for each ONU. After this command is enabled, the **VLAN value of the gpon-profile entry VLAN command changes depending on the final bound ONU port**, and the serial number of each ONU port is based on the VLAN corresponding to the original configuration, and the value of all VLANs is incremented step by step.

Example

In the flowmap-test ONU traffic mapping profile, the VLAN ID of the entry with index 2 corresponds to VLAN 10-20, and the VLAN ID follows the sequence number of the ONU with a step value of 30 (that is, the ONU with sequence number 1, 2, and 3 corresponds to VLAN 10-20, 40-50, and 70-80, respectively).

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile# gpon-profile entry 2 vlan 10-20

config-gpon-profile# gpon-profile entry 2 step-vlan-step 30

59.5.5 gpon-profile entry cos

Syntax

gpon-profile entry *index* **cos** *cos-list* [**vlan** *vid-list*]

no gpon-profile entry *index* **cos**

To configure CoS filtering for ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
cos-list	A list of CoS priorities for traffic mapping entries, such as 0, 1, 3, and 5-7
vid-list	A list of VLAN IDs corresponding to traffic mapping entries, such as 1, 3, 5-7

Default Value

None

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

The CoS filtering function corresponds to the 802.1p mapper service profile of ITU G.988, and points to different GEM interworking TPs according to different priority values to form an N:M service model.

Example

In the flowmap-test ONU traffic mapping profile, the CoS corresponding to entries with index 2 are 0-3 and 7.

OLT(config)# gpon profile onu-flow-mapping flowmap-test config-gpon-profile# gpon-profile entry 2 cos 0-3,7

59.5.6 gpon-profile entry virtual-port

Syntax

gpon-profile entry *index* **virtual-port** *vp-index*

To configure the virtual port corresponding to the ONU traffic mapping entry, run the command.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
vp-index	Perform traffic mapping destination virtual port indexes, ranging from 1 to 31

Default Value

None

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

A valid traffic map entry must contain this designation for a virtual port.

After the traffic mapping profile is applied to the ONU, the virtual port is allocated specific GEM port resources to form a GEM port service channel. The OLT also delivers the configurations of the corresponding GEM port through the virtual port. The virtual port number range takes effect under the same ONU, and each ONU can use the virtual port number starting from 1.

Example

In the ONU traffic mapping profile flowmap-test, the entries with index 2 are mapped to virtual port 1:

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile# gpon-profile entry 2 virtual-port 1

59.5.7 gpon-profile entry port-protected

Syntax

[**no**] **gpon-profile entry** *index* **port-protected**

To configure ONU user port isolation, run the following command.

Parameter Description

None

Default Value

Enable local port isolation for ONUs

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

If multiple traffic mapping entries actually correspond to the same MAC Bridge Service , for example, multiple user service ports are listed to different traffic mapping entries and mapped to the same virtual port, or a user service port is mapped to different virtual ports through different filter conditions, then only the local port isolation configuration of the ONU corresponding to the first traffic mapping entry takes effect.

Example

In the flowmap-test ONU traffic mapping profile, the local port of the corresponding index 2 is not isolated and provides Layer 2 forwarding services.

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile# no gpon-profile entry 2 port-protected

59.5.8 gpon-profile entry mac aging-time

Syntax

gpon-profile entry *index* **mac aging-time** *time*

no gpon-profile entry *index* **mac aging-time**

To configure the aging time of the ONU MAC address, run the above command.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
time	Aging time, range 10-1000000, unit seconds

Default Value

Default value defined by the ONU implementation

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

If multiple traffic mapping entries actually correspond to the same MAC Bridge Service, for example, multiple user service ports are listed to different traffic mapping entries and mapped to the same virtual port, or a user service port is mapped to different virtual ports through different filter conditions, then only the MAC address aging time configuration for the first traffic mapping entry takes effect.

Example

In the flowmap-test ONU traffic mapping profile, the MAC address aging time of entries with index 2 is 120 seconds.

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile# gpon-profile entry 2 mac aging-time 120

59.5.9 no gpon-profile entry

Syntax

no gpon-profile entry *index*

To deletes the ONU traffic, run the above command.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40

Default Value

None

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

None

Example

Delete the entries in the ONU traffic mapping profile flowmap-test that are configured with index 2:

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile#

no gpon-profile entry 2

59.5.10 gpon onu flow-mapping-profile

Syntax

gpon onu flow-mapping-profile *flowmap-prof-name* **no gpon onu flow-mapping-profile**

To configure the ONU by referring to the ONU Traffic Mapping Profile, run the above command.

Parameter Description

Parameter	Parameter Description
flowmap-prof-name	The name of the traffic mapping template

Default Value

No traffic mapping template configuration.

After the null-configured ONU is authenticated, the default ONU profile configuration takes effect. In the default ONU type template configuration, an ONU traffic mapping template named flow-mapping-default-hgu or flow-mapping-default is delivered based on the matching ONU type.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The ONU traffic mapping template and the virtual port of the ONU and the T-Cont binding template must be configured before the ONU service is actually configured and delivered.

Example

The ONU corresponding to port gpon0/0/1:1 refers to the configuration of the flowmap-test traffic mapping profile.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu flow-mapping-profile flowmap-test

59.6 ONU Virtual Port and T-Cont Configuration Commands

59.6.1 gpon profile onu-virtual-port

Syntax

gpon profile onu-virtual-port *vp-prof-name*

To create an ONU virtual port profile and enter the virtual port profile configuration mode, run the above command.

no gpon profile onu-virtual-port *vp-prof-name*

To delete the ONU virtual port template, run the above command.

Parameter Description

Parameter	Parameter Description
vp-prof-name	The name of the virtual port template

Default Value

By default, an ONU virtual port profile named virtual-port-default exists. The configuration of each virtual port template remains the default.

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named ***vp-prof-name*** does not exist, create a template and enter the ONU virtual port profile configuration mode, otherwise it will directly enter the configuration mode of the virtual port template.

The virtual port template contains the configuration of downstream encryption, rate limiting, and queues on the virtual port.

Example

Create or configure the virtual port profile vp-test for the ONU.

OLT(config)# gpon profile onu-virtual-port vp-test

59.6.2 gpon-profile encryption

Syntax

gpon-profile encryption {**enable** | **disable**}

no gpon-profile encryption

To enable downlink encryption on the virtual port of the ONU, run the above commands.

Parameter Description

None

Default Value

Disable downlink encryption on virtual ports of the ONU

Command Mode

ONU virtual port template configuration mode

Usage Guidelines

Due to the point-to-multi-point physical channel mechanism in the PON downlink direction, the downlink unencrypted traffic can be observed by other ONUs under the same PON port, and the downlink encryption function of the PON port can be enabled to prevent the ONU under the same PON port from maliciously intercepting the data of other users.

The encryption key is generated by the ONU, and the OLT obtains from the ONU through PLOAM messages.

Different virtual ports of the same ONU can be configured with different downstream encryption enablements, but the key used for downstream encryption is based on the ONU.

Example

The following example shows how to configure the virtual port profile vp-test of the ONU to enable downlink encryption on the virtual port.

OLT(config)# gpon profile onu-virtual-port vp-test

config-gpon-profile# gpon-profile encryption enable

59.6.3 gpon-profile upstream queue

Syntax

gpon-profile upstream queue *num* [**drop-precedence** { **not-config** | **no-marking** | **internal- marking** | **dei** | **pcp-8p0d** | **pcp-7p1d** | **pcp-6p2d** | **pcp-5p3d** | **dscp-af-class** }]

no gpon-profile upstream queue

To configure the priority queue corresponding to the upstream of the virtual port of the ONU and the priority flag for dropping, run the above commands.

Parameter Description

Parameter	Parameter Description
num	Queue number, range 1-8, queue 8 has the highest priority, queue 1 has the lowest priority

Default Value

Corresponding to queue 8, discard the priority mark to maintain the current configuration state of ONU.

Command Mode

ONU virtual port template configuration mode

Usage Guidelines

In the upstream direction of the ONU, if there are multiple virtual ports (GEM ports) that share the bandwidth of the same T-Cont, you need to schedule traffic from different virtual ports. Priority queue scheduling is one way to handle this scheduling need.

The **gpon-profile onu-scheduler** configuration in the T-Cont profile specifies the scheduling policy and weights. The bandwidth allocation of the OLT for the T-Cont determines the actual uplink egress rate limit. This command is used to configure the mapping between virtual ports and queues.

If the ONU declares that its Traffic management option is Rate, the ONU does not support priority queue scheduling on virtual port traffic by T-Cont nodes, and only supports rate limiting policy control.

The drop priority tag is used to control how to identify packets that can be preferentially dropped when a queue is congested. **internal-marking** specifies Priority to drop colored packets identified by the TrTCM mechanism for the ingress of the preceded uni port. **dei** specifies that packets with DEI ID 1 in the VLAN tag are discarded preferentially. **pcp-8p0d|pcp-7p1d|pcp-6p2d|pcp-5p3d** specifies preferential dropout, which indicates packets that can be preferentially dropped according to the VLAN Tag priority field of the corresponding PCP encoding mechanism (IEEE 802.1ad). **dscp-af-class** specifies that packets that are preferentially dropped according to the DSCP field of the corresponding DSCP coding mechanism (IETF RFC 2597). **No-marking** is used to disable preferential drops**. not- config** is used to maintain the current configuration state of the ONU.

Example

The following example shows how to configure the corresponding queue 7 for the upstream of the ONU virtual port profile vp-test, and mark the drop priority as internal-marking.

OLT(config)# gpon profile onu-virtual-port vp-test

config-gpon-profile# gpon-profile upstream queue 7 drop-precedence internal-marking

drop-precedenceParameter is supported in 12.3.0C/12.5.0A or later.

59.6.4 gpon-profile upstream rate-limit-profile

Syntax

gpon-profile upstream rate-limit-profile *rate-limit-prof-name*

no gpon-profile upstream rate-limit-profile

To configure an uplink rate limit policy on the virtual port of the ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
rate-limit-prof-name	Name of the rate limit template

Default Value

None

Command Mode

ONU virtual port template configuration mode

Usage Guidelines

In the upstream direction of the ONU, if there are multiple virtual ports (GEM ports) that share the bandwidth of the same T-Cont, you need to schedule traffic from different virtual ports. Rate limiting policy control is one way to handle this scheduling demand.

The rate limiting policy configuration can specify the guaranteed bandwidth and peak bandwidth of each virtual port to limit and prioritize traffic through different virtual ports.

If the ONU declares that its traffic management option is Priority, the ONU does not support the uplink rate limit policy control on the virtual port, and only the T-Cont node can perform priority queue scheduling for the traffic on the virtual port.

Example

The following example shows how to configure the uplink rate limiting policy of the VP-test profile of the virtual port profile of the ONU and use the template rt-vp-tv.

OLT(config)# gpon profile onu-virtual-port vp-test

config-gpon-profile# gpon-profile upstream rate-limit-profile rt-vp-tv

59.6.5 gpon-profile downstream queue

Syntax

gpon-profile downstream queue *num*

no gpon-profile downstream queue

To configure a priority queue for the downstream link of the virtual port of the ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
num	Queue number, range 1-8, queue 8 has the highest priority, queue 1 has the lowest priority

Default Value

If no configuration is performed, the ONU is kept as default.

Command Mode

ONU virtual port template configuration mode

Usage Guidelines

In the downstream direction of the ONU, if there are multiple virtual ports (GEM ports) mapped to the same user service port, you need to schedule traffic from different virtual ports. Priority queue scheduling is one way to handle this scheduling need.

This command is used to configure the correspondence between the virtual port and the priority queue of the user's service port.

Example

The following example shows how to configure the corresponding queue 3 for the downstream of the virtual port profile vp-test of the ONU:

OLT(config)# gpon profile onu-virtual-port vp-test

config-gpon-profile# gpon-profile downstream queue 3

59.6.6 gpon-profile downstream rate-limit-profile

Syntax

gpon-profile downstream rate-limit-profile *rate-limit-prof-name* **no gpon-profile downstream rate-limit-profile**

To configure a downlink rate limit policy on the virtual port of the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
rate-limit-prof-name	Name of the rate limit template

Default Value

None

Command Mode

ONU virtual port template configuration mode

Usage Guidelines

In the downstream direction of the ONU, if there are multiple virtual ports (GEM ports) mapped to the same user service port, you need to schedule traffic from different virtual ports. Rate limiting policy control is one way to handle this scheduling demand.

The rate limiting policy configuration can specify the guaranteed bandwidth and peak bandwidth of the downstream traffic of each virtual port, so as to limit and prioritize the traffic of different virtual ports.

Example

The following example shows how to configure the ONU virtual port profile vp-test to use the downstream rate limiting policy of the module rt-vp-tv-dn

OLT(config)# gpon profile onu-virtual-port vp-test

config-gpon-profile# gpon-profile downstream rate-limit-profile rt-vp-tv-dn

59.6.7 gpon profile onu-tcont

Syntax

gpon profile onu-tcont *tcont-prof-name*

To create an ONU T-Cont profile and enter the T-Cont profile configuration mode, run the above command.

no gpon profile onu-tcont *tcont-prof-name*

To delete the ONU T-Cont template, run the above command.

Parameter Description

Parameter	Parameter Description
tcont-prof-name	The name of the T-Cont template

Default Value

By default, an ONU T-Cont template with the name tcont-default exists. The T-Cont type is 3, the peak rate PIR is 1024000kbps, the guaranteed rate CIR is 512kbps, and the other T-Cont template configurations remain the default.

Command Mode

Global Configuration Mode

Usage Guidelines

When the template named tcont-prof-name does not exist, create a template and enter the ONU T-Cont template configuration mode, otherwise it directly enters the configuration mode of the T-Cont template.

The T-Cont profile contains the configuration of the upstream bandwidth and scheduling mode of the T-Cont.

Example

The following example shows how to create/configure the ONU T-Cont template tcont-test.

OLT(config)# gpon profile onu-tcont tcont-test

59.6.8 gpon-profile tcont-type

Syntax

gpon-profile tcont-type 1 { **fir** *fir-value* | **fir-nrt** *fir-nrt-value* } **gpon-profile tcont-type 2 cir** *cir-value*

gpon-profile tcont-type 3 pir { *pir-value* | **unlimited** } **cir** *cir-value* **gpon-profile tcont-type 4 pir** { *pir-value* | **unlimited** }

gpon-profile tcont-type 5 pir { *pir-value* | **unlimited** } **cir** *cir-value* { **fir** *fir-value* | **fir-nrt** *fir-nrt-value* } [**non-assured** | **best-effort**]

To configure the T-Cont type and bandwidth, run the above command.

Parameter Description

Parameter	Parameter Description
type-value	ITU-defined T-Cont reference classification number, range 1-5
pir-value	Peak bandwidth, in kbps
cir-value	Guaranteed bandwidth, in kbps
fir-value	High real-time fixed bandwidth, in kbps
fir-nrt-value	Non-real-time fixed bandwidth, in kbps
unlimited	Peak bandwidth is not throttled
non-assured	The "Unguaranteed" level is used to allocate additional bandwidth that is greater than the guaranteed bandwidth
best-effort	The Best Effort level allocates additional bandwidth that is greater than the guaranteed bandwidth

Default Value

None

Command Mode

ONU T-Cont template configuration mode

Usage Guidelines

A valid T-Cont template must contain this specification for the T-Cont type and bandwidth.

ITU G.984.3 predefines five common T-Cont service model classifications, which are defined as follows:

	Type 1	**Type 2**	**Type 3**	**Type 4**	**Type 5**
Fixed bandwidth	FIR	0	0	0	FIR
Guaranteed bandwidth	CIR=FIR	CIR	CIR	0	CIR>=FIR
Peak bandwidth	PIR=FIR	PIR=CIR	PIR > CIR	PIR	PIR>=CIR
Additional bandwidth allocation levels	None	None	Not guaranteed	Best effort	No warranties or best effort

This command configures the corresponding type of T-Cont and the parameter of the bandwidth of the specified type.

Slightly different from the ITU standard definition, the fixed bandwidth can be specified as a fixed bandwidth with high real-time requirements, or a fixed bandwidth with None real-time requirements, to ensure high real-time performance in specific demand situations.

The OLT supports T-Cont to configure a minimum bandwidth of 256 kbps and a granularity of 64 kbps for each bandwidth.

For T-Cont Type 5, you can configure the choice to allocate the level of additional bandwidth greater than the guaranteed bandwidth, with the "best effort" level being used by default when not specified.

Example

The following example shows how to configure the T-Cont type of the ONU T-Cont profile tcont-test to be 5, with a peak bandwidth of 1244160kbps, a guaranteed bandwidth of 102400kbps, and a non-real-time fixed bandwidth of 1024kbps.

OLT(config)# gpon profile onu-tcont tcont-test

config-gpon-profile# gpon-profile tcont-type 5 pir 1244160 cir 102400 fir-nrt 1024

59.6.9 gpon-profile alloc-type

Syntax

gpon-profile alloc-type {**sr** | **nsr** | **sr-force**} **no gpon-profile alloc-type**

To configure T-Cont to allocate bandwidth by type, run the above commands.

Parameter Description

Parameter	Parameter Description
sr	If the ONU supports the bandwidth, the system reports the allocated bandwidth based on the ONU status
nsr	The allocated bandwidth is not reported based on the ONU status
sr-force	Mandatory bandwidth allocation based on ONU status

Default Value

Allocate bandwidth based on the ONU status

Command Mode

ONU T-Cont template configuration mode

Usage Guidelines

ITU G.984.3 defines a mechanism for ONUs to report the length of data waiting to be sent in their queues through GTC, which is called ONU status escalation. Based on the corresponding information, the OLT can calculate the length of the appropriate allocation time slot for the ONU to implement the dynamic bandwidth allocation of T-Cont.

In some cases, the ONU may work abnormally or be maliciously modified, resulting in the data length to be sent being reported to be inconsistent with the actual situation, resulting in the OLT always allocating a large amount of unnecessary bandwidth to the ONU. In this case, the OLT can configure a policy that does not allocate bandwidth based on ONU status reporting.

Example

The following example shows how to configure the ONU T-Cont profile tcont-test not to report bandwidth allocation based on ONU status.

OLT(config)# gpon profile onu-tcont tcont-test

config-gpon-profile# gpon-profile alloc-type nsr

59.6.10 gpon-profile onu-scheduler policy

Syntax

gpon-profile onu-scheduler policy {**sp** | **wrr**}

no gpon-profile onu-scheduler policy

To configure a priority queue scheduling policy for the upstream T-Cont egress of the ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
sp	The upstream T-Cont egress adopts a strict priority scheduling strategy
wrr	The uplink T-Cont exit adopts a weighted round-robin scheduling strategy

Default Value

Adopt a strict priority scheduling strategy

Command Mode

ONU T-Cont template configuration mode

Usage Guidelines

In the upstream direction of the ONU, if there are multiple virtual ports (GEM ports) that share the bandwidth of the same T-Cont, you need to schedule traffic from different virtual ports. Priority queue scheduling is one way to handle this scheduling need.

The gpon-profile upstream queue configuration in the virtual port template specifies the mapping between virtual ports and queues. The bandwidth allocation of the OLT to the T-Cont determines the actual uplink egress rate limiting. This command is used to configure an egress scheduling policy.

If the ONU declares that its Traffic management option is Rate, the ONU does not support priority queue scheduling on virtual port traffic by T-Cont nodes, and only supports rate limiting policy control.

Example

The following example shows how to configure the scheduling policy of the ONU T-Cont profile tcont-test corresponding to the upstream T-Cont egress of the ONU to use weighted round-robin scheduling.

OLT(config)# gpon profile onu-tcont tcont-test

config-gpon-profile# gpon-profile onu-scheduler policy wrr

59.6.11 gpon-profile onu-scheduler weight

Syntax

gpon-profile onu-scheduler weight *w1* [*w2*] [*w3*] [*w4*] [*w5*] [*w6*] [*w7*] [*w8*]

no gpon-profile onu-scheduler weight

To configure the priority queue of the upstream T-Cont egress of the ONU to schedule the weights of each queue, run the above commands.

Parameter Description

Parameter	Parameter Description
w1 ... w8	Weights from queue 1 to queue 8, ranging from 0 to 100

Default Value

All queues have a weight of 1

Command Mode

ONU template configuration mode

Usage Guidelines

If the scheduling policy of the upstream T-Cont egress of the ONU is set to a weighted round-robin policy, the weights of each queue for scheduling are based on the value set in this command. Parameterw1 ... *w8 corresponds to* **the weights of queues 1-8 specified in the gpon-profile upstream queue configuration in the virtual port profile.**

For configurations with a weight value of 0, the SP+WRR scheduling mode corresponds. Queues with a weight value of 0 are prioritized for strict priority scheduling, and then a weighted round-robin is performed for queues with a weight value of non-0.

Example

The following example shows how to configure the ONU T-Cont profile tcont-test to set the weight of each queue for the ONU uplink T-Cont egress to 2:2:3:4:5:6:7:8.

OLT(config)# gpon profile onu-tcont tcont-test

config-gpon-profile# gpon-profile onu-scheduler weight 2 2 3 4 5 6 7 8

59.6.12 gpon profile onu-tcont-virtual-port-bind

Syntax

gpon profile onu-tcont-virtual-port-bind *tvpb-prof-name*

To create a virtual port and T-Cont binding profile of the ONU to enter the configuration mode of binding the virtual port to the T-Cont template, run the above command.

no gpon profile onu-tcont-virtual-port-bind *tvpb-prof-name*

To delete the template for binding the virtual port of the ONU to the T-Cont, run the above command.

Parameter Description

Parameter	Parameter Description
tvpb-prof-name	The name of the template that binds the virtual port to the T-Cont

Default Value

By default, there is a template for binding the virtual port of the ONU named tvbind-default to the T-Cont. It contains a binding relationship, virtual port 1 references the configuration of the ONU virtual port template virtual-port-default, and corresponds to the configuration of T-Cont 1 and T-Cont 1 references the ONU T-cont template tcont-default.

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named tvpb-prof-name does not exist, create a template and enter the configuration mode of binding the template between the virtual port of the ONU and the T-Cont, otherwise go directly to the configuration mode of the virtual port and the T-Cont binding template.

The virtual port and T-Cont binding template specifies the correspondence between the virtual port and the T-Cont, and the configuration of the virtual port template of the ONU referenced by the virtual port.

Example

The following example shows how to create/configure the virtual port of the ONU to bind the template tvpb-test with the T-Cont.

OLT(config)# gpon profile onu-tcont-virtual-port-bind tvpb-test

59.6.13 gpon-profile virtual-port profile tcont profile

Syntax

gpon-profile virtual-port *vp-index* **profile** *vp-prof-name* **tcont** *tcont-index* **profile** *tcont-prof-name*

no gpon-profile virtual-port *vp-index*

The command is used to configure the configuration of the ONU virtual port reference ONU virtual port profile, configure the T-Cont corresponding to the virtual port of the ONU, and configure the T-Cont reference ONU T-Cont profile.

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
vp-prof-name	The name of the virtual port profile of the ONU that is referenced by the virtual port
tcont-index	T-Cont index corresponding to the virtual port, range 1-8
tcont-prof-name	The name of the ONU T-Cont template referenced by the T-Cont

Default Value

None

Command Mode

Bind the virtual port of the ONU to the T-Cont template configuration mode

Usage Guidelines

You can configure multiple virtual ports of an ONU to correspond to the same T-Cont, and the same T-Cont index tcont-index *is represented as the same T-Cont* in the virtual port and T-Cont binding profile.

For the same T-Cont index tcont-index, ensure that the referenced T-Cont template tcont-prof-name is the same.

All virtual ports included in the traffic mapping template referenced by the ONU must be configured with the corresponding virtual port template and T-Cont here, otherwise the ONU service configuration will fail to be delivered.

Example

The following example shows how to configure the virtual port and T-Cont binding template tvpb-test contains four virtual port entries: virtual port 1 refers to virtual port template vp-test1 corresponding to T-Cont 1, virtual port 2 refers to virtual port template vp-test2 to correspond to T-Cont 1, and virtual port 3 refers to virtual port template vp-test3 to correspond to T-Cont 2, virtual port 4 references the configuration of virtual port template vp-test3 corresponding to T-Cont 3, T-Cont 1 and 3 reference T-Cont template tcont-test1, T-Cont 2 refers to the configuration of T-Cont template tcont-test2.

OLT(config)# gpon profile onu-tcont-virtual-port-bind tvpb-test

config-gpon-profile# gpon-profile virtual-port 1 profile vp-test1 tcont 1 profile tcont-test1

config-gpon-profile# gpon-profile virtual-port 2 profile vp-test2 tcont 1 profile tcont-test1

config-gpon-profile# gpon-profile virtual-port 3 profile vp-test3 tcont 2 profile tcont-test2

config-gpon-profile# gpon-profile virtual-port 4 profile vp-test3 tcont 3 profile tcont-test1

59.6.14 gpon onu tcont-virtual-port-bind-profile

Syntax

gpon onu tcont-virtual-port-bind-profile *tvpb-prof-name*

no gpon onu tcont-virtual-port-bind-profile

To configure the configuration of the ONU reference ONU virtual port and the T-Cont binding profile, run the above commands.

Parameter Description

Parameter	Parameter Description
tvpb-prof-name	The name of the template that binds the virtual port to the T-Cont

Default Value

Configure the None virtual port and T-Cont binding template.

After the null-configured ONU is authenticated, the default ONU profile configuration takes effect. In the default ONU type template configuration, bind the virtual port of the ONU named tvbind-default to the T-Cont template.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The ONU traffic mapping template and the virtual port of the ONU and the T-Cont binding template must be configured before the ONU service is actually configured and delivered.

Based on the ONU virtual port and T-Cont binding template, the OLT will automatically assign a GEM port to each virtual port and an Alloc-ID to each T-Cont. After the ONU is activated and goes online, the corresponding ONU service configurations are delivered.

Example

The ONU corresponding to the gpon0/0/1:1 port refers to the configuration of the virtual port and the T-Cont binding profile tvpb-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu tcont-virtual-port-bind-profile tvpb-test

59.6.15 gpon onu virtual-port gem-port

Syntax

gpon onu virtual-port *vp-index*

gem-port *gem-port-id*

GEM port corresponding to the virtual port of the ONU.

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
gem-port-id	GEM Port : The value ranges from 256 to 4094

Default Value

Auto-allocation

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This command is used only to show run to view the automatic GEM port assigned to the virtual port of the ONU . Configuring ONU References When the virtual port of the ONU is configured with the T-Cont binding profile, the OLT automatically allocates the GEM port of the virtual port of the ONU.

Example

None

59.6.16 gpon onu virtual-port shutdown

Syntax

gpon onu virtual-port *vp-index* {**shutdown** | **no-shutdown**}

To enable the virtual port of the ONU on the OLT side, run the above command.

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
shutdown	Disable the virtual port
no-shutdown	Enable virtual ports

Default Value

Enable virtual ports

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Enable the virtual port and control the traffic forwarding of the corresponding GEM port through the PON port on the OLT side .

Example

The following example shows how to configure disable port 2 of ONU corresponding to gpon0/0/1:1 port.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 2 shutdown

59.6.17 gpon onu virtual-port downstream rate-limit

Syntax

gpon onu virtual-port *vp-index* **downstream rate-limit kbps** *value* [*burst-size* **bs**]

gpon onu virtual-port *vp-index* **downstream rate-limit kbps cir** *trtcm-cir* **pir** *trtcm-pir* [**cbs** *trtcm-cbs*] [**pbs** *trtcm-pbs*]

no gpon onu virtual-port *vp-index* **downstream rate-limit**

To configure the OLT side to limit the downlink rate of the virtual port of the ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
value	Use the downlink rate-limiting bandwidth rate, in kbps, in the range of 1-2488320 (GPON) or 1-9953280 (XG(S)PON).
bs	Downlink rate limit burst block size, in KB, range 0-4096

Default Value

No rate limit

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The configured bandwidth rate must be an integer multiple of 64kbps, or if not, the nearest integer multiple of 64kbps will be taken up.

You must set the Qos mode in the OLT egress direction to gpon qos-mode **virtual-port egress** for this rate limit configuration command to take effect.

Example

The ONU corresponding to port gpon0/0/1:1 is configured with a downlink rate limit of 200 Mbit/s on virtual port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 1 downstream rate-limit kbps 200000

59.6.18 gpon onu virtual-port dot1q-translating-tunnel

Syntax

gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode QinQ translate** *qinq-inner-vlan-map qinq-outer-vlan* [*cos-val*]

no gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode QinQ translate** *qinq-inner-vlan- map*

Configure the OLT to translate entries into the QinQ VLAN of the virtual port service of the ONU.

gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode flat translate 1to1** *flat-vlan-old flat-vlan-new* [*cos-val*]

no gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode flat translate 1to1** *flat-vlan-old*
Configure a flat 1:1 connection between the OLT and the ONU virtual port service VLAN translation entries.

gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode flat translate nto1** *flat-old-vlan-map flat-new-vlan* [*cos-val*]

no gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode flat translate nto1** *flat-vlan-old*
Configure the flat N:1 of the OLT to the virtual port service of the ONU VLAN translation entries.

gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode mix translate** *mix-old-vlan-map mix-inner-vlan mix-outer-vlan* [*cos-val*]

no gpon onu virtual-port *vp-index* **dot1q-translating-tunnel mode mix translate** *mix-old-vlan-map*
Configure the OLT to translate the mix VLAN entry of the ONU virtual port service.

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
qinq-inner-vlan-map	The original VLAN that matches the upstream translation of the QinQ VLAN, for example, 10-15, 40, 50-55
qinq-outer-vlan	QinQ VLAN Translation: Translates the destination external VLAN in the uplink direction
flat-vlan-old	Flat 1:1 VLAN Translation: The original VLAN that matches the upstream translation
flat-old-vlan-map	Flat N: 1 VLAN translation matches the original VLAN in the upstream direction, for example, 10-15, 40, 50-55
flat-new-vlan	Flat VLAN Translation: The destination VLAN is translated in the uplink direction
mix-old-vlan-map	Mix VLAN translates the original VLAN in the uplink direction
mix-inner-vlan	Mix VLAN: translates the target inner VLAN in the uplink direction

mix-outer-vlan	Mix VLAN translates the destination outer VLAN in the uplink direction
cos-val	Translate the VLAN CoS corresponding to the destination VLAN, which is 0 if not specified

Default Value

No translation entries are translated by VLANs configured with GPON ports.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The VLAN translation entry will take effect only when the corresponding GPON port's VLAN mode is configured with the translation mode "switchport mode dot1q-translating-tunnel". The QinQ/Flat/Mix translation types in VLAN translation entries exhibit behavior consistent with the same-named translation types configured under the physical port's "switchport dot1q-translating-tunnel" command.

QinQ: Searches whether the VLAN of the packet matches the qinq-inner-vlan-map of an entry in the uplink direction, and adds the outer VLAN of the qinq-outer-vlan of the corresponding entry to the packet in the uplink direction. In the downstream direction, check whether the outer VLAN of the packet matches the qinq-outer-vlan of a certain entry, and if it does, the outer VLAN is stripped away.

