3Com® Switch 4200G Family
Configuration Guide

4200G 12-Port (3CR17660-91)
4200G 24-Port (3CR17661-91)
4200G 48-Port (3CR17662-91)

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ENVIRONMENTAL STATEMENT

It is the policy of 3Com Corporation to be environmentally-friendly in all operations. To uphold our policy, we are committed to:

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Conserving energy, materials and natural resources in all operations.

Reducing the waste generated by all operations. Ensuring that all waste conforms to recognized environmental standards. Maximizing the recyclable and reusable content of all products.

Ensuring that all products can be recycled, reused and disposed of safely.

Ensuring that all products are labelled according to recognized environmental standards.

Improving our environmental record on a continual basis.

End of Life Statement

3Com processes allow for the recovery, reclamation and safe disposal of all end-of-life electronic components.

Regulated Materials Statement

3Com products do not contain any hazardous or ozone-depleting material.

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About This Guide

This guide provides information about configuring your network using the commands supported on the 3Com® Switch 4200-G Family.

The descriptions in this guide applies to the Switch 4200-G.

Organization of the Manual

The Switch 4200 Family Configuration Guide consists of the following chapters:

- **CLI Overview—**Provides an introduction to the CLI interface.
- **Logging In—**Provides information on the different ways to log into the switch.
- **Configuration File System Management—**Details the Configuration File System Management.
- **Address Management—**Details hoe to configure the switch on which the Address Manage (AM) feature is enabled.
- **VLAN Operation—**Details how to configure VLANs.
- **DHCP**—Details Dynamic Host Configuration Protocol.
- **Voice-VLAN**—Details configuration information to create Voice-VLAN.
- **GVRP Configuration**—Details GARP VLAN Registration Protocol configuration.
- **Port Operation—**Details how to configure Ethernet ports.
- **Link Aggregation—**Details how to aggregating several ports together
- **Port Isolation—**Details how to configure ports to be controlled on Layer 2.
- **DLDP—**Details overview and fundamentals for Device Link Detection Protocol.
- **MAC Address Table Management—**Details MAC address table configuration.
- **MSTP**—Details Multiple spanning tree protocol.
- **802.1x Configuration—**Details how to configure 802.1x.
- **HABP Configuration—**Details how to configure HABP
- **AAA &RADIUS**—Details AAA and RADIUS Configuration.
- **EAD**—Details Endpoint Admission Defense Configuration.
- **Centralized MAC address authentication—**Details Centralized MAC address authentication configuration.
- **ARP—**Details Address Resolution Protocol table configuration.
- **DHCP**—Details Dynamic Host Configuration Protocol.
- **ACL Configuration—**Details how to configure QoS/ACL..

- **QoS**—Details Quality of Service.
- **Mirroring**—Details how to configure Mirroring.
- **IGMP Snooping**—Details Internet Group Management Protocol Snooping
- **Multicast Protocol—**Details how to configure multicast protocols.
- **Clustering**—Details Clustering Configuration.
- **SNMP**—Details Simple Network Management Protocol Configuration.
- **RMON**—Details Remote Monitoring Configuration.
- **NTP—**Details Network time protocol.
- **SSH**—Details Secure Shell authentication.
- **File System Management—**Details how to configure the file system management.
- **FTP and TFTP—**Details how to configure the FTP and TFTP protocols.
- **Information Center—**Details how to configure the Information Center
- **BootROM and Host Software—**Details how to how to load BootROM and host software to a switch
- **Basic System Configuration—**Details how to how to configure a basic system.
- **IP Performance Configuration—**Details how to configure routing protocols
- **Network Protocol Operation—**Details how to configure network protocols
- **Network Connectivity Tests—**Details how to perform a connectivity test.
- **Device Management—**Details how to manage devices.
- **VLAN-VPN**—Details configuration information to create VLAN-VPNs.
- **DHCP Relay**—Details Dynamic Host Configuration Protocol relay configuration.
- **Static Route**—Details Static Route Configuration.
- **UDP Helper**—Details UDP Configuration.

Intended Readership

The manual is intended for the following readers:

- Network administrators
- Network engineers
- Users who are familiar with the basics of networking

Conventions

This manual uses the following conventions:

Table 1 Icons

Icon	Notice Type	Description
	Information note	Information that describes important features or instructions.
	Caution	Information that alerts you to potential loss of data or potential damage to an application, system, or device.

Table 1 Icons (Continued)

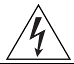
Icon	Notice Type	Description
	Warning	Information that alerts you to potential personal injury.

Table 2 Text conventions

Convention	Description
`Screen displays`	This typeface represents text as it appears on the screen.
Keyboard key names	If you must press two or more keys simultaneously, the key names are linked with a plus sign (+), for example: Press Ctrl+Alt+Del
The words "enter" and "type"	When you see the word "enter" in this guide, you must type something, and then press Return or Enter. Do not press Return or Enter when an instruction simply says "type."
`Fixed command text`	This typeface indicates the fixed part of a command text. You must type the command, or this part of the command, exactly as shown, and press *Return* or *Enter* when you are ready to enter the command. Example: The command **`display history-command`** must be entered exactly as shown.
`Variable command text`	This typeface indicates the variable part of a command text. You must type a value here, and press *Return* or *Enter* when you are ready to enter the command. Example: in the command **`super`** ***`level`***, a value in the range 0 to 3 must be entered in the position indicated by ***`level`***
{ x | y | ... }	Alternative items, one of which must be entered, are grouped in braces and separated by vertical bars. You must select and enter one of the items. Example: in the command **`flow-control {hardware	none	software}`**, the braces and the vertical bars combined indicate that you must enter one of the parameters. Enter either **`hardware`**, or **`none`**, or **`software`**.
[ ]	Items shown in square brackets [ ] are optional. Example 1: in the command **`display users [all]`**, the square brackets indicate that the parameter **`all`** is optional. You can enter the command with or without this parameter. Example 2: in the command **`user-interface`** [**`type`**] **`first-number`** [**`last-number`**] the square brackets indicate that the parameters [**`type`**] and [**`last-number`**] are both optional. You can enter a value in place of one, both or neither of these parameters. Alternative items, one of which can optionally be entered, are grouped in square brackets and separated by vertical bars. Example 3: in the command **`header [shell	incoming	login]`** ***`text`***, the square brackets indicate that the parameters **`shell`**, **`incoming`** and **`login`** are all optional. The vertical bars indicate that only one of the parameters is allowed.

Related Manuals

The *3Com Switch 4200 Family Getting Started Guide* provides information about installation.

The *3Com Switch 4200 Family Command Reference Guide* provides all the information you need to use the configuration commands.

1 CLI OVERVIEW

Introduction to the CLI

A S4200G series Ethernet switch provides a command line interface (CLI) and commands for you to configure and manage the Ethernet switch. The CLI is featured by the following:

- Commands are grouped by levels. This prevents unauthorized users from operating the switch with relevant commands.
- Users can gain online help at any time by entering the question mark "?".
- Commonly used diagnosing utilities (such as Tracert and Ping) are available.
- Debugging information of various kinds is available.
- The command history is available. You can recall and execute a history command easily.
- You can execute a command by only entering part of the command in the CLI, as long as the keywords you input uniquely identify the corresponding ones.

Command Level/Command View

To prevent unauthorized accesses, commands are grouped by command levels.

Commands fall into four levels: visit, monitor, system, and manage:

- Visit level: Commands at this level are mainly used to diagnose network and change the language mode of user interface, and cannot be saved in configuration files. For example, the **ping**, **tracert**, and **language-mode** commands are at this level.
- Monitor level: Commands at this level are mainly used to maintain the system and diagnose service problems, and cannot be saved to configuration files. For example, the **display** and **debugging** commands are at this level.
- System level: Commands at this level are mainly used to configure services. Commands concerning routing and network layers are at this level. You can utilize network services by using these commands.
- Manage level: Commands at this level are associated with the basic operation of the system, and the system supporting modules. These commands provide supports to services. Commands concerning file system, FTP/TFTP/XModem downloading, user management, and level setting are at this level.

Users logging into a switch also fall into four levels, each of which corresponding to one of the above command levels. Users at a specific level can only use the commands of the same level and those of the lower levels.

Switching between User Levels

A user can switch the user level from one to another by executing a related command after logging into a switch. The administrator can also set user level switching passwords so that users can switch their levels from lower ones to higher ones only when they input the correct passwords.

Setting a user level switching password

Table 1 lists the operations to set a user level switching password.

Table 1 Set a user level switching password

Operation	Command	Description
Enter system view	system-view	—
Set a password for switching from a lower user level to the user level identified by the *level* argument	**super password** [**level** *level* **]** { **simple** | **cipher** } *password*	Optional A password is necessary only when a user switches from a lower user level to a higher user level.

Switching to another user level

Table 2 lists operations to switch to another user level.

Table 2 Switch to another user level

Operation	Command	Description
Switch to the user level identified by the *level* argument	**super** [*level*]	Required Execute this command in user view. If a password for switching to the user level identified by the *level* argument is set and you want to switch to a lower user level, you will remain at the lower user level unless you provide the correct password after executing this command.

For security purpose, the password a user enters when switching to a higher user level is not displayed. A user will remain at the original user level if the user has tried three times to enter the correct password but fails to do this.

Configuring the Level of a Specific Command in a Specific View

You can configure the level of a specific command in a specific view. Commands fall into four command levels: visit, monitor, system, and manage, which are identified as 0, 1, 2, and 3 respectively. The administrator can change the command level a command belongs to.

Table 3 lists the operations to configure the level of a specific command.

Table 3 Configure the level of a specific command in a specific view

Operation	Command	Description
Enter system view	system-view	—
Configure the level of a specific command in a specific view	**command-privilege level** *level* **view** *view command*	Required Use this command with caution to prevent inconvenience on maintenance and operation.

CLI Views

CLI views are designed for different configuration tasks. They are interrelated. You will enter user view once you log into a switch successfully, where you can perform operations such as displaying operation status and statistical information. And by executing the **system-view** command, you can enter system view, where you can enter other views by executing the corresponding commands.

The following CLI views are provided:

- User view

- System view
- Ethernet port view
- VLAN view
- VLAN interface view
- LoopBack interface view
- Local user view
- User interface view
- FTP client view
- SFTP client view
- MST region view
- Cluster view
- Public key view
- Public key editing view
- Basic ACL view
- Advanced ACL view
- Layer 2 ACL view
- RADIUS scheme view
- ISP domain view

Table 4 lists information about CLI views (including the operations you can performed in these views, how to enter these views, and so on).

Table 4 CLI views

View	Available operation	Prompt example	Enter method	Quit method
User view	Display operation status and statistical information	<S4200G>	Enter user view once logging into the switch.	Execute the **quit** command in user view to log out of the switch.
System view	Configure system parameters	[4200G]	Execute the **system-view** command in user view.	Execute the **quit** or **return** command to return to user view.
Ethernet port view	Configure Ethernet port parameters	[4200G-GigabitEthernet1/0/1]	Execute the **interface gigabitethernet** 1/0/1 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
		[4200G-TenGigabitEthernet1/1/1]	Execute the **interface tengigabitethernet** 1/1/1 command in system view.	

Table 4 CLI views (Continued)

View	Available operation	Prompt example	Enter method	Quit method
VLAN view	Configure VLAN parameters	[4200G-Vlan1]	Execute the **vlan** 1 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
VLAN interface view	Configure IP interface parameters for VLANs and aggregated VLANs	[4200G-Vlan-interface1]	Execute the **interface vlan-interface** 1 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
LoopBack interface view	Configure LoopBack interface parameters	[4200G-LoopBack0]	Execute the **interface loopback** 0 command in system view	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
Local user view	Configure local user parameters	[4200G-luser-user1]	Execute the **local-user** user1 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
User interface view	Configure user interface parameters	[4200G-ui0]	Execute the **user-interface** 0 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
FTP client view	Configure FTP client parameters	[ftp]	Execute the **ftp** command in user view.	Execute the **quit** command to return to user view.
SFTP client view	Configure SFTP client parameters	<sftp-client>	Execute the **sftp** 10.1.1.1 command in system view.	Execute the **quit** command to return to user view.
MST region view	Configure MST region parameters	[4200G-mst-region]	Execute the **stp region-configuration** command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.

Table 4 CLI views (Continued)

View	Available operation	Prompt example	Enter method	Quit method
Cluster view	Configure cluster parameters	[4200G-cluster]	Execute the **cluster** command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
Public key view	Configure RSA public keys for SSH users	[4200G-rsa-publi c-key]	Execute the **rsa peer-public-key** S4200G003 command in system view.	Execute the **peer-public-key end** command to return to system view.
Public key editing view	Edit RSA public keys of SSH users	[4200G-rsa-key-c ode]	Execute the **public-key-code begin** command in public key view.	Execute the **public-key-code end** command to return to public key view.
Basic ACL view	Define rules for a basic ACL (ACLs with their IDs ranging from 2000 to 2999 are basic ACLs.)	[4200G-acl-basic-2000]	Execute the **acl number** 2000 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
Advanced ACL view	Define rules for an advanced ACL (ACLs with their IDs ranging from 3000 to 3999 are advanced ACLs.)	[4200G-acl-adv-3000]	Execute the **acl number** 3000 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
Layer 2 ACL view	Define the sub-rules of Layer 2 ACLs, which is numbered from 4000 to 4999.	[4200G-acl-ether netframe-4000]	Execute the **acl number** 4000 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
RADIUS scheme view	Configure RADIUS parameters	[4200G-radius-1]	Execute the **radius scheme** 1 command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.
ISP domain view	Configure parameters for an ISP domain	[4200G-isp-3Co m163.net]	Execute the **domain** 3Com163.net command in system view.	Execute the **quit** command to return to system view. Execute the **return** command to return to user view.

CLI Features

Online Help

CLI provides two types of online help: complete online help and partial online help. They assist you with your configuration.

Complete online help

Enter a “?” character in any view on your terminal to display all the commands available in the view and their brief descriptions. The following takes user view as an example.

```
<S4200G> ?
User view commands:
  boot          Set boot option
  cd            Change the current path
  clock         Specify the system clock
  cluster       Run cluster command
  copy          Copy the file
  debugging     Enable system debugging functions
  delete        Delete the file
  dir           Display the file list in system
  display       Display current system information
  <omitted>
```

Enter a command, a space, and a “?” character (instead of a keyword available in this position of the command) on your terminal to display all the available keywords and their brief descriptions. The following takes the **clock** command as an example.

```
<S4200G> clock ?
  datetime     Specify the time and date
  summer-time  Configure summer time
  timezone     Configure time zone
```

Enter a command, a space, and a “?” character (instead of an argument available in this position of the command) on your terminal to display all the available arguments and their brief descriptions. The following takes the **interface vlan** command as an example.

```
[4200G] interface vlan ?
  <1-4094>  VLAN interface number
[4200G] interface vlan 1 ?
  <cr>
```

The string <cr> means no argument is available in the position occupied by the “?” character. You can execute the command without providing any other information.

Partial online help

Enter a string followed directly by a “?” character on your terminal to display all the commands beginning with the string. For example:

```
<S4200G> pi?
ping
```

Enter a command, a space, and a string followed by a “?” character on your terminal to display all the keywords that belong to the command and begin with the string (if available). For example:

```
<S4200G> display ver?
  version
```

Enter a command, the first several characters of an available keyword which uniquely identifies the keyword, and press <Tab>, to complete the keyword will be automatically completed.

Terminal Display

CLI provides the following display feature:

- Display suspending. That is, the displaying of output information can be paused when the screen is full and you can then perform the three operations listed in Table 5 as needed.

Table 5 Displaying-related operations

Operation	Function
Press <Ctrl+C>	Suspend displaying and executing.
Press the space key	Scroll the output information up by one page.
Press <Enter>	Scroll the output information up by one line.

Command History

CLI can store the latest executed commands as history commands so that users can recall and execute them again. By default, CLI can store 10 history commands for each user. Table 6lists history command-related operations.

Table 6 Access history commands

Operation	Operation	Description
Display history commands	Execute the **display history-command** command	This command displays valid history commands.
Recall the previous history command	Press the up-arrow key or <Ctrl+P>	This operation recalls the previous history command (if available).
Recall the next history command	Pressing the down-arrow key or <Ctrl+N>	This operation recalls the next history command (if available).

As the Up and Down keys have different meanings in HyperTerminal running on Windows 9x, these two keys can be used to recall history commands only in terminals running Windows 3.x or Telnet running in Windows 3.x. You can press <Ctrl+P> or <Ctrl+N> in Windows 9x to achieve the same purpose.

If you enter and execute the same command successively for multiple times, only the first command is buffered.

Error Messages

If the command you enter passes the syntax check, it will be successfully executed; otherwise an error message will appear. Table 7 lists the common error messages.

Table 7 Common error messages

Error message	Description
Unrecognized command	The command does not exist.
	The keyword does not exist.
	The parameter type is wrong.
	The parameter value is out of range.
Incomplete command	The command entered is incomplete.
Too many parameters	You have entered too many parameters.
Ambiguous command	The parameters entered are ambiguous.
Wrong parameter found at '^' position.	The parameter labeled by '^' is unrecognizable.

Command Edit

The CLI provides basic command edit functions and supports multi-line editing. The maximum number of characters a command can contain is 256. Table 8 lists the CLI edit operations.

Table 8 Edit operations

Press…	**To…**
A common key	Insert the character the key represents at the cursor and move the cursor one character to the right if the edit buffer is not full.
The Backspace key	Delete the character on the left of the cursor and move the cursor one character to the left.
The left arrow key or <Ctrl+B>	Move the cursor one character to the left.
The right arrow key or <Ctrl+F>	Move the cursor one character to the right.
The up arrow key or <Ctrl+P>	Access history commands.
The down arrow key or <Ctrl+N>	
The Tab key	Utilize the partial online help. That is, when you enter an incomplete keyword and the Tab key, if the entered keyword uniquely identifies an existing keyword, the system completes the keyword and displays the command on the next line, or else (if the entered keyword neither uniquely identifies nor matches an existing keyword) the system displays your original input on a new line without any change.

2 LOGGING INTO AN ETHERNET SWITCH

Logging into an Ethernet Switch

You can log into an S4200-G series Ethernet switch in one of the following ways:

- Logging in locally through the Console port
- Telneting locally or remotely to an Ethernet port
- Telneting to the Console port using a modem
- Logging into the Web-based network management system
- Logging in through NMS (network management system)

Introduction to the User Interface

Supported User Interfaces

S4200-G series Ethernet switch supports two types of user interfaces: AUX and VTY.

Table 9 Description on user interface

User interface	Applicable user	Port used	Description
AUX	Users logging in through the Console port	Console port	Each switch can accommodate one AUX user.
VTY	Telnet users and SSH users	Ethernet port	Each switch can accommodate up to five VTY users.

As the AUX port and the Console port of a S4200G series switch are the same one, you will be in the AUX user interface if you log in through this port.

User Interface Number

Two kinds of user interface index exist: absolute user interface index and relative user interface index.

1. The absolute user interface indexes are as follows:
   - AUX user interface: 0
   - VTY user interfaces: Numbered after AUX user interfaces and increases in the step of 1
2. A relative user interface index can be obtained by appending a number to the identifier of a user interface type. It is generated by user interface type. The relative user interface indexes are as follows:
   - AUX user interface: AUX 0
   - VTY user interfaces: VTY 0, VTY 1, VTY 2, and so on.

Common User Interface Configuration

Table 10 Common user interface configuration

Operation	Command	Description
Lock the current user interface	lock	Optional Execute this command in user view. A user interface is not locked by default.
Specify to send messages to all user interfaces/a specified user interface	**send** { **all** | *number* | *type number }*	Optional Execute this command in user view.
Disconnect a specified user interface	**free user-interface** [*type] number*	Optional Execute this command in user view.
Enter system view	system-view	—
Enter user interface view	**user-interface** [*type*] *first-number* [*last-number]*	—
Set the command that is automatically executed when a user logs into the user interface	**auto-execute command** *text*	Optional By default, no command is automatically executed when a user logs into a user interface.
Display the information about the current user interface/all user interfaces	**display users** [**all**]	You can execute this command in any view.
Display the physical attributes and configuration of the current/a specified user interface	**display user-interface** [*type number* | *number*]	You can execute this command in any view.

CAUTION:

- The **auto-execute command** command may cause you unable to perform common configuration in the user interface, so use it with caution.
- Before executing the **auto-execute command** command and save your configuration, make sure you can log into the switch in other modes and cancel the configuration.

3 LOGGING IN THROUGH THE CONSOLE PORT

Introduction

To log in through the Console port is the most common way to log into a switch. It is also the prerequisite to configure other login methods. By default, you can log into an S4200G series Ethernet switch through its Console port only.

To log into an Ethernet switch through its Console port, the related configuration of the user terminal must be in accordance with that of the Console port.

Table 11 lists the default settings of a Console port.

Table 11 The default settings of a Console port

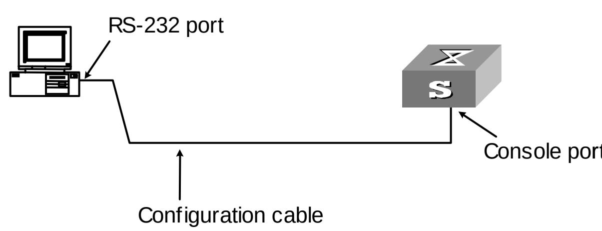
Setting	Default
Baud rate	9,600 bps
Flow control	Off
Check mode	No check bit
Stop bits	1
Data bits	8

After logging into a switch, you can perform configuration for AUX users. Refer to "Console Port Login Configuration" for more.

Setting up the Connection to the Console Port

- Connect the serial port of your PC/terminal to the Console port of the switch, as shown in Figure 1.

Figure 1 Diagram for setting the connection to the Console port



- If you use a PC to connect to the Console port, launch a terminal emulation utility (such as Terminal in Windows 3.X or HyperTerminal in Windows 9X) and perform the configuration shown in Figure 2 through Figure 4 for the connection to be created. Normally, the parameters of a terminal are configured as those listed in Table 11. And the type of the terminal is set to VT100.

Figure 2 Create a connection

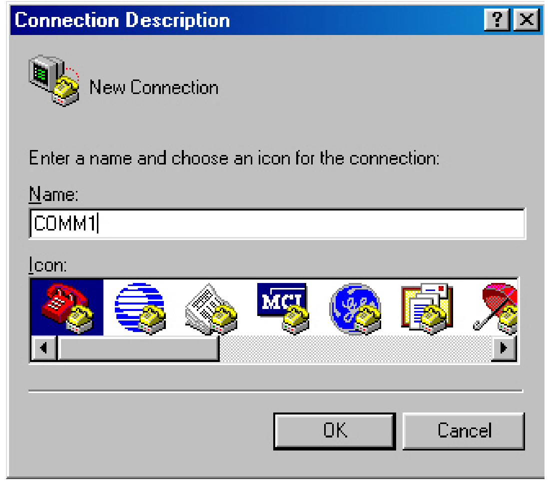
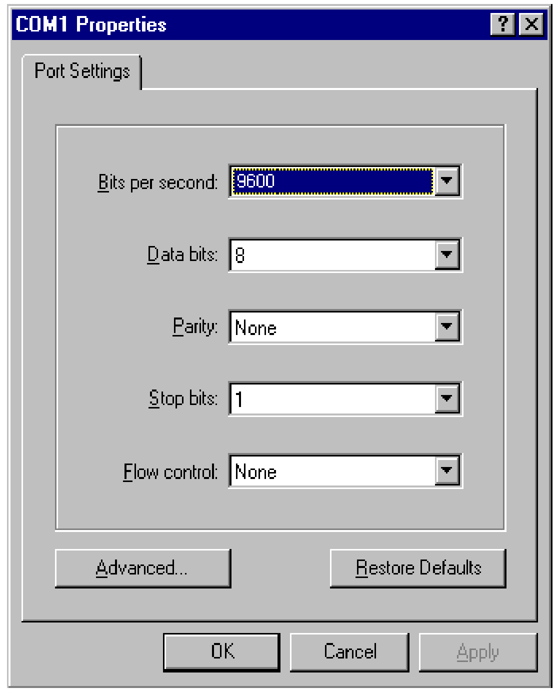


Figure 3 Specify the port used to establish the connection

Figure 4 Set port parameters



- Turn on the switch. The user will be prompted to press the Enter key if the switch successfully completes POST (power-on self test). The prompt (such as <S4200G>) appears after the user presses the Enter key.
- You can then configure the switch or check the information about the switch by executing commands. You can also acquire help by type the ? character.

Console Port Login Configuration

Common Configuration

Table 12 lists the common configuration of Console port login.

Table 12 Common configuration of Console port login

Configuration		Description
Console port configuration	Baud rate	Optional The default baud rate is 9,600 bps.
	Check mode	Optional By default, the check mode of the Console port is set to “none”, which means no check bit.
	Stop bits	Optional The default stop bits of a Console port is 1.
	Data bits	Optional The default data bits of a Console port is 8.
AUX user interface configuration	Configure the command level available to the users logging into the AUX user interface	Optional By default, commands of level 3 are available to the users logging into the AUX user interface.

Table 12 Common configuration of Console port login (Continued)

Configuration		Description
Terminal configuration	Make terminal services available	Optional By default, terminal services are available in all user interfaces
	Set the maximum number of lines the screen can contain	Optional By default, the screen can contain up to 24 lines.
	Set history command buffer size	Optional By default, the history command buffer can contain up to 10 commands.
	Set the timeout time of a user interface	Optional The default timeout time is 10 minutes.

CAUTION: *Changing of Console port configuration terminates the connection to the Console port. To establish the connection again, you need to modify the configuration of the termination emulation utility running on your PC accordingly. Refer to "Setting up the Connection to the Console Port" for more.*

Console Port Login Configurations for Different Authentication Modes

Table 13 lists Console port login configurations for different authentication modes.

Table 13 Console port login configurations for different authentication modes

Authentication mode	Console port login configuration		Description
None	Perform common configuration	Perform common configuration for Console port login	Optional Refer to "Common Configuration" for more.
Password	Configure the password	Configure the password for local authentication	Required
	Perform common configuration	Perform common configuration for Console port login	Optional Refer to "Common Configuration" for more.

Table 13 Console port login configurations for different authentication modes (Continued)

Authentication mode	Console port login configuration		Description
Scheme	Specify to perform local authentication or RADIUS authentication	AAA configuration specifies whether to perform local authentication or RADIUS authentication	Optional Local authentication is performed by default. Refer to the "AAA&RADIUS Configuration" for more.
	Configure user name and password	Configure user names and passwords for local/remote users	Required ■ The user name and password of a local user are configured on the switch. ■ The user name and password of a remote user are configured on the RADIUS server. Refer to user manual of RADIUS server for more.
	Manage AUX users	Set service type for AUX users	Required
	Perform common configuration	Perform common configuration for Console port login	Optional Refer to "Common Configuration" for more.

Changes of the authentication mode of Console port login will not take effect unless you restart the switch.

Console Port Login Configuration with Authentication Mode Being None

Configuration Procedure

Table 14 Console port login configuration with the authentication mode being none

Operation	Command	Description
Enter system view	system-view	—
Enter AUX user interface view	**user-interface aux** 0	—
Configure not to authenticate users	authentication-mode none	Required By default, users logging in through the Console port are not authenticated.

Table 14 Console port login configuration with the authentication mode being none

Operation		Command	Description
Configure the Console port	Set the baud rate	**speed** *speed-value*	Optional The default baud rate of an AUX port (also the Console port) is 9,600 bps.
	Set the check mode	**parity** { **even** | **mark** | **none** | **odd** | **space** }	Optional By default, the check mode of a Console port is set to **none**, that is, no check bit.
	Set the stop bits	**stopbits** { **1** | **1.5** | **2** }	Optional The stop bits of a Console port is 1.
	Set the data bits	**databits** { **7** | **8 }**	Optional The default data bits of a Console port is 8.
Configure the command level available to users logging into the user interface		**user privilege level** *level*	Optional By default, commands of level 3 are available to users logging into the AUX user interface.
Make terminal services available		shell	Optional By default, terminal services are available in all user interfaces.
Set the maximum number of lines the screen can contain		**screen-length** *screen-length*	Optional By default, the screen can contain up to 24 lines. You can use the **screen-length** 0 command to disable the function to display information in pages.
Set the history command buffer size		**history-command max-size** *value*	Optional The default history command buffer size is 10. That is, a history command buffer can store up to 10 commands by default.
Set the timeout time for the user interface		**idle-timeout** *minutes* [*seconds* **]**	Optional The default timeout time of a user interface is 10 minutes. With the timeout time being 10 minutes, the connection to a user interface is terminated if no operation is performed in the user interface within 10 minutes. You can use the **idle-timeout** 0 command to disable the timeout function.

*Note that the command level available to users logging into a switch depends on both the **authentication-mode** { **password** | **scheme** | **none** } command and the **user privilege level** level command, as listed in Table 15.*

Table 15 Determine the command level (A)

Scenario			
Authentication mode	**User type**	**Command**	**Command level**
None (**authentication-mode none**)	Users logging in through Console ports	The **user privilege level** *level* command not executed	Level 3
		The **user privilege level** *level* command already executed	Determined by the *level* argument

Configuration Example

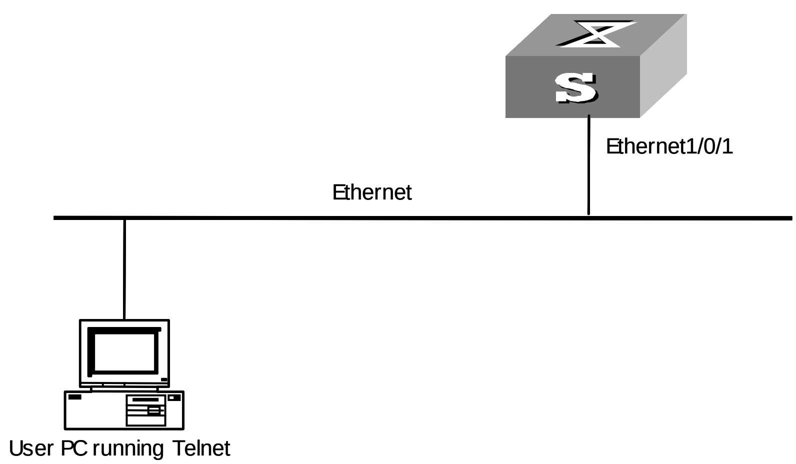
Network requirements

Assume that you are a level 3 VTY user and want to perform the following configuration for users logging in through the Console port:

- Do not authenticate users logging in through the Console port.
- Commands of level 2 are available to users logging into the AUX user interface.
- The baud rate of the Console port is 19,200 bps.
- The screen can contain up to 30 lines.
- The history command buffer can contain up to 20 commands.
- The timeout time of the AUX user interface is 6 minutes.