Flat: Searches whether the VLAN of the packet matches the flat-vlan-old or flat-old-vlan-map of an entry in the upstream direction, and replaces the VLAN of the packet with the flat-new-vlan of the corresponding entry. In the downstream direction, check whether the VLAN of the packet matches the flat-new-vlan of an entry, replace the VLAN of the packet with flat-vlan-old, or reverse translate the downlink packet for N:1 translation based on the MAC address entry when the original VLAN determines the uplink of the corresponding traffic.

Mix : Searches whether the VLAN of the packet matches the mix-old-vlan-map of an entry in the upstream direction, and if it does, the VLAN of the packet is translated into mix-inner-vlan for the inner VLAN and mix-outer-vlan for the outer VLAN. In the downlink direction, the VLAN of the packet matches the outer mix-outer-vlan and the inner mix-inner-vlan, and if so, the VLAN of the packet is replaced with the unique VLAN determined by the corresponding entry mix-old-vlan-map, or the original VLAN is used to determine the uplink of the corresponding traffic based on the MAC address entry for N:1 translation, and the downlink packet is reversed.

If a virtual port contains any of the translation entries of this Syntax, the virtual port will no longer inherit the VLAN translation entries of the GPON port configuration. After deleting all the translation entry configurations of this Syntax, this virtual port will re-inherit the VLAN translation entries of the GPON port configuration.

If the downstream traffic is unknown unicast, broadcast, or multicast, the downstream traffic does not send packets to the virtual port corresponding to the ONU, and the corresponding traffic will not be translated according to the translation entries configured in this command.

Example

The ONU corresponding to port gpon0/0/1:1 is configured on virtual port 1 to perform Mix translation 44 <=> outer layer 959 and inner layer 1301, Flat translation 45 <=> 2199, Mix translation 46 <=> outer layer 959 and inner layer 4073.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 1 dot1q-translating-tunnel mode mix translate 44 1301 959

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 1 dot1q-translating-tunnel mode flat translate 1to1 45 2199

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 1 dot1q-translating-tunnel mode mix translate 46 4073 959

59.6.19 gpon onu virtual-port dynamic maximum

Syntax

gpon onu virtual-port *vp-index* **dynamic maximum** *value*

no gpon onu virtual-port *vp-index* **dynamic maximum**

To configure the maximum number of dynamic MAC addresses that can be learned from the OLT to the virtual port of the ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
value	The maximum number of dynamic MAC addresses to be learned, ranging from 1 to 512

Default Value

No restrictions

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Configuring the maximum number of dynamic MAC addresses allowed for the virtual port of the ONU can prevent a large number of source MAC addresses from being used in the ONU from abnormal service traffic. When the number of dynamic MAC addresses on the virtual port of the ONU reaches the configured limit, the new MAC addresses on the virtual port of the ONU will no longer be learned by the OLT , and the corresponding packets will be discarded by the OLT.

Example

The maximum number of dynamic MAC addresses that can be learned on the virtual port of the ONU corresponding to the gpon0/0/1:1 port is 10.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 1 dynamic maximum 10

59.6.20 gpon onu virtual-port remote-id

Syntax

gpon onu virtual-port *vp-index* **remote-id** *rid*

no gpon onu virtual-port *vp-index* **remote-id**

When DHCP Snooping is enabled on the OLT, the remote-id of Option 82 sub-option 2 is tagged for DHCP packets from the virtual port of the ONU .

Parameter Description

Parameter	Parameter Description
vp-index	Configured virtual port index, ranging from 1 to 31
rid	remote-id information

Default Value

For example, if the SN of the ONU is ABCD:12345678 and the virtual port is 3, the corresponding remote-id is 4142434412345678-3 by default.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

For details about how to configure DHCP snooping, see DHCP-snooping Configuration Command.

Example

The DHCP remote-id of virtual port 3 is set to 8/1/1-3 on the ONU corresponding to gpon0/0/1:1:1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 3 remote-id 8/1/1-3

59.6.21 gpon onu tcont alloc-id

Syntax

gpon onu tcont *tcont-index* **alloc-id** *alloc-id*

no gpon onu tcont *tcont-index* **alloc-id**

To configure the ONU to assign an Alloc-ID to the specified index T-Cont, run the above commands.

Parameter Description

Parameter	Parameter Description
tcont-index	T-Cont index under ONU, range 1-8
alloc-id	Specified Alloc-ID, range 256-1151 (GPON port) or 1024-2815 (XG(S) PON port).

Default Value

None

When you configure a virtual port to bind a T-Cont profile to an ONU, the OLT automatically assigns an Alloc-ID to each T-Cont based on the binding configuration and T-Cont configuration, and creates an Alloc-ID configuration corresponding to the T-Cont.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Under the same PON port, each T-Cont must use a different Alloc-ID for the corresponding uplink DBA to work properly.

In general, it is not recommended to manually configure the assignment relationship between T-Cont and Alloc-ID in some T-Cont configurations.

Generally, you need to manually specify an Alloc-ID only when there is a problem with the ONU slot allocation for a specific Alloc-ID under the PON port, or if a specific Alloc-ID resource of the OLT encounters a problem.

If the number of T-Conts used by the ONU is less than the number of T-Cont T-Cont to which Alloc-IDs have been assigned , the T-Cont to Alloc-ID assignment relationship is not automatically released and must be manually deleted.

Example

The ONU corresponding to port gpon0/0/1:1 has T-Cont 1 corresponding to Alloc-ID 512, and T-Cont 2 corresponding to Alloc-ID 590.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu tcont 1 alloc-id 512 OLT(config-gpon0/0/1:1)# gpon onu tcont 2 alloc-id 590

59.7 ONU Rate Limit Template Configuration Commands

59.7.1 gpon profile onu-rate-limit

Syntax

gpon profile onu-rate-limit *rate-limit-prof-name*

To create an ONU rate-limit template and enter the rate-limit template configuration, run the command.

no gpon profile onu-rate-limit *rate-limit-prof-name*

To delete the ONU rate limit template, run the command.

Parameter Description

Parameter	Parameter Description
rate-limit-prof-name	The name of the rate limit template

Default Value

By default, an ONU rate-limiting profile named ratelimit-default exists. It includes a peak bandwidth of 1244160kbps and a guaranteed bandwidth of 1244160kbps.

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named *rate-limit-prof-name* does not exist, create a template and enter the ONU rate limiting profile configuration mode, otherwise go directly to the configuration mode of the rate limiting template.

The ONU rate limiting profile contains the configuration of the rate limiting function, which can be referenced when configuring the ONU rate limiting function in multiple places, such as the ONU virtual port profile and the ONU user port template.

Example

The following example shows how to create or configure the ONU rate limit template rt-limit-test.

OLT(config)# gpon profile onu-rate-limit rt-limit-test

59.7.2 gpon-profile pir cir

Syntax

gpon-profile pir *pir-value* **cir** *cir-value*

To configure the ONU rate limit, run the above command.

Parameter Description

Parameter	Parameter Description
pir-value	Peak bandwidth, in kbps
cir-value	Guaranteed bandwidth, in kbps

Default Value

None

Command Mode

ONU rate limite template configuration mode

Usage Guidelines

A valid rate limit template must include this configuration for the rate limit policy.

Configure a two-speed and three-color speed limit policy. When there is congestion, try to meet the guaranteed bandwidth first, and when all the rate-limit flows meet the guaranteed bandwidth, there is still free bandwidth, and then meet the peak bandwidth. Traffic that exceeds the peak bandwidth is dropped.

Example

The peak bandwidth of the RT-limit-test module of the ONU is 100 Mbit/s and the bandwidth is 10 Mbit/s

OLT(config)# gpon profile onu-rate-limit rt-limit-test config-gpon-profile# gpon-profile pir 100000 cir 10000

59.8 ONU Uplink Optical Module Parameter Query and Alarm Configuration Commands

59.8.1 show gpon interface onu optical-transceiver- diagnosis

Syntax

show gpon interface *onu-intf-name* **onu optical-transceiver-diagnosis**

To display the parameter information of the optical module, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

The parameter information of the optical module of the corresponding uplink PON port of the ONU can be displayed only after the ONU is registered.

Example

The following example shows how to display the optical module information of the corresponding uplink PON port of the ONU defined by the CTC of gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu optical-transceiver-diagnosis

Interface Temperature(degree) Voltage(V) Current(mA) RxPower(dBm) TxP

ower(dBm)

--- --- --- --- --- ---

gpon0/0/1:1 30.42 3.26 16.60 -21.02 1.2

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59.8.2 show gpon onu-optical-transceiver-diagnosis

Syntax

show gpon onu-optical-transceiver-diagnosis interface *pon-intf-name*

To check per OLT PON port and display the uplink PON port optical module parameter information of ONU, run the above command.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Check the parameter information of all ONUs in the specified PON port format: **gponchassis/***slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

The parameter information of the optical module of the corresponding uplink PON port of the ONU can be displayed only after the ONU is registered.

Example

The following example shows how to display the parameter information of the optical module corresponding to the PON port of all ONUs in gpon0/0/1.

OLT# show gpon onu-optical-transceiver-diagnosis interface gpon0/0/1

Interface	Temp(degree)	Volt(V)	Bias(mA)	RxPow(dBm)	TxPow(dBm)
gpon0/0/1:1	30.77	3.26	16.70	-20.97	1.41
gpon0/0/1:2	25.82	3.26	13.85	-20.32	2.31

59.8.3 gpon profile onu-optical-alarm

Syntax

gpon profile onu-optical-alarm *optical-alarm-prof-name*

To create an ONU optical power alarm template and enter the optical power alarm template configuration mode, run the above command.

no gpon profile onu-optical-alarm *optical-alarm-prof-name*

To delete the ONU optical power alarm template, run the above command.

Parameter Description

Parameter	Parameter Description
optical-alarm-prof-name	Name of the optical power alert template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named *optical-alarm-prof-name* does not exist, create a template and enter the ONU optical power alarm template configuration mode.

The ONU optical power alarm template contains the configuration of the optical power for the optical module on the PON port of the ONU to send and receive optical power alarms. The corresponding alarm thresholds are sent to the ONU, and the optical power alarm is generated by the ONU, and the OLT is notified through the OMCI.

Example

The following example shows how to create or configure an ONU optical power alarm template optical-alarm-test.

OLT(config)# gpon profile onu-optical-alarm optical-alarm-test

59.8.4 gpon-profile optical-alarm threshold

Syntax

gpon-profile optical-alarm {**rx-power-low** | **rx-power-high** | **tx-power-low** | **tx-power-high**} **threshold** *thr*

no gpon-profile optical-alarm {**rx-power-low** | **rx-power-high** | **tx-power-low** | **tx-power-high**} **threshold**

To configure the ONU optical power alarm threshold, run the above commands.

Parameter Description

Parameter	Parameter Description
rx-power-low	Configure an alarm indicating that the received optical power is too low
rx-power-high	Configure an alarm for high received optical power
tx-power-low	Configure an alarm for sending an alarm that the optical power is too low
tx-power-high	Configure an alarm for sending an alarm about the high optical power
thr	Optical power alarm threshold, unit: 0.5 dBm

Default Value

None

Command Mode

ONU optical power alarm template configuration mode

Usage Guidelines

For the alarm that the received optical power is too low or too high, the threshold range can be set to -80~0, that is, -40dBm~0dBm. For sending an alarm that the optical power is too low or too high, the configurable threshold range is -80~20, that is, -40dBm~10dBm.

For an unconfigured optical power alarm type, the ONU determines whether an alarm will be generated by the ONU.

Example

The ONU optical power alarm template optical-alarm-test sets the low received optical power to -29 dBm, the received low optical power to -10 dBm, the low Received Optical Power to -1 dBm, and the High Sent Optical Power to 2.5 dBm

OLT(config)# gpon profile onu-optical-alarm optical-alarm-test

config-gpon-profile# gpon-profile optical-alarm rx-power-low threshold -58 config-gpon-profile# gpon-profile optical-alarm rx-power-high threshold -20 config-gpon-profile# gpon-profile optical-alarm tx-power-low threshold -2 config-gpon-profile# gpon-profile optical-alarm tx-power-high threshold 5

59.8.5 gpon onu optical-alarm-profile

Syntax

gpon onu optical-alarm-profile *optical-alarm-prof-name*

no gpon onu optical-alarm-profile

To configure the ONU by referring to the optical power alarm template, run the above commands.

Parameter Description

Parameter	Parameter Description
optical-alarm-prof-name	Name of the optical power alert template

Default Value

The optical power alarm template configuration is not referenced, and the specific ONU behavior is determined by the ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

If the ONU port does not reference an optical power alarm template, the optical power alarm reported by the ONU to the OLT will be ignored by the OLT and no log will be recorded or reported to the NMS.

Example

The ONU corresponding to port gpon0/0/1:1 is configured in the optical power alarm profile optical-alarm-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu optical-alarm-profile optical-alarm-test

59.9 ONU Ethernet User Port Configuration Commands

59.9.1 gpon profile onu-uni

Syntax

gpon profile onu-uni *uni-prof-name*

To create an ONU Ethernet user port template and enter the Ethernet user port template configuration mode, run the above command.

no gpon profile onu-uni *uni-prof-name*

To delete ONU Ethernet user port template, run the above command.

Parameter Description

Parameter	Parameter Description
uni-prof-name	The name of the Ethernet user port template.

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

When the template named *uni-prof-name* does not exist, create a template and enter the ONU Ethernet user port profile configuration mode, otherwise directly enter the configuration mode of the Ethernet user port template.

The ONU Ethernet user port template contains configurations for the Ethernet user port, such as the self-negotiation rate, duplex line sequence, flow control, maximum frame length allowed, and queue scheduling.

Example

The following example shows how to create/configure the ONU Ethernet user port profile uni-test.

OLT(config)# gpon profile onu-uni uni-test

59.9.2 gpon-profile speed

Syntax

gpon-profile speed {**10** | **100** | **1000** | **auto**}

no gpon-profile speed

To configure the ONU Ethernet user port rate, run the above commands.

Parameter Description

Parameter	Parameter Description
10	Use a 10Mbps rate
100	Use a 100Mbps rate
1000	Use a 1000Mbps rate
auto	Use the auto-negotiation rate

Default Value

Use the auto-negotiation rate

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

Not all combinations of rate and duplex are reasonable, and the OLT or ONU may ignore the corresponding configuration for those that are not reasonable.

Example

The port rate of the ONU Ethernet user port profile uni-test is 1000Mbps

OLT(config)# gpon profile onu-uni uni-test config-gpon-profile# gpon-profile speed 1000

59.9.3 gpon-profile duplex

Syntax

gpon-profile duplex {**full** | **half** | **auto**}

no gpon-profile duplex

To configure the ONU Ethernet user port duplex mode, run the above command.

Parameter Description

Parameter	Parameter Description
full	Use full-duplex mode
half	Use half-duplex mode
auto	Use self-negotiating duplex mode

Default Value

Use self-negotiating duplex mode

Command Mode

ONU Ethernet user port profile configuration mode

Usage Guidelines

Not all combinations of rate and duplex are reasonable, and the OLT or ONU may ignore the corresponding configuration for those that are not reasonable.

Example

The ONU Ethernet user port profile uni-test sets the port duplex mode to full-duplex:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile duplex full

59.9.4 gpon-profile eth-wiring

Syntax

gpon-profile eth-wiring {**dce** | **dte** | **auto** | **not-config**}

no gpon-profile eth-wiring

To configure the ONU Ethernet user port line sequence, run the above command.

Parameter Description

Parameter	Parameter Description
dce	DCE line sequence (MDI-X) is used
dte	Use DTE line sequence (MDI).
auto	Automatic selection
not-config	The ONU is kept in the default state and is not configured

Default Value

The ONU is kept by default and is not configured.

Command Mode

ONU Ethernet user port profile configuration mode

Usage Guidelines

None

Example

The ONU Ethernet user port profile uni-test is configured with DCE for line sequence

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile eth-wiring dce

59.9.5 gpon-profile flow-control

Syntax

gpon-profile flow-control {**on** | **off**}

no gpon-profile flow-control

To enable flow control on the ONU Ethernet user port, run the command.

Parameter Description

Parameter	Parameter Description
on	Enable the flow control function
off	Disable the flow control function

Default Value

Disable the flow control function

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

None

Example

Configure the UNI-test configuration of the ONU Ethernet user port profile to enable the flow control function:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile flow-control on

59.9.6 gpon-profile max-frame-size

Syntax

gpon-profile max-frame-size *value*

no gpon-profile max-frame-size

To configure the maximum frame length allowed to pass through an ONU Ethernet user port, run the above commands.

Parameter Description

Parameter	Parameter Description
value	Maximum frame length, range 64-1996

Default Value

Length 1518 bytes

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

None

Example

The maximum frame length allowed to pass through the ONU Ethernet user port template uni-test configuration is 1800 :

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile max-frame-size 1800

59.9.7 gpon-profile upstream bandwidth

Syntax

gpon-profile upstream bandwidth *rate-limit-prof-name*

no gpon-profile upstream bandwidth

To configure the rate limit profile for the uplink bandwidth of the ONU Ethernet user port, run the above commands.

Parameter Description

Parameter	Parameter Description
rate-limit-prof-name	Name of the rate limit template

Default Value

None

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

None

Example

Configure the upstream bandwidth rate limit of the ONU Ethernet user port profile uni-test, refer to the configuration of the rate limiting profile rt-limit-test:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile upstream bandwidth rt-limit-test

59.9.8 gpon-profile downstream bandwidth

Syntax

gpon-profile downstream bandwidth *rate-limit-prof-name*

no gpon-profile downstream bandwidth

To configure the rate limit template for the downlink bandwidth of the ONU Ethernet user port, and refer to the rate limit template, run the above commands.

Parameter Description

Parameter	Parameter Description
rate-limit-prof-name	Name of the rate limit template

Default Value

None

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

None

Example

The following example shows how to configure the downlink bandwidth rate limit for the ONU Ethernet user port template uni-test, refer to the configuration of the rate limiting template rt-limit-test:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile downstream bandwidth rt-limit-test

59.9.9 gpon-profile eth-function

Syntax

gpon-profile eth-function {**bridge** | **ip** | **either** | **not-config**}

no gpon-profile eth-function

To configure the ONU Ethernet user port to carry service functions, run the above commands.

Parameter Description

Parameter	Parameter Description
bridge	Switching business
ip	IP routing services
either	Select either the switching service or the IP routing service
not-config	The ONU is kept by default and is not configured

Default Value

The ONU is kept by default and is not configured

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

This configuration is inherited from the G.984 protocol, and the configuration management of IP routes is deleted in G.988.

Example

The UNI-test configuration of the ONU Ethernet user port profile bears IP routing services:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile eth-function ip

59.9.10 gpon-profile scheduler policy

Syntax

gpon-profile scheduler policy {**sp** | **wrr**}

no gpon-profile scheduler policy

To configure a scheduling policy for the ONU Ethernet user port, run the above commands.

Parameter Description

Parameter	Parameter Description
sp	Adopt a strict priority scheduling strategy
wrr	Adopt a weighted round-robin scheduling strategy

Default Value

Disregard the configuration, that is, the configuration will not be delivered by default, which is determined by the default behavior of the ONU.

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

If this command is configured to ignore the configuration state, G.988 is used to configure the weight of each queue in **gpon-profile scheduler weight**. Otherwise, use the private extension OMCI to implement the scheduling policy and the weight of each queue for the delivery configuration.

Example

The ONU Ethernet user port profile uni-test sets the egress scheduling policy to weighted round-robin scheduling:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile scheduler policy wrr

59.9.11 gpon-profile scheduler weight

Syntax

gpon-profile scheduler weight *w1* [*w2*] [*w3*] [*w4*] [*w5*] [*w6*] [*w7*] [*w8*]

no gpon-profile scheduler weight

To configure the weights of each queue on the ONU Ethernet user port, run the above commands.

Parameter Description

Parameter	Parameter Description
w1 ... *w8*	The weights of queues 1 to 8 range from 0 to 255, where 255 indicates that the corresponding queue weight configuration is not delivered

Default Value

All queues have a weight of 255 and are not delivered

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

If the **gpon-profile scheduler policy** is configured to ignore the configuration state, G.988 is used to configure the weights of each queue. In other cases, the private extension OMCI is used to deliver the corresponding scheduling policy and the weights of each queue.

If **gpon-profile scheduler policy** is set to a weighted round-robin policy, the weights of each queue used in this command. Parameterw1 ... *w8 corresponds to queue 1 specified in the gpon-profile downstream queue configuration in the virtual port template* - when private extended OMCI is used, for the configuration with a weight value of 0, it corresponds to the sp+wrr scheduling mode. Queues with a weight value of 0 are prioritized for strict priority scheduling, and then a weighted round-robin is performed for queues with a weight value of non-0.

Example

The ONU Ethernet user port profile uni-test configures the weight of each queue for egress to 2:2:3:4:5:6:7:8

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile scheduler weight 2 2 3 4 5 6 7 8

59.9.12 gpon-profile scheduler drop-precedence

Syntax

gpon-profile scheduler drop-precedence { **not-config** | **no-marking** | **internal-marking** | **dei** | **pcp- 8p0d** | **pcp-7p1d** | **pcp-6p2d** | **pcp-5p3d** | **dscp-af-class** }

no gpon-profile scheduler drop-precedence

To configure the drop priority flag for the ONU Ethernet user port, run the above commands.

Parameter Description

None

Default Value

The drop priority tag maintains the current configuration state of the ONU.

Command Mode

ONU Ethernet user port template configuration mode

Usage Guidelines

If the gpon-profile scheduler policy is configured to ignore the configuration state, G.988 is used to configure the drop priority tag. In other cases, the private extension OMCI is used to deliver the drop-priority tag corresponding to the configuration.

The drop priority tag is used to control how to identify packets that can be preferentially dropped when a queue is congested. internal-marking preferentially discards colored packets identified by the downlink rate-limiting TrTCM mechanism on the preceded virtual port. dei specifies that packets with DEI ID 1 in the VLAN tag are discarded preferentially. pcp-8p0d|pcp-7p1d|pcp-6p2d|pcp-5p3d specifies preferential dropout, which packets can be preferentially dropped according to the corresponding PCP encoding mechanism (IEEE 802.1ad) VLAN Tag priority field. dscp-af-class specifies that packets that are preferentially dropped according to the DSCP field of the corresponding DSCP encoding mechanism (IETF RFC 2597). No-marking is used to turn off preferential drops. not-config is used to maintain the current configuration state of the ONU.

Example

The ONU Ethernet user port profile uni-test configuration drop priority is marked as dei :

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile scheduler drop-precedence dei

59.9.13 gpon onu uni uni-profile

Syntax

gpon onu uni *port* **uni-profile** *uni-prof-name*

no gpon onu uni *port* **uni-profile**

To configure an ONU Ethernet User Port Refers to the ONU Ethernet User Port template Configuration, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding Ethernet user port
uni-prof-name	Name of the Ethernet user port template

Default Value

The Ethernet user port template configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

If the Ethernet user port profile configuration is not referenced, the OLT does not deliver the configuration related to the Ethernet user port profile. If an Ethernet user port template has been referenced and the corresponding reference is deleted, the OLT will deliver each configuration in the Ethernet user port template as the default configuration on this port.

Example

Ethernet user port 2 of the ONU corresponding to the gpon0/0/1:1 port refers to the configuration of the Ethernet user port profile uni-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 uni-profile uni-test

59.9.14 gpon onu uni shutdown

Syntax

gpon onu uni *port* {**shutdown** | **no-shutdown**}

no gpon onu uni *port* **shutdown**

To configure the ONU Ethernet user port enable/disable, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding Ethernet user port
shutdown	Enable the Ethernet user port
no-shutdown	Disable the Ethernet user port

Default Value

Enable the Ethernet user port.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU corresponding to the gpon0/0/1:1 port closes Ethernet user port 2.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 shutdown

59.9.15 show gpon interface onu port state

Syntax

show gpon interface *onu-intf-name* **onu port** *port-num* **state**

To display the ONU Ethernet user port status, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port-num	Check the corresponding Ethernet user port

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Check the status of Ethernet user port 3 of the ONU corresponding to the gpon0/0/1:1 port.

OLT# show gpon interface gpon0/0/1:1 onu port 3 state

gpon0/0/1:1 uni-port 3 up

10/100 BASE-T(100Mbps Full-Duplex)

59.10 ONU IP Host Configuration Commands

59.10.1 gpon onu ip-host option

Syntax

gpon onu ip-host *port* **option** [**ipstack**] [**dhcp**] [**ping**] [**tracert**]

no gpon onu ip-host *port* **option**

To enable the ONU IP host function option, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
ipstack	Enable the IP stack
dhcp	Enable DHCP
ping	Enable Echo Reply
tracert	Enable the response to ICMP Trace Route operations (TTL exceed).

Default Value

The ONU uses it self-defined default values.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This command is used to enable the functions and options of an ONU IP host. You can specify to turn on one, many, or none of them. When the default configuration or the no command is executed, the OLT does not perform any configuration operations on the corresponding OMCI ME.

If the ONU supports the G.988 protocol, you need to enable ipstack if you want the corresponding IP host to run the state. If the ONU only supports G.984.4, then the ONU may not support the ipstack option and should not be configured to enable ipstack.

If the IP host does not have the corresponding traffic mapping configured, the corresponding configuration may never take effect.

Example

IP Host 2 of the ONU corresponding to port gpon0/0/1:1 is configured to enable the IP stack, enable DHCP , and enable responses to PING and Tracert.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu ip-host 2 option ipstack dhcp ping tracert

59.10.2 gpon onu ip-host address

Syntax

gpon onu ip-host *port* **address** *ip-address netmask* [*gateway*]

no gpon onu ip-host *port* **address**

To configure the static IP address of the ONU IP host, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
ip-address	IP address, format A.B.C.D
netmask	Subnet mask, format A.B.C.D
gateway	Gateway, format A.B.C.D

Default Value

None, the IP address, mask, and gateway are all 0.0.0.0.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

If DHCP is enabled for the ONU IP host option, the static IP address configured in this command may not take effect.

Example

The IP host 2 of the ONU corresponding to port gpon0/0/1:1 is configured with a static IP address of 192.168.0.10 , a subnet mask of 255.255.255.0, and a default gateway of 192.168.0.1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu ip-host 2 address 192.168.0.10 255.255.255.0 192.168.0.1

59.10.3 gpon onu ip-host DNS

Syntax

gpon onu ip-host *port* **DNS pri-dns** *dns1* **sec-dns** *dns2*

no gpon onu ip-host *port* **DNS**

To configure the preferred and alternate DNS servers for the ONU IP host, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
dns1	Preferred DNS server IP address, format A.B.C.D
dns2	Alternate DNS server IP address, format A.B.C.D

Default Value

None, the DNS service is unavailable.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

If DHCP is enabled for the ONU IP host option, the DNS service configured in this command may not take effect.

Example

The IP host 2 of the ONU corresponding to port gpon0/0/1:1 is configured with 8.8.8.8 as the preferred DNS server and 8.8.4.4 as the alternative DNS server.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu ip-host 2 DNS pri-dns 8.8.8.8 sec-dns 8.8.4.4

59.10.4 gpon onu ip-host extend

Syntax

gpon onu ip-host *port* **extend nat** {**enable** | **disable**} **pppoe** {**username** *user* **password** *pass* **auth- proto** {**auto** | **chap** | **pap**} **dial-mode** {**always** | **on-demand timeout** *inactivity-time* | **manual**} |

disable}

no gpon onu ip-host *port* **extend**

To configure the extended parameter, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
enable	Enable the NAT service
disable	Disable the NAT service
user	PPPOE username
pass	PPPOE user password
auto	The PPP authentication protocol is Auto
chap	The PPP authentication protocol is CHAP
pap	The PPP authentication protocol is PAP
always	PPPOE dialing is always online
on-demand	PPPOE dials only when there is traffic in the service
manual	PPPOE manual dialing
inactivity-time	The idle timeout period of a PPPOE connection, in seconds
disable	Disable the PPPOE service

Default Value

None, do not configure the extended parameter.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

Example

The IP host 2 of the ONU corresponding to port gpon0/0/1:1 is configured to enable NAT service, the PPPOE user name is ad003, and the user password is 123456, the PPP authentication protocol is CHAP, the PPPOE dial-up mode is only dialed when there is service traffic, and the idle timeout time is 5 minutes.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu ip-host 2 extend nat enable pppoe username ad003 password 1234

59.10.5 show gpon interface onu ip-host

Syntax

show gpon interface *onu-intf-name* **onu ip-host** { *port-num* | **all** }

To display the current working information of the ONU specified or all IP host ports, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port-num	Check the corresponding IP host port
all	View all IP host ports of the ONU

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

When the extension parameter of an ONU IP host is configured, the extension work information is additionally displayed.

Example

The following example shows how to check the current working information of the IP host port 1 of the ONU corresponding to port gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu ip-host 1

IP host	port id	: 1
IP opti	on	: ipstack dhcp
Mac add	ress	: 00:e0:0f:34:89:12
Onu ide	ntifier	:
Conf ig	IP address	: 0.0.0.0
Conf ig	subnet mask	: 0.0.0.0
Conf ig	default gateway	: 0.0.0.0
Conf ig	primary DNS	: 0.0.0.0
Conf ig	secondary DNS	: 0.0.0.0
Curr ent	IP address	: 10.2.100.101
Curr ent	subnet mask	: 255.255.255.0

Curr ent default gateway : 10.2.100.1

Curr ent primary DNS : 8.8.8.8

Curr ent secondary DNS : 8.8.4.4

Curr ent domain name :

Curr ent host name :

59.11 ONU User Port VLAN Configuration Commands

59.11.1 gpon profile onu-vlan

Syntax

gpon profile onu-vlan *vlan-prof-name*

To create an ONU VLAN profile and enter the VLAN profile configuration mode, run the above command.

no gpon profile onu-vlan *vlan-prof-name*

To delete the ONU VLAN template, run the above command.

Parameter Description

Parameter	Parameter Description
vlan-prof-name	The name of the VLAN template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named vlan-prof-name does not exist, create a template and enter the ONU VLAN template configuration mode, otherwise it will go directly to the configuration mode of the VLAN template.

The ONU VLAN template contains configurations for ONU user ports, VLAN modes, PVIDs, and translation entries.

Example

The following example shows how to create/configure the ONU VLAN profile vlan-test.

OLT(config)# gpon profile onu-vlan vlan-test

59.11.2 gpon-profile vlan mode

Syntax

gpon-profile vlan mode {**transparent** | **tag** | **translation** | **trunk** | **vlan-stacking** | **aggregation** | **transparent2** | **trunk2** | **custom** | **old-style** ...}

no gpon-profile vlan mode

To configure the VLAN mode of the ONU user port, run the above commands.