Network diagram

Figure 5 Network diagram for AUX user interface configuration (with the authentication mode being none)



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
```

2 Enter AUX user interface view.

```
[4200G] user-interface aux 0
```

3 Specify not to authenticate users logging in through the Console port.

```
[4200G-ui-aux0] authentication-mode none
```

4 Specify commands of level 2 are available to users logging into the AUX user interface.

```
[4200G-ui-aux0] user privilege level 2
```

5 Set the baud rate of the Console port to 19,200 bps.

```
[4200G-ui-aux0] speed 19200
```

6 Set the maximum number of lines the screen can contain to 30.

```
[4200G-ui-aux0] screen-length 30
```

7 Set the maximum number of commands the history command buffer can store to 20.

```
[4200G-ui-aux0] history-command max-size 20
```

8 Set the timeout time of the AUX user interface to 6 minutes.

```
[4200G-ui-aux0] idle-timeout 6
```

Console Port Login Configuration with Authentication Mode Being Password

Configuration Procedure

Table 16 Console port login configuration with the authentication mode being password

Operation		Command	Description
Enter system view		system-view	—
Enter AUX user interface view		**user-interface aux** 0	—
Configure to authenticate users using the local password		authentication-mode password	Required
Set the local password		**set authentication password** { **cipher** | **simple }** *password*	Required
Configure the Console port	Set the baud rate	**speed** *speed-value*	Optional The default baud rate of an AUX port (also the Console port) is 9,600 bps.
	Set the check mode	**parity** { **even** | **mark** | **none** | **odd** | **space** }	Optional By default, the check mode of a Console port is set to **none**, that is, no check bit.
	Set the stop bits	**stopbits** { **1** | **1.5** | **2** }	Optional The default stop bits of a Console port is 1.
	Set the data bits	**databits** { **7** | **8 }**	Optional The default data bits of a Console port is 8.
Configure the command level available to users logging into the user interface		**user privilege level** *level*	Optional By default, commands of level 3 are available to users logging into the AUX user interface.

Table 16 Console port login configuration with the authentication mode being password

Operation	Command	Description
Make terminal services available to the user interface	shell	Optional By default, terminal services are available in all user interfaces.
Set the maximum number of lines the screen can contain	**screen-length** *screen-length*	Optional By default, the screen can contain up to 24 lines. You can use the **screen-length** 0 command to disable the function to display information in pages.
Set history command buffer size	**history-command max-size** *value*	Optional The default history command buffer size is 10. That is, a history command buffer can store up to 10 commands by default.
Set the timeout time for the user interface	**idle-timeout** *minutes* [*seconds* **]**	Optional The default timeout time of a user interface is 10 minutes. With the timeout time being 10 minutes, the connection to a user interface is terminated if no operation is performed in the user interface within 10 minutes. You can use the **idle-timeout** 0 command to disable the timeout function.

*Note that the level the commands of which are available to users logging into a switch depends on both the **authentication-mode** { **password** | **scheme** | **none** } and the **user privilege level** level command, as listed in Table 17.*

Table 17 Determine the command level (B)

Scenario			Command level
Authentication mode	**User type**	**Command**	
Local authentication (**authentication-mode password**)	Users logging into the AUX user interface	The **user privilege level** *level* command not executed	Level 3
		The **user privilege level** *level* command already executed	Determined by the *level* argument

Configuration Example

Network requirements

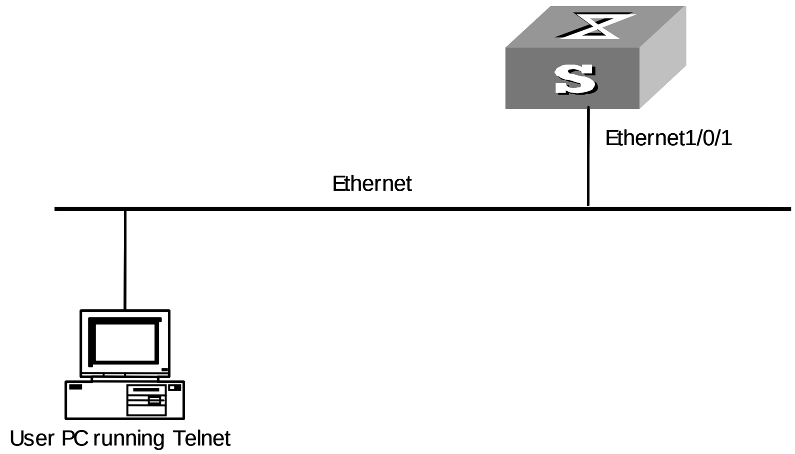
Assume that you are a level 3 VTY user and want to perform the following configuration for users logging in through the Console port:

- Authenticate users logging in through the Console port using the local password.
- Set the local password to 123456 (in plain text).
- The commands of level 2 are available to users logging into the AUX user interface.
- The baud rate of the Console port is 19,200 bps.
- The screen can contain up to 30 lines.

- The history command buffer can store up to 20 commands.
- The timeout time of the AUX user interface is 6 minutes.

Network diagram

Figure 6 Network diagram for AUX user interface configuration (with the authentication mode being password)



Configuration procedure

1. Enter system view.

```
<S4200G> system-view
```

2. Enter AUX user interface view.

```
[4200G] user-interface aux 0
```

3. Specify to authenticate users logging in through the Console port using the local password.

```
[4200G-ui-aux0] authentication-mode password
```

4. Set the local password to 123456 (in plain text).

```
[4200G-ui-aux0] set authentication password simple 123456
```

5. Specify commands of level 2 are available to users logging into the AUX user interface.

```
[4200G-ui-aux0] user privilege level 2
```

6. Set the baud rate of the Console port to 19,200 bps.

```
[4200G-ui-aux0] speed 19200
```

7. Set the maximum number of lines the screen can contain to 30.

```
[4200G-ui-aux0] screen-length 30
```

8. Set the maximum number of commands the history command buffer can store to 20.

```
[4200G-ui-aux0] history-command max-size 20
```

9. Set the timeout time of the AUX user interface to 6 minutes.

```
[4200G-ui-aux0] idle-timeout 6
```

Console Port Login Configuration with Authentication Mode Being Scheme

Configuration Procedure

Table 18 Console port login configuration with authentication mode being scheme

<table>
<tr><th colspan="2">Operation</th><th>Command</th><th>Description</th></tr>
<tr><td colspan="2">Enter system view</td><td>system-view</td><td>—</td></tr>
<tr><td rowspan="3">Configure the authentication mode</td><td>Enter the default ISP domain view</td><td>domain system</td><td rowspan="3">Optional
By default, the local AAA scheme is applied. If you specify to apply the local AAA scheme, you need to perform the configuration concerning local user as well.
If you specify to apply an existing scheme by providing the radius-scheme-name argument, you need to perform the following configuration as well:
■ Perform AAA&RADIUS configuration on the switch. (Refer to “AAA&RADIUS Configuration” for more.)
■ Configure the user name and password accordingly on the AAA server. (Refer to the user manual of AAA server.)</td></tr>
<tr><td>Specify the AAA scheme to be applied to the domain</td><td>scheme { local | radius-scheme radius-scheme-name [local] | none }</td></tr>
<tr><td>Quit to system view</td><td>quit</td></tr>
<tr><td colspan="2">Create a local user (Enter local user view.)</td><td>local-user user-name</td><td>Required
No local user exists by default.</td></tr>
<tr><td colspan="2">Set the authentication password for the local user</td><td>password { simple | cipher } password</td><td>Required</td></tr>
<tr><td colspan="2">Specify the service type for AUX users</td><td>service-type terminal [level level]</td><td>Required</td></tr>
<tr><td colspan="2">Quit to system view</td><td>quit</td><td>—</td></tr>
<tr><td colspan="2">Enter AUX user interface view</td><td>user-interface aux 0</td><td>—</td></tr>
<tr><td colspan="2">Configure to authenticate users locally or remotely</td><td>authentication-mode scheme</td><td>Required
The specified AAA scheme determines whether to authenticate users locally or remotely.
Users are authenticated locally by default.</td></tr>
</table>

Table 18 Console port login configuration with authentication mode being scheme

Operation		Command	Description
Configure the Console port	Set the baud rate	**speed** *speed-value*	Optional The default baud rate of the AUX port (also the Console port) is 9,600 bps.
	Set the check mode	**parity** { **even** | **mark** | **none** | **odd** | **space** }	Optional By default, the check mode of a Console port is set to **none**, that is, no check bit.
	Set the stop bits	**stopbits** { **1** | **1.5** | **2** }	Optional The default stop bits of a Console port is 1.
	Set the data bits	**databits** { **7** | **8 }**	Optional The default data bits of a Console port is 8.
Configure the command level available to users logging into the user interface		**user privilege level** *level*	Optional By default, commands of level 3 are available to users logging into the AUX user interface.
Make terminal services available to the user interface		shell	Optional By default, terminal services are available in all user interfaces.
Set the maximum number of lines the screen can contain		**screen-length** *screen-length*	Optional By default, the screen can contain up to 24 lines. You can use the **screen-length** 0 command to disable the function to display information in pages.
Set history command buffer size		**history-command max-size** *value*	Optional The default history command buffer size is 10. That is, a history command buffer can store up to 10 commands by default.
Set the timeout time for the user interface		**idle-timeout** *minutes [seconds]*	Optional The default timeout time of a user interface is 10 minutes. With the timeout time being 10 minutes, the connection to a user interface is terminated if no operation is performed in the user interface within 10 minutes. You can use the **idle-timeout** 0 command to disable the timeout function.

Note that the level the commands of which are available to users logging into a switch depends on the ***authentication-mode*** *{* ***password*** *|* ***scheme*** *|* ***none*** *} command, the* ***user privilege level*** *level command, and the* ***service-type terminal*** *[* ***level*** *level] command, as listed in Table 19.*

Table 19 Determine the command level

Scenario			Command level
Authentication mode	**User type**	**Command**	
authentication-mode scheme	Users logging into the Console port and pass AAA&RADIUS or local authentication	The **user privilege level** *level* command is not executed, and the **service-type terminal** [**level** *level]* command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is not executed, and the **service-type terminal** [**level** *level]* command specifies the available command level.	Determined by the **service-type terminal** [**level** *level]* command
		The **user privilege level** *level* command is executed, and the **service-type terminal** [**level** *level]* command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is executed, and the **service-type terminal** [**level** *level]* command specifies the available command level.	Determined by the **service-type terminal** [**level** *level]* command

Configuration Example

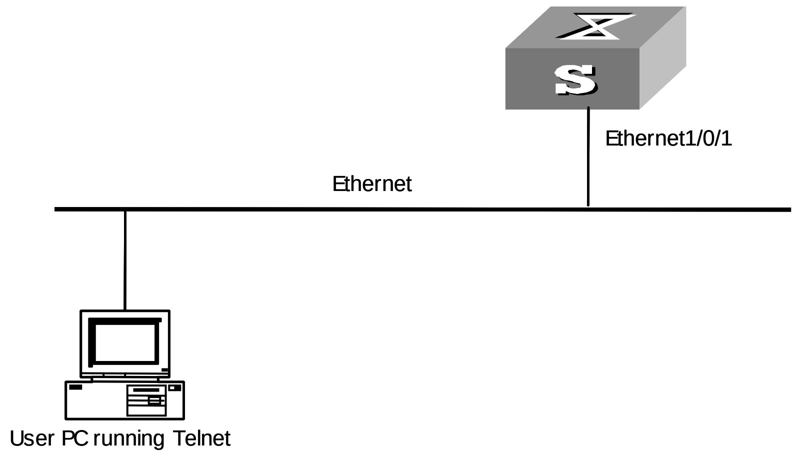
Network requirements

Assume that you are a level 3 VTY user and want to perform the following configuration for users logging in through the Console port:

- Configure the name of the local user to be “guest”.
- Set the authentication password of the local user to 123456 (in plain text).
- Set the service type of the local user to Terminal.
- Configure to authenticate users logging in through the Console port in the scheme mode.
- The commands of level 2 are available to users logging into the AUX user interface.
- The baud rate of the Console port is 19,200 bps.
- The screen can contain up to 30 lines.
- The history command buffer can store up to 20 commands.
- The timeout time of the AUX user interface is 6 minutes.

Network diagram

Figure 7 Network diagram for AUX user interface configuration (with the authentication mode being scheme)



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
```

2 Create a local user named guest and enter local user view.

```
[4200G] local-user guest
```

3 Set the authentication password to 123456 (in plain text).

```
[4200G-luser-guest] password simple 123456
```

4 Set the service type to Terminal.

```
[4200G-luser-guest] service-type terminal level 2
[4200G-luser-guest] quit
```

5 Enter AUX user interface view.

```
[4200G] user-interface aux 0
```

6 Configure to authenticate users logging in through the Console port in the scheme mode.

```
[4200G-ui-aux0] authentication-mode scheme
```

7 Specify commands of level 2 are available to users logging into the AUX user interface.

```
[4200G-ui-aux0] user privilege level 2
```

8 Set the baud rate of the Console port to 19,200 bps.

```
[4200G-ui-aux0] speed 19200
```

9 Set the maximum number of lines the screen can contain to 30.

```
[4200G-ui-aux0] screen-length 30
```

10 Set the maximum number of commands the history command buffer can store to 20.

```
[4200G-ui-aux0] history-command max-size 20
```

11 Set the timeout time of the AUX user interface to 6 minutes.

```
[4200G-ui-aux0] idle-timeout 6
```

4 LOGGING IN USING MODEM

Introduction

The administrator can log into the Console port of a remote switch using a modem through PSTN (public switched telephone network) if the remote switch is connected to the PSTN through a modem to configure and maintain the switch remotely. When a network operates improperly or is inaccessible, you can log into the switches in the network in this way to configure these switches, to query logs and warning messages, and to locate problems.

To log into a switch in this way, you need to configure the terminal and the switch properly, as listed in Table 20.

Table 20 Requirements for logging into a switch using a modem

Item	Requirement
Administrator side	The PC can communicate with the modem connected to it.
	The modem is properly connected to PSTN.
	The telephone number of the switch side is available.
Switch side	The modem is connected to the Console port of the switch properly.
	The modem is properly configured.
	The modem is properly connected to PSTN and a telephone set.
	The authentication mode and other related settings are configured on the switch. Refer to Table 76 in "Logging in through Telnet".

Configuration on the Administrator Side

The PC can communicate with the modem connected to it. The modem is properly connected to PSTN. And the telephone number of the switch side is available.

Configuration on the Switch Side

Modem Configuration

Perform the following configuration on the modem directly connected to the switch:

```
AT&F      ----------------------- Restore the factory settings
ATS0=1----------------------- Configure to answer automatically after the first ring
AT&D ----------------------- Ignore DTR signal
AT&K0----------------------- Disable flow control
AT&R1----------------------- Ignore RTS signal
AT&S0----------------------- Set DSR to high level by force
ATEQ1&W----------------------- Disable the modem from returning command response and the result, save the changes
```

You can verify your configuration by executing the **AT&V** command.

The above configuration is unnecessary to the modem on the administrator side.The configuration commands and the output of different modems may differ. Refer to the user manual of the modem when performing the above configuration.

Switch Configuration

After logging into a switch through its Console port by using a modem, you will enter the AUX user interface. The corresponding configuration on the switch is the same as those when logging into the switch locally through its Console port except that:

- When you log in through the Console port using a modem, the baud rate of the Console port is usually set to a value lower than the transmission speed of the modem. Otherwise, packets may get lost.
- Other settings of the Console port, such as the check mode, the stop bits, and the data bits, remain the default.

The configuration on the switch depends on the authentication mode the user is in. Refer to Table 13 in Chapter 3 for the information about authentication mode configuration.

Configuration on switch when the authentication mode is none

Refer to "Configuration on switch when the authentication mode is none".

Configuration on switch when the authentication mode is password

Refer to "Configuration on switch when the authentication mode is password".

Configuration on switch when the authentication mode is scheme

Refer to "Configuration on switch when the authentication mode is scheme".

Modem Connection Establishment

1 Configure the user name and password on the switch. Refer to "Console Port Login Configuration with Authentication Mode Being None", "Configuration on switch when the authentication mode is password", and "Configuration on switch when the authentication mode is scheme" in Chapter 3 for more.

2 Perform the following configuration on the modem directly connected to the switch.

```
AT&F      ----------------------- Restore the factory settings
ATS0=1----------------------- Configure to answer automatically after
the first ring
AT&D ----------------------- Ignore DTR signal
AT&K0----------------------- Disable flow control
AT&R1----------------------- Ignore RTS signal
AT&S0----------------------- Set DSR to high level by force
ATEQ1&W----------------------- Disable the modem from returning command
response and the result, save the changes
```

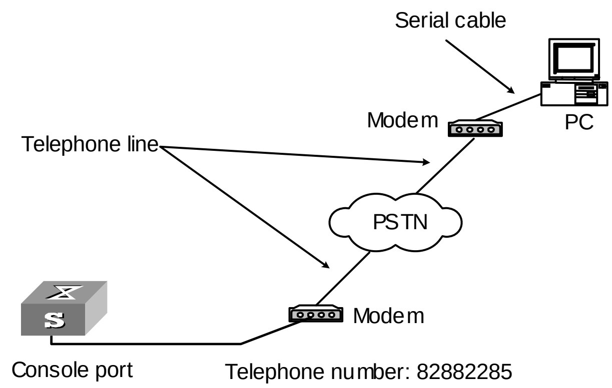
You can verify your configuration by executing the **AT&V** command.

The configuration commands and the output of different modems may differ. Refer to the user manual of the modem when performing the above configuration.

It is recommended that the baud rate of the AUX port (also the Console port) be set to a value lower than the transmission speed of the modem. Otherwise, packets may get lost.

3 Connect your PC, the modems, and the switch, as shown in Figure 8.

Figure 8 Establish the connection by using modems



4 Launch a terminal emulation utility on the PC and set the telephone number to call the modem directly connected to the switch, as shown in Figure 9 and Figure 10.

Note that you need to set the telephone number to that of the modem directly connected to the switch.

Figure 9 Set the telephone number

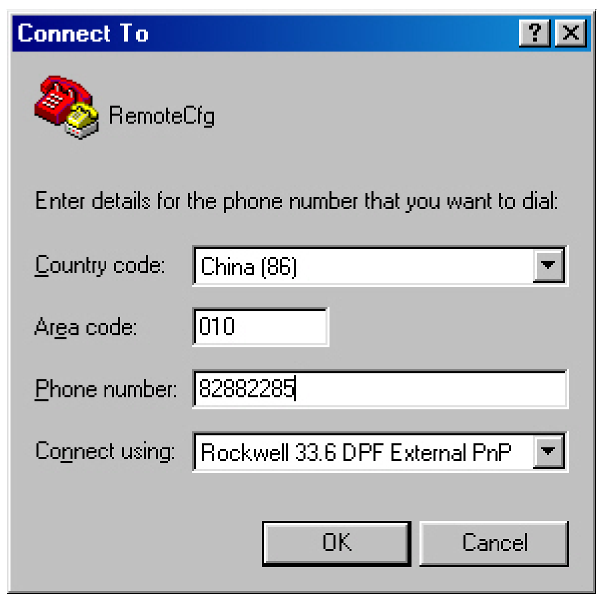
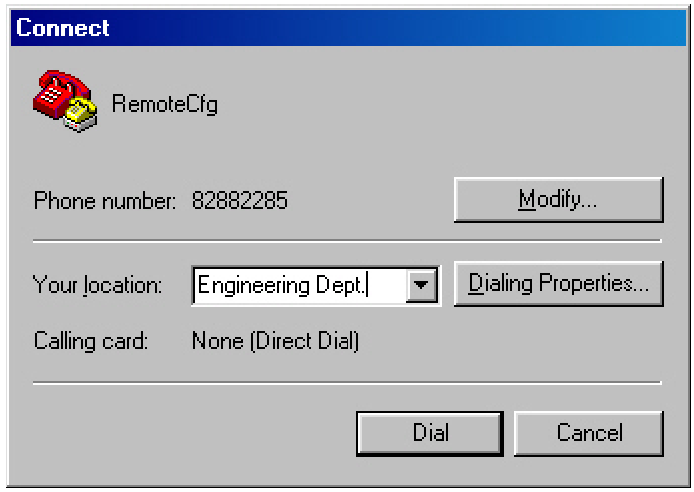


Figure 10 Call the modem



5 Provide the password when prompted. If the password is correct, the prompt (such as <S4200G>) appears. You can then configure or manage the switch. You can also enter the character ? at anytime for help.

If you perform no AUX user-related configuration on the switch, the commands of level 3 are available to modem users. Refer to the CLI Overview module for information about command level.

5 LOGGING IN THROUGH WEB-BASED NETWORK MANAGEMENT SYSTEM

Introduction

An S4200-G series switch has a Web server built in. You can log into an S4200-G series switch through a Web browser and manage and maintain the switch intuitively by interacting with the built-in Web server.

To log into an S4200-G series switch through the built-in Web-based network management system, you need to perform the related configuration on both the switch and the PC operating as the network management terminal.

Table 21 Requirements for logging into a switch through the Web-based network management system

Item	Requirement
Switch	The management VLAN of the switch is configured. The route between the switch and the network management terminal is available. (Refer to the Management VLAN Configuration module for more.)
	The user name and password for logging into the Web-based network management system are configured.
PC operating as the network management terminal	IE is available.
	The IP address of the management VLAN interface of the switch is available.

HTTP Connection Establishment

1 Log into the switch through the Console port and assign an IP address to the management VLAN interface of the switch.

- Connect to the Console port. To log into a switch through the Console port, you need to connect the serial port of your PC (or terminal) to the Console port of the switch using a configuration cable, as shown in Figure 11.

Figure 11 Connect to the Console port

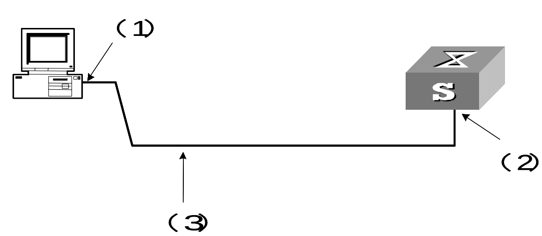
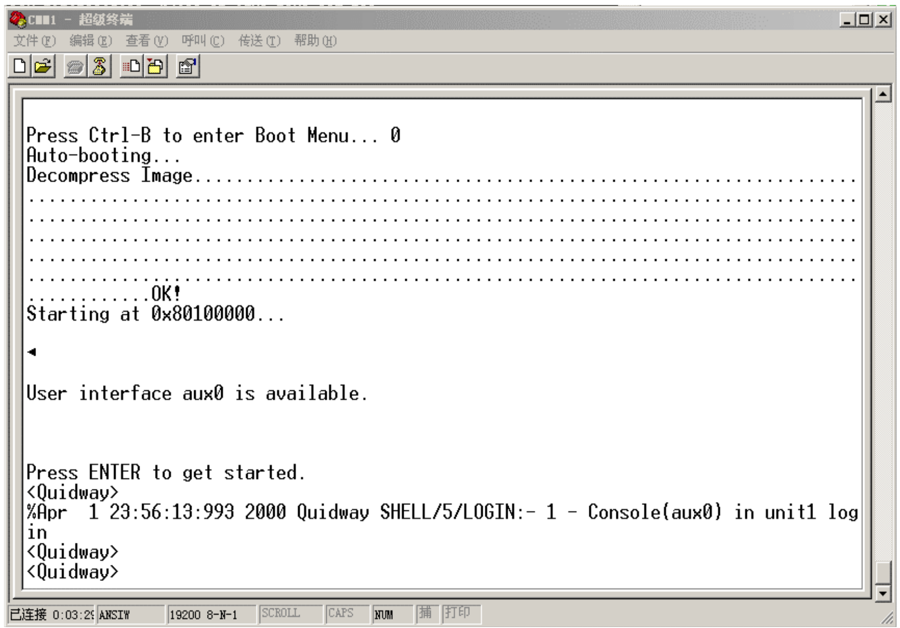


Table 22 Callouts

(1) RS-232 port	(2) Console port	(3) Configuration cable

- Launch a terminal emulation utility (such as Terminal in Windows 3.X or HyperTerminal in Windows 9X) on the PC, with the baud rate set to 9,600 bps, data bits set to 8, parity check set to off, and flow control set to off.
- Turn on the switch. When the switch is starting, the information about self-testing appears on the terminal window. When you press Enter after the self-testing finishes, the prompt (such as <S4200G>) appears, as shown in the Figure 12.

Figure 12 The terminal window



- Execute the following commands in the terminal window to assign an IP address to the management VLAN interface of the switch.

`<S4200G>` **`system`**

a Enter management VLAN interface view.

`[4200G]` **`interface vlan-interface 1`**

b Remove the existing IP address of the management VLAN interface.

`[4200G-VLAN-interface1]` **`undo ip address`**

c Configure the IP address of the management VLAN interface to be 10.153.17.82.

`[4200G-VLAN-interface1]` **`ip address 10.153.17.82 255.255.255.0`**

2 Configure the user name and the password for the Web-based network management system.

- Add a Telnet user account for the switch, setting the user level to level 3 (the administration level).

a Configure the user name to be admin.

`[4200G]` **`local-user admin`**

b Set the user level to level 3.

`[4200G-luser-admin]` **`service-type telnet level 3`**

c Set the password to admin.

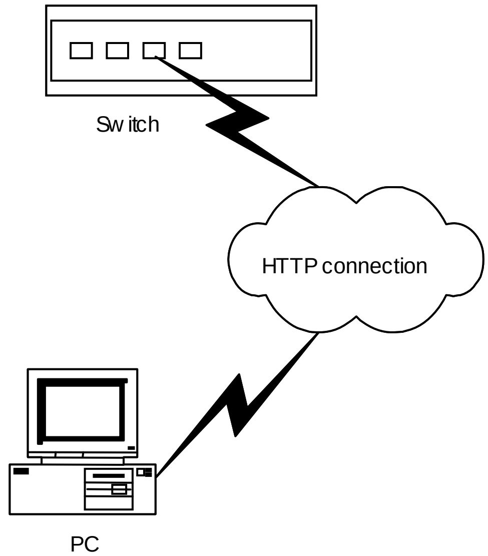
`[4200G-luser-admin]` **`password simple admin`**

- Configure a static route from the switch to the gateway.

`[4200G]` **`ip route-static ip-address 0.0.0.0 255.255.255.255`**

3 Establish an HTTP connection between your PC and the switch, as shown in Figure 13.

Figure 13 Establish an HTTP connection between your PC and the switch



4 Log into the switch through IE. Launch IE on the Web-based network management terminal (your PC) and enter the IP address of the management VLAN interface of the switch (here it is http://10.153.17.82). (Make sure the route between the Web-based network management terminal and the switch is available.)

5 When the login interface (shown in Figure 14) appears, enter the user name and the password configured in step 2 and click <Login> to bring up the main page of the Web-based network management system.

Figure 14 The login page of the Web-based network management system

6 LOGGING IN THROUGH NMS

Introduction

You can also log into a switch through an NMS (network management station), and then configure and manage the switch through the agent module on the switch.

- The agent here refers to the software running on network devices (switches) and as the server.
- SNMP (simple network management protocol) is applied between the NMS and the agent.

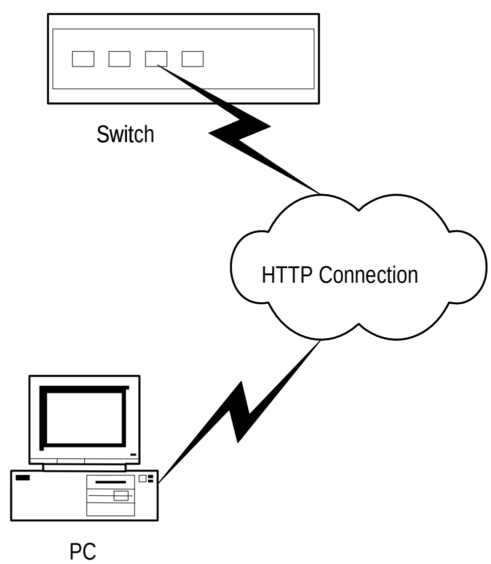
To log into a switch through an NMS, you need to perform related configuration on both the NMS and the switch.

Table 23 Requirements for logging into a switch through an NMS

Item	Requirement
Switch	The management VLAN of the switch is configured. The route between the NMS and the switch is available. (Refer to the Management VLAN Configuration module for more.)
	The basic SNMP functions are configured. (Refer to the SNMP module for more.)
NMS	The NMS is properly configured. (Refer to the user manual of your NMS for more.)

Connection Establishment Using NMS

Figure 15 Network diagram for logging in through an NMS



7 CONTROLLING LOGIN USERS

Introduction

A switch provides ways to control different types of login users, as listed in Table 24.

Table 24 Ways to control different types of login users

Login mode	Control method	Implementation	Related section
Telnet	By source IP addresses	Through basic ACLs	Controlling Telnet Users by Source IP Addresses
	By source and destination IP addresses	Through advanced ACLs	Controlling Telnet Users by Source and Destination IP Addresses
SNMP	By source IP addresses	Through basic ACLs	Controlling Network Management Users by Source IP Addresses
WEB	By source IP addresses	Through basic ACLs	Controlling Web Users by Source IP Address.
	Disconnect Web users by force	By executing commands in CLI	Disconnecting a Web User by Force.

Controlling Telnet Users

Prerequisites

The controlling policy against Telnet users is determined, including the source and destination IP addresses to be controlled and the controlling actions (permitting or denying).

Controlling Telnet Users by Source IP Addresses

Controlling Telnet users by source IP addresses is achieved by applying basic ACLs, which are numbered from 2000 to 2999.

Table 25 Control Telnet users by source IP addresses

Operation	Command	Description
Enter system view	system-view	
Create a basic ACL or enter basic ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	As for the **acl number** command, the **config** keyword is specified by default.
Define rules for the ACL	**rule** [*rule-id*] { **permit** | **deny** } [**source** { *sour-addr sour-wildcard* | **any** }] [**time-range** *time-name]* [**fragment**]	Required
Quit to system view	quit	
Enter user interface view	**user-interface** [*type*] *first-number* [*last-number*]	
Apply the ACL to control Telnet users by source IP addresses	**acl** *acl-number* { **inbound** | **outbound** }	Required The **inbound** keyword specifies to filter the users trying to Telnet to the current switch. The **outbound** keyword specifies to filter users trying to Telnet to other switches from the current switch.

Controlling Telnet Users by Source and Destination IP Addresses

Controlling Telnet users by source and destination IP addresses is achieved by applying advanced ACLs, which are numbered from 3000 to 3999. Refer to the ACL module for information about defining an ACL.