Parameter Description

Parameter	Parameter Description
transparent	Transparent transmission mode. Forward all traffic directly.
tag	Label mode. For uplink untagged packets, add a PVID or discard them. If the VLAN ID is a PVID, the downstream packet is stripped of the tag and forwarded, otherwise it is discarded.
translation	Translation mode. For uplink untagged packets, add the PVID. Search for tagged packets in the translation entry, and if they hit, they are forwarded for translation or discarded. For downstream packets, if the VLAN ID is a PVID , the system strips the tag and forwards it. Otherwise, a reverse lookup is performed in the translation entry, and if it is hit, a reverse translation is forwarded, otherwise it is discarded.

trunk	Relay mode. For uplink untagged packets, add the PVID. The tagged packet is searched for in the allowed items and forwarded if it hits, otherwise it is discarded. For downstream packets, If the VLAN ID is PVID , the tag is stripped and forwarded. Otherwise, look in the allowed, forward if hit, otherwise discard.
vlan-stacking	VLAN overlay mode. For uplink untagged packets, add the PVID. If the tagged packet is searched, the outer tag is added for forwarding, otherwise it is discarded. For downstream packets, if the VLAN ID is a PVID , the system strips the tag and forwards it. Otherwise, a reverse lookup is performed in the translation table entry, and if it hits, the tag is stripped and forwarded, otherwise it is discarded.
aggregation	Aggregation mode. For uplink untagged packets, add the PVID. Search for tagged packets in the translation entry, and if they hit, they are forwarded for translation or discarded. For downstream packets, if the VLAN ID is a PVID , the system strips the tag and forwards it. Otherwise, the corresponding uplink source VLAN is searched according to the MAC address and VLAN, and if it is hit, the reverse translation is forwarded, otherwise it is discarded.
transparent2	Transparent transmission mode 2. The desired behavior is the same as transparent, delivered in a different way.
trunk2	Relay mode 2. The desired behavior is the same as trunk, delivered in a different way.
custom	Custom mode. For upstream packets, configure matching rules and processing behaviors based on custom entries. For downlink packets, configure them in the downlink mode of the custom mode.

old-style	Old style pattern. For some ONUs that do not support the above extended VLAN mode, you need to configure this mode. The command Parameter is described in the following section.

Default Value

Transparent transmission mode

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

Except for the old VLAN mode, all other VLAN modes are configured and delivered using the ITU G.988 Extended VLAN tagging operation configuration data ME. The ME definition only contains the matching rules and behavior configuration for the uplink direction, and the matching rules and behaviors in the downlink direction are configured by the ONU itself according to the configuration of the uplink direction (custom-downstream-mode is configured according to the custom mode in custom mode). Different ONUs may have different understandings of the reverse configuration of the downlink direction, and the specific downlink reverse configuration behavior is determined by the ONU implementation.

The upstream direction matching rules and behaviors of the translation mode and the aggregation mode are the same, so the OLT of the two modes actually delivers the same configuration behavior. G.988 does not require the ONU to process aggregation translation in the downlink direction, but China Telecom requires that the MDU ONU must support aggregation, and the SFU ONU can optionally support it, and whether the ONU supports the aggregation behavior is determined by the ONU implementation.

If the transparent configuration does not meet your expectations, you can try transparent2. For trunk mode, if the trunk configuration does not meet your expectations, you can try trunk2.

Example

ONU VLAN Profile: vlan-test: Set the VLAN mode to Tag mode:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan mode tag

trunk2 is available in the version above @60120

custom is available in the version above @10518.

old-style is available in the version above @106025.

The specific implementation of each mode is as follows.

transparent: If a matching Nonetag stream is not processed, the ONU should default to the default nonetag, single-tag, and double-tag flows that are not processed.

transparent2: Delivers three rules, and the default flows that match Nonetag, single tag, and double tag are not processed. **tag:** A single tag is dropped by default. Add a layer of tag to the nonetag stream to pvid.

translation| aggregation: The default stream is dropped by a single tag. Add a layer of tag to the nonetag stream to pvid. For each set of translation-entry or aggregation-entry old_vlan = > new_vlan form a rule, match a single tag stream for this old_vlan, strip off a layer of tag, and add a layer of tag for this new_vlan.

trunk : Single-tag default stream drop. Add a layer of tag to the nonetag stream to pvid. For VLAN-allowed, a rule is formed for each VLAN, and the matching single tag flow is this VLAN and is not processed.

trunk2: Single-tag default flow drop. Add a layer of tag to the nonetag stream to pvid. For VLAN-allowed, a rule is formed for each VLAN to match a single-tag flow for this VLAN, strip one layer of tag, and add a layer of tag for this VLAN.

vlan-stacking: Single-tag default flow drop. Add a layer of tag to the nonetag stream to pvid. For each set of translation-entry or aggregation-entry old_vlan = > new_vlan form a rule, match a single tag stream for this old_vlan and add a layer of tag for this new _vlan. (Use the Add an inner tag operation).

custom : first deliver a rule that matches the Nonetag stream and does not process it, at this time, the ONU contains three default rules that do not process the Nonetag, single tag, and double tag streams according to the protocol requirements, and then delivers all the rules in turn according to the custom-entry, in order from index to large, if the matching rule (**filter**), the rule that is delivered later overrides the rule that is delivered first.

59.11.3 gpon-profile vlan mode old-style

Syntax

gpon-profile vlan mode old-style upstream {**transparent** | **force-single-tag** *vlanid* [*cos* [*dei*]] | **prepend-tag** *vlanid* [*cos* [*dei*]]} **downstream** {**transparent** | **outer-tag-strip**}

To configure the VLAN mode of the ONU user port to the old style, run the command.

Parameter Description

Parameter	Parameter Description
transparent	In the old style, the uplink or downlink behavior was configured as transparent transmission.
force-single- tag	The uplink behavior of the old style mode is configured to force a single label. Tag packets overwrite tag, and tags are added to untagged packets.
prepend-tag	The uplink behavior of the old style mode is configured to append tags. Single-tag packets are appended with an outer label, double-tag packets override the outer labels, and untagged packets are appended with a single label.
outer-tag-strip	The old style mode line behavior was configured to remove the outer label. Tag packets remove the outer label and untagged packets are transparently transmitted.
vlanid	The VLAN ID of the uplink packet in the old style mode is replaced or appended , in the range 1-4094.
cos	The CoS value of the uplink packet in the old style mode is replaced or appended,

	ranging from 0 to 7.
dei	The DEI value of the uplink packet in the old style mode is replaced or appended, ranging from 0 to 1.

Default Value

Transparent transmission mode

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

In the old VLAN mode, the configuration is delivered using the ITU G.988 VLAN tagging operation configuration data ME. Try this mode when ONU does not support Extended VLAN tagging operation configuration data ME.

It is possible that the ONU has different support characteristics for different associated user port objects, for example it may be that the ONU supports the Ethernet user port configuration with a different VLAN mode configuration, while the IP host only supports the old style mode.

Example

ONU VLAN template vlan-test sets the VLAN mode to the old style mode, forcing single-layer VLAN 45 in the uplink , specifying cos 2 dei 0, and stripping VLAN in the downlink

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan mode old-style upstream force-single-tag 45 2 0 downstream outer-tag-strip

59.11.4 gpon-profile vlan pvid

Syntax

gpon-profile vlan pvid *vid* [*cos-val* | **cos-by-dscp**]

no gpon-profile vlan pvid

To configure the default VLAN and CoS of the ONU user port, run the above command.

Parameter Description

Parameter	Parameter Description
vid	Configure the default VLAN of the port, ranging from 1 to 4094
cos-val	Configure the default VLAN CoS value of the port, ranging from 0 to 7
cos-by-dscp	Configure the port default VLAN CoS obtained from the DSCP mapping

Default Value

Default VLAN 1, default CoS 0.

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

The default VLAN and CoS configuration of a port are invalid for VLAN transparent transmission mode, custom mode, and old style mode.

cos-by-dscp sets cos to the mapping value of dscp based on the mapping relationship configured for **dscp-to-cos-mapping**.

Example

ONU VLAN template vlan-test Configure the default VLAN of the port to 100 and the CoS is obtained from the DSCP mapping:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan pvid 100 cos-by-dscp

59.11.5 gpon-profile vlan step-pvid

Syntax

gpon-profile vlan step-pvid *start-vid step*

no gpon-profile vlan step-pvid

To configure the default VLAN of the ONU user port to generate the ONU port sequence number, run the above command.

Parameter Description

Parameter	Parameter Description
start-vid	Configure the default VLAN starting value of the port, ranging from 1 to 4094
step	The default VLAN of a port is based on the step value of the ONU port sequence number, ranging from 1 to 4094

Default Value

The ONU port sequence number is not generated, and the **gpon-profile vlan pvid i**s used, and VLAN 1 is the default.

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

The default VLAN configuration of a port is valid for VLAN transparent transmission mode, custom mode, and old style mode None.

In some scenarios, the default VLAN of a port needs to be independent for each ONU, and the default VLAN value of the port configured in the gpon-profile vlan pvid command is overridden by using the default VLAN = (*start-vid* + (ONU port sequence number -- 1) x *step*) % 4094 , which will change depending on the final bound ONU port.

After this command is configured, the default VLAN CoS of a port is still based on the value set in the gpon-profile vlan pvid command.

Example

The default VLAN starting value of the ONU VLAN profile vlan-test configuration port is 100, and the step value followed by the ONU sequence number is 4 (that is, the ONU with sequence numbers 1/2/3 corresponds to VLAN 100/104/108 respectively).

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan step-pvid 100 4

59.11.6 gpon-profile vlan translation-entry

Syntax

gpon-profile vlan translation-entry *old_vid new_vid* [*cos-val*]

no gpon-profile vlan translation-entry *old_vid*

To configure the VLAN translation entry for the ONU user port, run the above commands.

Parameter Description

Parameter	Parameter Description
old_vid	The VLAN is translated as the original vlanid , ranging from 1 to 4094
new_vid	VLAN translation new vlanid , range 1-4094
cos-val	VLAN translation new cos , range 0-7

Default Value

None

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

VLAN translation entries for VLAN translation, **vlan-stacking**, and aggregation Take effect. For translation mode and aggregation mode, i.e., if the traffic matches old_vid, its VLAN ID is replaced to new_vid. For the overlay mode, i.e., if the traffic matches the old_vid, then a Tag is added to the outer layer with a VLAN ID of new_vid.

If the cos-valParameter of the new CoS is not configured for VLAN translation, the CoS in the original matching VLAN tag is used for the VLAN translation. Currently, a maximum of 30 VLAN translation entries are supported.

Example

ONU VLAN Template vlan-test User Port VLAN Translation Entry VLAN 44 is translated to 2187 and VLAN 45 is translated to 3851 and CoS 5 is specified

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan translation-entry 44 2187 config-gpon-profile# gpon-profile vlan translation-entry 45 3851 5

59.11.7 gpon-profile vlan aggregation-entry

Syntax

gpon-profile vlan aggregation-entry *old_vid_list new_vid* [*cos-val*]

no gpon-profile vlan aggregation-entry *old_vid_list*

To configure translation entries in the form of VLAN aggregation for ONU user ports, run the above commands.

Parameter Description

Parameter	Parameter Description
old_vid_list	The VLAN translates the original vlanid list, for example, 5-7, 1001-1010, and ID range 1-4094
new_vid	VLAN translation new vlanid , range 1-4094
cos-val	VLAN translation new cos , range 0-7

Default Value

None

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

Translation entries in the form of VLAN aggregation are actually simplified versions of common translation entries. The functionality is the same as that of a normal translation entry. When a translation entry in aggregate form has only one original VLAN for the same new VLAN, it will be displayed as a normal translation entry. When a normal translation entry has multiple original VLANs for the same translation new VLAN, the translation entry will be displayed as an aggregate.

Currently, a maximum of 30 VLAN translation entries are supported. For aggregated translation entries, each different original VLAN is treated as a different translation item.

Example

ONU VLAN Template vlan-test User Port VLAN Aggregation Translation Entry VLAN 80-85 Translated to 4001 :

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan aggregation-entry 80-85 4001

59.11.8 gpon-profile vlan trunk vlan-allowed

Syntax

gpon-profile vlan trunk vlan-allowed *vid_list*

no gpon-profile vlan trunk vlan-allowed *vid_list*

To configure the list of VLANs that are allowed to pass through the ONU user port VLAN trunk mode, run the above commands.

Parameter Description

Parameter	Parameter Description
vid_list	Allowe to pass through the list of vlanids, such as 5-7, 1001-1010, ID range 1-4094

Default Value

None

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

Currently, a maximum of 30 VLANs are supported.

Example

The VLAN trunk mode of vlan-test user port for the ONU VLAN template is 21-25,4221:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan trunk vlan-allowed 21-25,4221

59.11.9 gpon-profile vlan ether-type

Syntax

gpon-profile vlan ether-type {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **vlan** *vid* **no gpon-profile vlan ether-type** {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **vlan**

To configure the ONU user port to specify the default VLAN based on the Ethernet type, run the above commands.

gpon-profile vlan ether-type {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **step-vlan** *start-vid step*

no gpon-profile vlan ether-type {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **step-vlan**

To configure the ONU user port to generate a default VLAN based on the Ethernet type and based on the ONU port sequence number, run the above commands.

gpon-profile vlan ether-type {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **cos** {*cos-val* | **by-inner-tag** | **by- dscp**}

no gpon-profile vlan ether-type {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **cos**

To configure the ONU user port to specify the CoS based on the Ethernet type, run the above commands.

[**no**] **gpon-profile vlan ether-type** {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**} **drop**

To disable the ONU user port to forward packets of the specified Ethernet type, run the above commands.

Parameter Description

Parameter	Parameter Description
ipoe | **pppoe** | **arp** | **ipv6** | **eapol**	VLAN configuration operations are performed for Ethernet types 0x0800, 0x8863 or 0x8864, 0x0806, 0x86DD, 0x888E, and so on
vid	The default VLAN of the port, range 1-4094
start-vid	The default VLAN start value of the port ranges from 1 to 4094
step	The default VLAN of a port is based on the step value of the ONU port number, ranging from 1 to 4094
cos-val	The specified VLAN CoS value in the range of 0-7
by-inner-tag	The specified VLAN CoS is obtained from the original inner VLAN tag
by-dscp	The specified VLAN CoS is obtained from the DSCP mapping

Default Value

None

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

ether-type ... A vlan is used to add a VLAN based on the Ethernet type for untagged packets. Its priority is higher than that of the gpon-profile vlan pvid configuration. This configuration works for VLAN transparent mode, custom mode, and old style mode.

ether-type ... step-vlan configuration and ether-type... The functions and relationships of the VPON-profile VLAN step-PVID and GPON-profile VLAN PVID configurations are basically the same, except for the matching of the Ethernet type.

Specifying CoS according to the Ethernet type is effective for adding the default VLAN behavior to untagged packets in other modes other than VLAN transparent transmission mode, which is higher than the gpon-profile vlan pvid configuration. At the same time, it is also valid for VLAN entries in VLAN translation mode, overlay mode, and aggregation mode, as well as for VLAN trunk mode allowed to pass through VLAN. When CoS is not configured to specify based on Ethernet type, the default CoS is specified by the gpon-profile vlan pvid configuration, which defaults to 0.

The Ethernet-type packet forwarding feature takes effect for all VLAN modes except the custom mode and the old style mode.

After you configure that Ethernet packets are not allowed to be forwarded, all VLAN configurations of the Ethernet type are deleted, except for the custom mode and the old style mode.

Example

The ONU VLAN profile vlan-test uses VLAN 89 for IPv4 and ARP packets, starting from 100 and stepping by 4 for the ONU sequence number (that is, the ONU with sequence number 1/2/3 corresponds to VLAN 100/104/108), and IPv4 packets CoS 3 is used, CoS 0 is used for ARP packets, CoS 2 is used for PPPoE packets, and IPv6 packets are discarded

The ONU VLAN profile vlan-test uses VLAN 89 for IPv4 and ARP packets, starting from 100 and stepping by 4 for the ONU sequence number (that is, the ONU with sequence number 1/2/3 corresponds to VLAN 100/104/108), and IPv4 packets CoS 3 is used, CoS 0 is used for ARP packets, CoS 2 is used for PPPoE packets, and IPv6 packets are discarded.

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan ether-type ipoe vlan 89 config-gpon-profile# gpon-profile vlan ether-type arp vlan 89

config-gpon-profile# gpon-profile vlan ether-type pppoe step-vlan 100 4 config-gpon-profile# gpon-profile vlan ether-type ipoe cos 3

config-gpon-profile# gpon-profile vlan ether-type arp cos 0 config-gpon-profile# gpon-profile vlan ether-type pppoe cos 2 config-gpon-profile# gpon-profile vlan ether-type ipv6 drop

59.11.10 gpon-profile vlan filter-default-tpid

Syntax

gpon-profile vlan filter-default-tpid*tpid*

no gpon-profile vlan filter-default-tpid

To configure the default TPID of the VLAN matching rule for the ONU user port, run the above commands.

Parameter Description

Parameter	Parameter Description
tpid	Configure the default TPID of the port VLAN matching rule, ranging 0x0000-0xFFFF

Default Value

0x8100

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

The default TPID configuration for the port VLAN matching rule has effect for VLAN Legacy Style Mode None.

In custom-entry, you can set the TPID of the matching rule to by-default-tpid to filter by the default TPID.

Currently, TPID filtering is not directly applied to extended VLAN modes other than custom mode, but the default TPID of VLAN matching rules is also delivered, and the ONU implementation may perform VLAN label recognition based on the configured default TPID.

Example

The default TPID for the matching rules of ONU VLAN template vlan-test configuring VLAN is 0x9100:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan filter-default-tpid 0x9100

59.11.11 gpon-profile vlan treatment-default-tpid

Syntax

gpon-profile vlan treatment-default-tpid*tpid*

no gpon-profile vlan treatment-default-tpid

To configure the default TPID for the VLAN behavior of the ONU user port, run the above commands.

Parameter Description

Parameter	Parameter Description
tpid	Configure the default TPID for port VLAN behavior, ranging 0x0000-0xFFFF

Default Value

0x8100

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

The default TPID configuration for port VLAN behavior is not valid for VLAN legacy style mode。

In custom-entry, you can set the TPID of the behavior (treatment) to by-default-tpid to process the treatment according to the default TPID.

At present, for the extended VLAN mode other than the custom mode, the TPID processing is not directly applied as the default TPID, but the default TPID of the VLAN behavior will also be delivered, and for the case of adding the VLAN Tag operation without a tag, and copying the TPID from inner tag, the ONU implementation may use the default TPID of the configured VLAN behavior.

Example

ONU VLAN template vlan-test sets the default TPID of the port VLAN behavior to 0x9100

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan treatment-default-tpid 0x9100

59.11.12 gpon-profile vlan dscp-to-cos-mapping

Syntax

gpon-profile vlan dscp-to-cos-mapping *cos-valdscp-list*

no gpon-profile vlan dscp-to-cos-mapping

To configure the mapping rules from the ONU user port VLAN DSCP to the CoS, run the above command.

Parameter Description

Parameter	Parameter Description
cos-val	The mapped CoS value, in the range of 0-7
dscp-list	List of DSCP before mapping, e.g. 0,21-42,63, dscp range 0-63

Default Value

For DSCP 0-7 corresponds to CoS 0, DSCP 8-15 corresponds to CoS 1,... , DSCP 56-63 corresponds to CoS 7, and so on.

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

The port VLAN DSCP to CoS mapping rule configuration is not valid for the VLAN legacy style pattern.

DSCP that is not configured will maintain the default mapping. No operation will restore all mappings to the Default Value value.

Example

ONU VLAN template vlan-test configures the mapping rules of port VLAN DSCP to CoS as follows: dscp 0-20 to cos7, dscp 35, 45-50 to cos1, and others to keep the default mapping:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan dscp-to-cos-mapping 7 0-20

config-gpon-profile# gpon-profile vlan dscp-to-cos-mapping 1 35,45-50

59.11.13 gpon-profile vlan custom-downstream-mode

Syntax

gpon-profile vlan custom-downstream-mode {**inverse-all** | **transparent-all** | **discard-all**}

gpon-profile vlan custom-downstream-mode inverse {**vlan** | **cos** | **vlan-and-cos**} **no-match** {**transparent** |**discard**}

no gpon-profile vlan custom-downstream-mode

To configure the downlink mode of the ONU user port VLAN in custom mode, run the above commands.

Parameter Description

Parameter	Parameter Description
inverse-all	All operations are the opposite of the uplink. The specific reverse configuration and the behavior of processing frames with no match are determined by the ONU implementation
transparent- all	Transparently transmit all frames
discard-all	Discard all frames
inverse	Configure the field that does the opposite
no-match	Configure the handling behavior for frames with no matches
vlan	Do the opposite for VLANs
cos	Do the opposite for CoS
vlan-and-cos	Do the opposite for VLANs and CoS
transparent	Frame pass-through with no match
discard	Frame drops with no matches

Default Value

All operations are the opposite of the uplink.

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

Valid only for custom mode.

Example

ONU VLAN Profile vlan-test: Configure the downstream mode of the port VLAN custom mode to perform the opposite operation on the VLAN and CoS, and the frame pass-through with no match is performed:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan custom-downstream-mode inverse vlan-and-cos no-match transparent

59.11.14 gpon-profile vlan custom-entry filter

Syntax

gpon-profile vlan custom-entry *index* **filter no-tag** [**ether-type** {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**}]

gpon-profile vlan custom-entry *index* **filter single-tag** [**inner-vlan** *ivid*] [**inner-cos** *icos*] [**inner-tpid** {**0x8100** | **by-default-tpid** [**dei** {**0** | **1**}]}] [**ether-type** {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**}]

gpon-profile vlan custom-entry *index* **filter single-tag default**

gpon-profile vlan custom-entry *index* **filter double-tag** [**outer-vlan** *ovid*] [**outer-cos** *ocos*] [**outer- tpid** {**0x8100** | **by-default-tpid** [**dei** {**0** | **1**}]}] [**inner-vlan** *ivid*] [**inner-cos** *icos*] [**inner-tpid** {**0x8100** | **by-default-tpid** [**dei** {**0** | **1**}]}] [**ether-type** {**ipoe** | **pppoe** | **arp** | **ipv6** | **eapol**}]

gpon-profile vlan custom-entry *index* **filter double-tag default**

Configure the matching rules for the custom entries of the VLAN on the user port of the ONU.

no gpon-profile vlan custom-entry *index*

To delete the custom entry of the ONU user port VLAN, run the command.

Parameter Description

Parameter	Parameter Description
index	Index of port VLAN custom entries, ranging from 1 to 30
no-tag	Match the Nonetag frame
single-tag	Match single-tag frames
double-tag	Match double-tag frames
default	The default matching rule when there are no other matching entries for

	single or double tag frames
outer-vlan	Matching rules filter the outer VLANs
inner-vlan	Matching rules filter the inner VLANs
outer-cos	Matching rules filter the outer layer of CoS
inner-cos	Matching rules filter the inner layer of CoS
outer-tpid	Matching rules filter the outer TPID
inner-tpid	Matching rules filter the inner TPID
dei	Matching rules filter the outer or inner layer of DEI
ether-type	Matching rules filter Ethernet types
ovid	Configure filtered outer VLANs in the range 1-4094
ivid	Configure filtered inner VLANs in the range 1-4094
ocos	Configure the outer layer of CoS for filtration, ranging from 0-7
icos	Configure the inner layer of filtered CoS, ranging from 0 to 7
0x8100	Set the outer or inner TPID of the filtered layer to 0x8100
by-default-tpid	The outer or inner TPID for which filtering is configured is obtained from the default TPID
0	The DEI of the outer or inner layer of the configured filter is 0
1	The DEI of the outer or inner layer of the configured filter is 1
ipoe | pppoe | arp | ipv6 | eapol	The Ethernet types for which filtering is configured are 0x0800, 0x8863 or 0x8864, 0x0806, 0x86DD, 0x888E

Default Value

None

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

Valid only for custom mode.

Fields that are not configured are not filtered by default.

The size of the index determines the order of delivery, but the matching order of the entries is related to the size of the index, and the matching order is determined by the size of each field of the filter. The default matching rule configured as default is always at the end of the matching order.

Each index entry can be configured with a filter and a treatment, and configuring other filters/treatment will override the previous corresponding configuration.

If you create a filter first, treatment remove-tag 0 will be automatically generated, and if treatment is created first, a matching rule of filter no-tag will be automatically generated without filtering other fields.

The no operation deletes the entire VLAN custom entry, including the matching rule (filter) and the processing behavior (treatment). Currently, a maximum of 30 VLAN custom entries are supported.

Example

ONU VLAN Template vlan-test Configure the index of the port VLAN custom entry is 10, the matching rule is to match a single tag frame, the inner VLAN is 100, the inner TPID is determined by the default TPID, the Ethernet type is ipoe, and CoS and DEI are not filtered:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan custom-entry 10 filter single-tag inner-vlan 100 inner-tpid by-default-tpid ether-type ipoe

59.11.15 gpon-profile vlan custom-entry treatment

Syntax

gpon-profile vlan custom-entry *index* **treatment discard-frame**

gpon-profile vlan custom-entry *index* **treatment remove-tag** {**0** | **1** | **2**} [**add-inner-tag vlan** {*new- ivid* | **by-inner-vlan** | **by-outer-vlan**} **cos** {*new-icos* | **by-inner-cos** | **by-outer-cos** | **by-dscp**} **tpid**

{**by-inner-tpid** | **by-outer-tpid** | **0x8100** | **by-default-tpid dei** {**by-inner-dei** | **by-outer-dei** | **0** | **1**}}

[**add-outer-tag vlan** {*new-ovid* | **by-inner-vlan** | **by-outer-vlan**} **cos** {*new-ocos* | **by-inner-cos** | **by-outer-cos** | **by-dscp**} **tpid** {**by-inner-tpid** | **by-outer-tpid** | **0x8100** | **by-default-tpid dei** {**by-inner-dei** | **by-outer-dei** | **0** | **1**}}]]

To configure the processing behavior of custom entries for VLANs on ONU user ports, run the above commands.

no gpon-profile vlan custom-entry *index*

To delete the custom entry of the ONU user port VLAN, run the above command.

Parameter Description

Parameter	Parameter Description
index	Index of port VLAN custom entries, ranging from 1 to 30
discard-frame	Matching frames are discarded
remove-tag	Matching frames are removed as tags (not removed if the number of tags removed is 0)
0 | **1** | **2**	The number of tags removed. When it is 0, the tag is not removed; When it is 1, the tag is removed for a single tag frame, and the outer tag is removed for a double tag frame; 2 to remove all tags.
add-inner-tag	Add an inner tag
add-outer-tag	Add an outer tag
vlan	Configure the VLAN of the added tag
cos	Configure the CoS of the added tag
tpid	Configure the TPID of the added tag
dei	Configure the DEI of the added tag
new-ivid	Specify the VLAN of the inner tag, ranging from 1 to 4094
new-ovid	Specify the VLAN of the outer tag, ranging from 1 to 4094
by-inner-vlan	The added VLAN of the tag uses the inner VLAN of the original frame
by-outer-vlan	The VLAN of the added tag uses the outer VLAN of the original frame
new-icos	Specify the CoS of the inner voltage, ranging from 0-7
new-ocos	Specify the outer voltage of CoS, ranging from 0-7
by-inner-cos	The added tag of the CoS uses the inner CoS of the original frame
by-outer-cos	The added tag of CoS uses the outer CoS of the original frame

by-dscp	The added tag of CoS is obtained by DSCP mapping
by-inner-tpid	The TPID of the added tag uses the inner TPID of the original frame
by-outer-tpid	The added tag TPID uses the outer TPID of the original frame
0x8100	The TPID of the added tag is specified as 0x8100
by-default-tpid	The TPID of the added tag is obtained from the default TPID
by-inner-dei	The added tag DEI uses the inner DEI of the original frame
by-outer-dei	The added tag of DEI uses the outer DEI of the original frame
0	The DEI of the added tag is specified as 0
1	The DEI of the added tag is specified as 1

Default Value

None

Command Mode

ONU VLAN template configuration mode

Usage Guidelines

Valid only for custom mode.

Modifications to tags can be achieved by a combination of removal and addition.

Each index entry can be configured with a filter and a treatment, and configuring other filters/treatment will override the previous corresponding configuration.

If you create a filter first, treatment remove-tag 0 will be automatically generated, and if treatment is created first, a matching rule of filter no-tag will be automatically generated without filtering other fields.

The no operation deletes the entire VLAN custom entry, including the matching rule (filter) and the processing behavior (treatment). Currently, a maximum of 30 VLAN custom entries are supported.

Example

ONU VLAN template vlan-test configuration port VLAN custom entry index is 10, the processing behavior is to remove layer 1 tag, and then add the inner layer tag, VLAN is 200, CoS is obtained by DSCP mapping, TPID uses the inner layer TPID of the original frame:

OLT(config)# gpon profile onu-vlan vlan-test

config-gpon-profile# gpon-profile vlan custom-entry 10 treatment remove-tag 1 add-inner-tag vlan 200 cos by-dscp tpid by-inner-tpid

59.11.16 gpon onu vlan-profile

Syntax

gpon onu uni *port***vlan-profile** *vlan-prof-name* **no gpon onu uni** *port***vlan-profile**

To configure the ONU Ethernet user port reference ONU VLAN profile configuration, run the above commands.

gpon onu ip-host *port* **vlan-profile** *vlan-prof-name* **no gpon onu ip-host** *port* **vlan-profile**

To configure the ONU IP host port reference ONU VLAN profile configuration, run the above commands.

gpon onu veip *port* **vlan-profile** *vlan-prof-name* **no gpon onu veip** *port* **vlan-profile**

To configure the ONU VLAN profile configuration for the ONU virtual Ethernet access port, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
vlan-prof-name	Name of VLAN template

Default Value

The VLAN profile configuration is not referenced, and the VLAN profile is transparently transmitted.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

If no VLAN template configuration is referenced, the OLT does not deliver VLAN template configurations. If a VLAN template has been referenced and the corresponding reference is deleted, the OLT will deliver the VLAN transparent transmission configuration on each configuration on this port, that is, the VLAN transparent transmission mode configuration, and if the old style mode is deleted, the transparent transmission configuration of the old style mode will be delivered.

Example

Ethernet user port 2 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the VLAN profile vlan-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 vlan-profile vlan-test

59.11.17 show gpon interface onu uni-vlan-config

Syntax

show gpon interface *onu-intf-name* **onu uni-vlan-config** [**remote**]

To display the VLAN configuration of all user ports of the ONU, run the above commands.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
remote	Get it from the ONU in real time

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

If the user port does not refer to the configuration of the ONU VLAN template, this command will not display the VLAN configuration of the corresponding port.

If there is a remoteParameter to obtain the configuration from the ONU in real time, this command will still attempt to obtain the configuration from the ONU even if the user port does not have a configuration that references the ONU VLAN template.

Example

Check the local VLAN configurations of all user ports of the ONU corresponding to port gpon0/0:1:1 and the VLAN configurations obtained from the ONU in real time.