Table 26 Define an advanced ACL

Operation	Command	Description
Enter system view	system-view	
Create an advanced ACL or enter advanced ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	As for the **acl number** command, the **config** keyword is specified by default.
Define rules for the ACL	**rule** [*rule-id*] { **permit** | **deny** } *rule-string*	Required You can define rules as needed to filter by specific source and destination IP addresses.
Quit to system view	quit	
Enter user interface view	**user-interface** [*type*] *first-number* [*last-number*]	
Apply the ACL to control Telnet users by specified source and destination IP addresses	**acl** *acl-number* { **inbound** | **outbound** }	Required The **inbound** keyword specifies to filter the users trying to Telnet to the current switch. The **outbound** keyword specifies to filter users trying to Telnet to other switches from the current switch.

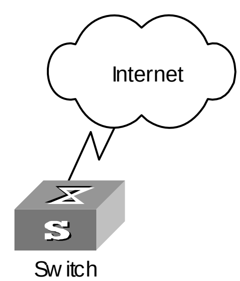
Configuration Example

Network requirements

Only the Telnet users sourced from the IP address of 10.110.100.52 and 10.110.100.46 are permitted to log into the switch.

Network diagram

Figure 16 Network diagram for controlling Telnet users using ACLs



Configuration procedure

1 Define a basic ACL.

```
<S4200G> system-view
[4200G] acl number 2000 match-order config
[4200G-acl-basic-2000] rule 1 permit source 10.110.100.52 0
[4200G-acl-basic-2000] rule 2 permit source 10.110.100.46 0
[4200G-acl-basic-2000] rule 3 deny source any
[4200G-acl-basic-2000] quit
```

2 Apply the ACL.

```
[4200G] user-interface vty 0 4
[4200G-ui-vty0-4] acl 2000 inbound
```

Controlling Network Management Users by Source IP Addresses

You can manage a S4200G series Ethernet switch through network management software. Network management users can access switches through SNMP.

You need to perform the following two operations to control network management users by source IP addresses.

- Defining an ACL
- Applying the ACL to control users accessing the switch through SNMP

Prerequisites

The controlling policy against network management users is determined, including the source IP addresses to be controlled and the controlling actions (permitting or denying).

Controlling Network Management Users by Source IP Addresses

Controlling network management users by source IP addresses is achieved by applying basic ACLs, which are numbered from 2000 to 2999.

Table 27 Control network management users by source IP addresses

Operation	Command	Description
Enter system view	system-view	
Create a basic ACL or enter basic ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	As for the **acl number** command, the **config** keyword is specified by default.
Define rules for the ACL	**rule** [*rule-id*] { **permit** | **deny** } [**source** { *sour-addr sour-wildcard* | **any** }] [**time-range** *time-name]* [**fragment**]	Required
Quit to system view	quit	
Apply the ACL while configuring the SNMP community name	**snmp-agent community** { **read** | **write** } *community-name* [[**mib-view** *view-name*] | [**acl** *acl-number]*]*	Optional
Apply the ACL while configuring the SNMP group name	**snmp-agent group** { **v1** | **v2c }** *group-name* [**read-view** *read-view]* [**write-view** *write-view*] [**notify-view** *notify-view*] [**acl** *acl-number]* **snmp-agent group v3** *group-name* [**authentication** | **privacy**] [**read-view** *read-view]* [**write-view** *write-view*] [**notify-view** *notify-view*] [**acl** *acl-number]*	Optional
Apply the ACL while configuring the SNMP user name	**snmp-agent usm-user** { **v1** | **v2c** } *user-name group-name* [**acl** *acl-number]* **snmp-agent usm-user v3** *user-name group-name* [**authentication-mode** { **md5** | **sha** } *auth-password*] [**privacy-mode des56** *priv-password **]*** [**acl** *acl-number]*	Optional

You can specify different ACLs while configuring the SNMP community name, the SNMP group name and the SNMP user name.

As SNMP community name is a feature of SNMP V1 and SNMP V2, the specified ACLs in the command that configures SNMP community names (the **snmp-agent community** command) take effect in the network management systems that adopt SNMP V1 or SNMP V2.

Similarly, as SNMP group name and SNMP user name are features of SNMP V2 and the higher SNMP versions, the specified ACLs in the commands that configure SNMP group names (the **snmp-agent group** command and the **snmp-agent group v3** command) and SNMP user names (the **snmp-agent usm-user** command and the **snmp-agent usm-user v3** command) take effect in the network management systems that adopt SNMP V2 or higher SNMP versions. If you configure both the SNMP group name and the SNMP user name and specify ACLs in the two operations, the switch will filter network management users by both SNMP group name and SNMP user name.

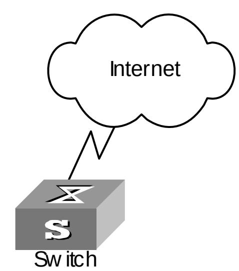
Configuration Example

Network requirements

Only SNMP users sourced from the IP addresses of 10.110.100.52 and 10.110.100.46 are permitted to access the switch.

Network diagram

Figure 17 Network diagram for controlling SNMP users using ACLs



Configuration procedure

1 Define a basic ACL.

```
<S4200G> system-view
[4200G] acl number 2000 match-order config
[4200G-acl-basic-2000] rule 1 permit source 10.110.100.52 0
[4200G-acl-basic-2000] rule 2 permit source 10.110.100.46 0
[4200G-acl-basic-2000] rule 3 deny source any
[4200G-acl-basic-2000] quit
```

2 Apply the ACL to only permit SNMP users sourced from the IP addresses of 10.110.100.52 and 10.110.100.46 to access the switch.

```
[4200G] snmp-agent community read 3Com acl 2000
[4200G] snmp-agent group v2c 3Comgroup acl 2000
[4200G] snmp-agent usm-user v2c 3Comuser 3Comgroup acl 2000
```

Controlling Web Users by Source IP Address

You can manage a S4200G series Ethernet switch remotely through Web. Web users can access a switch through HTTP connections.

You need to perform the following two operations to control Web users by source IP addresses.

- Defining an ACL
- Applying the ACL to control Web users

Prerequisites

The controlling policy against Web users is determined, including the source IP addresses to be controlled and the controlling actions (permitting or denying).

Controlling Web Users by Source IP Addresses

Controlling Web users by source IP addresses is achieved by applying basic ACLs, which are numbered from 2000 to 2999.

Table 28 Control Web users by source IP addresses

Operation	Command	Description
Enter system view	system-view	
Create a basic ACL or enter basic ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	As for the **acl number** command, the **config** keyword is specified by default.
Define rules for the ACL	**rule** [*rule-id*] { **permit** | **deny** } [**source** { *sour-addr sour-wildcard* | **any** }] [**time-range** *time-name]* [**fragment**]	Required
Quit to system view	quit	
Apply the ACL to control Web users	**ip http acl** *acl-number*	Optional

Disconnecting a Web User by Force

The administrator can disconnect a Web user by force using the related command.

Table 29 Disconnect a Web user by force

Operation	Command	Description
Disconnect a Web user by force	**free web-users** { **all** | **user-id** *userid* | **user-name** *username* }	Required Execute this command in user view.

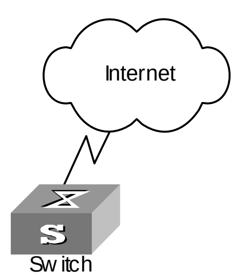
Configuration Example

Network requirements

Only the users sourced from the IP address of 10.110.100.46 are permitted to access the switch.

Network diagram

Figure 18 Network diagram for controlling Web users using ACLs



Configuration procedure

1 Define a basic ACL.

```
<S4200G> system-view
[4200G] acl number 2030 match-order config
[4200G-acl-basic-2030] rule 1 permit source 10.110.100.46 0
[4200G-acl-basic-2030] rule 2 deny source any
```

2 Apply the ACL to only permit the Web users sourced from the IP address of 10.110.100.46 to access the switch.

```
[4200G] ip http acl 2030
```

8 CONFIGURATION FILE MANAGEMENT

Introduction to Configuration File

Configuration file records and stores user configurations performed to a switch. It also enables users to check switch configurations easily.

Upon powered on, a switch loads the configuration file known as saved-configuration file, which resides in the Flash, for initialization. If the Flash contains no configuration file, the system initializes using the default settings. Comparing to saved-configuration file, the configuration file which is currently adopted by a switch is known as the current-configuration.

A configuration file conforms to the following conventions:

- The content of a configuration files is a series of commands.
- Only the non-default configuration parameters are saved.
- The commands are grouped into sections by command view. The commands that are of the same command view are grouped into one section. Sections are separated by empty lines or comment lines. (A line is a comment line if it starts with the character "#".)
- The sections are listed in this order: system configuration section, physical port configuration section, logical interface configuration section, routing protocol configuration section, and so on.
- A configuration file ends with a "return".

Configuration File-Related Configuration

You can perform the following operations on an S4200G series switch:

- Saving the current configuration to a configuration file or erasing a configuration file in the Flash
- Checking/Setting the configuration file to be used when the switch starts the next time
- Setting a configuration file to be of the main/backup attribute

Perform the following configuration in user view.

Table 30 Configure a configuration file

Operation	Command	Description
Save the current configuration to a specified configuration file and specify the configuration file to be of the main or backup attribute	**save** [*cfgfile* | [**safely**] [**backup** | **main**]]	Optional This command can be executed in any view.
Erase the configuration file in the Flash	**reset saved-configuration** [**backup** | **main**]	Optional
Specify that the switch starts without loading the configuration file	**undo startup saved-configuration** [**unit** *unit-id*]	Optional

Table 30 Configure a configuration file (Continued)

Operation	Command	Description
Specify the configuration file to be used when the switch starts the next time	**startup saved-configuration** *cfgfile* [**backup** | **main**]	Optional By default, the main configuration file is used.
Check the configuration file	**display saved-configuration** [**unit** *unit-id*] [**by-linenum**]	Optional This command can be executed in any view.
Check the current configuration	**display current-configuration** [**configuration** [*configuration-type*] | **interface** [*interface-type*] [*interface-number*] | **vlan** [*vlan-id*]] [**by-linenum**] [**|** { **begin** | **include** | **exclude** } *regular-expression]*	
Display the configuration performed in the current view	**display this** [**by-linenum**]	
Display the information about the configuration file to be used for startup.	**display startup** [**unit** *unit-id* **]**	

CAUTION: Currently, the extension of a configuration file is cfg. Configuration files reside in the root directory.

9 VLAN CONFIGURATION

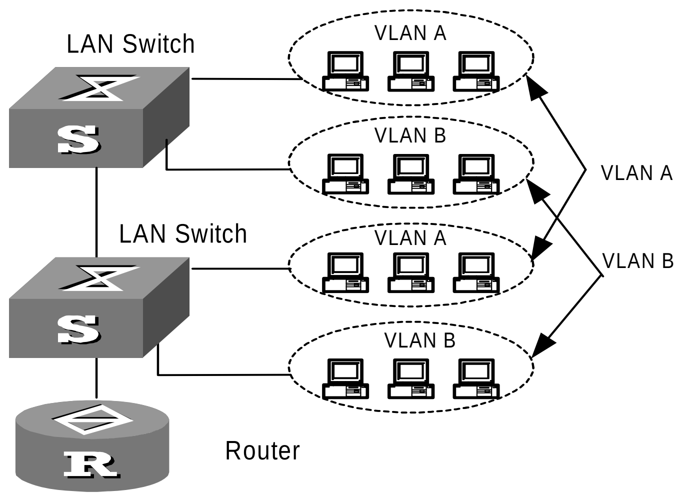
VLAN Overview

Introduction to VLAN

The virtual local area network (VLAN) technology is developed for switches to control broadcast operations in LANs.

By creating VLANs in a physical LAN, you can divide the LAN into multiple logical LANs, each of which has a broadcast domain of its own. Hosts in the same VLAN communicate with each other as if they are in a LAN. However, hosts in different VLANs cannot communicate with each other directly. Figure 19 illustrates a VLAN implementation.

Figure 19 A VLAN implementation



A VLAN can span across multiple switches, or even routers. This enables hosts in a VLAN to be dispersed in a more loose way. That is, hosts in a VLAN can belong to different physical network segment.

VLAN enjoys the following advantages.

1 Broadcasts are confined to VLANs. This decreases bandwidth utilization and improves network performance.

2 Network security is improved. VLANs cannot communicate with each other directly. That is, hosts in different VLANs cannot communicate with each other directly. To enable communications between different VLANs, network devices operating on Layer 3 (such as routers or Layer 3 switches) are needed.

3 Configuration workload is reduced. VLAN can be used to group specific hosts. When the physical position of a host changes, no additional network configuration is required if the host still belongs to the same VLAN.

VLAN standard is described in IEEE 802.1Q, which is issued by IEEE in 1999.

VLAN Classification

You can create port-based and policy-based VLAN types a Switch 4200G:

The port-based VLAN members are defined in terms of switch ports. You can add ports to which close-related hosts are connected to the same port-based VLAN. This is the simplest yet most effective way to create VLANs.

Policy-based VLANs enable a switch to forward received packets that match specific QoS/ACLs to specific VLANs. For instructions on creating policy-based VLANs, see "QoS Configuration" on page 213.

VLAN Configuration

Basic VLAN Configuration

Table 31 Basic VLAN configuration

Operation	Command	Description
Enter system view	system-view	-
Create a VLAN and enter VLAN view	**vlan** *vlan-id*	Required The *vlan-id* argument ranges from 1 to 4094.
Assign a name for the VLAN	name	Optional By default, the name of a VLAN is its VLAN ID.
Specify the description string of the VLAN	**description** *string*	Optional By default, the description string of a VLAN is its VLAN ID.

Configuring a Port-Based VLAN

Configuration prerequisites

Before configuring a port-based VLAN, you need to create it first.

Configuration procedure

Table 32 Configure a port-based VLAN

Operation	Command	Description
Enter system view	system-view	-
Enter VLAN view	**vlan** *vlan-id*	Required The *vlan-id* argument ranges 1 from to 4094.
Add specified Ethernet ports to the VLAN	**port** *interface-list*	Required By default, all the ports belong to the default VLAN.

Displaying a VLAN

After the above configuration, you can execute the **display** command in any view to view the running of the VLAN configuration, and to verify the effect of the configuration.

Table 33 Display the information about specified VLANs

Operation	Command
Display the information about specified VLANs	**display vlan** [*vlan-id1* [**to** *vlan-id2*] | **all** | **static** | **dynamic**]

VLAN Configuration Example

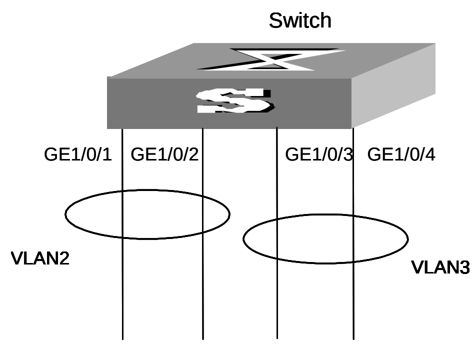
Port-based VLAN Configuration Example

Network requirements

- Create VLAN 2 and VLAN 3, with the name of VLAN 2 being v2, and the description string being home.
- Add GigabitEthernet1/0/1 and GigabitEthernet1/0/2 ports to VLAN 2; add GigabitEthernet1/0/3 and GigabitEthernet1/0/4 ports to VLAN 3.

Network diagram

Figure 20 Network diagram for VLAN configuration



Configuration procedure

1 Create VLAN 2 and enter VLAN view.

```
[4200G] vlan 2
```

2 Set the name of VLAN 2 to v2.

```
[4200G-vlan2] name v2
```

3 Specify the description string of VLAN 2 to be home.

```
[4200G-vlan2] description home
```

4 Add GigabitEthernet1/0/1 and GigabitEthernet1/0/2 ports to VLAN 2.

```
[4200G-vlan2] port GigabitEthernet1/0/1 GigabitEthernet1/0/2
```

5 Create VLAN 3 and enter VLAN view.

```
[4200G-vlan2] vlan 3
```

6 Add GigabitEthernet1/0/3 and GigabitEthernet1/0/4 ports to VLAN 3.

```
[4200G-vlan3] port GigabitEthernet1/0/3 GigabitEthernet1/0/4
```

10 MANAGEMENT VLAN CONFIGURATION

Introduction to Management VLAN

Management VLAN

To manage an Ethernet switch remotely through Telnet or network management, the switch need to be assigned an IP address. As for a S4200G series Layer 2 Ethernet switch, only the management VLAN interface can be assigned an IP address.

You can assign an IP address to a management VLAN interface in one of the following three ways:

- Using commands to assign IP addresses
- Through BOOTP (In this case, the switch operates as a BOOTP client.)
- Through dynamic host configuration protocol (DHCP) (In this case, the switch operates as a DHCP client)

The three above mentioned ways are mutually exclusive. That is, the IP address obtained in a new way overwrites the one obtained in the previously configured way and the overwritten IP address is then released. For example, if you assign an IP address to a VLAN interface by using the corresponding commands and then apply for another IP address through BOOTP (using the **ip address bootp-alloc** command), the former IP address will be removed, and the final IP address of the VLAN interface is the one obtained through BOOTP.

Static Route

A static route is configured manually by an administrator. You can make a network with relatively simple topology to operate properly by simply configuring static routes for it. Configuring and using static routes wisely helps to improve network performance and can guarantee bandwidth for important applications.

The disadvantages of static route lie in that: When a fault occurs or the network topology changes, static routes may become unreachable, which in turn results in network failures. In this case, manual configurations are needed to recover the network.

To access a 4200G 24-Port series Ethernet switch through networks, you can configure static routes for it.

Management VLAN Configuration

Prerequisites

Before configuring the management VLAN, make sure the VLAN operating as the management VLAN exists. If VLAN 1 (the default VLAN) is the management VLAN, just go ahead.

Configuring the Management VLAN

Table 34 Configure the management VLAN

Operation	**Command**	**Description**
Enter system view	system-view	-
Configure a specified VLAN to be the management VLAN	**management-vlan** *vlan-id*	Required By default, VLAN 1 operates as the management VLAN.
Create the management VLAN interface and enter VLAN interface view	**interface vlan-interface** *vlan-id*	Required
Assign an IP address to the management VLAN interface	**ip address** { *ip-address net-mask* | **bootp-alloc** | **dhcp-alloc }**	Required By default, the management VLAN interface has no IP address.
Provide a description string for the management VLAN interface	**description** *string*	Optional By default, the description string of the management VLAN interface is Vlan-interface vlan-id Interface.
Add a default route	**ip route-static** 0.0.0.0 0.0.0.0 { *interface-type interface-number* | *gateway-address* } [**preference** *value*]	Required
Shut down the management VLAN interface	Shutdown	Optional By default, a management VLAN interface is down if all the Ethernet ports in the management VLAN are down; a management VLAN interface is up if one or more Ethernet ports in the management VLAN are up.
Bring up the management VLAN interface	undo shutdown	

- To configure the management VLAN of a switch operating as a cluster management device to be a cluster management VLAN (using the **management-vlan** vlan-id command) successfully, make sure the vlan-id argument provided in the **management-vlan** vlan-id command is consistent with that of the management VLAN.
- Shutting down or bringing up a management VLAN interface has no effect on the up/down status of the Ethernet ports in the management VLAN.

Configuration Example

Network requirements

The administrator wants to manage the switch S4200GA remotely through Telnet. The requirements are as follows: S4200GA has an IP address, and the route between S4200GA and the remote console is reachable.

You need to configure the switch as follows:

- Assigning an IP address to the management VLAN interface
- Configuring a default route

Configuration procedure

1 Enter system view.

```
<S4200GA> system-view
```

2 Create VLAN 10 and configure VLAN 10 to be the management VLAN.

```
[4200GA] vlan 10
[4200GA-vlan10] quit
[4200GA] management-vlan 10
```

3 Create the VLAN 10 interface and enter VLAN interface view.

```
[4200GA] interface vlan-interface 10
```

4 Configure the IP address of VLAN 10 interface to be 1.1.1.1.

```
[4200GA-Vlan-interface10] ip address 1.1.1.1 255.255.255.0
[4200GA-Vlan-interface10] quit
```

5 Configure a default route.

```
[4200GA] ip route-static 0.0.0.0 0.0.0.0 1.1.1.2
```

Displaying and Debugging Management VLAN

Table 35 Display and debug management VLAN

Operation	Command	Description
Display the IP-related information about a management VLAN interface	**display ip interface** [**vlan-interface** *vlan-id*]	Optional You can execute the **display** commands in any view.
Display the information about a management VLAN interface	**display interface vlan-interface** [*vlan-id*]	
Display summary information about the routing table	display ip routing-table	
Display detailed information about the routing table	display ip routing-table verbose	
Display the routes leading to a specified IP address	**display ip routing-table** *ip-address* [*mask*] [**longer-match**] [**verbose**]	
Display the routes leading to specified IP addresses	**display ip routing-table** *ip-address1 mask1 ip-address2 mask2* [**verbose**]	
Display the routes filtered by a specified access control list (ACL)	**display ip routing-table acl** { *acl-number* | *acl-name* } [**verbose**]	
Display the routes filtered by a specified IP prefix	**display ip routing-table ip-prefix** *ip-prefix-name* [**verbose**]	
Display the routing table in a tree structure	display ip routing-table radix	
Display the statistics of the routing table	display ip routing-table statistics	

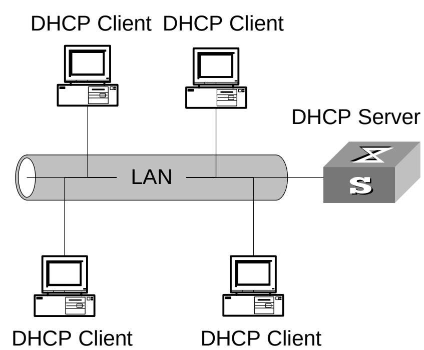
11 DHCP/BOOTP CLIENT CONFIGURATION

Introduction to DHCP Client

As the network scale expands and the network complexity increases, the network configurations become more and more complex accordingly. It is usually the case that the computer locations change (such as the portable computers or wireless networks) or the number of the computers exceeds that of the available IP addresses. The dynamic host configuration protocol (DHCP) is developed to meet these requirements. It adopts the client/server model. The DHCP client requests configuration information from the DHCP server dynamically, and the DHCP server returns corresponding configuration information based on policies.

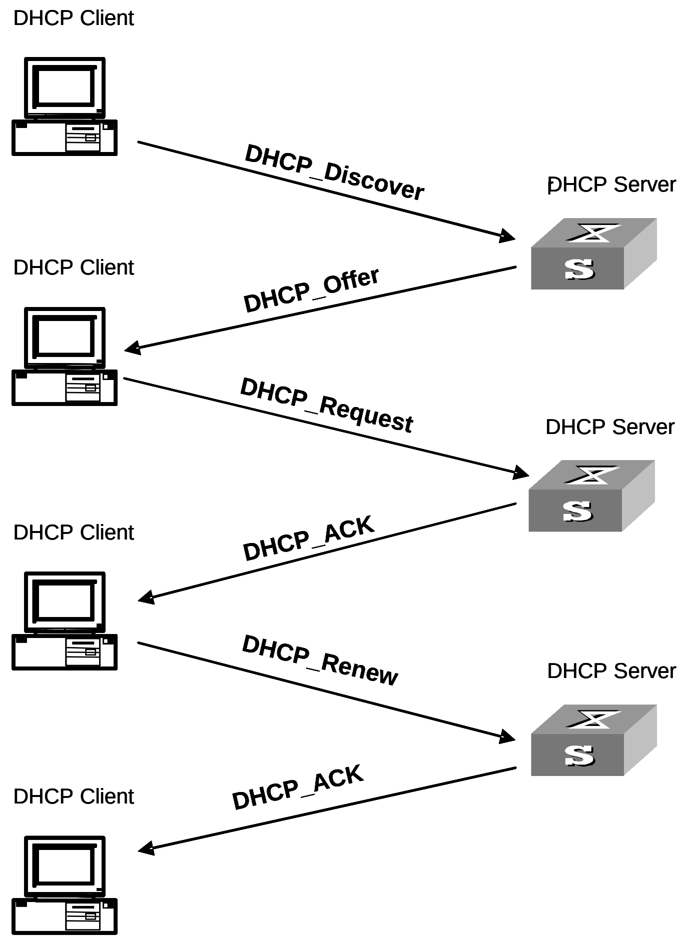
A typical DHCP implementation usually involves a DHCP server and multiple clients (such as PCs and portable computers), as shown in Figure 21.

Figure 21 A typical DHCP implementation



The interactions between a DHCP client and a DHCP server are shown in Figure 22.

Figure 22 Interaction between a DHCP client and a DHCP server



To obtain valid dynamic IP addresses, a DHCP client exchanges different information with the DHCP server in different phases. Usually, the following three modes are involved:

1 The DHCP client accesses the network for the first time

In this case, the DHCP client goes through the following four phases to establish connections with the DHCP server.

- Discovery. The DHCP client discovers a DHCP server by broadcasting DHCP_Discover packets in the network. Only the DHCP servers respond to this type of packets.
- Offer. Upon receiving DHCP_Discover packets, a DHCP server select an available IP address from an address pool and sends a DHCP_Offer packet that carries the selected IP address and other configuration information to the DHCP client. The DHCP client only accepts the first-arrived DHCP_Offer packet (if there are many DHCP servers), and broadcasts a DHCP_Request packet to each DHCP server. The packet contains the IP address carried by the DHCP_Offer packet.
- Acknowledgement. Upon receiving the DHCP_Request packet, the DHCP server that owns the IP address the DHCP_Request packet carries sends a DHCP_ACK packet to the DHCP client. In this way, the DHCP client binds TCP/IP protocol components to its network adapter.
- IP addresses offered by other DHCP servers (if any) through DHCP_Offer packets but not selected by the DHCP client are still available for other clients.

2 The DHCP client accesses the network for the second time

In this case, the DHCP client establishes connections with the DHCP server through the following steps.

a After accessing the network successfully for the first time, the DHCP client can access the network again by broadcasting a DHCP_Request packet that contains the IP address assigned to it last time instead of a DHCP_Discover packet.

b Upon receiving the DHCP_Request packet and, when the IP address applied by the client is available, the DHCP server that owns the IP address responds with a DHCP_ACK packet to enable the DHCP client to use the IP address again.

c If the IP address is not available (for example, it is assigned to another DHCP client), the DHCP server responds with a DHCP_NAK packet, which enables the DHCP client to request for a new IP address by sending a DHCP_Discover packet once again.

3 The DHCP client extends the lease of an IP address

IP addresses assigned dynamically are only valid for a specified period of time and the DHCP servers reclaim their assigned IP addresses at the expiration of these periods. Therefore, the DHCP client must be able to extend the period if it is to use a dynamically assigned IP address for a period longer than allowed.

By default, a DHCP client updates its IP address lease automatically by sending DHCP_Request packets to the DHCP server when half of the specified period expires. The DHCP server, in turn, responds with a DHCP_ACK packet to notify the DHCP client of the new lease if the IP address is still available. The DHCP clients implemented by the switches support this lease auto-update process.

Introduction to BOOTP Client

A BOOTP client can request the server for an IP address through BOOTP. It goes through the following two phases to apply for an IP address.

- Sending a BOOTP request packet to the server
- Processing the BOOTP response packet received from the server

To obtain an IP address through BOOTP, a BOOTP client first sends a BOOTP request packet to the server. Upon receiving the request packet, the server returns a BOOTP response packet. The BOOTP client then retrieves the assigned IP address from the response packet.

The BOOTP packets are based on user datagram protocol (UDP). To ensure reliable packet transmission, a timer is triggered when the BOOTP client sends a request packet to the server. If no response packet from the server is received after the timer times out, the client resends the request packet. The packet is resent every five seconds and three times at most. After that, no packet is resent if there is still no response packet from the server.

DHCP/BOOTP Client Configuration

An S4200G series Ethernet switch can operate as a DHCP/BOOTP client. In this case, the IP address of the management VLAN interface is obtained through DHCP/BOOTP.

Prerequisites

Before configuring the management VLAN, you need to create the VLAN to be operating as the management VLAN. As VLAN 1 is created by default, you do not need to create it if you configure VLAN 1 to be the management VLAN.

Configuring a DHCP/BOOTP Client

Table 36 Configure DHCP/BOOTP client

Operation	Command	Description
Enter system view	system-view	Required
Configure a specified VLAN to be the management VLAN	**management-vlan** *vlan-id*	Required By default, VLAN 1 operates as the management VLAN.
Create the management VLAN interface and enter VLAN interface view	**interface vlan-interface** *vlan-id*	Required
Configure the way in which the management VLAN interface obtains an IP address	**ip address** { **bootp-alloc** | **dhcp-alloc }**	Required By default, no IP address is assigned to the management VLAN interface.
Display the information about the BOOTP client	**display bootp client** [**interface vlan-interface** *vlan-id*]	Optional You can execute these two commands in any view.
Display the information about the DHCP client	**display dhcp client** [**verbose**]	

Configuration Example

Network requirements

To manage the switch S4200GA remotely, which operates as a DHCP client, through Telnet, The following are required:

- S4200GA has an IP address that is obtained through DHCP
- The route between S4200GA and the remote console is reachable.

To achieve this, you need to perform the following configuration for the switch:

- Configuring the management VLAN interface to obtain an IP address through DHCP
- Configuring a default route

Configuration procedures

1 Enter system view.

```
<S4200GA> system-view
```

2 Create VLAN 10 and configure VLAN 10 to be the management VLAN.

```
[4200GA] vlan 10
[4200GA-vlan10] quit
[4200GA] management-vlan 10
```

3 Create VLAN 10 interface and enter VLAN interface view.

```
[4200GA] interface vlan-interface 10
```

4 Configure the management VLAN interface to obtain an IP address through DHCP.

```
[4200GA-Vlan-interface10] ip address dhcp-alloc
[4200GA-Vlan-interface10] quit
```

5 Configure a default route.

```
[4200GA] ip route-static 0.0.0.0 0.0.0.0 1.1.1.2
```

12 VOICE VLAN CONFIGURATION

Voice VLAN Configuration

Introduction to Voice VLAN

Voice VLANs are VLANs configured specially for voice data stream. By adding the ports with voice devices attached to voice VLANs, you can perform QoS-related configuration for voice data, ensuring the transmission priority of voice data stream and voice quality.

S4200G series Ethernet switches determine whether a received packet is a voice packet by checking its source MAC address. Voice packets can also be identified by organizationally unique identifier (OUI) addresses. You can configure an OUI address for voice packets or specify to use the default OUI address.

An OUI address is a globally unique identifier assigned to a vendor by IEEE. It forms the first 24 bits of a MAC address.