OLT# show gpon interface gpon0/0/1:1 onu uni-vlan-config

---

gpon0/0/1:1 vlan config of eth-uni 2

VLAN Mode: tag Pvid: 122

Def-cos: 0

Filter-default-tpid: 0x8100

Treatment-default-tpid: 0x8100 Dscp-to-cos-mapping:

0,1-7 => 0 8-15 => 1 16-23 => 2 24-31 => 3 32-39 => 4 40-47 => 5 48-55 => 6 56-63 => 7

OLT# show gpon interface gpon0/0/1:1 onu uni-vlan-config remote

---

gpon0/0/1:1 vlan config of eth-uni 2

ME class: Extended VLAN tagging operation configuration data Received frame VLAN tagging operation table max size: 0

Input TPID: 0x8100

Output TPID: 0x8100

Downstream mode: 0 (inverse-all)

DSCP to P-bit mapping: 0000002492494924926db6db924924b6db6ddb6db6ffffff

0,1-7 => 0 8-15 => 1 16-23 => 2 24-31 => 3 32-39 => 4 40-47 => 5 48-55 => 6 56-63 => 7

Received frame VLAN tagging operation table: 2 entries

|Filter |Treatment

```
|
Index|Outer                    |Inner                    |Ethertype|TagsToRemove|Outer
|Inner                    |
|Priority VID TPID/DEI|Priority VID TPID/DEI|          |          |Prior
ity VID TPID/DEI|Priority VID TPID/DEI|
----- ------- ---- -------- ------- ---- -------- --------- ---------- -----

1       15 4096    0b000       15 4096    0b000          0          0
15    0    0b000         0  122    0b000
2       15 4096    0b000       14 4096    0b000          0          3
15    0    0b000         15    0    0b000
```

Remote parameter is supported in Linux2 system.

59.12 ONU MAC Address Filtering Configuration Commands

59.12.1 gpon profile onu-mac-filter

Syntax

gpon profile onu-mac-filter *mac-filter-prof-name*

To create an ONU MAC address filter profile and enter the MAC address filter template configuration mode, run the above command.

no gpon profile onu-mac-filter *mac-filter-prof-name*

To delete the ONU MAC address filter template, run the above command.

Parameter Description

Parameter	Parameter Description
mac-filter-prof-name	The name of the MAC address filtering template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named mac-filter-prof-name does not exist, create a template and enter the ONU MAC address filter template configuration mode, otherwise go directly to the configuration mode of the MAC address filter template.

In the ONU MAC address filtering template, you can configure the user port to forward or filter MAC addresses in the specified list. WHEN USING MAC

In forwarding mode, packets hit by MAC addresses in the list will be forwarded and discarded when they are not in the list. If the filter mode is used, the MAC address of the packet will be discarded if it hits in the list and forwarded if it is not in the list.

Example

Create/configure the ONU MAC address filtering template mac-filter-test.

OLT(config)# gpon profile onu-mac-filter mac-filter-test

59.12.2 gpon-profile filtertype

Syntax

gpon-profile filtertype {**filter** | **forword**}

To configure ONU MAC address filter mode, run the above command.

Parameter Description

Parameter	Parameter Description
filter	The MAC address of the packet is discarded if it hits in the filtered list, and forwarded if it is not in the list
forword	The MAC address of the packet will be forwarded if it hits in the filter list and will be discarded if it is not in the list

Default Value

forword , the MAC address of the packet will be forwarded if it hits in the filter list and will be discarded if it is not in the list

Command Mode

ONU MAC address filter template configuration mode

Usage Guidelines

None

Example

ONU MAC address filtering profile mac-filter-test: Configure the port MAC address filtering mode to hit list drop, miss forwarding

OLT(config)# gpon profile onu-mac-filter mac-filter-test config-gpon-profile# gpon-profile filtertype filter

59.12.3 gpon-profile entry

Syntax

gpon-profile entry *num* { **src** | **dst** } *AA:BB:CC:DD:EE:FF*

To configure ONU MAC address filtering entries, run the above command.

no gpon-profile entry *num*

To delete the ONU MAC, run the above command.

Parameter Description

Parameter	Parameter Description
num	Specified MAC address filtering entry index, ranging from 1 to 40
src	The matching MAC address is the source address
dst	The matching MAC address is the destination address
AA:BB:CC:DD:EE:FF	Matching MAC address

Default Value

None

Command Mode

ONU MAC address filter template configuration mode

Usage Guidelines

None

Example

The MAC-filter-test configuration port of the MAC address filtering profile MAC Address Filter-Test discards packets whose source MAC addresses are 00:01:00:01:00:01 and 00:01:00:00:00:02, and all other packets are forwarded.

OLT(config)# gpon profile onu-mac-filter mac-filter-test config-gpon-profile# gpon-profile filtertype filter

config-gpon-profile# gpon-profile entry 1 src 00:01:00:01:00:01 config-gpon-profile# gpon-profile entry 2 src 00:01:00:01:00:02

59.12.4 gpon onu mac-filter-profile

Syntax

gpon onu uni *port* **mac-filter-profile** *mac-filter-prof-name* **no gpon onu uni** *port* **mac-filter-profile**

Configure the ONU Ethernet user port reference MAC address filter template.

gpon onu virtual-port *port* **mac-filter-profile** *mac-filter-prof-name*

no gpon onu virtual-port *port* **mac-filter-profile**

Configure the ONU virtual port reference MAC address filter profile configuration.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
mac-filter-prof-name	The name of the MAC address filter template, 1-48 characters

Default Value

The MAC address filtering profile configuration is not referenced, and traffic is not filtered for MAC addresses.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The G.988 protocol specifies that MAC address filtering is used to filter the egress traffic on the corresponding port. Therefore, if you need to filter the upstream traffic, you should use the virtual port reference MAC address filter template configuration. If you want to filter downstream traffic, then you should use the Ethernet User Port Reference MAC Address Filtering Template configuration.

Example

The virtual port 1 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the MAC address filtering profile mac-filter-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu virtual-port 1 mac-filter-profile mac-filter-test

59.13 ONU Storm Control Configuration Commands

59.13.1 gpon profile onu-storm-control

Syntax

gpon profile onu-storm-control *storm-prof-name*

To create an ONU storm control profile and enter the storm control profile configuration mode, run the above command.

no gpon profile onu-storm-control

storm-prof-name

To delete the ONU storm control template, run the above command.

Parameter Description

Parameter	Parameter Description
storm-prof-name	The name of the storm control template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named storm-prof-name does not exist, create a template and enter the ONU storm control template configuration mode, otherwise you can directly enter the configuration mode of the storm control template.

In the ONU storm control template, you can configure traffic limits for uplink broadcasting, multicast, and unknown unicast in the corresponding Layer 2 forwarding domain to prevent abnormal upstream traffic from the ONU from impacting the uplink network.

Example

The following example shows how to create or configure the ONU storm control profile storm-test.

OLT(config)# gpon profile onu-storm-control storm-test

59.13.2 gpon-profile storm-control upstream

Syntax

gpon-profile storm-control upstream broadcast *rate-limit-prof-name*

no gpon-profile storm-control upstream broadcast

To configure the rate limit policy for the onu uplink broadcast storm control, run the above command.

gpon-profile storm-control upstream multicast *rate-limit-prof-name*

no gpon-profile storm-control upstream multicast

To configure an ONU uplink multicast storm control rate limit policy, run the above command.

gpon-profile storm-control upstream unicast *rate-limit-prof-name*

no gpon-profile storm-control upstream unicast

To configure an ONU uplink unknown unicast storm rate limit policy, run the above command.

Parameter Description

Parameter	Parameter Description
rate-limit-prof-name	The name of the speed limit template referenced by the storm control

Default Value

None，the corresponding traffic is not subject to storm control rate limit

Command Mode

ONU storm control profile configuration mode

Usage Guidelines

The storm rate limiting policy takes effect only for upstream traffic and None for downstream traffic.

Example

The ONU storm control profile storm-test is configured to refer to the configuration of the rate limiting profile rt-st-bc for the uplink broadcast storm control policy, the configuration of the rate limiting profile rt-st-mc for the uplink multicast storm control policy, and the configuration of the rate limiting profile rt-st-nuc for the uplink unknown unicast storm control policy

OLT(config)# gpon profile onu-storm-control storm-test

config-gpon-profile# gpon-profile storm-control upstream broadcast rt-st-bc

config-gpon-profile# gpon-profile storm-control upstream multicast rt-st-mc

config-gpon-profile# gpon-profile storm-control upstream unicast rt-st-nuc

59.13.3 gpon-profile entry storm-control

Syntax

gpon-profile entry *index* **storm-control** *storm-prof-name*

no gpon-profile entry *index* **storm-control**

To configure traffic mapping entry referring to the ONU Storm Control template configuration, run the command.

Parameter Description

Parameter	Parameter Description
index	Index of specified traffic map entries, ranging from 1-40
storm-prof-name	The name of the referenced ONU storm control template

Default Value

None，no storm control

Command Mode

ONU traffic mapping template configuration mode

Usage Guidelines

Storm Control is actually configured on the Dot1 rate limiter , which points to the MAC Bridge Service generated by the traffic mapping entries , if multiple traffic mapping entries actually correspond to the same MAC Bridge Service For example, if multiple user service ports are listed to different traffic mapping entries and reflected to the same virtual port, or a user service port is mapped to different virtual ports through different filter conditions, then only the storm control function configuration corresponding to the first traffic mapping entry takes effect.

For other configurations of the ONU Traffic Mapping profile and the reference configuration commands, see the section on ONU Traffic Mapping Commands.

Example

The following example shows how to configure entries with index 2 in the ONU traffic mapping profile flowmap-test to load the storm control function from the storm control profile storm-test:

OLT(config)# gpon profile onu-flow-mapping flowmap-test

config-gpon-profile# gpon-profile entry 2 storm-control storm-test

59.14 ONU Group Multicast Configuration Commands

59.14.1 gpon profile onu-mcst-oper

Syntax

gpon profile onu-mcst-oper *mcst-oper-prof-name*

To create an ONU multicast behavior template and enter the multicast behavior configuration mode, run the above command.

no gpon profile onu-mcst-oper *mcst-oper-prof-name*

To delete the ONU multicast behavior profile, run the above command.

Parameter Description

Parameter	Parameter Description
mcst-oper-prof-name	Name of the multicast behavior template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

When a template named mcst-oper-prof-name does not exist, create a template and enter the ONU multicast behavior profile configuration mode, otherwise it directly enters the configuration mode of the multicast behavior profile.

In the ONU multicast behavior profile, you can configure the parameters for multicast operation on the ONU user port, including the multicast protocol version, control mode, fast group departure, maximum number of concurrent groups, VLAN tag processing, and configuration of each protocol parameter.

Example

The following example shows how to create/configure the ONU multicast behavior template mcst-oper-test.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

59.14.2 gpon-profile igmp-version

Syntax

gpon-profile igmp-version {*num* | **MLDv1** | **MLDv2**}

no gpon-profile igmp-version

To configure the multicast protocol version on which the ONU runs, run the above command.

Parameter Description

Parameter	Parameter Description
num	The version number of the running IPv4 IGMP, ranging from 1 to 3
MLDv1	Running IPv6 MLDv1
MLDv2	Running IPv6 MLDv2

Default Value

Operating IGMPv2

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

None

Example

The ONU multicast behavior template mcst-oper-test configures the ONU user port to run IGMPv3 :

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile igmp-version 3

59.14.3 gpon-profile multicast-control-mode

Syntax

gpon-profile multicast-control-mode {**igmp-snooping** | **igmp-spr** | **igmp-proxy**}

no gpon-profile multicast-control-mode

To configure the multicast mode in which the ONU runs, run the above commands.

Parameter Description

Parameter	Parameter Description
igmp-snooping	Run IGMP snooping working mode
igmp-spr	Run the IGMP snooping with proxy reporting working mode
igmp-proxy	Run the IGMP proxy working mode

Default Value

Run IGMP snooping working mode

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

None

Example

The multicast behavior profile mcst-oper-test of the ONU user port is configured to run the IGMP proxy working mode:

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile multicast-control-mode igmp-proxy

59.14.4 gpon-profile fast-leave-mode

Syntax

gpon-profile fast-leave-mode {**enable** | **disable**}

no gpon-profile fast-leave-mode

To configure the ONU multicast fast off-group enablement, run the above command.

Parameter Description

None

Default Value

Disable fast degrouping

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

None

Example

The MCU multicast behavior profile mcst-oper-test enables fast group departure on the ONU user port.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile fast-leave-mode enable

59.14.5 gpon-profile max-simultaneous-group

Syntax

gpon-profile max-simultaneous-group *num*

no gpon-profile max-simultaneous-group

To configure the maximum number of concurrent groups allowed for ONU multicast, run the above command.

Parameter Description

Parameter	Parameter Description
num	Maximum number of concurrent groups

Default Value

There is no limit to the number of concurrent groups

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

The ONU counts only the number of concurrent groups for dynamic multicast entries and restricts new dynamic multicast groups based on the maximum number of concurrent groups.

Example

The ONU multicast behavior profile mcst-oper-test configures the maximum number of concurrent groups allowed on the ONU user port to 4 :

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile max-simultaneous-group 4

59.14.6 gpon-profile max-mcst-bandwidth

Syntax

gpon-profile max-mcst-bandwidth *bw*

no gpon-profile max-mcst-bandwidth

To configure the maximum multicast bandwidth of the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
bw	The maximum multicast bandwidth in kbps ranges from 1 to 2,488,320

Default Value

There is no limit on the maximum multicast bandwidth

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

The ONU collects multicast bandwidth statistics only for dynamic multicast entries, and adds up the bandwidth corresponding to the gpon-profileentry *index* imputed-group-bandwidth *bw for all dynamic multicast entries that have been added* If the cumulative bandwidth is less than the maximum multicast bandwidth configured in this command, the group is allowed, otherwise the new dynamic multicast group request is not allowed.

Example

The ONU multicast behavior profile mcst-oper-test sets the maximum multicast bandwidth of the ONU user port to 100 mbps.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile max-mcst-bandwidth 100000

59.14.7 gpon-profile upstream-igmp-tag

Syntax

gpon-profile upstream-igmp-tag {**transparent** | **add** *vlanid* [*cos* [*dei*]] | **replace** *vlanid* [*cos* [*dei*]]}

no gpon-profile upstream-igmp-tag

To configure VLAN tag processing for ONU multicast to uplink multicast protocol packets, run the above command:

Parameter Description

Parameter	Parameter Description
transparent	Transparent transmission
add	Add an outer VLAN tag
replace	Replace the VLAN tag
vlanid	Add or replace the destination VLAN ID
cos	The destination VLAN CoS that is added or replaced
dei	The target VLAN DEI that is added or replaced

Default Value

Transparent transmission

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

When configured to add an outer VLAN tag, if no CoS or DEI is specified, 0 is used for the corresponding parameter.

If no CoS is specified, only the VLAN ID is replaced and the CoS is not modified. If a CoS has been specified but no DEI has been specified, the DEIParameter uses 0.

Example

The ONU multicast behavior profile mcst-oper-test sets the user port to 2999 for the VLAN for the uplink multicast protocol packets, and specifies CoS to 5 and DEI to 0.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile upstream-igmp-tag replace 2999 5 0

59.14.8 gpon-profile downstream-mcst-tag

Syntax

gpon-profile downstream-mcst-tag {**transparent** | **strip** | **add** *vlanid* [*cos* [*dei*]] | **replace** *vlanid* [*cos* [*dei*]]}

no gpon-profile downstream-mcst-tag

To configure ONU multicast processing of downlink multicast protocol packets and multicast data packets, run the above commands.

Parameter Description

Parameter	Parameter Description
transparent	Transparent transmission
add	Add an outer VLAN tag
strip	Strip the outer VLAN tag
replace	Replace the VLAN tag
vlanid	Add or replace the destination VLAN ID
cos	The destination VLAN CoS that is added or replaced
dei	The target VLAN DEI that is added or replaced

Default Value

Transparent transmission

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

Note that multicast protocol packets and multicast data packets are processed in the same way.

When configured to add an outer VLAN tag, if no CoS or DEI is specified, 0 is used for the corresponding parameter.

If no CoS is specified, only the VLAN ID is replaced and the CoS is not modified. If a CoS has been specified but no DEI has been specified, the DEIParameter uses 0.

Example

The MCST-oper-test multicast behavior profile for the ONU is configured to strip the user port from the outbound VLAN Tag for downstream multicast protocol packets and multicast data packets:

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile downstream-mcst-tag strip

59.14.9 gpon-profile robustness

Syntax

gpon-profile robustness *num*

no gpon-profile robustness

To configure the ONU multicast robustness variable, run the above command.

Parameter Description

Parameter	Parameter Description
num	Multicast robustness variables, range 1-7

Default Value

When snooping IGMPv3/MLDv2, the robustness variable synchronized from the uplink network Query packet is used. Other cases use a value defined by the ONU implementation.

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

None

Example

The ONU multicast behavior template mcst-oper-test configures the user port multicast robustness variable to 3 :

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile robustness 3

59.14.10 gpon-profile query-interval

Syntax

gpon-profile query-interval *num*

no gpon-profile query-interval

To configure the ONU multicast query interval, run the above commands.

Parameter Description

Parameter	Parameter Description
num	Multicast general query interval, in seconds, in the value range: 1~3600

Default Value

125 seconds.

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

The multicast generic query interval is valid only if the ONU is working in IGMP proxy mode.

Example

The MCST-oper-test multicast behavior template for ONU sets the general multicast query interval of a user port to 90 seconds.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile query-interval 90

59.14.11 gpon-profile response-time

Syntax

gpon-profile response-time *num*

no gpon-profile response-time

To configure the maximum response time for multicast generic queries on the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
num	The maximum response time for multicast general queries is 0.1 seconds, and the value range is 1~36000

Default Value

10 seconds

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

The maximum response time for multicast generic queries is valid only when the ONU is working in IGMP proxy mode.

Example

The multicast behavior template mcst-oper-test configures the maximum response time of multicast general queries on user ports to 18.5 seconds.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile response-time 185

59.14.12 gpon-profile last-member-query-interval

Syntax

gpon-profile last-member-query-interval *num*

no gpon-profile last-member-query-interval

To configure the query interval for the last member of the ONU multicast to leave the group, run the above command.

Parameter Description

Parameter	Parameter Description
num	The query interval of the last member leaving the group, unit: 0.1 seconds, range 1-65535

Default Value

1s

Command Mode

ONU multicast behavior template configuration mode

Usage Guidelines

The multicast last member out-of-group query interval is valid only if the ONU is working in IGMP proxy mode.

Example

The ONU multicast behavior template mcst-oper-test sets the time interval for the last member of multicast on a user port to be queried out of the group in 2.3 seconds.

OLT(config)# gpon profile onu-mcst-oper mcst-oper-test

config-gpon-profile# gpon-profile last-member-query-interval 23

59.14.13 gpon onu mcst-oper-profile

Syntax

gpon onu uni *port* **mcst-oper-profile** *mcst-oper-prof-name* **no gpon onu uni** *port* **mcst-oper-profile**

To configure the ONU Ethernet user port reference multicast behavior profile configuration, run the above command.

gpon onu veip *port* **mcst-oper-profile** *mcst-oper-prof-name* **no gpon onu veip** *port* **mcst-oper-profile**

To configure the ONU virtual Ethernet access port to reference the multicast behavior template, run the above command.

gpon onu ip-host *port* **mcst-oper-profile** *mcst-oper-prof-name*

no gpon onu ip-host *port* **mcst-oper-profile**

To configure ONU IP host port reference multicast behavior profile configuration, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
mcst-oper-prof-name	Name of the multicast behavior template

Default Value

The multicast behavior template configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

For the ONU multicast behavior template, the multicast configuration must be referenced in the same port to the ONU dynamic multicast entry configuration template or the ONU static multicast entry configuration template.

Because multiple ports may be associated to the same MAC Bridge Service in a traffic mapping template, enabling multicast on one port will connect the downstream multicast GEM Port to the MAC Bridge Service, potentially affecting all user ports under it, causing ports that are not configured for multicast to always receive multicast traffic. When a port is configured to enable multicast configuration, the OLT considers that the ONU needs to have multicast control, and the OLT will issue multicast configuration to all ports that have not been multicast configured, specifying that the dynamic and static multicast entries are empty, that is, no multicast is allowed.

In order for ONU multicast to work, the multicast function of the OLT must be enabled at the same time, and the configuration is described in the GPON Multicast Configuration Command.

Example

Ethernet user port 2 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the multicast behavior profile mcst-oper-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 mcst-oper-profile mcst-oper-test

59.14.14 gpon profile onu-mcst-static-group

Syntax

gpon profile onu-mcst-static-group *mcst-static-group-prof-name*

To create an ONU multicast static entry profile and enter the multicast static entry configuration mode, run the above command.

no gpon profile onu-mcst-static-group *mcst-static-group-prof-name*

To delete the ONU multicast static entry template, run the above command.

Parameter Description

Parameter	Parameter Description
mcst-static-group-prof-name	The name of the multicast static entry template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named mcst-static-group-prof-name does not exist, create a template and enter the ONU multicast static entry template configuration mode, otherwise it will directly enter the configuration mode of the multicast static entry template.

In the ONU multicast static entry template, you can configure the multicast entry of the ONU user port None on whether there is a multicast protocol and a multicast entry that is always forwarded .

Example

Create/configure the ONU multicast static entry template mcst-static-test.

OLT(config)# gpon profile onu-mcst-static-group mcst-static-test

59.14.15 gpon profile onu-mcst-dynamic-group

Syntax

gpon profile onu-mcst-dynamic-group *mcst-dyn-group-prof-name*

To create an ONU multicast dynamic entry template to enter the multicast dynamic entry configuration mode, run the above command.

no gpon profile onu-mcst-dynamic-group *mcst-dyn-group-prof-name*

To delete the ONU multicast dynamic entry template, run the above command.

Parameter Description

Parameter	Parameter Description
mcst-dyn-group-prof-name	Name of the multicast dynamic entry template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named mcst-dyn-group-prof-name does not exist, create a template and enter the ONU multicast dynamic entry template configuration mode, otherwise it directly enters the configuration mode of the multicast dynamic entry template.

In the ONU multicast dynamic entry template, you can configure the multicast entries that the ONU user port allows forwarding when the corresponding multicast protocol is added.

Example

Create/configure the ONU multicast dynamic entry template mcst-dyn-test.

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

59.14.16 gpon-profile entry multicast-group-address- range

Syntax

gpon-profile entry *index* **multicast-group-address-range** *A.B.C.D* [**to** *E.F.G.H*]

gpon-profile entry *index* **multicast-group-address-range** *X:X:X:X::X* [**to** *Y:Y:Y:Y::Y*]

no gpon-profile entry *index* **multicast-group-address-range**

To configure the multicast group corresponding to the ONU user port multicast allow entry, run the commands.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
A.B.C.D	IPv4 multicast allows entries to start with IPv4 addresses corresponding to the range of multicast groups
E.F.G.H	IPv4 multicast allows entries to end IPv4 addresses in the corresponding multicast group range
X:X:X:X::X	IPv6 multicast allows entries to start IPv6 addresses for the corresponding multicast group range
Y:Y:Y:Y::Y	IPv6 multicast allows entries to end IPv6 addresses in the corresponding multicast group range

Default Value

None

Command Mode

ONU multicast dynamic entry template configuration mode or ONU multicast static entry template configuration mode

Usage Guidelines

A valid multicast dynamic or static entry must contain this designation for a multicast group. The configured address must be a valid IPv4 or IPv6 multicast address.

Example

The ONU multicast dynamic entry profile mcst-dyn-test configures that the allowed entry with index 1 is IPv4 multicast, and the multicast group range starts at 225.1.1.1 and ends at 225.1.3.255:

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 multicast-group-address-range 225.1.1.1 to 225.1.3.255

59.14.17 gpon-profile entry multicast-vlan-id

Syntax

gpon-profile entry *index* **multicast-vlan-id** *vid*

no gpon-profile entry *index* **multicast-vlan-id**

To configure the multicast VLAN ID of the ONU user port multicast allow entry.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
vid	Multicast allows entries corresponding to the multicast VLAN ID , range 1-4094

Default Value

Enable untagged multicast streams

Command Mode

ONU multicast dynamic entry template configuration mode or ONU multicast static entry template configuration mode

Usage Guidelines

None

Example

The ONU multicast dynamic entry template mcst-dyn-test configures the VLAN ID of the multicast allowed entry with index 1 to 2000:

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 multicast-vlan-id 2000

59.14.18 gpon-profile entry source-ip-address

Syntax

gpon-profile entry *index* **source-ip-address** *A.B.C.D*

gpon-profile entry *index* **source-ip-address** *X:X:X:X::X*

no gpon-profile entry *index* **source-ip-address**

To configure the multicast source address corresponding to the multicast allow entry on the ONU user port, run the above command.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
A.B.C.D	IPv4 multicast allows entries to correspond to the multicast source
X:X:X:X::X	IPv6 multicast allows entries to correspond to the multicast source

Default Value

Enable multicast streams from any source

Command Mode

ONU multicast dynamic entry template configuration mode or ONU multicast static entry template configuration mode

Usage Guidelines

None

Example

The multicast dynamic entry profile mcst-dyn-test of the ONU multicast dynamic entry configuration index 1 sets the multicast source address of the multicast allowed entry to IPv4 10.0.0.100 :

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 source-ip-address 10.0.0.100

59.14.19 gpon-profile entry imputed-group-bandwidth

Syntax

gpon-profile entry *index* **imputed-group-bandwidth** *bw*

no gpon-profile entry *index* **imputed-group-bandwidth**

To configure the multicast bandwidth corresponding to the multicast allowed entries on the ONU user port, run the command.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
bw	Multicast allows entries to have the corresponding multicast bandwidth, in kbps, in the range of 1-2488320

Default Value

Entries are allowed without multicast bandwidth limit

Command Mode

ONU multicast dynamic entry template configuration mode

Usage Guidelines

When the ONU receives a request to add a group, it confirms whether to allow the group addition based on the configured maximum multicast bandwidth limit of the ONU, the bandwidth of each dynamic entry of the added group, and the bandwidth corresponding to the request for a new group.

Example

The ONU multicast dynamic entry template mcst-dyn-test configures a multicast allowable entry with index 1 to have a multicast bandwidth of 4 Mbps :

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 imputed-group-bandwidth 4000

59.14.20 gpon-profile entry multicast-gemport

Syntax

gpon-profile entry *index* **multicast-gemport** *gem-port-id*

no gpon-profile entry *index* **multicast-gemport**

To configure the multicast GEM port corresponding to the ONU user port to allow the entry, run the above commands.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
gem-port-id	Multicast GEM Port , range 4093-4093

Default Value

The multicast GEM port for the allowed entry is 4093

Command Mode

ONU multicast dynamic entry template configuration mode or ONU multicast static entry template configuration mode

Usage Guidelines

Only one multicast GEM port can be supported on the same OLT physical port. The same multicast GEM port must be used for the multicast configuration of all ONUs under the PON port.

Example

The ONU multicast dynamic entry profile mcst-dyn-test is configured for a multicast allowed entry with index 1 and the multicast GEM port is 4093 :

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 multicast-gemport 4093

59.14.21 gpon-profile entry preview-length

Syntax

gpon-profile entry *index* **preview-length** *len*

no gpon-profile entry *index* **preview-length**

To configure the controllable multicast preview duration for the multicast entries on the ONU user port, run the above command.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
len	Preview duration, unit: seconds, range 1-65535

Default Value

Allowed entries are always allowed to have the permission to add groups, and no controllable multicast preview control is required

Command Mode

ONU multicast dynamic entry template configuration mode

Usage Guidelines

The ONU must support G.988-2012 to support the corresponding function.

Example

The MCST-dyn-test multicast dynamic entry template for ONU is configured to be 5 minutes in a single preview of a multicast allowed entry with index 1.

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 preview-length 300

59.14.22 gpon-profile entry preview-repeat-time

Syntax

gpon-profile entry *index* **preview-repeat-time** *repeat-time*

no gpon-profile entry *index* **preview-repeat-time**

To configure the minimum interval for controllable multicast preview for ONU user port multicast allowed entries, run the above commands.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
repeat-time	Preview minimum interval in seconds, range 1-65535

Default Value

No minimum interval

Command Mode

ONU multicast dynamic entry template configuration mode

Usage Guidelines

The ONU must support G.988-2012 to support the corresponding function.

This command configures the minimum interval between two previews in a controllable multicast preview cycle. If the number of previews in a multicast preview cycle has reached the limit, the interval configured by this command will not allow multicast previews.

Example

The ONU multicast dynamic entry template mcst-dyn-test is configured with index 1 to allow controllable multicast previews of entries with a minimum interval of 3 minutes

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 preview-repeat-time 180

59.14.23 gpon-profile entry preview-repeat-count

Syntax

gpon-profile entry *index* **preview-repeat-count** *repeat-count*

no gpon-profile entry *index* **preview-repeat-count**

To configure the number of controllable multicast previews for the multicast entries on the user port of the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
repeat-count	Previews, range 1-65535

Default Value

No limit on preview times

Command Mode

ONU multicast dynamic entry template configuration mode

Usage Guidelines

The ONU must support G.988-2012 to support the corresponding function.

This command configures the number of times a multicast preview can be allowed in a multicast preview cycle. If the number of previews in a multicast preview cycle has reached the limit, multicast previews will no longer be allowed in the current cycle, and you must wait until the next cycle to request a new preview after resetting the preview count.

Example

The MCST-dyn-test multicast dynamic entry template for ONU configures that the number of controllable multicast previews allowed for multicast entries with index 1 is 5 times.

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 preview-repeat-count 5

59.14.24 gpon-profile entry preview-reset-time

Syntax

gpon-profile entry *index* **preview-reset-time** *reset-time*

no gpon-profile entry *index* **preview-reset-time**

To configure the controllable multicast preview cycle reset time for the ONU user port multicast allow entry, run the above command.

Parameter Description

Parameter	Parameter Description
index	The user port allows multicast entry indexing, ranging from 1-40
reset-time	The preview period resets the time, ranging from 1 to 24, for example, 2 is 2:00 AM local time

Default Value

Controllable multicast preview cycle reset is not performed

Command Mode

ONU multicast dynamic entry template configuration mode

Usage Guidelines

The ONU must support G.988-2012 to support the corresponding function.

If the ONU does not have an accurate time configuration, any configuration with reset-time set to 1-24 is reset every 24 hours.

Example

The multicast dynamic entry profile mcst-dyn-test for the ONU multicast dynamic entry configuration index 1 allows the controllable multicast preview period to reset every day.

OLT(config)# gpon profile onu-mcst-dynamic-group mcst-dyn-test

config-gpon-profile# gpon-profile entry 1 preview-reset-time 4

59.14.25 gpon onu mcst-static-group-profile

Syntax

gpon onu uni *port* **mcst-static-group-profile** *mcst-static-group-prof-name*

no gpon onu uni *port* **mcst-static-group-profile**

To configure the ONU Ethernet user port reference multicast static entry template configuration, run the above command.

gpon onu veip *port* **mcst-static-group-profile** *mcst-static-group-prof-name*

no gpon onu veip *port* **mcst-static-group-profile**

To configure the ONU virtual Ethernet access port to reference the multicast static entry template, run the above command.

gpon onu ip-host *port* **mcst-static-group-profile** *mcst-static-group-prof-name*

no gpon onu ip-host *port* **mcst-static-group-profile**

To configure the ONU IP host port reference multicast static entry template configuration, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
mcst-static-group-prof-name	The name of the multicast static entry template

Default Value

The multicast static entry template configuration is not referenced, and there are no multicast static entries.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Multicast entries are delivered to ONU only if there is a reference to the ONU multicast behavior profile configuration on the same port.