A voice VLAN can operate in two modes: automatic mode and manual mode. You can configure the operation mode for a voice VLAN according to data stream passing through the ports of the voice VLAN.

- When a voice VLAN operates in the automatic mode, the switch learns source MAC addresses from untagged packets sent by IP phones (an IP phone sends untagged packets when powered on) and adds the port with the IP phones attached to the voice VLAN. A port in a voice VLAN ages if the corresponding OUI address is not updated when the aging time expires.
- When a voice VLAN operates in the manual mode, you need to execute related commands to add a port to the voice VLAN or remove a port from the voice VLAN.

As for tagged packets sent by IP phones, a switch only forwards them (rather than learns the MAS addresses) regardless of the voice VLAN operation mode.

Voice VLAN packets can be forwarded by trunk ports and hybrid ports. You can enable a trunk port or a hybrid port to forward voice and service packets simultaneously by enabling the voice VLAN function for it.

As multiple types of IP phones exist, you need to match port mode with types of voice stream sent by IP phones, as listed in Table 37.

Table 37 Port modes and voice stream types

Port voice VLAN mode	Voice stream type	Port type	Supported or not
Automatic mode	Tagged voice stream	Access	Not supported
		Trunk	Supported Make sure the default VLAN of the port exists and is not a voice VLAN. And the access port permits the packets of the default VLAN.
		Hybrid	Supported Make sure the default VLAN of the port exists and is in the list of the tagged VLANs whose packets are permitted by the access port.
	Untagged voice stream	Access	Not supported, because the default VLAN of the port must be a voice VLAN and the access port is in the voice VLAN. To do so, you can also add the port to the voice VLAN manually.
		Trunk	
		Hybrid	
Manual mode	Tagged voice stream	Access	Not supported
		Trunk	Supported Make sure the default VLAN of the port exists and is not a voice VLAN. And the access port permits the packets of the default VLAN.
		Hybrid	Supported Make sure the default VLAN of the port exists and is in the list of the tagged VLANs whose packets are permitted by the access port.
	Untagged voice stream	Access	Supported Make sure the default VLAN of the port is a voice VLAN.
		Trunk	Supported Make sure the default VLAN of the port is a voice VLAN and the port permits the packets of the VLAN.
		Hybrid	Supported Make sure the default VLAN of the port is a voice VLAN and is in the list of untagged VLANs whose packets are permitted by the port.

CAUTION: *•If the voice stream transmitted by an IP phone is tagged and the port which the IP phone is attached to is 802.1x-enabled, assign different VLAN IDs for the voice VLAN, the default VLAN of the port, and the 802.1x guest VLAN to ensure the two functions to operate properly.*

•If the voice stream transmitted by the IP phone is untagged, the default VLAN of the port which the IP phone is attached can only be configured as a voice VLAN for the voice VLAN function to take effect. In this case, 802.1x authentication is unavailable.

Voice VLAN Configuration

Configuration Prerequisites

- Create the corresponding VLAN before configuring a voice VLAN.
- VLAN 1 is the default VLAN and do not need to be created. But VLAN 1 does not support the voice VLAN function.

Configuring a voice VLAN to operate in automatic mode

Table 38 Configure a voice VLAN to operate in automatic mode

Operation	Command	Description
Enter system view	system-view	—
Enter port view	**interface** *interface-type interface-number*	Required
Enable the voice VLAN function for the port	voice vlan enable	Required By default, the voice VLAN function is disabled.
Set the voice VLAN operation mode to automatic mode	voice vlan mode auto	Optional The default voice VLAN operation mode is automatic mode.
Quit to system view	quit	—
Set an OUI address that can be identified by the voice VLAN	**voice vlan mac-address** *oui* **mask** *oui-mask* [**description** *string* **]**	Optional If you do not set the OUI address, the default OUI address is used.
Enable the voice VLAN security mode	voice vlan security enable	Optional By default, the voice VLAN security mode is enabled.
Set the aging time for the voice VLAN	**voice vlan aging** *minutes*	Optional The default aging time is 1,440 minutes.
Enable the voice VLAN function globally	**voice vlan** *vlan-id* **enable**	Required

Configuring a voice VLAN to operate in manual mode

Table 39 Configure a voice VLAN to operate in manual mode

Operation	Command	Description
Enter system view	system-view	-
Enter port view	**interface** *interface-type interface-num*	Required
Enable the voice VLAN function for the port	voice vlan enable	Required By default, the voice VLAN function is disabled on a port.
Set voice VLAN operation mode to manual mode	undo voice vlan mode auto	Required The default voice VLAN operation mode is automatic mode.
Quit to system view	quit	-

Table 39 Configure a voice VLAN to operate in manual mode (Continued)

Operation			Command	Description
Add a port to the VLAN	Access port	Enter VLAN view	**vlan** *vlan-id*	Required
		Add the port to the VLAN	**port** *port-type port-num*	
	Trunk or hybrid port	Enter port view	**interface** *interface-type interface-num*	
		Add the port to the voice VLAN	**port trunk permit vlan** *vlan-id* **port hybrid vlan** *vlan-id* { **tagged | untagged }**	
		Configure the voice VLAN to be the default VLAN of the port	**port trunk pvid vlan** *vlan-id* **port hybrid pvid vlan** *vlan-id*	Optional Refer to Table 37 to determine whether or not this operation is needed.
Quit to system view			quit	-
Set an OUI address to be one that can be identified by the voice VLAN			**voice vlan mac-address** *oui* **mask** *oui-mask* [**description** *string* **]**	Optional If you do not set the address, the default OUI address is used.
Enable the voice VLAN security mode			voice vlan security enable	Optional By default, the voice VLAN security mode is enabled.
Set aging time for the voice VLAN			**voice vlan aging** *minutes*	Optional The default aging time is 1,440 minutes.
Enable the voice VLAN function globally			**voice vlan** *vlan-id* **enable**	Required

CAUTION:

- You can enable voice VLAN feature for only one VLAN at a moment.
- If the VLAN for whom the voice VLAN function is enabled is a dynamic VLAN, the VLAN becomes a static VLAN after you enable the voice VLAN function.
- A port operating in the automatic mode cannot be added to/removed from a voice VLAN.
- When a voice VLAN operates in the security mode, the devices in it only permit packets whose source addresses are the voice OUI addresses that can be identified. Packets whose source addresses cannot be identified, including certain authentication packets (such as 802.1x authentication packets), will be dropped. So, do not transmit both voice data and service data in a voice VLAN. If you have to do so, make sure the voice VLAN do not operate in the security mode.

Voice VLAN Displaying and Debugging

Table 40 Display and debug a voice VLAN

Operation	Command	Description
Display voice VLAN configuration	display voice vlan status	You can execute the **display** command in any view.
Display the currently valid OUI addresses	display voice vlan oui	
Display the ports operating in the current voice VLAN	**display vlan** *vlan-id*	

Voice VLAN Configuration Example

Voice VLAN Configuration Example (Automatic Mode)

Network requirements

- Create VLAN 2 and configure it as a voice VLAN.
- Configure GigabitEthernet1/0/1 port as a trunk port, with VLAN 6 as the default port.
- GigabitEthernet1/0/1 port can be added to/removed from the voice VLAN automatically according to the type of the data stream that reaches the port.

Configuration procedure

1 Create VLAN 2.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] vlan 2
```

2 Configure GigabitEthernet1/0/1 port to be a trunk port, with VLAN 6 as the default VLAN.

```
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] port link-type trunk
[4200G-GigabitEthernet1/0/3] port trunk pvid vlan 6
```

3 Enable the voice VLAN function for the port and configure the port to operate in automatic mode.

```
[4200G-GigabitEthernet1/0/1] voice vlan enable
[4200G-GigabitEthernet1/0/1] voice vlan mode auto
```

4 Enable the voice VLAN function globally.

```
[4200G-GigabitEthernet1/0/1] quit
[4200G] voice vlan 2 enable
```

Voice VLAN Configuration Example (Manual Mode)

Network requirements

- Create VLAN 3 and configure it as a voice VLAN.
- Configure GigabitEthernet1/0/1 port as a trunk port for it to be added to/removed form the voice VLAN.
- Configure the OUI address to be 0011-2200-0000, with the description string being test.

Configuration procedure

1 Create VLAN 3.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] vlan 3
```

2 Configure GigabitEthernet1/0/3 port to be a trunk port and add it to VLAN 3.

```
[4200G] interface GigabitEthernet1/0/3
[4200G-GigabitEthernet1/0/3] port link-type trunk
[4200G-GigabitEthernet1/0/3] port trunk permit vlan 3
```

3 Enable the voice VLAN function for the port and configure the port to operate in manual mode.

```
[4200G-GigabitEthernet1/0/3] voice vlan enable
[4200G-GigabitEthernet1/0/3] undo voice vlan mode auto
[4200G-GigabitEthernet1/0/3] quit
```

4 Specify an OUI address.

```
[4200G] voice vlan mac-address 0011-2200-0000 mask ffff-ff00-0000
description test
```

5 Enable the voice VLAN function globally.

```
[4200G] voice vlan 3 enable
```

6 Display voice VLAN-related configurations.

```
[4200G] display voice vlan status
Voice Vlan status: ENABLE
Voice Vlan ID: 3
Voice Vlan security mode: Security
Voice Vlan aging time: 1440 minutes
Current voice vlan enabled port mode:
PORT                     MODE
----------------------------------------
GigabitEthernet1/0/3            MANUAL
```

7 Remove GigabitEthernet1/0/3 port from the voice VLAN.

```
[4200G] interface GigabitEthernet1/0/3
[4200G-GigabitEthernet1/0/3] undo port trunk permit vlan 3
```

13 GVRP CONFIGURATION

Introduction to GVRP

GVRP (GARP VLAN registration protocol) is an application of GARP (generic attribute registration protocol). GVRP is based on the mechanism of GARP; it maintains dynamic VLAN registration information and propagates the information to other switches.

GARP is a generic attribute registration protocol. This protocol provides a mechanism for the switching members in a switched network to register, distribute and propagate information about VLANs, multicast addresses, and so on between each other.

After the GVRP feature is enabled on a switch, the switch can receive the VLAN registration information from other switches to dynamically update the local VLAN registration information (including current VLAN members, which ports these VLAN members get to, and so on), and propagate the local VLAN registration information to other switches so that all the switching devices in the same switched network can have the same VLAN information. The VLAN registration information includes not only the static registration information configured locally, but also the dynamic registration information from other switches.

GVRP Mechanism

GARP Timers

The information exchange between GARP members is completed by messages. The messages performing important functions for GARP fall into three types: Join, Leave and LeaveAll.

- When a GARP entity expects other switches to register certain attribute information of its own, it sends out a Join message.
- When a GARP entity expects other switches to unregister certain attribute information of its own, it sends out a Leave message.
- Once a GARP entity starts up, it starts the LeaveAll timer. After the timer times out, the GARP entity sends out a LeaveAll message.

The join message and the Leave message are used together to complete the unregistration and re-registration of information. Through message exchange, all the attribute information to be registered can be propagated to all the switches in the same switched network.

GARP has the following timers:

- Hold: When a GARP entity receives a piece of registration information, it does not send out a Join message immediately. Instead, to save the bandwidth resources, it starts the Hold timer, puts all registration information it receives before the timer times out into one Join message and sends out the message after the timer times out.
- Join: To transmit the Join messages reliably to other entities, a GARP entity sends each Join message two times. The Join timer is used to define the interval between the two sending operations of each Join message.
- Leave: When a GARP entity expects to unregister a piece of attribute information, it sends out a Leave message. Any GARP entity receiving this message starts its

Leave timer, and unregisters the attribute information if it does not receives a Join message again before the timer times out.

- LeaveAll: Once a GARP entity starts up, it starts the LeaveAll timer, and sends out a LeaveALL message after the timer times out, so that other GARP entities can re-register all the attribute information on this entity. After that, the entity restarts the LeaveAll timer to begin a new cycle.

GVRP port registration mode

GVRP has the following port registration modes:

- Normal: In this mode, both dynamic and manual creation, registration and unregistration of VLANs are allowed.
- Fixed: In this mode, when you create a static VLAN on a switch and the packets of this VLAN are allowed to pass through the current port, the switch joins the current port to this VLAN and adds a VLAN entry to the local GVRP database (a table maintained by GVRP). But GVRP cannot learn dynamic VLAN through this port, and the dynamic VLANs learned through other ports on this switch cannot be pronounced through this port.
- Forbidden: In this mode, all the VLANs except VLAN 1 are unregistered on the port, and no other VLANs can be created or registered on the port.

GARP operation procedure

Through the mechanism of GARP, the configuration information on a GARP member will be propagated to the whole switched network. A GARP can be a terminal workstation or a bridge; it instructs other GARP member to register/unregister its attribute information by declaration/recant, and register/unregister other GARP member's attribute information according to other member's declaration/recant.

The protocol packets of GARP entity use specific multicast MAC addresses as their destination MAC addresses. When receiving these packets, the switch distinguishes them by their destination MAC addresses and delivers them to different GARP application (for example, GVRP) for further processing.

GVRP Packet Format

The GVRP packets are in the following format:

Figure 23 Format of GVRP packets

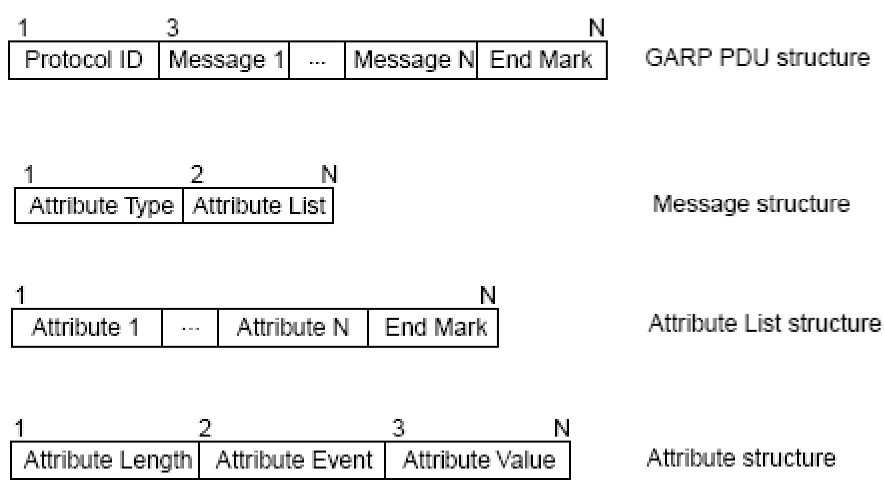


Table 41describes the packet fields Figure 23.

Table 41 Description of the packet fields

Field	Description	Value
Protocol ID	Protocol ID	1
Message	Each message consists of two parts: Attribute Type and Attribute List.	—
Attribute Type	It is defined by specific GARP application.	The attribute type of GVRP is 0x01.
Attribute List	It contains multiple attributes.	—
Attribute	Each general attribute consists of three parts: Attribute Length, Attribute Event and Attribute Value. Each LeaveAll attribute consists of two parts: Attribute Length and LeaveAll Event.	—
Attribute Length	The length of the attribute	2 to 255
Attribute Event	The event described by the attribute	0: LeaveAll Event 1: JoinEmpty 2: JoinIn 3: LeaveEmpty 4: LeaveIn 5: Empty
Attribute Value	The value of the attribute	The attribute value of GVRP is the VID.
End Mark	End mark of the GVRP PDU.	—

Protocol Specifications

GVRP is defined in IEEE 802.1Q standard.