For multicast streams that meet the multicast static entries of multicast groups, multicast VLANs, multicast source addresses, and GEM ports, the ONU always forwards the multicast flow and does not require a multicast protocol to add a group request. Multicast static entries are also not limited by the maximum number of concurrent groups allowed and the maximum multicast bandwidth. Multicast protocol plus group requests that match static entries are always forwarded to the OLT.

Because multiple ports may be associated to the same MAC Bridge Service in a traffic mapping template, enabling multicast on one port will connect the downstream multicast GEM Port to the MAC Bridge Service, potentially affecting all user ports under it, causing ports that are not configured for multicast to always receive multicast traffic. When a port is configured to enable multicast configuration, the OLT thinks that the ONU needs to have multicast control, and the OLT will also deliver the multicast configuration to all ports that have not been multicast configured, specifying that the dynamic and static multicast entries are empty, that is, no multicast is allowed.

In order for ONU multicast to work, the multicast function of the OLT must be enabled at the same time, and the configuration is described in the GPON Multicast Configuration Command.

Example

Ethernet user port 2 of the ONU corresponding to the gpon0/0/1:1 port refers to the configuration of the multicast static entry template mcst-static-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 mcst-static-group-profile mcst-static-test

59.14.26 gpon onu mcst-dynamic-group-profile

Syntax

gpon onu uni *port* **mcst-dynamic-group-profile** *mcst-dyn-group-prof-name*

no gpon onu uni *port* **mcst-dynamic-group-profile**

To configure ONU Ethernet user port reference multicast dynamic entry template configuration, run the above commands.

gpon onu veip *port* **mcst-dynamic-group-profile** *mcst-dyn-group-prof-name*

no gpon onu veip *port* **mcst-dynamic-group-profile**

To configure the ONU virtual Ethernet access port to reference the multicast dynamic entry template, run the above commands.

gpon onu ip-host *port* **mcst-dynamic-group-profile** *mcst-dyn-group-prof-name*

no gpon onu ip-host *port* **mcst-dynamic-group-profile**

To configure ONU IP host port reference multicast dynamic entry template configuration, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port
mcst-dyn-group-prof-name	Name of the multicast dynamic entry template

Default Value

The multicast dynamic entry template configuration is not referenced, and there are no multicast dynamic entries.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Multicast entries are delivered to ONU only if there is a reference to the ONU multicast behavior profile configuration on the same port

When the ONU receives a multicast protocol group request, if the corresponding multicast information does not match the static multicast entry, it will check the multicast dynamic entry, and if the multicast information matches the multicast dynamic entry, if the limit of the maximum number of concurrent groups and the maximum multicast bandwidth is not triggered, and the corresponding controllable multicast permission control does not restrict the traffic, it will allow the corresponding multicast traffic to be forwarded, and forward the corresponding multicast protocol group request to the OLT. If the multicast dynamic entry configuration is not matched, or if a restriction condition is triggered, the ONU will not allow the multicast traffic to be forwarded, and the multicast protocol plus group request will not be forwarded to the OLT.

Because multiple ports may be associated to the same MAC Bridge Service in a traffic mapping template, enabling multicast on one port will connect the downstream multicast GEM Port to the MAC Bridge Service, potentially affecting all user ports under it, causing ports that are not configured for multicast to always receive multicast traffic. When a port is configured to enable multicast configuration, the OLT considers that the ONU needs to have multicast control, and the OLT will issue multicast configuration to all ports that have not been multicast configured, specifying that the dynamic and static multicast entries are empty, that is, no multicast is allowed.

In order for ONU multicast to work, the multicast function of the OLT must be enabled at the same time, and the configuration is described in the GPON Multicast Configuration Command.

Example

Ethernet user port 2 of the ONU corresponding to the gpon0/0/1:1 port refers to the configuration of the multicast dynamic entry template mcst-dyn-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 mcst-dynamic-group-profile mcst-dyn-test

59.15 ONU Loop Detection Configuration Commands

59.15.1 gpon onu loopback-detect protocol

Syntax

gpon onu loopback-detect protocol {**CTC** | **private**}

no gpon onu loopback-detect protocol

To configure the OMCI protocol used by the ONU loop detection function, run the above command.

Parameter Description

Parameter	Parameter Description
CTC	Extend the OMCI protocol management loop detection function using China Telecom standards
private	Use the private extended OMCI protocol to manage loop detection capabilities

Default Value

Extend the OMCI protocol using China Telecom standards.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

You need to configure the OMCI protocol used for loop detection management, and then configure the loop detection function for the ONU.

Example

The ONU corresponding to the gpon0/0/1:1 port uses the private extended OMCI protocol to manage loop detection.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu loopback-detect protocol private

59.15.2 gpon profile onu-loopback-detection

Syntax

gpon profile onu-loopback-detection *loopback-detect-prof-name*

To create an ONU loop detection profile and enter the loop detection template configuration mode, run the above command.

no gpon profile onu-loopback-detection *loopback-detect-prof-name*

To delete the ONU loop detection template, run the above command.

Parameter Description

Parameter	Parameter Description
loopbackdetect-prof-name	Name of the loop detection template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named loopback-detect-prof-name does not exist, create a template and enter the ONU loop detection template configuration mode, otherwise it will directly enter the configuration mode of the loop detection template.

In the ONU loop detection template, you can configure loop detection enablement, port, VLAN, detection frequency, recovery frequency, and behavior after the loop is detected that is extended by the China Telecommunications standard extension OMCI.

Example

Create or configure the ONU loop detection profile loop-detect-test.

OLT(config)# gpon profile onu-loopback-detection loop-detect-test

59.15.3 gpon-profile admin-state

Syntax

gpon-profile admin-state {**enable** | **disable**} **no gpon-profile admin-state**

To enable loop detection on the ONU, run the above command.

Parameter Description

None

Default Value

Enable loop detection.

Command Mode

ONU loopback detection template configuration mode

Usage Guidelines

The configuration of the ONU loop detection template is delivered using the China Telecom Standard Extension OMCI.

Example

Configure the loop-detect-test loop detection profile of the ONU loop detection profile to disable the loop detection function.

OLT(config)# gpon profile onu-loopback-detection loop-detect-test

config-gpon-profile# gpon-profile admin-state disable

59.15.4 gpon-profile auto-shut

Syntax

gpon-profile auto-shut {**enable** | **disable**}

no gpon-profile auto-shut

Configure ONU loop detection to automatically shut down ports when loops are discovered.

Parameter Description

None

Default Value

Automatically disables the port when a loop is discovered.

Command Mode

ONU loopback detection template configuration mode

Usage Guidelines

The configuration of the ONU loop detection template is delivered using the China Telecom Standard Extension OMCI.

Example

The loop-detect-test configuration of the ONU loop detection profile does not disable the port when the loop is discovered.

OLT(config)# gpon profile onu-loopback-detection loop-detect-test

config-gpon-profile# gpon-profile auto-shut disable

59.15.5 gpon-profile message-frequency

Syntax

gpon-profile message-frequency *num*

no gpon-profile message-frequency

To configure the frequency at which the ONU loop detects the frequency of sending detection packets, run the above command.

Parameter Description

Parameter	Parameter Description
num	The frequency of sending loop detection packets, ranging from 1 to 65535, in PPS

Default Value

8PPS

Command Mode

ONU loopback detection template configuration mode

Usage Guidelines

None

Example

The loop-detect-test configuration of the ONU loop detection profile sets the frequency of sending detection packets to 1 second for the ONU loop detection and sending one detection packet.

OLT(config)# gpon profile onu-loopback-detection loop-detect-test

config-gpon-profile# gpon-profile message-frequency 1

59.15.6 gpon-profile loop-recovery-interval

Syntax

gpon-profile loop-recovery-interval *num*

no gpon-profile loop-recovery-interval

To configure the time interval at which the ONU loop detects the time interval between automatically shutting down the port and then re-opening the port when the loop is found, run the above command.

Parameter Description

Parameter	Parameter Description
num	The interval between enable and disable the port. The range is 1-65535. The unit is second.

Default Value

300 seconds

Command Mode

ONU loopback detection template configuration mode

Usage Guidelines

The configuration of the ONU loop detection template is delivered using the China Telecom Standard Extension OMCI.

When the ONU loop detection is configured to **gpon-profile auto-shut enable**, in order to provide a mechanism for the automatic recovery of the network after the loop problem is resolved, China Telecom Standard extends the loop detection managed by the OMCI, which requires the ONU to re-open the port that is automatically shut down at a certain interval. This command configures the time for maintaining the port shutdown state after the port is automatically closed, that is, the time interval for the port to be reopened. Once the port is reopened, the port will be automatically shut down again if the loop persists.

Example

The loop-detect-test configuration of the ONU loop detection template automatically closes the port when the loop is discovered and then reopens the port at a time interval of 10 minutes

OLT(config)# gpon profile onu-loopback-detection loop-detect-test

config-gpon-profile# gpon-profile loop-recovery-interval 600

59.15.7 gpon-profile port-vlan-table

Syntax

gpon-profile port-vlan-table uni *port* [**cvlan** *cvid* | **svlan** *svid*]*

no gpon-profile port-vlan-table uni *port* [**cvlan** *cvid* | **svlan** *svid*]*

To configure the VLAN entry of the ONU loop detection port to specify the loop detection of the combination of Ethernet user port, inner VLAN, and outer VLAN, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding Ethernet user port
cvid	Configure the corresponding inner VLAN
svid	Configure the corresponding external VLAN

Default Value

None

Command Mode

ONU loopback detection template configuration mode

Usage Guidelines

The configuration of the ONU loop detection template is delivered using the China Telecom Standard Extension OMCI.

You can configure a combination of multiple Ethernet user ports, inner VLANs, and outer VLANs, and the ONU will use the configured inner VLAN and outer VLAN to send loop detection packets on the configured Ethernet user ports for loop detection. If no cvlan or svlan is specified, a loop detection packet without a VLAN tag is sent, and if neither the cvlan nor the svlan is specified, a loop detection packet with a noneVLAN tag is sent.

When you delete an entry, you must match the Ethernet user port, inner VLAN, and outer VLAN before you can delete the entry.

The default value of the corresponding attribute table is not specified in the China Telecom standard, nor does it specify the modification and deletion method of the corresponding table row, and some ONUs may contain the default configuration, and there may be problems that the corresponding default configuration cannot be deleted or modified.

Example

The loop-detect-test ONU loop detection template configures Ethernet user port 1 to loop detect the untagged path, and configures Ethernet user port 2 to loop detect CVLAN 85

OLT(config)# gpon profile onu-loopback-detection loop-detect-test config-gpon-profile# gpon-profile port-vlan-table uni 1

config-gpon-profile# gpon-profile port-vlan-table uni 2 cvlan 85

59.15.8 gpon onu loopback-detection-profile

Syntax

gpon onu loopback-detection-profile *loopback-detect-prof-name*

no gpon onu loopback-detection-profile

To configure the ONU Reference Loop Detection template, run the above command.

Parameter Description

Parameter	Parameter Description
loopbackdetect-prof-name	The name of the loop detection template

Default Value

The loop detection template configuration is not referenced, and the ONU maintains its default configuration.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The configuration of the ONU loop detection template is delivered using the China Telecom Standard Extension OMCI. If the OMCI protocol used for the management of the ONU loop detection function is not configured as CTC, or the ONU does not support the corresponding extended OMCI, this command does not take effect.

Example

The ONU corresponding to port gpon0/0/1:1 refers to the configuration of the loop-detect-test loop detection profile.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu loopback-detection-profile loop-detect-test

59.15.9 gpon onu uni loopback-detect

Syntax

gpon onu uni *port* **loopback-detect** {**enable** | **disable**}

no gpon onu uni *port* **loopback-detect**

To enable the loop detection on the ONU Ethernet user port, run the command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding Ethernet user port

Default Value

Disable loop detection.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Use a private extension to deliver the OMCI. If the OMCI protocol used for the management of the ONU loop detection function is not set to private, or the ONU does not support the corresponding extended OMCI, this command does not take effect.

It should be noted that the loop detection function managed by the private extension OMCI is disabled by default, which is inconsistent with China Telecom's extension.

Example

Enable loop detection on Ethernet user port 2 of the ONU corresponding to the gpon0/0/1:1 port.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu uni 2 loopback-detect enable

59.16 ONU Voice Service Configuration Commands

59.16.1 gpon profile onu-voip

Syntax

gpon profile onu-voip *voip-prof-name*

To create an ONU voice service template and enter the voice service template configuration mode, run the above command.

no gpon profile onu-voip *voip-prof-name*

To delete the ONU voice service template, run the above command.

Parameter Description

Parameter	Parameter Description
voip-prof-name	Name of the Speech service template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named **voip-prof-name** does not exist, create a template and enter the ONU voice service template configuration mode, otherwise go directly to the configuration mode of the voice service template.

You can configure general behaviors related to the voice service in the ONU voice service template, including the voice protocol type, protocol parameter, server address, domain name, and the IP host port index used by the ONU for voice protocol interaction.

Example

The following example shows how to create/configure the ONU voice service template voip-test.

OLT(config)# gpon profile onu-voip voip-test

59.16.2 gpon-profile bind ip-host udp-port

Syntax

gpon-profile bind ip-host *port* **udp-port** *udp-port* [**dscp***dscp-val*]

To configure the ONU IP host port, UDP port number, and DSCP priority value used by the ONU Voice service, run the above command.

Parameter Description

Parameter	Parameter Description
port	The IP host port used by the Speech service
udp-port	The UDP port number used by the Voice service to communicate with the server
dscp-val	The DSCP priority value used by the Speech service to communicate with the server

Default Value

None

DSCP default value is 32 (0x20, CS4).

Command Mode

ONU voice service template configuration mode

Usage Guidelines

A valid Speech Service configuration must contain the designation of this ONU IP host port and UDP port number.

The ONU IP host port determines the ONU IP address used by the voice service to interact with the server, the corresponding VLAN processing, and the corresponding GEM port channel. For details about how to configure IP addresses, see section Configuring an ONU IP Host. For VLAN processing,

For details, see VLAN Configuration of ONU User Ports and Traffic Mapping of ONU. For the uplink virtual port channel, see the ONU Traffic Mapping Configuration section and the virtual port and T-Cont configuration chapters.

The DSCP value configured in this command is used for non-RTP packets. You must run the **gpon-profilertpdscp** value command to configure the DSCP value value of RTP packets.

Example

The ONU voice service profile voip-test configures that the voice service uses ONU IP host port No. 2 and UDP port number 2712

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile bind ip-host 2 udp-port 2712

59.16.3 gpon-profile voip-type

Syntax

gpon-profile voip-type {**h.248** | **sip**}

no gpon-profile voip-type

To configure the protocol type used by the ONU voice service, run the above command.

Parameter Description

Parameter	Parameter Description
h.248	ITU-T H.248 protocol
sip	SIP protocol

Default Value

Use the SIP protocol.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The voice protocol type of the ONU voice service profile voip-test is set to H.248

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile voip-type h.248

59.16.4 gpon-profile h.248 primary-mgc secondary-mgc

Syntax

gpon-profile h.248 primary-mgc *primary-mgc-uri* [**secondary-mgc** *secondary-mgc-uri*]

To configure the ONU voice service using MGC (Media Gateway Controller) of H.248 protocol, run the above command.

Parameter Description

Parameter	Parameter Description
primary-mgc-uri	The active MGC address can be in the form of an IP address or domain name, or it can contain a port designation
secondary-mgc-uri	An alternate MGC address, which can be in the form of an IP or domain name, or it can contain a port designation

Default Value

None

Command Mode

ONU voice service template configuration mode

Usage Guidelines

For voice services that use the H.248 protocol, this command must be included for the MGC designation. When the configuration does not contain secondary-mgc, the standby MGC is not enabled.

Example

The voip-test configuration of the ONU voice service profile is H.248 with the active MGC set to h248.example.com, the server port number to 8000, and the standby MGC to 10.0.5.248

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile h.248 primary-mgc h248.example.com:8000 secondary-mgc 10.0.5.248

59.16.5 gpon-profile h.248 version message-format

Syntax

gpon-profile h.248 version *value* **message-format** {**text-long** | **text-short** | **binary**}

no gpon-profile h.248 version

To configure the protocol version number and message format when the ONU Voice Service uses the H.248 protocol, run the above command.

Parameter Description

Parameter	Parameter Description
value	The MGC protocol version, in the range of 0-4, indicates that the version is not specified
text-long	The message format is long text
text-short	The message format is in short text format
binary	The message format is binary

Default Value

The protocol version is not specified, and the message format is long text.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The MGC protocol version of H.248 is set to v4 and the message format is binary in the voip-test ONU voice service profile voip-test

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile h.248 version 4 message-format binary

59.16.6 gpon-profile h.248 max-retry-time max-retry- count

Syntax

gpon-profile h.248 max-retry-time *time* **max-retry-count** *count*

no gpon-profile h.248 max-retry-time

To configure the maximum retry time of MGC transactions when the ONU voice service uses the H.248 protocol and the maximum number of times messages are retransmitted to MGC, run the following command.

Parameter Description

Parameter	Parameter Description
time	The maximum retry time, in seconds, ranges from 0 to 65535, where 0 represents the default value determined by the ONU
count	The maximum number of retransmissions, in the range of 0-65535, 0 indicates the default value determined by the ONU

Default Value

Both the maximum retry time and the maximum number of retransmissions use the default values determined by the ONU.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The maximum retry time for an MGC transaction on H.248 is 10 seconds, and the maximum number of messages to be retransmitted to the MGC is 3 times

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile h.248 max-retry-time 10 max-retry-count 3

59.16.7 gpon-profilesip proxy-server outbound-proxy

Syntax

gpon-profilesip proxy-server *proxy-uri* [**outbound-proxy** *out-proxy-uri*]

no gpon-profilesip proxy-server

To configure a SIP proxy server and an optional SIP outgoing proxy server when the ONU voice service uses the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
proxy-uri	The SIP proxy server address, which can be in the form of an IP address or domain name, or it can contain a port designation
out-proxy-uri	The address of the SIP outgoing proxy server can be in the form of an IP address or a domain name, or it can contain a port designation

Default Value

None

Command Mode

ONU voice service template configuration mode

Usage Guidelines

For Speech services that use the SIP protocol, this command must be included for the designation of the SIP proxy server. If the configuration does not contain outbound-proxy, the SIP outgoing proxy server is not enabled.

Example

The VOIP voice service profile voip-test sets the SIP active proxy server address to sip.example.com , the server port number 6000, and the SIP outgoing proxy server address to 10.0.5.31.

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip proxy-server sip.example.com:6000 outbound-proxy 10.0.5.31

59.16.8 gpon-profilesip registrar

Syntax

gpon-profilesip registrar *registrar-uri*

no gpon-profilesip registrar

To configure the SIP registration server when the ONU voice service uses the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
registrar-uri	The SIP registration server address, which can be in the form of an IP or domain name, or it can contain a port designation.

Default Value

None

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The VOIP voice service profile voip-test configures the SIP registration server address to 10.0.5.32 and the server port number 6003

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip registrar 10.0.5.32:6003

59.16.9 gpon-profilesip primary-dns secondary-dns

Syntax

gpon-profilesip primary-dns *dns1* [**secondary-dns** *dns2*]

no gpon-profilesip primary-dns

To configure the preferred and alternate DNS servers when the ONU voice service uses the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
dns1	Preferred DNS server IP address
dns2	Alternate DNS server IP address

Default Value

None, which uses the DNS configuration specified by the ONU IP host port corresponding to the ONU voice service .

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

When the ONU voice service template voip-test is configured to use the SIP protocol, the preferred DNS server address is 10.1.1.3, and the alternate server address is 10.1.1.4 :

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip primary-dns 10.1.1.3 secondary-dns 10.1.1.4

59.16.10 gpon-profilesip reg-exp-time rereg-head-time

Syntax

gpon-profilesip reg-exp-time *exp-time* **rereg-head-time** *rereg-time*

no gpon-profilesip reg-exp-time

To configure the registration expiration time when the ONU Voice Service uses SIP protocol and the timeout period to trigger re-registration, run the above command.

Parameter Description

Parameter	Parameter Description
exp-time	Registration expiration time, in seconds, in the range of 0-65535, 0 means that it will never expire
rereg-time	The timeout period for triggering re-registration, in seconds, ranges from 0 to 65535

Default Value

The registration expiration time is 3600 seconds, and the timeout time to trigger re-registration is 360 seconds.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The VOIP-test configuration of the ONU voice service profile voip-test configures that the SIP registration expiration time is 5,000 seconds, and the timeout time for re-registration is 300 seconds.

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip reg-exp-time 5000 rereg-head-time 300

59.16.11 gpon-profilesip domain-name

Syntax

gpon-profilesip domain-name *name*

no gpon-profilesip domain-name

To configure the host domain name when the ONU voice service uses the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
name	domain name

Default Value

None, which uses the current address of the ONU IP host port corresponding to the ONU voice service

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

Set the SIP host domain name to sip-test in the ONU voice service profile voip-test

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip domain-name sip-test

59.16.12 gpon-profilesip uri-format

Syntax

gpon-profilesip uri-format [**tel** | **sip**]

no gpon-profilesip uri-format

To configure the URI format when the ONU Voice Service uses the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
tel	Use the TEL URI format
sip	Use SIP URI format

Default Value

Use the TEL URI format

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The URI format when using SIP is configured in the VOIP-test ONU voice service profile is SIP format.

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip uri-format sip

59.16.13 gpon-profilesip dial-timeout

Syntax

gpon-profilesip dial-timeout critical *critical-dial-timeout* **partial** *partial-dial-timeout*

no gpon-profilesip dial-timeout

To configure the timer time for dial plan processing when the ONU Voice service uses the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
critical-dial-timeout	Key dial timer time, range 1000-30000, in milliseconds
partial-dial-timeout	Partially matched dial timer time, range 2000-60000, in milliseconds

Default Value

The key dial timer time Default value is 4000 milliseconds.

The Default Value of the partially matched dial-up timer is 16000 milliseconds.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service profile voip-test configures the timer time for SIP dial plan processing to be 1 second for the key dial timer and 5 seconds for the partially matched dial timer:

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip dial-timeout critical 1000 partial 5000

59.16.14 gpon-profilesip feature

Syntax

gpon-profilesip feature caller-id *caller-id-feature*

gpon-profilesip feature call-waiting *call-waiting-feature*

gpon-profilesip feature call-progress-or-transfer *call-p-t-feature* **gpon-profilesip feature call-presentation** *call-present-feature*

gpon-profilesip feature direct-connect {**disable** | **enable** [**uri** *uri-str* | **dial-one-delay** *delay-time*]*} **no gpon-profilesip feature**

To configure the application service feature when the ONU voice service uses the SIP protocol, run the commands.

Parameter Description

Parameter	Parameter Description
caller-id- feature	Caller ID display features. If the configuration is in bitmap mode, unless otherwise specified, data bit 1 indicates that the corresponding function is enabled, and 0 indicates that the corresponding function is disabled. 0x0001 - Caller ID display 0x0002 - Caller name is displayed 0x0004 - Hide your phone number (both number and name are masked) 0x0008 - Local number privacy, set to 0 to send the local number by default, and 1 to hide the local number by default 0x0010 - Native Name Privacy, set to 0 to send the native name by default, and 1 to hide the native name by default 0x0020 - Block calls from anonymous numbers
call-waiting-feature	Call Waiting feature. The configuration is in bitmap format, with data bit 1 indicating that the corresponding function is enabled and 0 indicating that the corresponding function is disabled. 0x0001 - Call Waiting 0x0002 - Caller ID is displayed
	Call process and call forwarding features. The configuration is in bitmap format, with data bit 1 indicating that the corresponding function is enabled and 0 indicating that the corresponding function is disabled. 0x0001 - Three-way calling 0x0002 - Call forwarding 0x0004 - Call on hold 0x0008 - Call

call-p-t- feature	Park 0x0010 - Do Not Disturb 0x0020 - Intermittent disconnect is allowed during an emergency call 0x0040 - The original call is put on hold during an emergency call 0x0080 - Six-way call
call-present-feature	Call Prompt feature. The configuration is in bitmap format, with data bit 1 indicating that the corresponding function is enabled and 0 indicating that the corresponding function is disabled. 0x0001 - Via a ring prompt when there is a waiting message 0x0002 - Prompted by a special dial tone when there is a waiting message 0x0004 - Prompted by a visual message when there is a waiting message 0x0008—Prompt when a call is forwarded
uri-str	Dial-free access to the URI. When you enable the dial-free access feature, you can configure to specify the destination URI for dial-free access.
delay-time	Dial-free connection delay. It can be configured when the dial-free connection function is enabled, which indicates the time (seconds) that dial-free needs to wait for a dial tone.

Default Value

If no configuration is performed, the ONU is kept as default.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

Some application service features may require the corresponding feature access number gpon-profilesip code to be configured at the same time, or additional information registration configuration can be used before you can use it.

Example

The ONU voice service profile voip-test configures the SIP application service call process and call forwarding features, enables the features of three-way call, six-party call, call forwarding, and call hold, and disables the features of call parking, Do Not Disturb mode, allowing intermittent disconnection during emergency calls, and holding the original call during emergency calls.

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip feature call-progress-or-transfer 0x0087

59.16.15 gpon-profilesip code

Syntax

gpon-profilesip code cancel-call-waiting *code-num*

gpon-profilesip code call-hold *code-num*

gpon-profilesip code call-park *code-num*

gpon-profilesip code caller-id-activate *code-num*

gpon-profilesip code caller-id-deactivate *code-num*

gpon-profilesip code do-not-disturb-activate *code-num*

gpon-profilesip code do-not-disturb-deactivate *code-num*

gpon-profilesip code do-not-disturb-pin-change *code-num*

gpon-profilesip code emergency-service-number *code-num*

gpon-profilesip code intercom-service *code-num*

gpon-profilesip code unattended-call-transfer *code-num*

gpon-profilesip code attended-call-transfer *code-num*

no gpon-profilesip code cancel-call-waiting

no gpon-profilesip code call-hold

no gpon-profilesip code call-park

no gpon-profilesip code caller-id-activate

no gpon-profilesip code caller-id-deactivate

no gpon-profilesip code do-not-disturb-activate

no gpon-profilesip code do-not-disturb-deactivate

no gpon-profilesip code do-not-disturb-pin-change

no gpon-profilesip code emergency-service-number no gpon-profilesip code intercom-service

no gpon-profilesip code unattended-call-transfer no gpon-profilesip code attended-call-transfer

To configure the feature access number when the ONU voice service uses the SIP protocol, run the above commands.

Parameter Description

Parameter	Parameter Description
code-num	Configure the access number of the corresponding feature, which can be configured only for characters 0 to 9 or # or * symbols, and the length of 1 to 5 characters
cancel-call-waiting	Turn off call waiting
call-hold	Call hold
call-park	Call Park

caller-id-activate	Enable the sending of the local number
caller-id-deactivate	Hide your phone number
do-not-disturb-activate	Do Not Disturb mode is enabled
do-not-disturb-deactivate	Do Not Disturb mode is disabled
emergency-service- number	Emergency services number
intercom-service	Intercom service
unattended-call-transfer	Call is blinded
attended-call-transfer	In-seat call forwarding

Default Value

If no configuration is performed, the ONU is kept as default.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

Some features may need to be enabled before the gpon-profilesip feature is enabled.

Example

The ONU voice service profile voip-test is configured to enable SIP to enable the operation number of the local number to send the local number to *67 :

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile sip code call-hold *67

59.16.16 gpon-profile soft-switch-vendor

Syntax

gpon-profile soft-switch-vendor *vendor-name* **no gpon-profile soft-switch-vendor**

To configure the softswitch vendor for the ONU voice service H.248 or SIP, run the above command.

Parameter Description

Parameter	Parameter Description
vendor-name	Softswitch vendor logo, 4 characters

Default Value

4 null characters indicate an unknown vendor

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service template voip-test is configured with the softswitch vendor ID as PLNT :

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile soft-switch-vendor PLNT

Default Value

4 null characters indicate an unknown vendor

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service template voip-test is configured with the softswitch vendor ID as PLNT :

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile soft-switch-vendor PLNT

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile soft-switch-vendor PLNT

59.16.17 gpon-profile media fax-mode

Syntax

gpon-profile media fax-mode {**passthru** | **t.38**}

no gpon-profile media fax-mode

To configure the fax mode of the ONU voice service, run the above command..

Parameter Description

Parameter	Parameter Description
passthru	Direct transmission mode
t.38	ITU-T T.38 mode

Default Value

Direct transmission mode

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service profile voip-test configures the fax mode to T.38 mode:

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile media fax-mode t.38

59.16.18 gpon-profile media order

Syntax

gpon-profile media order *order-val* [**codec** *codec-val*] [**packet-period** *period-val*] [**silence-suppress** {**on** | **off**}]

no gpon-profile media order *order-val*

To configure the encoding mode, packet cycle, and mute suppression enabled for the alternative media data encoding options for the ONU voice service, run the above command.

Parameter Description

Parameter	Parameter Description
order-val	Option number, range 1-4
codec-val	Encoding code, range 0-18 0 : PCMU 8000Hz 1 : reserved 2 : reserved 3 : GSM 8000Hz 4 : ITU-T G.723 8000Hz 5 : DVI4 8000Hz 6 : DVI4 16000Hz 7 : LPC 8000Hz 8 : PCMA 8000Hz 9 : ITU-T G.722 8000Hz 10 : L16,2 channels 44100 Hz 11 : L16,1 channel 44100Hz 12 : QCELP 8000Hz 13 : CN 8000Hz 14 : MPA 90000Hz 15 : ITU-T G.728 8000Hz 16 : DVI4 11025Hz 17 : DVI4 22050Hz 18 : ITU-T G.729 8000Hz
period-val	Packet cycle, in milliseconds (ms), ranges from 10 to 30 ms
on	Silent suppression is enabled

off	Silence suppression is disabled

Default Value

The default value of all 4 options is PCMU 8000Hz , the packet period is 10 milliseconds, and mute suppression is disabled.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service template voip-test configures 4 options for media data encoding.

The first one is PCMU 8000Hz, the packet period is 20 milliseconds, and the mute suppression is disabled. The second is PCMA 8000Hz, the packet period is 10 milliseconds, and the silence suppression is enabled

The third is the encoding mode ITU-T G.729 8000Hz, the packet period is 20 milliseconds, and the silence suppression is enabled. The fourth is the encoding mode ITU-T G.729 8000Hz, the packet period is 20 milliseconds, and the mute suppression is disabled.

```
OLT(config)#          profile onu-voip voip-test
gpon
...# gpon-profile     media order 1 codec 0 packet-period 20 silence-suppress off
...# gpon-profile     media order 2 codec 8 packet-period 10 silence-suppress on
...# gpon-profile     media order 3 codec 18 packet-period 20 silence-suppress on
...# gpon-profile     media order 4 codec 18 packet-period 20 silence-suppress off
```

59.16.19 gpon-profile media out-of-band-dtmf

Syntax

gpon-profile media out-of-band-dtmf {**enable** | **disable**} **no gpon-profile media out-of-band-dtmf**

To enable out-of-band DTMF bearer for the ONU voice service, run the above commands.

Parameter Description

None

Default Value

Disable out-of-band DTMF bearer

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The VOIP profile of the ONU voice service profile voip-test is configured to enable out-of-band DTMF bearer:

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile media out-of-band-dtmf enable

59.16.20 gpon-profile rtp port-range

Syntax

gpon-profile rtp port-range *start end*

no gpon-profile rtp port-range

To configure the available UDP port range for the RTP protocol of the ONU Voice Service, run the above commands.

Parameter Description

Parameter	Parameter Description
start	The minimum number of UDP ports available for the RTP protocol
end	The maximum number of UDP ports available for the RTP protocol

Default Value

50000-50100

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service profile voip-test configures the RTP protocol, and the available UDP port range is 60000-60100 :

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile rtp port-range 60000 60100

59.16.21 gpon-profilertpdscp

Syntax

gpon-profilertpdscp *value*

no gpon-profilertpdscp

To configure DSCP for the RTP protocol of the ONU voice service, run the above commands.

Parameter Description

Parameter	Parameter Description
value	DSCP value

Default Value

46 （ 0x2E Expedited Forwarding ）

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service profile voip-test is configured with RTP protocol DSCP 34 (AF41).

OLT(config)# gpon profile onu-voip voip-test config-gpon-profile# gpon-profile rtp dscp 34

59.16.22 gpon-profile voice jitter-target

Syntax

gpon-profile voice jitter-target *value*

no gpon-profile voice jitter-target

To configure the jitter target value for the ONU voice service, run the above commands.

Parameter Description

Parameter	Parameter Description
value	Jitter target values in the range of 1-3000 in milliseconds (ms).

Default Value

None jitter target limit.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The ONU voice service profile voip-test sets the jitter target value to 10 ms:

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile voice jitter-target 10

59.16.23 gpon-profile voice jitter-buffer-max

Syntax

gpon-profile voice jitter-buffer-max *value*

no gpon-profile voice jitter-buffer-max

To configure the maximum jitter buffer for the ONU voice service, run the commands.

Parameter Description

Parameter	Parameter Description
value	Jitter buffer maximum, ranging from 1-3000 in milliseconds (ms).

Default Value

The value defined by the ONU implementation.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The maximum jitter buffer for the ONU voice service template voip-test is 200 ms:

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile voice jitter-buffer-max 200

59.16.24 gpon-profile voice echo-cancel

Syntax

gpon-profile voice echo-cancel {**enable** | **disable**}

no gpon-profile voice echo-cancel

To enable the echo cancellation function for the ONU voice service, run the above commands.

Parameter Description

None

Default Value

Disable the echo cancellation function.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The following example shows how to configure the VOIP-test function to enable echo cancellation on the ONU voice service profile.

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile voice echo-cancel enable

59.16.25 gpon-profile voice switchhook-flash-time

Syntax

gpon-profile voice switchhook-flash-time minimum *min* **maximum** *max*

no gpon-profile voice switchhook-flash-time

To configure the tap spring time for the ONU voice service, run the above commands.

Parameter Description

Parameter	Parameter Description
min	The minimum time of the spring is 1-3000 in milliseconds (ms).
max	The maximum time of the spring in the range of 1-3000 must be greater than the minimum time configuration, in milliseconds (ms).

Default Value

The value defined by the ONU implementation.

Command Mode

ONU voice service template configuration mode

Usage Guidelines

None

Example

The voip-test configuration of the ONU voice service template is 20-500 milliseconds.

OLT(config)# gpon profile onu-voip voip-test

config-gpon-profile# gpon-profile voice switchhook-flash-time minimum 20 maximum 500

59.16.26 gpon onu voip voip-profile

Syntax

gpon onu voip *port* **voip-profile** *voip-prof-name*

no gpon onu voip *port* **voip-profile**

To configure the ONU voice port and refer to the ONU voice service template configuration, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port
voip-prof-name	The name of the Speech service template

Default Value

The Speech service template configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The voice port 2 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the voice service profile voip-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 voip-profile voip-test

59.16.27 gpon profile onu-sip-dial-plan

Syntax

gpon profile onu-sip-dial-plansip-*dial-plan-prof-name*

To create an ONU SIP dial plan profile and enter the SIP dial plan profile configuration mode, run the above command.

no gpon profile onu-sip-dial-plansip-dial-plan-prof-name

To delete the ONU SIP dial plan template, run the above command.

Parameter Description

Parameter	Parameter Description
sip-dial-plan-prof-name	The name of the SIP dial plan template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named sip-dial-plan-prof-name does not exist, create a template and enter the ONU SIP dial plan template configuration mode, otherwise it will directly enter the configuration mode of the SIP dial plan template.

The ONU SIP dial plan template can be configured to determine the completion of dialing when the SIP protocol is used for voice services. This feature is also known as SIP number graphs.

The H.248 protocol is used for voice services, and because each dialing behavior interacts with the softswitch, the functions of the dial plan (or number graph) are configured on the softswitch and do not need to be configured on the ONU.

Example

The following example shows how to create/configure the ONU SIP dial plan template sip-dial-plan-test.

OLT(config)# gpon profile onu-sip-dial-plan s ip-dial-plan-test

59.16.28 gpon-profile entry token

Syntax

gpon-profile entry *index* **token** *string*

no gpon-profile entry *index*

To configure the specific number chart entries for the ONU SIP dial plan, run the above commands.

Parameter Description

Parameter	Parameter Description
index	Index of specified SIP dial plan entries, ranging from 1 to 40
string	Dial plan entry contents

Default Value

None

Command Mode

ONU SIP Dial Plan Template Configuration Mode

Usage Guidelines

None

Example

ONU SIP dial plan template sip-dial-plan-test:
[124]xxx|3xxxx|01[12]x|0[2-8]xxxxxxx|01[35-9]xxxxxxxxxx.

OLT(config)# gpon profile onu-sip-dial-plan s ip-dial-plan-test config-gpon-profile# gpon-profile entry 1 token [124]xxx

config-gpon-profile# gpon-profile entry 2 token 3xxxx config-gpon-profile# gpon-profile entry 3 token 01[12]x

config-gpon-profile# gpon-profile entry 4 token 0[2-8]xxxxxxx

config-gpon-profile# gpon-profile entry 5 token 01[35-9]xxxxxxxxxx

59.16.29 gpon onu voip sip dial-plan

Syntax

gpon onu voip *portsip* **dial-plansip**-*dial-plan-prof-name*

no gpon onu voip *portsip* **dial-plan**

To configure the ONU voice-port reference ONU SIP dial plan template, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port
sip-dial-plan-prof-name	Name of the SIP dial plan template

Default Value

The SIP dial plan template configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

Voice port 2 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the SIP dial-up plan profile sip-dial-plan-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 sip dial-plan s ip-dial-plan-test

59.16.30 gpon onu voip shutdown

Syntax

[**no**] **gpon onu voip** *port* **shutdown**

To configure the ONU voice port to be disabled/enabled. run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port

Default Value

Enable the voice-port.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU corresponding to port gpon0/0/1:1 disables voice port 2.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 shutdown

59.16.31 gpon onu voip signal-gain

Syntax

gpon onu voip *port* **signal-gain rx** *rx-gain* **tx** *tx-gain*

no gpon onu voip *port* **signal-gain**

To configure the ONU voicepor signal gain, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port
rx-gain	Received signal gain, range -120-60 in 0.1dBm
tx-gain	Transmit signal gain, range -120-60 in 0.1dBm units

Default Value

Both the receive gain and the send gain are 0.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU voice port 2 corresponding to the gpon0/0/1:1 port receives a gain of 10dBm for receiving a signal , and gives a gain of 5dBm for sending a signal.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 signal-gain rx 100 tx 50

59.16.32 gpon onu voip h.248 termination-id message-id

Syntax

gpon onu voip *port* **h.248 termination-id** *tid* **message-id** *msg-id*

no gpon onu voip *port* **h.248**

To configure the terminal ID and message ID when the ONU voice port uses the H.248 protocol, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port
tid	Endpoint ID as an identifier that uniquely identifies the voiceport
msg-id	The message ID is used to identify the corresponding H.248 message from this voice port

Default Value

None

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

Voice port 2 of the ONU corresponding to port gpon0/0/1:1 is configured with terminal ID of 010001 and message ID of PLANET_voip_onu_test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 h.248 termination-id 010001 message-id PLANET_voip_onu_test

59.16.33 gpon onu voip sip user-aor display-name

Syntax

gpon onu voip *portsip* **user-aor** *aor-str* [**display-name** *dsp-string*] **no gpon onu voip** *portsip* **user-aor**

To configure the address (number) and display name of the ONU voice port when the SIP protocol is used, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port
aor-str	SIP voiceport address, up to 128 bytes
dsp-string	SIP voice-port display name, up to 25 bytes

Default Value

None

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The address (number) of the ONU corresponding to port gpon0/0/1:1 is 1082 and the display name is mytest when the SIP protocol is used.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 user-aor 1082 display-name mytest

59.16.34 gpon onu voip sip username password

Syntax

gpon onu voip *portsip* **username** *name* **password** *pass*

no gpon onu voip *portsip* **username**

To configure the username and password of the ONU voice port to use the SIP protocol, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding voice port
name	SIP username
pass	SIP user password

Default Value

None

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The user name of the ONU 2 corresponding to port gpon0/0/1:1 is ad003 and the user password is 123456 when the SIP protocol is used for the voice port 2 of the ONU corresponding to port gpon0/0/1 :1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voip 2 sip username ad003 password 123456

59.16.35 show gpon interface onu voip-status

Syntax

show gpon interface *onu-intf-name* **onu voip-status** [*port*]

To display the status of all or specified voiceports in the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port	Check the corresponding voice ports and view all voice ports under the ONU if not specified

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

None

Example

Check the status of all voice-ports corresponding to GPON0/0/1:1 ports.

OLT# show gpon interface gpon0/0/1:1 onu voip-status

```
 ----------------------------------------------
gpon0/0/1:1 voip-port 1 info
----------------------------------------------
```

adminState: no shutdown (1) operaState: enable (1)

hookState: on hook (1)

voipCodecUsed: PCMU (0)

voiceServiceStatus: Registered (1)

sessiontype: Idle/none (0)

voipLineState: Idle, on-hook (0)

emergencyCallStatus: No emergency call in progress (0)

59.17 ONU Virtual Ethernet Access Point Configuration Commands

59.17.1 gpon profile onu-veip

Syntax

gpon profile onu-veip *veip-prof-name*

To create an ONU virtual Ethernet access point template and enter the virtual Ethernet access point template configuration mode, run the above command.

no gpon profile onu-veip *veip-prof-name*

To delete the ONU virtual Ethernet access point template, run the above command.

Parameter Description

Parameter	Parameter Description
veip-prof-name	The name of the virtual Ethernet access point template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named veip-prof-name does not exist, create a template and enter the ONU virtual Ethernet access point profile configuration mode, otherwise, go directly to the configuration mode of the virtual Ethernet access point profile.

You can configure the information about the external management server (TR-069 server) in the non-OMCI management area of the virtual Ethernet access point in the ONU virtual Ethernet access point template and the corresponding access mode.

The non-OMCI management area corresponding to the ONU virtual Ethernet access point may also be managed through the local ONU web page, etc., and the configuration of the external management server of the virtual Ethernet access point may not be necessary.

Example

Create or configure the ONU virtual Ethernet access point profile veip-test.

OLT(config)# gpon profile onu-veip veip-test

59.17.2 gpon-profile mgmt bind ip-host

Syntax

gpon-profile mgmt bind ip-host *port*

To configure the ONU IP host port used by the ONU to connect the ONU to the external management server, run the above command.

Parameter Description

Parameter	Parameter Description
port	Connect to the IP host port used by the external management server

Default Value

None

Command Mode

ONU virtual Ethernet access point template configuration mode

Usage Guidelines

The configuration of a valid virtual Ethernet access point external management server must include the designation of this ONU IP host port.

The ONU IP host port determines the ONU IP address used by the management protocol (TR-069) of the non-OMCI management zone corresponding to the ONU virtual Ethernet access point to interact with the server, the corresponding VLAN processing, and the corresponding uplink virtual port (GEM port) channel. For details about how to configure IP addresses, see the section Configuring an ONU IP Host. For VLAN processing, see the VLAN Configuration of ONU User Ports and the Configuration of ONU Flow Mapping. For the uplink virtual port channel, see the ONU Traffic Mapping Configuration section and the Virtual Port and T-Cont Configuration chapter.

Example

The ONU Virtual Ethernet access point profile veip-test is configured to connect to an external management server using ONU IP host port 3.

OLT(config)# gpon profile onu-veip veip-test

config-gpon-profile# gpon-profile mgmt bind ip-host 3

59.17.3 gpon-profile tr-069 url

Syntax

gpon-profile tr-069 url *string*

no gpon-profile tr-069 url

To configure the TR-069 server URL corresponding to the non-OMCI management area of the ONU virtual Ethernet access point, run the above commands.

Parameter Description

Parameter	Parameter Description
string	The URL of the TR-069 server

Default Value

None

Command Mode

ONU virtual Ethernet access point template configuration mode

Usage Guidelines

None

Example

The ONU virtual Ethernet access point profile veip-test configures the TR-069 server URL to http://10.0.0.1001:8443/tr069:

OLT(config)# gpon profile onu-veip veip-test

config-gpon-profile# gpon-profile tr-069 url http://10.0.0.1001:8443/tr069

59.17.4 gpon-profile tr-069 username password

Syntax

gpon-profile tr-069 username *name* **password** *pass*

no gpon-profile tr-069 username password

To configure the username and password required for TR-069 server interaction in the non-OMCI management area of the ONU virtual Ethernet access point, run the above commands.

Parameter Description

Parameter	Parameter Description
name	TR-069 username
pass	TR-069 User Password

Default Value

None

Command Mode

ONU virtual Ethernet access point template configuration mode

Usage Guidelines

None

Example

The ONU virtual Ethernet access point profile veip-test is configured with TR-069 as ad003 and 123456 password as :

OLT(config)# gpon profile onu-veip veip-test

config-gpon-profile# gpon-profile tr-069 username ad003 password 123456

59.17.5 gpon-profile tr-069 vlan

Syntax

gpon-profile tr-069 vlan *vid cos-val*

no gpon-profile tr-069 vlan

To configure the VLAN ID and CoS used by TR-069 servers to interact with TR-069 servers in non-OMCI management areas under the ONU virtual Ethernet access point, run the above commands.

Parameter Description

Parameter	Parameter Description
vid	TR-069 VLAN used for interaction , range 1-4094
cos-val	Configure the default VLAN CoS value of the port, ranging from 0 to 7

Default Value

Priority VLAN, CoS 0

Command Mode

ONU virtual Ethernet access point template configuration mode

Usage Guidelines

None

Example

The ONU Virtual Ethernet access point profile veip-test configures the VLAN used by TR-069 interaction to 46 and CoS 5:

OLT(config)# gpon profile onu-veip veip-test

config-gpon-profile# gpon-profile tr-069 vlan 46 5

59.17.6 gpon onu veip veip-profile

Syntax

gpon onu veip *port* **veip-profile** *veip-prof-name*

no gpon onu veip *port* **veip-profile**

To configure an ONU Virtual Ethernet access point refers to the virtual ethernet access point template configuration, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding virtual Ethernet access point
veip-prof-name	The name of the virtual Ethernet access point template

Default Value

The configuration of the virtual Ethernet access point template is not referenced, and the corresponding function is not enabled.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The non-OMCI management area corresponding to the ONU virtual Ethernet access point may also be managed through the local ONU web page, etc., and the configuration of the external management server of the virtual Ethernet access point may not be necessary. Even if this command does not reference the corresponding configuration, the virtual Ethernet access point may still work as long as the corresponding traffic mapping is correctly configured.

Example

Virtual Ethernet access point 1 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the virtual Ethernet access point profile veip-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu veip 1 veip-profile veip-test

59.17.7 gpon onu veip shutdown

Syntax

gpon onu veip *port* {**shutdown** | **no-shutdown**}

no gpon onu veip *port* **shutdown**

To configure the ONU virtual Ethernet access point enable/disable, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding virtual Ethernet access point
shutdown	Disable the virtual Ethernet access point
no-shutdown	Enable the virtual Ethernet access point

Default Value

Enable

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU configuration corresponding to the gpon0/0/1:1 port disables Virtual Ethernet access point 2.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu veip 2 shutdown

59.18 ONU Common User Port Configuration Commands

59.18.1 gpon onu general-uni shutdown

Syntax

gpon onu general-uni *port* {**shutdown** | **no-shutdown**}

no gpon onu general-uni *port* **shutdown**

To configure the ONU general-user port shutdown or on, run the commands above.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding common user port
shutdown	Close the common user port
no-shutdown	Enable the common user port

Default Value

Enable

Command Mode

ONU Port Configuration Mode

Usage Guidelines

The effect of closing a generic user port may vary depending on the ONU implementation. The common user port operation corresponds to UNI-G ME in ITU G.988. According to the standard, each PPTP UNI ME should correspond to one UNI-G ME, and the port is down when either of the PPTP UNI ME and UNI-G ME configurations is down. However, the implementation of the actual ONU may not completely refer to the ITU standard, UNI-G may not have the actual corresponding PPTP UNI, and the specific definition of the shutdown operation is determined by the specific implementation of the ONU.

In the command configuration, you can use a question mark prompt to view the specific port type of a common user port and its number in the corresponding type, and prompt whether the ONU supports the information managed from the OMCI for the port identifier. However, even if the ONU identifies the port as a non-OMCI management port, you can still try to close the port from the OLT operation with this command.

Example

The ONU corresponding to port gpon0/0/1:1 is configured to disable universal user port 2.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu general-uni 2 shutdown

59.19 ONU SNMP Configuration Commands

59.19.1 gpon profile onu-snmp

Syntax

gpon profile onu-snmp *snmp-prof-name*

To create an ONU SNMP profile and enter the SNMP profile configuration mode, run the above command.

no gpon profile onu-snmp *snmp-prof-name*

To delete the ONU SNMP profile, run the above command.

Parameter Description

Parameter	Parameter Description
snmp-prof-name	The name of the SNMP template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

When the template named snmp-prof-name does not exist, create a template and enter the ONU SNMP profile configuration mode, otherwise it directly enters the configuration mode of the SNMP profile.

You can configure the SNMP protocol version, community name, trap target host, and access mode in an ONU SNMP profile.

Example

The following example shows how to create/configure the ONU SNMP profile snmp-test.

OLT(config)# gpon profile onu-snmp snmp-test

59.19.2 gpon-profile snmp bind ip-host

Syntax

gpon-profile snmp bind ip-host *port*

To configure the ONU IP host port to be used for ONU SNMP management, run the above command.

Parameter Description

Parameter	Parameter Description
port	IP host ports used by SNMP management, ranging from 1 to 8

Default Value

None

Command Mode

ONU SNMP profile configuration mode

Usage Guidelines

A valid SNMP configuration must contain the designation of this ONU IP host port.

The ONU IP host port determines the ONU IP address used by the ONU SNMP agent to listen and SNMP trap to send

VLAN processing and the corresponding uplink virtual port (GEM port) channel. For details about how to configure an IP address, see the section Configuring an ONU IP Host. For more information about VLAN processing, see VLAN Configuration on ONU User Ports and Traffic Mapping on ONU. For the uplink virtual port channel, see the ONU Traffic Mapping Configuration section and the Virtual Port and T-Cont configuration chapters.

Example

ONU SNMP profile snmp-test configuration provides SNMP management using ONU IP host port 2:

OLT(config)# gpon profile onu-snmp snmp-test

config-gpon-profile# gpon-profile snmp bind ip-host 2

59.19.3 gpon-profile snmp version

Syntax

gpon-profile snmp version *ver*

no gpon-profile snmp version

To configure the SNMP protocol version used for ONU SNMP management, run the above commands.

Parameter Description

Parameter	Parameter Description
ver	SNMP protocol version, range 1-3

Default Value

Version 2

Command Mode

ONU SNMP profile configuration mode

Usage Guidelines

None

Example

The SNMP profile snmp-test of the ONU SNMP profile is configured with the SNMP protocol version set to v3 :

OLT(config)# gpon profile onu-snmp snmp-test

config-gpon-profile# gpon-profile snmp version 3

59.19.4 gpon-profile snmp trap host

Syntax

gpon-profile snmp trap host *A.B.C.D* [**port** *dst-port*]

no gpon-profile snmp trap host

To configure the IP address and port number of the target host for the ONU SNMP trap, run the above commands.

Parameter Description

Parameter	Parameter Description
A.B.C.D	The IP address of the host to which the SNMP trap is targeted
dst-port	The UDP port number of the target host of the SNMP Trap, in the range 1-65535

Default Value

None, SNMP traps are not sent

The UDP port number of the destination host is 162 by default

Command Mode

ONU SNMP profile configuration mode

Usage Guidelines

None

Example

The ONU SNMP profile snmp-test sets the target host IP address of the SNMP trap to 10.114.1.1 and the port number to 163:

OLT(config)# gpon profile onu-snmp snmp-test

config-gpon-profile# gpon-profile snmp trap host 10.114.1.1 port 163

59.19.5 gpon-profile snmp security-name

Syntax

gpon-profile snmp security-name *sec-name*

no gpon-profile snmp security-name

To configure ONU SNMP security-name, run the above commands.

Parameter Description

Parameter	Parameter Description
sec-name	SNMP security-name string, length 1-32

Default Value

None

Command Mode

ONU SNMP profile configuration mode

Usage Guidelines

None

Example

The following example sets the SNMP security-name parameter to my-test-sec-name in the ONU SNMP profile snmp-test.

OLT(config)# gpon profile onu-snmp snmp-test

config-gpon-profile# gpon-profile snmp security-name my-test-sec-name

59.19.6 gpon-profile snmp read-community

Syntax

gpon-profile snmp read-community *rcomm*

no gpon-profile snmp read-community

To configure the ONU SNMP read operation group name, run the above commands.

Parameter Description

Parameter	Parameter Description
rcomm	SNMP read operation community name string, length 1-32

Default Value

None

Command Mode

ONU SNMP profile configuration mode

Usage Guidelines

None

Example

ONU SNMP profile snmp-test configuration SNMP read operation group name public:

OLT(config)# gpon profile onu-snmp snmp-test

config-gpon-profile# gpon-profile snmp read-community public

59.19.7 gpon-profile snmp write-community

Syntax

gpon-profile snmp write-community *wcomm*

no gpon-profile snmp write-community

To configure the ONU SNMP write group name, run the above commands.

Parameter Description

Parameter	Parameter Description
wcomm	SNMP write community name string, length 1-32

Default Value

None

Command Mode

ONU SNMP profile configuration mode

Usage Guidelines

None

Example

ONU SNMP Profile: snmp-test, configure SNMP write group name: private :

OLT(config)# gpon profile onu-snmp snmp-test

config-gpon-profile# gpon-profile snmp write-community private

59.19.8 gpon onu snmp-profile

Syntax

gpon onu snmp-profile *snmp-prof-name*

no gpon onu snmp-profile

To configure the ONU to refer to the SNMP profile configuration, run the above commands.

Parameter Description

Parameter	Parameter Description
snmp-prof-name	The name of the SNMP template

Default Value

The SNMP profile configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU corresponding to port gpon0/0/1:1 refers to the configuration of the SNMP profile snmp-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu snmp-profile snmp-test

59.20 ONU CATV Configuration Commands

59.20.1 GPON ONU CATV Protocol

Syntax

gpon onu catv protocol {**ITU** | **private**}

no gpon onu catv protocol

To configure the OMCI protocol used by ONU CATV management, run the above commands.

Parameter Description

Parameter	Parameter Description
ITU	CATV functions are managed using the ITU G.988 standard OMCI protocol
private	Use the private extension OMCI protocol to manage CATV functionality

Default Value

The ITU G.988 standard OMCI protocol is used.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

You need to configure the OMCI protocol used for CATV management, and then configure the ONU CATV function.

Example

The ONU corresponding to the gpon0/0/1:1 port uses the private extended OMCI protocol to manage the CATV function.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu catv protocol private

59.20.2 gpon profile onu-catv

Syntax

gpon profile onu-catv *catv-prof-name*

To create an ONU CATV profile and enter the CATV profile configuration mode, run the above command.

no gpon profile onu-catv *catv-prof-name*

To delete the ONU CATV template, run the above command.

Parameter Description

Parameter	Parameter Description
catv-prof-name	The name of the CATV template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named catv-prof-name does not exist, create a template and enter the ONU CATV template configuration mode, otherwise go directly to the configuration mode of the CATV profile.

You can configure CATV gain and alarm functions in the ONU CATV profile.

Currently, CATV template configuration is supported only when the CATV function is managed using the private extended OMCI protocol.

Example

The following example shows how to create/configure the ONU CATV template catv-test.

OLT(config)# gpon profile onu-catv catv-test

59.20.3 gpon-profile gain-type

Syntax

gpon-profile gain-type {**agc** [**agc-up-value** *agc-up-val*] [**agc-range** *agc-range-val*] | **mgc** [**mgc-tx-attenuation** *mgc-val*]}

To configure the gain type and corresponding gain parameter of the ONU CATV module, run the above command.

no gpon-profile gain-type {**agc** | **mgc**}

To configure the ONU CATV module gain type and restore the corresponding gain type Parameter to the default value, run the above command.

Parameter Description

Parameter	Parameter Description
agc	Auto gain
mgc	Manual gain
agc-up-val	Auto gain upper limit, range -80~0, unit 0.1dbm, default value -50
agc-range-val	Auto gain range, range 0~100, unit 0.1dbm, default value 100
mgc-val	Manual gain attenuation, range 0~150, unit 0.1dbm, default value 150

Default Value

Auto gain, upper limit -5.0dBm, range 10.0dBm

Command Mode

ONU CATV template configuration mode

Usage Guidelines

None

Example

ONU CATV template catv-test configuration port CATV gain type is manual gain with attenuation of 1.2dBm:

OLT(config)# gpon profile onu-catv catv-test

config-gpon-profile# gpon-profile gain-type mgc mgc-tx-attenuation 12

59.20.4 gpon-profile alarm

Syntax

gpon-profile alarm {**input** | **output** | **voltage** | **temperature**} {**low** | **high**} **threshold** *value value2*

no gpon-profile alarm {**input** | **output** | **voltage** | **temperature**} {**low** | **high**}

To configure ONU CATV alarms, run the above command.

Parameter Description

Parameter	Parameter Description
value	Alarm threshold. input: Receiving power alarm, range -150~-50, unit 0.1dBm **output**: send level, range -10000~10000, unit 0.1dBuV **voltage**: voltage, range 0~1000, unit 0.1V **temperature**: temperature, range -300~1000, unit 0.1 degrees Celsius
value2	Alarm clearing threshold

Default Value

Low Receiving Power: -15 dBm

Alarm if the receiving power is too high: -5 dBm

Send too low alarm: -1000dBuV

Send high level alarm: 1000dBuV

Low voltage alarm: 0V

High voltage alarm: 100V

Low temperature alarm: -30 degrees Celsius

High temperature alarm: 100 degrees Celsius

Command Mode

ONU CATV profile configuration mode

Usage Guidelines

None

Example

ONU CATV profile catv-test: When the CATV power is less than -10 dBm, the low power is generated alarm, and when the power is greater than -5 dBm, the low power is cleared.

OLT(config)# gpon profile onu-catv catv-test

config-gpon-profile# gpon-profile alarm input low threshold -100 -50

59.20.5 gpon onu catv catv-profile

Syntax

gpon onu catv *port* **catv-profile** *catv-prof-name*

no gpon onu catv *port* **catv-profile** *catv-prof-name*

To configure ONU CATV port reference CATV template, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding CATV port
catv-prof-name	The name of the CATV template

Default Value

The CATV template configuration is not referenced and is not delivered to the corresponding CATV template configuration.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Currently, CATV template configuration is supported only when the CATV function is managed using the private extended OMCI protocol.

Example

CATV port 1 of the ONU corresponding to port gpon0/0/1:1 refers to the configuration of the CATV template catv-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu catv 1 catv-profile catv-test

59.20.6 gpon onu catv enable

Syntax

gpon onu catv *port* {**enable| disable**}

To enable the ONU CATV port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding CATV port

Default Value

Enabled

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU corresponding to gpon0/0/1:1 port is disabled, and CATV port 2 is disabled.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu catv 2 disable

59.20.7 show gpon interface onu catv-info

Syntax

show gpon interface *onu-intf-name onu* **catv-info**

To display information about all CATV ports on the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

For the display of temperature and voltage, it is only supported when the CATV function is managed using the private extended OMCI protocol.

Example

View all CATV ports that correspond to gpon0/0/1:1 ports.

OLT# show gpon interface gpon0/0/1:1 onu catv-info

interface	Port	Temperature(degree)	Voltage(V)	RxPower(dBm)	TxVoltage(dBuV)
gpon0/0/1:1	1	0.0	0.0	-15.0	23.2

59.21 ONU Performance Statistics Configuration Commands

59.21.1 gpon onu pm

Syntax

gpon onu pm {**enable** | **disable**} **no gpon onu pm**

To enable ONU performance statistics, run the above command.

Parameter Description

None

Default Value

Disabled

Command Mode

ONU Port Configuration Mode

Usage Guidelines

After the performance statistics are enabled, the OLT will record the performance statistics of the supported ONUs, create and collect a new record entry every 15 minutes, and maintain a maximum of 96 record entries at each performance statistics location.

Example

Enable performance statistics on the ONU corresponding to the gpon0/0/1:1 port.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu pm enable

59.21.2 show gpon interface onu port statistics

Syntax

show gpon interface *onu-intf-name* **onu port** *port-num* {**current-statistics** | **history-statistics** *record-num* | **accumulate-statistics**}

To display the performance statistics of the ONU Ethernet user port, run the above commands.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port-num	Check the corresponding Ethernet user port
current-statistics	Check the performance statistics of the current period
history-statistics	Check performance statistics for historical periods
accumulate- statistics	Check the accumulated performance statistics
record-num	Check the historical performance statistics of a specified record entry, ranging from 1 to 96, with 1 being the first history, and the higher the value, the later the corresponding time.

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

You must enable the ONU performance statistics feature before you can view the performance statistics of the current and historical periods. If you disable the performance statistics operation, all recorded performance statistics entries will be cleared at the same time.

The ONU may not support the implementation of some statistical fields, in which case the display of the corresponding fields will be ignored in the corresponding show operation.

Example

Check the performance statistics of Ethernet user port 3 of the ONU corresponding to port gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu port 3 current-statistics Port 3 Interval 01 '11"

RxOctets	17
RxTotal Packets	28992620
RxUni castPackets	28992554
RxMulti castPackets	0
RxBroadcastPackets	16
RxDropEvents	5676756
TxOctets	2
TxTotal Packets	67819941
TxUni castPackets	27683644
TxMulti castPackets	17
TxBroadcastPackets	16842752
TxDropEvents	0
RxUndersizePackets	0
TxUndersizePackets	17576704
RxOversizePackets	25
TxOversizePackets	5716824
RxFragments	301
RxJabbers	131073
RxPackets64Octets	17511168
RxPackets65to127Octets	5675024
RxPackets128to255Octets	5675004
RxPackets256to511Octets	0
RxPackets512to1023Octets	0
RxPackets1024to1518Octets	25
TxPackets64Octets	5675076
TxPackets65to127Octets	8716288
TxPackets128to255Octets	2097152
TxPackets256to511Octets	25
TxPackets512to1023Octets	22360832
TxPackets1024to1518Octets	5677040
RxFcsErrors	131399
RxCrcErrored Packets	25
TxCrcErrored Packets	0
TxExcessiveCollisions	0
TxLateCollisions	2

RxPacketsTooLong 0
RxBufferOverflows 0
TxBufferOverflows 0
TxSingleCollisionPackets 33
TxMultipleCollisionsPackets 5674936 SQEs 0
TxDeferredTransmissio 716319244 TxInternalMACTransmitError 0
CarrierSenseError 0
RxAlignmentError 0
RxInternalMACReceiveError 0

59.21.3 show gpon interface onu virtual-port statistics

Syntax

show gpon interface *onu-intf-name* **onu virtual-port** *port-num* {**current-statistics** | **history-statistics** *record-num* | **accumulate-statistics**}

To display the performance statistics of the virtual port (IUM) of the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	Check the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port-num	Check the corresponding virtual port
current-statistics	Check the performance statistics of the current period
history-statistics	Check performance statistics for historical periods
accumulate- statistics	Check the accumulated performance statistics
record-num	Check the historical performance statistics of a specified record entry, ranging from 1 to 96, with 1 being the first history, and the higher the value, the later the corresponding time.

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

You must enable the ONU performance statistics feature before you can view the performance statistics of the current and historical periods. If you disable the performance statistics operation, all recorded performance statistics entries will be cleared at the same time.

Example

View the performance statistics of virtual port 1 of the ONU corresponding to port gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu virtual-port 1 current-statistics virtual-port 1 Gemport 257 Interval 08 '15"

RxTotal Frames 0

TxTotal Frames 0 RxTotal Bytes 0 TxTotal Bytes 0 EncryptKeyErrors 0

59.22 ONU POE Configuration Commands

59.22.1 gpon onu poe protocol

Syntax

gpon onu poe protocol {**ITU** | **private**}

no gpon onu poe protocol

To configure the OMCI protocol used by ONU POE management, run the above command.

Parameter Description

Parameter	Parameter Description
ITU	POE functions are managed using the ITU G.988 standard OMCI protocol
private	Use the private extension OMCI protocol to manage POE functions

Default Value

Use the private extension OMCI protocol.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

You need to configure the OMCI protocol used for POE management, and then configure the ONU POE function.

Example

The ONU corresponding to the gpon0/0/1:1 port uses the ITU G.988 standard OMCI protocol to manage the POE function.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu poe protocol ITU

59.22.2 gpon onu poe power-limit

Syntax

gpon onu poe power-limit *value*

no gpon onu poe power-limit

To configure the total power limit of the ONU PSE, run the above command.

Parameter Description

Parameter	Parameter Description
value	ONU PSE total power limit, range 1-400 in watts

Default Value

120W

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

The total power of the ONU PSE corresponding to the gpon0/0/1:1 port is limited to 60 watts.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu poe power-limit 60

59.22.3 gpon onu poe-port standard

Syntax

gpon onu poe-port *port* **standard** {**AF** | **AT**}

no gpon onu poe-port *port* **standard**

To Configure the corresponding POE Ethernet user port with the standard, run the command above.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding POE Ethernet user port
AF	Using the 802.3af standard, the maximum output power is 154W
AT	It uses the 802.3at standard and has a maximum output power of 30W

Default Value

The 802.3at standard is used

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with Ethernet user port 1 PSE, and the standard is 802.3af.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu poe-port 1 standard AF

59.22.4 gpon onu poe-port mode

Syntax

gpon onu poe-port *port* **mode** {**disable** | **normal** | **force-on**} **no gpon onu poe-port** *port* **mode**

To configure the PSE operation mode of the ONU Ethernet user port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding POE Ethernet user port
disable	Disable the power supply mode
normal	Normal mode, power supply after PD is detected
force-on	Forced power supply mode

Default Value

Normal mode

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured for Ethernet user port 1 PSE and uses the forced power supply mode.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu poe-port 1 mode force-on

59.22.5 gpon-profile poe enable

Syntax

gpon-profile poe {**enable** | **disable**} **no gpon-profile poe enable**

To enable he POE function on the ONU Ethernet user port, run the above command.

Parameter Description

None

Default Value

Disable the POE function

Command Mode

ONU Ethernet user port profile configuration mode

Usage Guidelines

This command takes effect only when the POE management is configured to use ITU standards. When the ONU Ethernet user port references the corresponding template, the configuration is delivered.

If the ONU does not support the management attributes of the corresponding ITU standard, the OLT will treat it as a special case when the POE function is disabled.

Example

Configure the UNI-test configuration of the ONU Ethernet user port profile to enable the POE function:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile poe enable

59.22.6 gpon-profile poe power-pair-pinout

Syntax

gpon-profile poe power-pair-pinout {**signal** | **spare**}

no gpon-profile poe power-pair-pinout

To configure the POE power supply pin of the ONU Ethernet user port, run the above command.

Parameter Description

Parameter	Parameter Description
signal	Powered by signal lines
spare	Powered by an idle line

Default Value

Maintain the configured ONU.

Command Mode

ONU Ethernet user port profile configuration mode

Usage Guidelines

This command takes effect only when the POE management is configured to use ITU standards. When the ONU Ethernet user port references the corresponding template, the configuration is delivered.

The ONU may not support this command for the configuration of the power supply pins. We recommend that you use the show gpon interface onu poe-status function to check that the POE Capabilities of the ONU contain Pinout-Changeable, and then configure this command to specify the power supply pins.

Example

ONU Ethernet user port profile uni-test Configure the POE power supply pin as an idle line:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile poe power-pair-pinout spare

59.22.7 gpon-profile poe power-pri

Syntax

gpon-profile poe power-pri {**critical** | **high** | **low**}

no gpon-profile poe power-pri

To configure the power supply priority of the ONU Ethernet user port, run the above command.

Parameter Description

Parameter	Parameter Description
critical	Highest priority
high	High priority
low	Low priority

Default Value

Maintain the configured ONU.

Command Mode

ONU Ethernet user port profile configuration mode

Usage Guidelines

This command takes effect only when the POE management is configured to use ITU standards. When the ONU Ethernet user port references the corresponding template, the configuration is delivered.

Example

The ONU Ethernet user port profile uni-test sets the POE power supply priority to High priority:

OLT(config)# gpon profile onu-uni uni-test

config-gpon-profile# gpon-profile poe power-pri high

59.22.8 gpon-profile poe pse-class

Syntax

gpon-profile poe pse-class *class-val*

no gpon-profile pse-class

To configure the POE power supply level of the ONU Ethernet user port, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

If you configure different OMCI protocol management POE functions, the contents displayed are different. The OLT obtains information about the ONU POE only in the configured OMCI mode .

Example

Check the POE status of the ONU corresponding to the gpon0/0/1:1 port.

OLT# show gpon interface gpon0/0/1:1 onu poe-status PoE protocol type: Private

interface Volt(V) Power(W) Temp(degree)

--- --- --- ---

gpon0/0/1:1 54.56 120 150.0

port AT/AF PwrStat WorkMode Detect-PD ClassCur(mA) PDReqPow(W) PollPow(W) PollCur(mA) PollVolt PollTemper ClassResult

---- ----- ------- -------- --------- ------------ ----------- ---------- -----------

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1 AT ON Normal Standard 40.4 30.00 8.26 152.0

54.37 76.2 class 4

2 AF ON Forceon None 40.5 30.00 8.18 150.2

54.50 77.3 class 4

OLT# show gpon interface gpon0/0/1:2 onu poe-status PoE protocol type: ITU

-------------------------- --

port :1

Oper Stat :ON

Poe Capabilities : Pinout-Changeable

Power Pair Pinout : A(Signal Pair)

Power Detection State : PSE dilvering Power

Power Class State : Class 4 PD

Power Priority : critical

Pse Class Control : Default

Invalid Signature Count :0

Power Denied Count :0

Overload Count :0

Short Count :0

Mps Absent Count :0

Current Power Consumption: 0.000(W)

59.23 ONU Voice VLAN Configuration Commands

59.23.1 gpon profile onu-voice-vlan

Syntax

gpon profile onu-voice-vlan *voice-vlan-prof-name*

To create an ONU voice VLAN template and enter the voice VLAN template configuration mode, run the above command.

no gpon profile onu-voice-vlan *voice-vlan-prof-name*

To delete the ONU voice VLAN template, run the above command.

Parameter Description

Parameter	Parameter Description
voice-vlan-prof-name	The name of the voice VLAN profile

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named voice-vlan-prof-name does not exist, create a template and enter the ONU voice VLAN profile configuration mode, otherwise go directly to the configuration mode of the voice VLAN profile.

In the ONU voice VLAN profile, you can configure the voice VLAN working mode and voice VLAN ID of each UNI port of the ONU, specify CoS and DSCP for the voice service flow, and identify the MAC address and prefix length of the voice service flow when the voice VLAN works in the MAC address pattern.

Example

The following example shows how to create or configure the ONU voice VLAN profile voice-vlan-test.

OLT(config)# gpon profile onu-voice-vlan voice-vlan-test

59.23.2 gpon-profile voice-vlan uni

Syntax

gpon-profile voice-vlan uni *port* **mode** {**mac-address** | **vlan**} **vlan-id** *vid* [**cos** *cos-val* | **dscpdscp-** *val*]

gpon-profile voice-vlan uni *port* **mode disable**

no gpon-profile voice-vlan uni *port*

To configure the ONU UNI port voice VLAN working mode, voice VLAN ID, and specify CoS or DSCP for voice service flows, run the above commands.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port in the range 1-32
mode **disable**	Disable the voice VLAN function on the corresponding port
mode **mac-** **address**	MAC address mode: identifies voice service flows based on MAC addresses, adds a specified voice VLAN ID to the voice service flow, and modifies CoS or DSCP
mode vlan	VLAN mode: Recognizes voice service flows based on VLANs, modifies CoS or DSCP for voice service flows, and carries voice VLAN ID information in the LLDP information of the port Based on this LLDP information, the peer voice device should send a service flow carrying the voice VLAN ID
vid	Voice VLAN ID , range 2-4094
cos-val	Modify the CoS value of the voice service flow in the range of 0-7
dscp-val	Modify the DSCP value for the voice service flow in the range of 0-63

Default Value

The voice VLAN feature is disabled on all ports.

If the voice VLAN is enabled, if the CoS and DSCP for the voice flow are not configured, the default value is 6.

Command Mode

ONU voice VLAN profile configuration mode

Usage Guidelines

This feature is implemented using the private extension OMCI

The configuration will be delivered only when the ONU MIB upload supports the corresponding private extension, and will not be delivered to the ONU even if the ONU UNI port is not reported.

Example

ONU voice VLAN profile voice-vlan-test configure port 1 to enable the voice VLAN function, the working mode is MAC address mode, the voice VLAN ID is 35, and the DSCP is modified to 48; Configure port 4 to enable the voice VLAN function, the working mode is VLAN mode, the voice VLAN ID is 36, and the CoS is 7:

OLT(config)# gpon profile onu-voice-vlan voice-vlan-test

config-gpon-profile# gpon-profile voice-vlan uni 1 mode mac-address vlan-id 35 dscp 48

config-gpon-profile# gpon

-profile voice-vlan uni 4 mode vlan vlan-id 36 cos 7

59.23.3 gpon-profile voice-vlan mac-address

Syntax

gpon-profile voice-vlan mac-address *mac-addr* [**prefix** *len*]

no gpon-profile voice-vlan mac-address *mac-addr*

To configure Adding/Deleting ONU voice vlans to identify the source mac address and prefix length of voice service flows when the mac address mode is used, run the above command.

Parameter Description

Parameter	Parameter Description
mac-addr	The source MAC address used to identify the voice service flow in the format AA:BB:CC:DD:EE:FF
len	The valid length of the source MAC address used to identify the voice service flow, ranging from 1 to 48

Default Value

None voice VLAN MAC address entry.

If no valid length is specified, the default value is set to MAC OUI length 24.

Command Mode

ONU voice VLAN profile configuration mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

ONU voice VLAN profile voice-vlan-test Configure two source MAC addresses to match, 00:05:4e:00:00:00 length 24 , 1c:5a:6b:f0:00:00 length 32 :

OLT(config)# gpon profile onu-voice-vlan voice-vlan-test

config-gpon-profile# gpon-profile voice-vlan mac-address 00:05:4e:00:00:00

config-gpon-profile# gpon-profile voice-vlan mac-address 1c:5a:6b:f0:00:00 prefix 32

59.23.4 gpon onu voice-vlan-profile

Syntax

gpon onu voice-vlan-profile *voice-vlan-prof-name*

no gpon onu voice-vlan-profile

To configure the ONU reference voice VLAN profile configuration, run the above command.

Parameter Description

Parameter	Parameter Description
voice-vlan-prof-name	The name of the voice VLAN profile

Default Value

The voice VLAN template configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU corresponding to port gpon0/0/1:1 refers to the configuration of the voice-vlan-test voice VLAN profile.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu voice-vlan-profile voice-vlan-test

59.24 ONU 802.1x Configuration Commands

59.24.1 gpon profile onu-dot1x

Syntax

gpon profile onu-dot1x *dot1x-prof-name*

To create an ONU 802.1x profile and enter the 802.1x profile configuration mode, run the above command.

no gpon profile onu-dot1x *dot1x-prof-name*

To delete the ONU 802.1x template, run the above command.

Parameter Description

Parameter	Parameter Description
dot1x-prof-name	The name of the 802.1x template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

When the template named dot1x-prof-name does not exist, create a template and enter the ONU 802.1x template configuration mode, otherwise go directly to the configuration mode of the 802.1x template.

In the ONU 802.1x profile, you can configure the 802.1x authentication server information of the ONU, as well as the 802.1x authentication enablement, multi-user control mode, and guest-VLAN of each UNI port.

Example

Create/configure the ONU 802.1x template dot1x-test.

OLT(config)# gpon profile onu-dot1x dot1x-test

59.24.2 gpon-profile dot1x authentication-server

Syntax

gpon-profile dot1x authentication-server *server-url* **secret** *secret-str* [**backup**]

no gpon-profile dot1x authentication-server *server-url*

To configure the ONU 802.1x authenticated Radius authentication server and key, run the above commands.

Parameter Description

Parameter	Parameter Description
server-url	The address of the 802.1x authenticated Radius authentication server
secret-str	The 802.1x authenticated Radius authentication server shares the key
backup	Serve as an alternate authentication server

Default Value

None authentication server configuration.

Command Mode

ONU 802.1x template configuration mode

Usage Guidelines

The ONU needs to have an access channel to the configured server address to complete 802.1x information authentication, and if necessary, you need to use the ONU IP host configuration command and the ONU traffic mapping configuration command to complete the necessary access channel configuration.

Example

The ONU 802.1x profile dot1x-test configures the active and standby authentication server addresses 192.168.100.101 and 192.168.100.102 , and the key is radius-test-key

OLT(config)# gpon profile onu-dot1x dot1x-test

config-gpon-profile# gpon-profile dot1x authentication-server 192.168.100.101 secret radius-test-key

config-gpon-profile# gpon-profile dot1x authentication-server 192.168.100.102 secret radius-test-key backup

59.24.3 gpon-profile dot1x uni enable

Syntax

gpon-profile dot1x uni *port* {**enable** | **disable**}

To enable 802.1x authentication on ONU UNI port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port in the range 1-32

Default Value

802.1x authentication is disabled on all ports and all traffic is allowed.

Command Mode

ONU 802.1x template configuration mode

Usage Guidelines

The corresponding configuration will be delivered only when the ONU MIB upload is uploaded to support the corresponding ME node, and for the ONU UNI port that is not reported, it will not be delivered to the ONU even if it is configured.

Example

ONU 802.1x profile dot1x-test configure port 1 and port 4 to enable 802.1x authentication:

OLT(config)# gpon profile onu-dot1x dot1x-test

config-gpon-profile# gpon-profile dot1x uni 1 enable config-gpon-profile# gpon-profile dot1x uni 4 enable

59.24.4 gpon-profile dot1x uni mode

Syntax

gpon-profile dot1x uni *port* **mode** {**single-user** | **multiple-hosts** | **multiple-auth**}

no gpon-profile dot1x uni *port* **mode**

To configure the ONU UNI port 802.1x multi-user control mode, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port in the range 1-32
single-user	In single-user mode, only one user can be authenticated and allowed on a port
multiple- hosts	In multi-user access mode, when a user on a port is authenticated, all users on the port are deemed to have passed the authentication and are allowed
multiple- auth	In the multi-user authentication mode, each user on the port must be independently authenticated before it can be allowed (cannot be used at the same time as the Guest-VLAN).

Default Value

If the Guest-VLAN is not configured, this function maintains the configured ONU by default. If Guest-VLAN is enabled, this feature defaults to multi-user access mode.

Command Mode

ONU 802.1x template configuration mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

The ONU 802.1x profile dot1x-test is configured to be single-user in single-user mode on port 1 and multi-user authentication mode on port 4

OLT(config)# gpon profile onu-dot1x dot1x-test

config-gpon-profile# gpon-profile dot1x uni 1 mode single-user config-gpon-profile# gpon-profile dot1x uni 4 mode multiple-auth

59.24.5 gpon-profile dot1x uni guest-vlan

Syntax

gpon-profile dot1x uni *port* **guest-vlan** *vid*

no gpon-profile dot1x uni *port* **guest-vlan**

To configure ONU UNI port 802.1x Guest-VLAN function, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding port in the range 1-32
vid	Guest-VLAN ID , range 1-4094

Default Value

The Guest-VLAN feature is not enabled.

Command Mode

ONU 802.1x template configuration mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If you enable the Guest-VLAN feature, you can assign the corresponding port to a specified Guest-VLAN when the client does not respond, and grant specific network access.

The guest-VLAN function cannot be used at the same time as the multi-user authentication mode.

Example

The ONU 802.1x profile dot1x-test is configured to enable the Guest-VLAN feature on port 1 with the Guest-VLAN ID 2399:

OLT(config)# gpon profile onu-dot1x dot1x-test

config-gpon-profile# gpon-profile dot1x uni 1 guest-vlan 2399

59.24.6 gpon onu dot1x-profile

Syntax

gpon onu dot1x-profile *dot1x-prof-name*

no gpon onu dot1x-profile

To configure the ONU by referring to the 802.1x profile configuration, run the above commands.

Parameter Description

Parameter	Parameter Description
dot1x-prof-name	The name of the 802.1x template

Default Value

The 802.1x template configuration is not referenced.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

None

Example

The ONU corresponding to port gpon0/0/1:1 refers to the configuration of the 802.1x profile dot1x-test.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu dot1x-profile dot1x-test

59.24.7 show gpon interface onu dot1x

Syntax

show gpon interface *onu-intf-name onu* **dot1x** [*port*]

To display all 802.1x authentication information for the UNI port specified by the ONU or the entire device, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port	View the specified ONU UNI port and view all 802.1x information about the ONU if it is not specified

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

The view of Supplicant MAC addresses as well as multi-user authentication entries is implemented using the private extension OMCI

Example

View all 802.1x authentication information about the ONU corresponding to the gpon0/0/1:1 port.

OLT# show gpon interface gpon0/0/1:1 onu dot1x

==========

Authentication server #1: 10.25.15.1

Shared secret of server #1: my-radius-key

==========

```
==================================================================

UNI 6 802.1x state:

==================================================================

802.1x authentication: Enabled

802.1x authentication mode: Multiple-authentication

Supplicant              000c.2972.209c
Authorized                   No
Authenticator state     Held
Backend state                Idle

Supplicant              000c.29e7.c10a
Authorized                   Yes
Authenticator state     Authenticated
Backend state                Idle

Supplicant              3c52.8264.9d94
Authorized                   No
Authenticator state     Held
Backend state                Idle

------------------------------------------------------------------
```

59.25 ONU File Supply Configuration Commands

59.25.1 gpon profile onu-file-provision

Syntax

gpon profile onu-file-provision *file-provision-prof-name*

To create an ONU file feed profile and enter the file feed template configuration mode, run the above command.

no gpon profile onu-file-provision *file-provision-prof-name*

To delete the ONU file feed template, run the above command.

Parameter Description

Parameter	Parameter Description
file-provision-prof-name	The name of the file feed template

Default Value

None

Command Mode

Global Configuration Mode

Usage Guidelines

If the template named file-provision-prof-name does not exist, create a template and enter the ONU file feed template configuration mode, otherwise go directly to the configuration mode of the file provisioning template.

In the ONU file provisioning template, you can configure the ONU file provisioning conditions, file type, file instance, local file name, transfer operation, URL, username and password, virtual port binding, VLAN, and file size.

Example

Create or configure the ONU file supply template file-provision-test.

OLT(config)# gpon profile onu-file-provision file-provision-test

59.25.2 gpon-profile file-provision condition supported- protocol

Syntax

gpon-profile file-provision condition supported-protocol {**none** | **ftp** | **tftp** | **sftp** | **http** | **https** | **flute** | **dsm-cc** | *number*}

no gpon-profile file-provision condition supported-protocol

To configure the supported transport protocols in the conditions for ONU file provision, run the above commands.

Parameter Description

Parameter	Parameter Description
none	None protocol support conditions
ftp	FTP support is required
tftp	TFTP support is required
sftp	SFTP support is required
http	HTTP support is required
https	HTTPS support is required
flute	FLUTE support is required
dsm-cc	DSM-CC support is required
number	Configure the number of the transport protocols to be supported, ranging from 1 to 16

Default Value

None protocol support conditions

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

If the transport protocol supported by the ONU does not contain the protocols that need to be supported here, all configurations of the file feed template will not be delivered to the ONU, and the ONU will maintain the default configuration. If the Never protocol support condition is configured, the None will issue a file and provide the template configuration regardless of the transmission protocol supported by the ONU.

Example

The supported transport protocol in the ONU file provision-test configuration condition is FTP

OLT(config)# gpon profile onu-file-provision file-provision-test

config-gpon-profile# gpon-profile file-provision condition supported-protocol ftp

59.25.3 gpon-profile file-provision file-type

Syntax

gpon-profile file-provision file-type {**software-image** | *number*}

no gpon-profile file-provision file-type

To configure the file type for the ONU file provision, run the above commands.

Parameter Description

Parameter	Parameter Description
software-image	Used for software imagery
number	Configure the ME type of the transfer file owner, ranging from 1-65535

Default Value

Used for software imagery

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

The file type needs to be determined according to the type of ME to which the file belongs, and the ME type value is derived from ITU G.988 Table 11.2.4-1.

Example

The ONU file provision-test profile type is for circuit pack (ME type is 6).

OLT(config)# gpon profile onu-file-provision file-provision-test config-gpon-profile# gpon-profile file-provision file-type 6

59.25.4 gpon-profile file-provision file-instance

Syntax

gpon-profile file-provision file-instance *number*

no gpon-profile file-provision file-instance

To configure an ONU file to feed the file instance, run the above command.

Parameter Description

Parameter	Parameter Description
number	Profile instance, range 0-65535

Default Value

Do not configure the profile instance and keep the default value of ONU.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

It should be the same as the ID of the ME to which the file belongs.

Example

The ONU file provision-test profile instance is 0

OLT(config)# gpon profile onu-file-provision file-provision-test

config-gpon-profile# gpon-profile file-provision file-instance 0

59.25.5 gpon-profile file-provision local-name

Syntax

gpon-profile file-provision local-name [*string*]

no gpon-profile file-provision local-name

To configure the local file name for the ONU file, run the above command.

Parameter Description

Parameter	Parameter Description
string	Configure the local file name string with a length of 0-128, and an empty string will be delivered when the string is empty

Default Value

Do not configure the local file name and keep the default ONU value.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

None

Example

The local file name of the ONU file provisioning template file-provision-test configuration is testfile :

OLT(config)# gpon profile onu-file-provision file-provision-test

config-gpon-profile# gpon-profile file-provision local-name testfile

59.25.6 gpon-profile file-provision action

Syntax

gpon-profile file-provision action {**none** | **download** | **upload** | **delete**}

no gpon-profile file-provision action

To configure the ONU file supply and transfer action, run the above command.

Parameter Description

Parameter	Parameter Description
none	If you specify an action for None, do not configure a transfer action and keep the default value of ONU
download	Download
upload	upload
delete	Delete

Default Value

If you specify an action for None, do not configure a transfer action and keep the default value of ONU

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

None

Example

ONU file provisioning template file-provision-test configuration transfer action download:

OLT(config)# gpon profile onu-file-provision file-provision-test config-gpon-profile# gpon-profile file-provision action download

59.25.7 gpon-profile file-provision url

Syntax

gpon-profile file-provision url *string*

no gpon-profile file-provision url

To configure the ONU file supply URL, run the above command.

Parameter Description

Parameter	Parameter Description
string	Configure the URL string with length 1-128

Default Value

Deliver an empty string.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

None

Example

The URL of the ONU file provisioning profile file-provision-test is ftp:// 192.168.1.1:21/:

OLT(config)# gpon profile onu-file-provision file-provision-test

config-gpon-profile# gpon-profile file-provision url ftp://192.168.1.1:21/

59.25.8 gpon-profile file-provision username password

Syntax

gpon-profile file-provision username *name* **password** *pass*

no gpon-profile file-provision username

To configure the username and password required for the ONU file to be provided to access the URL, run the above command.

Parameter Description

Parameter	Parameter Description
name	The username required to access the URL
pass	The user password required to access the URL

Default Value

None username and password.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

None

Example

The user name of the ONU file provision-test template is myname and the password is mypass

OLT(config)# gpon profile onu-file-provision file-provision-test

config-gpon-profile# gpon-profile file-provision username myname password mypass

59.25.9 gpon-profile file-provision bind virtual-port

Syntax

gpon-profile file-provision bind virtual-port *vp-index*

no gpon-profile file-provision bind virtual-port

To configure the virtual port to be used for ONU file provisioning, run the above command.

Parameter Description

Parameter	Parameter Description
vp-index	Configure virtual ports, ranging from 1 to 31

Default Value

Do not configure the virtual port to be used, and keep the default value of ONU.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

None

Example

The virtual port used by the ONU file provision-test profile file-provision-test is 1 :

OLT(config)# gpon profile onu-file-provision file-provision-test

config-gpon-profile# gpon-profile file-provision bind virtual-port 1

59.25.10 gpon-profile file-provision vlan

Syntax

gpon-profile file-provision vlan *vid*

no gpon-profile file-provision vlan

To configure the VLAN for ONU file provisioning, run the above command.

Parameter Description

Parameter	Parameter Description
vid	Configure a VLAN in the range 0-4094

Default Value

Do not configure VLANs and keep the default ONU values.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

In this example, the VLAN used by the multicast transport protocol is set to 0 for untag.

Example

The ONU file provisioning profile file-provision-test sets the VLAN to 100:

OLT(config)# gpon profile onu-file-provision file-provision-test config-gpon-profile# gpon-profile file-provision vlan 100

59.25.11 gpon-profile file-provision file-size

Syntax

gpon-profile file-provision file-size *number*

no gpon-profile file-provision file-size

To configure the size of the ONU file provision, run the above command.

Parameter Description

Parameter	Parameter Description
number	The size of the configuration file ranges from 0 to 4294967295 in bytes

Default Value

The size of the profile is not maintained, and the default value of the ONU is maintained.

Command Mode

ONU file provisioning template configuration mode

Usage Guidelines

If this parameter is set to 0, the file size is not limited.

Example

The size of the ONU file-provision-test file is 1024 :

OLT(config)# gpon profile onu-file-provision file-provision-test config-gpon-profile# gpon-profile file-provision file-size 1024

59.25.12 gpon onu file-provision-profile

Syntax

gpon onu file-provision-profile *file-provision-prof-name*

no gpon onu file-provision-profile

To configure the ONU reference file to feed the template, run the above command.

Parameter Description

Parameter	Parameter Description
file-provision-prof-name	The name of the file feed template

Default Value

No reference file is provided for template configuration.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

Deleting a template reference will deliver file type 0.

Example

Configure the file-provision-test profile for the ONU reference file corresponding to port gpon0/0/1:1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu file-provision-profile file-provision-test

59.25.13 gpon onu-file-provision-status-on

Syntax

[**no**] **gpon onu-file-provision-status-on**

To enable or disable the ONU provision-status notifications, run the above command.

Parameter Description

None

Default Value

Disabled

Command Mode

GPON Port Configuration Mode

Usage Guidelines

None

Example

Enable ONU file provisioning status notification on GPON0/0/1 ports.

OLT(config)# interface gpon0/0/1

OLT(config-gpon0/0/1)# gpon onu-file-provision-status-on

59.25.14 gpon file-provision

Syntax

gpon file-provision interface {*onu-intf-name* | *pon-intf-name* [*seq-range*]} [**noconfirm**]

To manually trigger ONU file provisioning (executes an action), run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf- name	Run MIB reset on the ONU corresponding to the specified ONU port in the following format: **gpon** *chassis*/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
pon-intf- name	Run a MIB reset on the ONU under the specified PON port in the following format: **gpon** *chassis*/*slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number
seq-range	Perform MIB reset for the specified ONU port sequence number range, and MIB reset for all ONUs under the PON port if not specified
noconfirm	Do not wait for a prompt to confirm the execution of the command

Default Value

None

Command Mode

EXEC mode

Usage Guidelines

After the ONU reference file feed template is configured and the ONU of the referenced file feed template triggers a MIB reset (including modifying the configured configuration template referenced by the ONU, bringing the ONU SO that always executes MIB reset when the ONU is configured, manually executing the ONU MIB reset, and the ONU going offline). If you need to trigger ONU file provisioning, you need to manually execute this command, and make sure that the ONU port has referenced the file supply template and the action configured by the template is not none, otherwise it will not be triggered.

Example

The ONU trigger file corresponding to the gpon0/0/1:1 port is supplied:

OLT# gpon file-provision interface gpon0/0/1:1

59.25.15 show gpon onu-file-provision

Syntax

show gpon onu-file-provision interface *pon-intf-name*

To display the ONU file provisioning status information using the OLT PON port, run the above command.

Parameter Description

Parameter	Parameter Description
pon-intf-name	Display the supply status of all ONU files in the specified PON port format: **gponchassis/***slot*/*port* chassis is the chassis number, slot is the slot number, and port is the GPON port number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

Only ONUs with active success status will be displayed.

Example

Displays the file provisioning status of all ONUs in gpon0/0/1.

OLT# show gpon onu-file-provision interface gpon0/0/1 Interface gpon0/0/1 display 2 ONUs:

IntfName Description SN Profile-name

Status

---------- ---------- ---------- ----------

---- ----------

gpon0/0/1:1 N/A MPCM:1F5FC7D8 N/A

N/A

gpon0/0/1:2 N/A FHTT:12345678 file-provis i

on-test File transfer completed successfully

59.26 ONU Home Gateway Configuration Commands

59.26.1 gpon onu wan

Syntax

gpon onu wan *port*

To create an ONU WAN port, run the above command.

gpon onu wan *port* [**create** | **delete**]

To create or delete an ONU WAN port, run the above command.

no gpon onu wan *port*

To clear the ONU WAN port configuration saved by the olt (used to configure onu profiles only), run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command mode

ONU port configuration mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the ONU MIB will not be re-delivered after the ONU MIB is reset. The configurator must use the show gpon interface onu wan command to determine the current working status of the corresponding ONU function in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU configuration corresponding to gpon0/0/1:1 creates WAN port 2.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 2 create

59.26.2 gpon onu wan admin-status

Syntax

gpon onu wan *port* **admin-status** {**enable| disable**}

To enable the ONU WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the ONU MIB will not be re-delivered after the ONU MIB is reset. The configurator must use the show gpon interface onu wan command to determine the current working status of the corresponding ONU function in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU configuration for gpon0/0/1:1 port enables WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 admin-status enable

59.26.3 gpon onu wan connection-name

Syntax

gpon onu wan *port* **connection-name** *connection-name*

To configure the ONU WAN port connection name, run the command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
connection-name	WAN port connection name

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the ONU MIB will not be re-delivered after the ONU MIB is reset. The configurator must use the show gpon interface onu wan command to determine the current working status of the corresponding ONU function in real time, and then deliver the necessary configuration from the OLT side.

Example

The connection name of the ONU corresponding to port gpon0/0/1:1 is INET_P__VID_44.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 connection-name INET_P_VID_44

59.26.4 gpon onu wan connection-type

Syntax

gpon onu wan *port* **connection-type** {**bridge** | **dhcp** | **static** | **pppoe** | **pppoe-bridge** | **pppoe-mix**}

To configure the ONU WAN port connection mode, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
bridge	Bridging mode
dhcp	DHCP mode
static	Static IP mode
pppoe	PPPOE mode
pppoe-bridge	PPPOE bridging mode
pppoe-mix	PPPOE hybrid mode

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface ONU WAN command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to port gpon0/0/1:1 is configured as a bridge on WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 connection-type bridge

59.26.5 gpon onu wan service-type

Syntax

gpon onu wan *port* **service-type** {**none** | [**internet**] [**voip**] [**tr069**] [**other**]}

To configure the ONU WAN port service type, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
none	No services are specified to be included
internet	Internet services
voip	Speech services
tr069	TR-069 Management Services
other	Other services

Default Value

Maintain the configured ONU

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to gpon0/0/1:1 is configured on WAN port 1 to provide TR-069 management services.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 service-type tr069

59.26.6 gpon onu wan nat

Syntax

gpon onu wan *port* **nat** {**enable| disable**}

To configure NAT enabled on the ONU WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to port gpon0/0/1:1 is configured to enable NAT on port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 nat enable

59.26.7 gpon onu wan mtu

Syntax

gpon onu wan *port* **mtu** *value*

To configure the MTU value of the ONU WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
value	MTU value range: 0-65535 in bytes

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The MTU value of WAN port 1 is set to 1450 for the ONU corresponding to gpon0/0/1:1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 mtu 1450

59.26.8 gpon onu wan tci

Syntax

gpon onu wan *port* **tci** [**vlan** *vid*] [**priority** *pri*] [**dei** {**0** | **1**}]

To configure the TCI information used by ONU WAN port traffic, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
vid	The value range of VLAN is 1-4094
pri	The priority value ranges from 0 to 7

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to port gpon0/0/1:1 is configured to use VLAN 44 priority 1 for WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 tci v lan 44 priority 1

59.26.9 gpon onu wan ip-version

Syntax

gpon onu wan *port* **ip-version** [**ipv4** | **ipv6** | **ipv4/ipv6**]

To configure the ONU WAN port to run the IP protocol version, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
ipv4	Enable IPv4
ipv6	Enable IPv6
ipv4/ipv6	Enable IPv4 + IPv6 dual-stack

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU configuration corresponding to gpon0/0/1:1 enables IPv4 + IPv6 dual-stack for WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 ip-version ipv4/ipv6

59.26.10 gpon onu wan ip

Syntax

gpon onu wan *port* **ip address** *addr mask* **gateway** *gw* **dns1** *dns1 dns2 dns2*

To configure the static IP address of the ONU WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
addr	WAN port IP address, format A.B.C.D
mask	Subnet mask, format A.B.C.D
gw	Default gateway, format A.B.C.D
dns1	Active DNS, format A.B.C.D
dns2	Alternate DNS in format A.B.C.D

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU configuration corresponding to port gpon0/0/1:1 is set to the static IP address of WAN port 1, and the IP address is 10.112.1.153/24, which is the default gateway.

10.112.1.254 , Active DNS 192.168.1.3 , None Standby DNS.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 ip address 10.112.1.153 255.255.255.0 gateway 10.112.1.254 dns1 192.168.1.3 dns2 0.0.0.0

59.26.11 gpon onu wan ipv6

Syntax

gpon onu wan *port* **ipv6 address** *addr* **prefix** *prefgateway gw* **dns1** *dns1 dns2 dns2*

To configure ONU WAN port static IPv6, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
addr	IPv6 address of the WAN port, format a, c:d::e
pref	IPv6 address subnet prefix length
gw	IPv6 default gateway in format a, c:d::e
dns1	IPv6 active DNS in format a, c:d::e
dns2	IPv6 alternate DNS in the format a, c:d:e

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to port gpon0/0/1:1 is configured with a static IPv6 address on WAN port 1, IP address 2001::1001/64 , default gateway 2001::1 , active DNS 2001::1, and Zero standby DNS.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 ipv6 address 2001::1001 prefix 64 gateway 2001::1 dns1 2001::1 dns2 ::

59.26.12 gpon onu wan auto-get-dns-address

Syntax

gpon onu wan *port* **auto-get-dns-address** {**enable| disable**}

To configure the ONU WAN port to automatically obtain DNS enablement, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

Configure the ONU corresponding to gpon0/0/1:1 to enable automatic DNS acquisition on WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 auto-get-dns-address enable

59.26.13 gpon onu wan dial-mode

Syntax

gpon onu wan *port* **dial-mode** {**always** | **on-demand timeout** *inactivity-time*}

To configure the PPPOE dial-up mode and connection timeout period for ONU WAN ports, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
always	PPPOE dialing is always online
on-demand	PPPOE dials only when there is traffic in the service
inactivity-time	The idle timeout period of a PPPOE connection, in seconds

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to gpon0/0/1:1 is configured with the PPPOE dialing mode of WAN port 1 to dial only when there is service traffic, and the idle timeout time is 5 minutes.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 dial-mode on-demand timeout 300

59.26.14 gpon onu wan pppoe username

Syntax

gpon onu *wan port* **pppoe username**

user **password** *pass*

To configure the username and password to be used by the PPPOE on the ONU WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
user	PPPOE username
pass	PPPOE user password

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The PPPOE user name of WAN port 1 is configured for the ONU corresponding to gpon0/0/1:1, and the user password is 123456.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 pppoe username ad003 password 123456

59.26.15 gpon onu wan pppoe-service-name

Syntax

gpon onu wan *port* **pppoe-service-name** *service-name*

To configure the PPPOE service name of the ONU WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
service-name	The name of the PPPOE service

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The PPPOE service of WAN port 1 is configured for the ONU corresponding to gpon0/0/1:1 and is named fast-internet.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 pppoe-service-name fast-internet

59.26.16 gpon onu wan bind

Syntax

gpon onu wan *port* **bind** { **none** | { **lan1** | **lan2** | **lan3** | **lan4** | **lan5** | **lan6** | **lan7** | **lan8** | **ssid1** | **ssid2** | **ssid3** | **ssid4** | **ssid5** | **ssid6** | **ssid7** | **ssid8** }* }

To configure the ONU WAN port to bind the user port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port
none	No user port is bound
lan1... 8	Bind the corresponding Ethernet user port 1... 8
ssid1... 8	Bind the corresponding WIFI SSID port 1... 8

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured to bind WAN port 1 to user ports 1, 3, and 4 and the WIFI SSID 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 bind lan1 lan3 lan4 ssid1

59.26.17 gpon onu wan lan-dhcp

Syntax

gpon onu wan *port* **lan-dhcp** {**enable| disable**}

To enable the DHCP server on the user port bound to the WAN port by the ONU, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to gpon0/0/1:1 enables DHCP on the user port bound to WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 lan-dhcp enable

59.26.18 gpon onu wan qos

Syntax

gpon onu wan *port* **qos** {**enable| disable**}

To enable the QOS attribute on the WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU configuration for gpon0/0/1:1 enables the QOS attribute for the user port bound to WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 qos enable

59.26.19 gpon onu wan dhcpv6-prefix-delegation

Syntax

gpon onu wan *port* **dhcpv6-prefix-delegation** {**enable| disable**}

To configure the DHCPv6 prefix proxy enabled for the ONU to bind the WAN port, run the above command.

Parameter Description

Parameter	Parameter Description
port	Configure the corresponding WAN port

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wan command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to gpon0/0/1:1 enables DHCPv6 prefix proxy for the user port bound to WAN port 1.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu wan 1 dhcpv6-prefix-delegation enable

59.26.20 gpon onu wifi 2.4G channel-Information channel-width-mode

Syntax

gpon onu wifi 2.4G channel-Information channel-width-mode {**20MHz** | **40MHz** | **20/40MHz**} {**auto** | **id** *channel_id*}

To configure the channel width and channel number of the ONU 2.4G WIFI port, run the above command.

Parameter Description

Parameter	Parameter Description
20MHz	Channel width 20MHz
40MHz	Channel width 40MHz
20/40MHz	Channel width 20/40MHz
auto	Channels are automatically selected
channel_id	Specify the channel number, ranging from 1 to 13, which may vary depending on the channel width

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the ONU MIB will not be re-delivered after the ONU MIB is reset. The configurator shall determine the current working status of the corresponding function of the ONU in real time through the corresponding show gpon interface onu WiFi command, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with a channel width mode of 2.4 GHz for the 2.4 GHz WIFI port, and the channel number of the 2.4 GHz mode is automatically obtained.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 2.4G channel-Information channel-width-mode 20MHz auto

59.26.21 gpon onu wifi 2.4G channel-Information txpower-mode

Syntax

gpon onu wifi 2.4G channel-Information txpower-mode {**15%** | **35%** | **50%** | **70%** | **100%**}

To configure the signal transmission power of the ONU 2.4G WIFI port, run the above command.

Parameter Description

Parameter	Parameter Description
15%	Set the WIFI signal transmit power to 15%
35%	Set the WIFI signal transmit power to 35%
50%	Set the WIFI signal transmit power to 50%
70%	Set the WIFI signal transmit power to 70%
100%	Set the WIFI signal transmit power to 100%

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 2.4G WIFI port, the command for gpon onu wifi 2.4G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with a 2.4G WIFI port with a signal transmission power of 15%.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 2.4G channel-Information txpower-mode 15%

59.26.22 gpon onu wifi 2.4G tx-rate

Syntax

gpon onu wifi 2.4G tx-rate {**auto** | **1m** | **2m** | **5.5m** | **6m** | **9m** | **11m** | **12m** | **18m** | **24m** | **36m** | **48m** | **54m** | **mc** *mcs-rate*}

To configure the ONU 2.4G WIFI port transmission rate, run the above command.

Parameter Description

Parameter	Parameter Description
auto	Set the WIFI port send rate to automatic
1m | **2m** | **5.5m** | **6m** | **9m** | **11m** | **12m** | **18m** | **24m** | **36m** | **48m** | **54m**	Set the WIFI port transmission rate to 1Mbps | 2Mbps | 5.5Mbps | 6Mbps | 9Mbps | 11MBps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps
mc	Set the WIFI port sending rate to the rate indicated by the MCS index value
mcs-rate	Specify the MCS index value in the range of 0-15

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 2.4G WIFI port, the command for gpon onu wifi 2.4G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wifi command to determine the current working state of the corresponding function of the ONU in real time state, and then deliver the necessary configurations from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with a 2.4G WIFI port transmission rate of 54 Mbps.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 2.4G tx-rate 54m

59.26.23 gpon onu wifi 2.4G ctrl-band

Syntax

gpon onu wifi 2.4G ctrl-band {**upper** | **lower**}

To configure the SSID control band mode of the ONU 2.4G WIFI port, run the command above.

Parameter Description

Parameter	Parameter Description
upper	Set the SSID control band mode of the WIFI port to the upper part
lower	Set the SSID control band mode of the WIFI port to the lower part

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 2.4G WIFI port, the command for gpon onu wifi 2.4G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with a 2.4G WIFI port and the SSID control band mode is upper.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 2.4G ctrl-band upper

59.26.24 gpon onu wifi 2.4G wlan-enable

Syntax

gpon onu wifi 2.4G wlan-enable {**enable** | **disable**}

To enable the ONU 2.4G Wi-Fi port, run the above command.

Parameter Description

None

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 2.4G WIFI port, the command for gpon onu wifi 2.4G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with the 2.4G WIFI port enabled.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 2.4G wlan-enable enable

59.26.25 gpon onu wifi 2.4G ssid

Syntax

gpon onu wifi 2.4G ssid *ssid* **ssid-admin** {**enable** | **disable**} Enable the SSID access point on the ONU 2.4G Wi-Fi port.

gpon onu wifi 2.4G ssid *ssid* **ssid-name**

To Configure the name of the access point for the ONU 2.4G WIFI port, run the above command.

gpon onu wifi 2.4G ssid *ssid* **ssid-broadcast-admin** {**enable** | **disable**}

To configure the ONU 2.4G WIFI port SSID to enable SSID name broadcasting on the access point, run the above command.

gpon onu wifi 2.4G ssid *ssid* **ssid-maxsta** *maxsta*

To configure the maximum number of users to access an ONU 2.4G WIFI port SSID, run the command above.

gpon onu wifi 2.4G ssid *ssid* **wlan-standard** {**802.11b** | **802.11g** | **802.11n** | **802.11b/g** | **802.11g/n** | **802.11b/g/n**}

To configure the ONU 2.4G WIFI port SSID access point wireless standard type, run the command above.

gpon onu wifi 2.4G ssid *ssid* **encrypt-mode** {**NONE** | **WEP** | **WPA** | **WPA2** | **WPA_WPA2**}

To configure the encryption mode of the ONU 2.4G WIFI port SSID access point, , run the command above.

gpon onu wifi 2.4G ssid *ssid* **encrypt-key** *key*

To *configure* the key of the ONU 2.4G WIFI port ssid access point, run the above command.

gpon onu wifi 2.4G ssid *ssid* **SGI** {**enable** | **disable**}

To configure the SSID access point of the ONU 2.4G WIFI port to enable SGI, run the command above.

Parameter Description

Parameter	Parameter Description
ssid	SSID access point sequence number
name	The name of the SSID access point
maxsta	The maximum number of users that can access an SSID endpoint ranges from 0 to 128, and 0 indicates the None limit
key	SSID access point key

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 2.4G WIFI port, the command for gpon onu wifi 2.4G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with 2.4G WIFI port ssid 1 The access point is enabled, the name is my-test, the name broadcast is enabled, the maximum number of access users is 40, the None line standard is 802.11b/g/n, the encryption mode is WPA2, the key bdyun2018 is enabled, and SGI is enabled.

```
OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 2.4G ssid 1 ssid-admin enable
```

OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	ssid-name my-test
OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	ssid-broadcast-admin enable
OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	ssid-maxsta 40
OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	wlan-standard 802.11b/g/n
OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	encrypt-mode WPA2
OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	encrypt-key bdyun2018
OLT(config-gpon0/0/1:1)# gpon onu w ifi	2.4G	ssid	SGI enable

59.26.26 gpon onu wifi 5G channel-Information channel- width-mode

Syntax

gpon onu wifi 5G channel-Information channel-width-mode {**20MHz** | **40MHz** | **80MHz(5G)**} {**auto** | **id** *channel_id*}

To configure the channel width and channel number of the ONU 5G WIFI port, run the above command.

Parameter Description

Parameter	Parameter Description
20MHz	Channel width 20MHz
40MHz	Channel width 40MHz
80MHz(5G)	Channel width 80MHz
auto	Channels are automatically selected
channel_id	Specify the channel number, and the optional values include 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 | 149 | 153 | 157 | 161 | 165

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 5G WIFI port, the command gpon onu wifi 5G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wifi command to determine the current working state of the corresponding function of the ONU in real time state, and then deliver the necessary configurations from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with the channel width mode of the 5G WIFI port to 80MHz, and the channel number of the 5G mode is automatically obtained.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G channel-Information channel-width-mode 80MHz(5G) auto

59.26.27 gpon onu wifi 5G channel-Information txpower- mode

Syntax

gpon onu wifi 5G channel-Information txpower-mode {**15%** | **35%** | **50%** | **70%** | **100%**}

To configure the transmission power of the ONU 5G WIFI port, run the above command.

Parameter Description

Parameter	Parameter Description
15%	Set the WIFI signal transmit power to 15%
35%	Set the WIFI signal transmit power to 35%
50%	Set the WIFI signal transmit power to 50%
70%	Set the WIFI signal transmit power to 70%
100%	Set the WIFI signal transmit power to 100%

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 5G WIFI port, the command gpon onu wifi 5G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with 70% signal transmission power of the 5G WIFI port.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G channel-Information txpower-mode 70%

59.26.28 gpon onu wifi 5G tx-rate

Syntax

gpon onu wifi 5G tx-rate {**auto** | **6m** | **9m** | **12m** | **18m** | **24m** | **36m** | **48m** | **54m** | **NSS** *nss-val mc- rate*}

To configure the ONU 5G WIFI port transmission rate, run the above command.

Parameter Description

Parameter	Parameter Description
auto	Set the WIFI port send rate to automatic
6m | **9m** | **12m** | **18m** | **24m** | **36m** | **48m** | **54m**	Set the WIFI port transmission rate to the specified 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps
NSS	Set the WIFI port send rate to the rate indicated by the NSS-MCS index value
nss-val	Specify the number of spatial streams, ranging from 1 to 2
mc-rate	Specify the MCS index value in the range of 0-9

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 5G WIFI port, the command gpon onu wifi 5G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wifi command to determine the current working state of the corresponding function of the ONU in real time state, and then deliver the necessary configurations from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with a 5G WIFI port transmission rate of 54 Mbps.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G tx-rate 54m

59.26.29 gpon onu wifi 5G ctrl-band

Syntax

gpon onu wifi 5G ctrl-band auto

To configure the ONU 5G WIFI port SSID control band mode, run the above command.

Parameter Description

None

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 5G WIFI port, the command gpon onu wifi 5G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator should use the corresponding show gpon interface onu wifi command to determine the current working state of the corresponding function of the ONU in real time state, and then deliver the necessary configurations from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with the SSID control band mode of the 5G WIFI port and the band mode is automatic.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ctrl-band auto

59.26.30 gpon onu wifi 5G wlan-enable

Syntax

gpon onu wifi 5G wlan-enable {**enable** | **disable**}

To configure the ONU 5G Wi-Fi port to be enabled, run the above command.

Parameter Description

None

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 5G WIFI port, the command gpon onu wifi 5G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with the 5G WIFI port enabled.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G wlan-enable enable

59.26.31 gpon onu wifi 5G ssid

Syntax

gpon onu wifi 5G ssid *ssid* **ssid-admin** {**enable** | **disable**}

To enable the SSID access point on the ONU 5G Wi-Fi port, run the above command.

gpon onu wifi 5G ssid *ssid* **ssid-name**

To configure the name of the access point for the ONU 5G WIFI port ssid, run the above command.

gpon onu wifi 5G ssid *ssid* **ssid-broadcast-admin** {**enable** | **disable**}

To configure the ONU 5G WIFI port ssid and enable ssid name broadcasting for the access point, run the above command.

gpon onu wifi 5G ssid *ssid* **ssid-maxsta** *maxsta*

To configure the maximum number of users to access an ONU 5G WIFI port SSID access point, run the above command.

gpon onu wifi 5G ssid *ssid* **wlan-standard** {**802.11a** | **802.11n** | **802.11a/n** | **802.11ac** | **802.11n/ac** | **802.11a/n/ac**}

To configure the wireless standard type of ONU 5G WIFI port ssid access point, run the above command.

gpon onu wifi 5G ssid *ssid* **encrypt-mode** {**NONE** | **WEP** | **WPA** | **WPA2** | **WPA_WPA2**}

To configure the encryption mode of the ONU 5G WIFI port SSID access point, run the above command.

gpon onu wifi 5G ssid *ssid* **encrypt-key** *key*

To configure the key of the ONU 5G WIFI port ssid access point, run the above command.

gpon onu wifi 5 ssid *ssid* **SGI** {**enable** | **disable**}

To configure the SSID of the ONU 5G Wi-Fi port to enable SGI, run the above command.

Parameter Description

Parameter	Parameter Description
ssid	SSID access point sequence number
name	The name of the SSID access point
maxsta	The maximum number of users that can access an SSID endpoint ranges from 0 to 128, and 0 indicates the None limit
key	SSID access point key

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If the ONU does not support the 5G WIFI port, the command gpon ONU WiFi 5G will not exist under ONU Port Configuration Mode.

For the ONU home gateway configuration, because the ONU may be managed by the TR-069 server, the ONU local WEB, etc., the OLT does not save the corresponding configuration, and the configuration cannot be viewed through show run, and the OLT will not resend the corresponding configuration after resetting the ONU MIB. The configurator shall use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding function of the ONU in real time, and then deliver the necessary configuration from the OLT side.

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with 5G WIFI port ssid 5 access point enabled, the name is my-test , the name broadcast is enabled, the maximum number of access users is 40, the None line standard is 802.11a/n/ac, the encryption mode is WPA2, the key bdyun2018 is enabled, and SGI is enabled.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 ssid-admin enable OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 ssid-name my-test

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 ssid-broadcast-admin enable OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 ssid-maxsta 40

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 wlan-standard 802.11a/n/ac OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 encrypt-mode WPA2

OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 encrypt-key bdyun2018 OLT(config-gpon0/0/1:1)# gpon onu w ifi 5G ssid 5 SGI enable

59.26.32 gpon onu wifi-region-code

Syntax

[**no**] **gpon onu wifi-region-code** *region-info* Configure the ONU WIFI port region code.

Parameter Description

| Parameter | Parameter Description |

| *region-info* | WIFI port area code |

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

For the ONU home gateway configuration, due to the local WEB and other aspects of the ONU management, the corresponding configuration is unsuccessful, the configuration personnel should use the corresponding show gpon interface onu wifi command to determine the current working status of the corresponding ONU function in real time, and then perform the necessary configuration from the OLT side .

Example

The ONU corresponding to the gpon0/0/1:1 port is configured with the ONU WIFI port area code CN.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu w ifi-region-code CN

59.26.33 show gpon interface onu wan

Syntax

show gpon interface *onu-intf-name onu* **wan** [*port*] **config**

To show the ONU specified WAN port or all WAN port configurations, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port	View the specified ONU WAN port

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

Check the configuration of WAN port 1 of the ONU corresponding to port gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu wan 1 config

59.26.34 show gpon interface onu wifi

Syntax

show gpon interface *onu-intf-name onu* **wifi** *ssid* **config**

To display the configuration of the WIFI ssid access point specified by the ONU and the corresponding WIFI port configuration, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
ssid	View the specified ONU WIFI SSID access point, ranging from 1 to 8

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

Check the configuration of the WIFI ssid 1 of the ONU corresponding to the gpon0/0/1:1 port .

OLT# show gpon interface gpon0/0/1:1 onu w ifi 1 config

59.27 ONU Other Management Configuration Commands

59.27.1 gpon onu always-check-template

Syntax

gpon onu always-check-template [**match** | **config** | **higher-precedence**]

no gpon onu always-check-template

To configure whether to re-detect the ONU profile and deliver the ONU when the ONU goes online, run the above commands

Parameter Description

Parameter	Parameter Description
match	Check whether the ONU can still be matched by the referenced template, and if not, select the template again for delivery
config	Check whether the ONU configuration of the referenced profile has changed, and re-deliver the current profile if there is a change
higher-precedence	Check whether there is a higher-priority ONU configuration profile that matches the ONU. If so, the system re-delivers the matching ONU configuration profile with the highest priority

Default Value

By default, ONU ports are not detected.

By default, match and config are enabled for ONU configuration templates created by users.

The onu-template-default, onu-template-default-hgu, and onu-template-default-veip-noeth configuration templates created by default enable match and higher-precedence checks by default.

The onu-template-default-veip configuration template created by the system is enabled by default to enable match and config checks.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

After the ONU is activated and the ONU is re-detected, the ONU will confirm whether the ONU needs to be re-delivered based on the configured check logic after the ONU is activated and the ONU is launched. Multiple check logics can be configured at the same time.

match checks whether the ONU can still be matched by the referenced template, and if not, clears all the original ONU configurations and selects a new template for delivery. This function is usually used for the transformation of the service model, when the ONU form corresponding to the same ONU binding changes and needs to be rematched to the new form to deliver different ONU configurations.

config checks whether the ONU configuration of the ONU referenced template has changed, and if there is a change, all the original ONU configurations are cleared and the current template is delivered again . This feature is usually used when the ONU configuration needs to be adjusted frequently and the ONU configuration is modified in batches following the template.

higher-precedence checks whether the PON port is bound to a higher-priority ONU configuration profile (including a preconfigured templateIf so, the matching highest-priority ONU configuration template is re-delivered. Note that if the ONU referenced template is no longer bound by the PON port, the priority will be considered lower than that of all other binding templates. When the referenced template is bound to a preconfigured template, the logic of this check does not take effect because there is no higher priority. This feature is usually used to override the configuration of some ONUs when the same template is used to deliver configurations.

For details about the configuration of ONU profiles, see GPON ONU Profile Configuration Commands.

Example

When the ONU corresponding to port gpon0/0/1:1 goes online, use match and config logic to check whether the ONU profile is re-detected and sent down .

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu always-check-template match config

59.27.2 gpon onu upstream-mac-security

Syntax

gpon onu upstream-mac-security {**enable| disable**}

no gpon onu upstream-mac-security

To configure learning protection for the upstream MAC address of the ONU, run the above command.

Parameter Description

None

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

If you enable the learning protection of the upstream MAC address of the ONU, the ONU prohibits the MAC address learned from the user port from migrating to the PON port.

This function is usually used to configure the situation that data forwarding is allowed between onu in the pon port, to prevent the onu from migrating and learning the mac under the user port to the pon port when the source is actually its own user port, and then the destination mac is forwarded to the mac address under this user port.

Example

The ONU corresponding to port gpon0/0/1:1 enables learning protection for the upstream MAC address.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu upstream-mac-security enable

59.27.3 gpon onu remote-access

Syntax

gpon onu remote-access {**telnet** | **ping** | **webUI**} {**enable| disable**}

no gpon onu remote-access

To configure ONU to enable Telnet/PING/Web access from the PON side, run the above command.

Parameter Description

None

Default Value

Maintain the configured ONU.

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

The IP address information available from the PON side of the ONU needs to be determined from other sources. For example, ONU WAN configuration or IP host configuration.

Example

The ONU configuration corresponding to port gpon0/0/1:1 enables Telnet and PING from the PON side, and disables Web access from the PON side.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu remote-access telnet enable OLT(config-gpon0/0/1:1)# gpon onu remote-access ping enable OLT(config-gpon0/0/1:1)# gpon onu remote-access webUI disable

59.27.4 gpon onu led-mode

Syntax

gpon onu led-mode {**off** | **normal** }

no gpon onu led-mode

To configure the working mode of the ONU indicator, run the above command.

Parameter Description

None

Default Value

None

Command Mode

ONU Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

Example

The ONU configuration indicator for the gpon0/0/1:1 port is off.

OLT(config)# interface gpon0/0/1:1

OLT(config-gpon0/0/1:1)# gpon onu led-mode off

59.27.5 show gpon interface onu lldp-information

Syntax

show gpon interface *onu-intf-name onu* **lldp-information** [*port*]

To display LLDP information for the ONU specified UNI port or all UNI ports, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number
port	View the specified ONU UNI ports, and if not specified, view all UNI ports of the ONU

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

Check the LLDP information of UNI port 1 of the ONU corresponding to port gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu lldp-information 1

==========

UNI 1 Remote Device LLDP Information:

==========

Entry index: 1

Chassis id subtype: MAC address Chassis id: 00e0.0f07.3d0f

Port id subtype: locally assigned Port id: Fas0/8 (466173302f38)

Port description: FastEthernet0/8 System name: JF-87

System description: Fiberhome(tm) S2200 Software, Version 2.2.0C Serial: 0S375209CC0102, Copyright (c) 2012 by FiberHome Networks Compiled: 2020-12-25 17:49:3 by SYS

System capabilities: R B Enabled capabilities: B

==========

Totally has 1 LLDP entry.

==========

Capability Codes:

(R) Router, (B)Bridge, (C)DOCSIS Cable Device, (T)Telephone (W)WLAN Access Point, (P)Repeater, (S)Station, (O)Other

59.27.6 show gpon interface onu mac address-table

Syntax

show gpon interface *onu-intf-name* **onu mac address-table** [*AA:BB:CC:DD:EE:FF*] [**vlan** *vid*]

To display the ONU MAC address table, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

AA:BB:CC:DD:EE:FF	Filter by the specified MAC address, and do not filter by MAC address if not specified
vid	Filter by specified VLAN, range 0-4094, do not filter by VLAN if not specified

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI.

Example

View the MAC address table of the ONU corresponding to port gpon0/0/1:1 and filter by VLAN 1.

OLT# show gpon interface gpon0/0/1:1 onu mac address-table vlan 1 Onu Mac Address Table (Total 2)

Vlan

Mac Address

Ports

1 000e.c63c.4d4d UNI 1

1 f46b.8c88.527d UNI 2

59.27.7 show gpon interface onu remote-access

Syntax

show gpon interface *onu-intf-name* **onu remote-access**

To display the ONU enabling information for Telnet/PING/Web access from the PON side, run the above command.

Parameter Description

Parameter	Parameter Description
onu-intf-name	View the specified ONU port in the following format: **gponchassis**/*slot*/*port*:*sequence* chassis is the chassis number, slot is the slot number, port is the GPON port number, and sequence is the ONU sequence number

Default Value

None

Command Mode

EXEC mode, Global Configuration Mode, Port Configuration Mode

Usage Guidelines

This feature is implemented using the private extension OMCI

Example

Check the Telnet/PING/Web access information of the ONU corresponding to port gpon0/0/1:1.

OLT# show gpon interface gpon0/0/1:1 onu remote-access

Telnet PING

WebUI

:Disable :Disable :Disable