GVRP Configuration

The GVRP configuration tasks include configuring the timers, enabling GVRP, and configuring the GVRP port registration mode.

Configuration Prerequisite

The port on which GVRP will be enabled must be set to a trunk port.

Configuration Procedure

Table 42 Configuration procedure

Operation	Command	Description
Enter system view	system-view	—
Configure the LeaveAll timer	**garp timer leaveall** *timer-value*	Optional By default, the LeaveAll timer is set to 1,000 centiseconds.
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure the Hold, Join, and Leave timers	**garp timer** { **hold** | **join** | **leave }** *timer-value*	Optional By default, the Hold, Join, and Leave timers are set to 10, 20, and 60 centiseconds respectively.
Exit and return to system view	quit	—

Table 42 Configuration procedure (Continued)

Operation	Command	Description
Enable GVRP globally	gvrp	Required By default, GVRP is disabled globally.
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable GVRP on the port	gvrp	Required By default, GVRP is disabled on the port. After you enable GVRP on a trunk port, you cannot change the port to a different type.
Configure GVRP port registration mode	**gvrp registration** { **normal** | **fixed** | **forbidden** }	Optional You can choose one of the three modes. By default, GVRP port registration mode is normal.

In a network that contains switches with both GVRP and MSTP employed, GVRP packets are forwarded along the CIST. If you want to broadcast packets of a specific VLAN through GVRP, be sure to map the VLAN to the CIST when configuring the MSTP VLAN mapping table (The CIST of a network is the spanning tree instance numbered 0.)

The timeout ranges of the timers vary depending on the timeout values you set for other timers. If you want to set the timeout time of a timer to a value out of the current range, you can set the timeout time of the associated timer to another value to change the timeout range of this timer.

Table 43 describes the relations between the timers:

Table 43 Relations between the timers

Timer	Lower threshold	Upper threshold
Hold	10 centiseconds	This upper threshold is less than or equal to one-half of the timeout time of the Join timer. You can change the threshold by changing the timeout time of the Join timer.
Join	This lower threshold is greater than or equal to twice the timeout time of the Hold timer. You can change the threshold by changing the timeout time of the Hold timer.	This upper threshold is less than one-half of the timeout time of the Leave timer. You can change the threshold by changing the timeout time of the Leave timer.
Leave	This lower threshold is greater than twice the timeout time of the Join timer. You can change the threshold by changing the timeout time of the Join timer.	This upper threshold is less than the timeout time of the LeaveAll timer. You can change the threshold by changing the timeout time of the LeaveAll timer.
LeaveAll	This lower threshold is greater than the timeout time of the Leave timer. You can change threshold by changing the timeout time of the Leave timer.	32,765 centiseconds

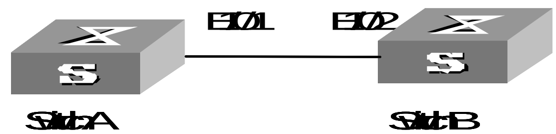
Configuration Example

Network requirements

You should enable GVRP on the switches to implement the dynamic registration and update of VLAN information between the switches.

Network diagram

Figure 24 Network diagram for GVRP configuration



Configuration procedure

1 Configure switch A:

a Enable GVRP globally.

```
<S4200G> system-view
[4200G] gvrp
```

b Set the port GigabitEthernet1/0/1 to a trunk port, and allow all VLAN packets to pass through the port.

```
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] port link-type trunk
[4200G-GigabitEthernet1/0/1] port trunk permit vlan all
```

c Enable GVRP on the trunk port.

```
[4200G-GigabitEthernet1/0/1] gvrp
```

2 Configure switch B:

a Enable GVRP globally.

```
<S4200G> system-view
[4200G] gvrp
```

b Set the port GigabitEthernet1/0/2 to a trunk port, and allow all VLAN packets to pass through the port.

```
[4200G] interface GigabitEthernet1/0/2
[4200G-GigabitEthernet1/0/2] port link-type trunk
[4200G-GigabitEthernet1/0/2] port trunk permit vlan all
```

c Enable GVRP on the trunk port.

```
[4200G-GigabitEthernet1/0/2] gvrp
```

Displaying and Maintaining GVRP

After the above configuration, you can use the **display** commands in any view to display the configuration information and operating status of GVRP, and thus verify your configuration. You can use the **reset garp statistics** command in user view to clear GARP statistics.

Table 44 Display and maintain GVRP

Operation	Command
Display GARP statistics	**display garp statistics** [**interface** *interface-list*]
Display the settings of the GARP timers	**display garp timer** [**interface** *interface-list*]
Display GVRP statistics	**display gvrp statistics** [**interface** *interface-list*]
Display the global GVRP status	display gvrp status
Clear GARP statistics	**reset garp statistics** [**interface** *interface-list*]

14 BASIC PORT CONFIGURATION

Ethernet Port Overview

Types and Numbers of Ethernet Ports

Table 45 lists the types and numbers of the Ethernet ports available on the S4200G series Ethernet switches.

Table 45 Description of Ethernet port type and port number

Device Model	Type and number of fixed ports	Number of expansion slots
Switch 4200G 12-port	12 × 10/100/1000M electrical interfaces	1
	Four Gigabit SFP Combo ports	
Switch 4200G 24-port	24 × 10/100/1000M electrical interfaces	2
	Four Gigabit SFP Combo ports	
Switch 4200G 48-port	48 × 10/100/1000M electrical interfaces	2
	Four Gigabit SFP Combo ports	

The Ethernet ports of the S4200G series switches have the following characteristics:

- The 10/100/1000BASE-TX Ethernet ports (except combo ports) support MDI/MDI-X autosensing. They can work in half-duplex/full-duplex or autonegotiation mode. They can also negotiate with other network devices for working mode and rate, automatically select the optimal working manner and rate, and simplify the system configuration and management.
- Gigabit SFP ports work in Gigabit full-duplex mode. The duplex mode can be set as full or auto, with a rate of 1000Mbps.
- 10 Gigabit Ethernet optical interfaces work in fixed 10,000 Mbps full-duplex mode.

Link Types of Ethernet Ports

An Ethernet port of the S4200G switch can operate in three different link types:

- Access: An access port can belong to only one VLAN, and is generally used to connect user PCs.
- Trunk: A trunk port can belong to more than one VLAN. It can receive/send packets from/to multiple VLANs, and is generally used to connect another switch.
- Hybrid: A hybrid port can belong to more than one VLAN. It can receive/send packets from/to multiple VLANs, and can be used to connect either a switch or user PCs.

A hybrid port allows the packets of multiple VLANs to be sent without tags, but a trunk port only allows the packets of the default VLAN to be sent without tags.

You can configure all the three types of ports on the same Ethernet switch. However, note that you cannot directly switch a port between trunk and hybrid and you must set the port as access before the switching. For example, to change a trunk port to hybrid, you must first set it as access and then hybrid.

Configuring the Default VLAN ID for an Ethernet Port

An access port can belong to only one VLAN. Therefore, the VLAN an access port belongs to is also the default VLAN of the access port. A hybrid/trunk port can belong to several VLANs, and so a default VLAN ID for the port is required.

- After you configure default VLAN IDs for Ethernet ports, the packets passing through the ports are processed in different ways depending on different situations:

Table 46 Processing of incoming/outgoing packet

<table>
<tr><th rowspan="2">Port type</th><th colspan="2">Processing of an incoming packet</th><th rowspan="2">Processing of an outgoing packet</th></tr>
<tr><th>If the packet does not carry a VLAN tag</th><th>If the packet carries a VLAN tag</th></tr>
<tr><td>Access</td><td rowspan="3">Receive the packet and add the default tag to the packet.</td><td>If the VLAN ID is just the default VLAN ID, receive the packet.
If the VLAN ID is not the default VLAN ID, discard the packet.</td><td>Deprive the tag from the packet and send the packet.</td></tr>
<tr><td>Trunk</td><td rowspan="2">If the VLAN ID is just the default VLAN ID, receive the packet.
If the VLAN ID is not the default VLAN ID but is one of the VLAN IDs allowed to pass through the port, receive the packet.
If the VLAN ID is neither the default VLAN ID, nor one of the VLAN IDs allowed to pass through the port, discard the packet.</td><td>If the VLAN ID is just the default VLAN ID, deprive the tag and send the packet.
If the VLAN ID is not the default VLAN ID, keep the original tag unchanged and send the packet.</td></tr>
<tr><td>Hybrid</td><td>If the VLAN ID is just the default VLAN ID, deprive the tag and send the packet.
If the VLAN ID is not the default VLAN ID, deprive the tag or keep the tag unchanged (whichever is done is determined by the port hybrid vlan vlan-id-list { tagged | untagged } command) and send the packet.</td></tr>
</table>

CAUTION:

To guarantee the proper packet forwarding, the default VLAN ID of the local hybrid port or trunk port should be identical with that of the hybrid port or trunk port on the peer switch.

Adding an Ethernet Port to Specified VLANs

You can add the specified Ethernet port to a specified VLAN. After that, the Ethernet port can forward the packets of the specified VLAN, so that the VLAN on this switch can intercommunicate with the same VLAN on the peer switch.

An access port can only be added to one VLAN, while hybrid and trunk ports can be added to multiple VLANs.

Note that the port shall be added to an existing VLAN.

Configuring Ethernet Ports

Making Basic Port Configuration

Table 47 Make basic port configuration

Operation	Command	Remarks
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable the Ethernet port	**undo shutdown**	By default, the port is enabled. Use the **shutdown** command to disable the port.
Allow jumbo frames to pass through the Ethernet por	**jumboframe enable**	Optional The maximum ethernet frame size supported is 9216 bytes.
Set the description of the Ethernet port	**description** *text*	By default, no description is defined for an Ethernet port.
Set the duplex mode of the Ethernet port	**duplex** { **auto** | **full** | **half** }	The port defaults to **auto** (autonegotiation) mode.
Set the rate of the Ethernet port	**speed** { **10** | **100** | **1000** | **auto** }	By default, the speed of the port is set to **auto** mode.
Set the MDI attribute of the Ethernet port	***mdi { across | auto | normal }***	Be default, the MDI attribute of the port is set to **auto** mode.

*To use the optical interface on a combo port, install the SFP and issue the **undo shutdown** command in the interface. The corresponding 10/100/1000BASE-T port will automatically be shutdown.*

*The **speed** and **mdi** commands are not available on the combo port.*

*The **mdi** command is not available on the Ethernet ports of the expansion interface card.*

Setting the Ethernet Port Broadcast Suppression Ratio

You can use the **broadcast-suppression** commands to restrict the broadcast traffic allowed to pass through a port. After that, if the broadcast traffic on the port exceeds the value you set, the system will maintain an appropriate broadcast traffic ratio by discarding the overflow traffic, so as to suppress broadcast storm, avoid network congestion and ensure normal network services.

You can execute the **broadcast-suppression** command in system view or Ethernet port view:

- If you execute the command in system view, the command takes effect on all ports.

- If you execute the command in Ethernet port view, the command takes effect only on current port.

Table 48 Set the Ethernet port broadcast suppression ratio

Operation	Command	Remarks
Enter system view	system-view	—
Set the global broadcast suppression ratio	**broadcast-suppression** { *ratio* | **pps** *max-pps* }	By default, the ratio is 100%, that is, the system does not suppress broadcast traffic globally.
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Set the broadcast suppression ratio on current port	**broadcast-suppression** { *ratio* | **pps** *max-pps* }	By default, the ratio is 100%, that is, the system does not suppress broadcast traffic on the port.

Enabling Flow Control on a Port

After flow control is enabled on both the local and the peer switches, if congestion occurs on the local switch, the switch will inform its peer to suspend packet sending. In this way, packet loss is reduced and normal network services are guaranteed.

Table 49 Enable flow control on a port

Operation	Command	Remarks
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable flow control on the Ethernet port	flow-control	By default, flow control is not enabled on the port.

Configuring Access Port Attribute

Table 50 Configure access port attribute

Operation	Command	Remarks
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure the link type for the port as access	**port link-type access**	By default, the link type for the port is access.
Add the current access port into the specified VLAN	**port access vlan** *vlan-id*	Optional

Configuring Hybrid Port Attribute

Table 51 Configure hybrid port attribute

Operation	Command	Remarks
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Set the link type for the port as hybrid	**port link-type hybrid**	Required
Set the default VLAN ID for the hybrid port	**port hybrid pvid vlan** *vlan-id*	Optional By default, the VLAN of a hybrid port is VLAN 1.

Table 51 Configure hybrid port attribute

Add the current hybrid port into the specified VLAN	**port hybrid vlan** *vlan-id-list* { **tagged** | **untagged** }	Optional For a hybrid port, you can configure to tag the packets of specific VLANs, based on which the packets of those VLANs can be processed in differently ways.

Configuring Trunk Port Attribute

Table 52 Configure trunk port attribute

Operation	Command	Remarks
Enter system view	System-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Set the link type for the port as trunk	**port link-type trunk**	Required
Set the default VLAN ID for the trunk port	**port trunk pvid vlan** *vlan-id*	Optional By default, the VLAN of a trunk port is VLAN 1.
Add the current trunk port into the specified VLAN	**port trunk permit vlan** { *vlan-id-list* | **all** }	Optional

Copying Port Configuration to Other Ports

To keep the configuration of some other ports consistent with a specified port, you can copy the configuration of the specified port to these ports.

The configuration may include:

- VLAN settings: Includes the permitted VLAN types and default VLAN ID.
- LACP settings: LACP enabled/disabled.
- QoS settings: Includes traffic limiting, priority marking, default 802.1p priority, bandwidth reservation, congestion avoidance, traffic direction, and traffic statistics.,
- STP settings: Includes STP enabling/disabling, link attribute (point-to-point or not), STP priority, path cost, maximum transmission speed, loop protection, root protection, and edge port or not.
- Port setting: Includes port link type, port speed, and duplex mode.

Table 53 Copy port configuration to other ports

Operation	Command	Remarks
Enter system view	**system-view**	—
Copy port configuration to other ports	**copy configuration source** { *interface-type interface-number* | **aggregation-group** *source-agg-id* } **destination** { *interface-list* [**aggregation-group** *destination-agg-id*] | **aggregation-group** *destination-agg-id* }	Optional

If you specify the source aggregation group ID, the system uses the port with the smallest port number in the aggregation group as the source.

If you specify the destination aggregation ID, the configuration of the source port will be copied to all ports in the aggregation group.

Setting Loopback Detection for an Ethernet Port

Loopback detection is used to monitor if loopback occurs on a switch port.

After you enable loopback detection on Ethernet ports, the switch can monitor if external loopback occurs on them. If there is a loopback port found, the switch will put it under control.

- If loopback is found on an access port, the system disables the port, sends a Trap message to the client and removes the corresponding MAC forwarding entry.
- If loopback is found on a trunk or hybrid port, the system sends a Trap message to the client. When the loopback port control function is enabled on these ports, the system disables the port, sends a Trap message to the client and removes the corresponding MAC forwarding entry.

Table 54 Set loopback detection for an Ethernet port

Operation	Command	Remarks
Enter system view	**system-view**	—
Enable loopback detection globally	**loopback-detection enable**	Optional By default, loopback detection is disabled globally.
Set time interval for port loopback detection	**loopback-detection interval-time** *time*	Optional The default interval is 30 seconds.
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable loopback detection on a specified port	**loopback-detection enable**	Optional By default, port loopback detection is disabled.
Enable loopback port control on the trunk or hybrid port	**loopback-detection control enable**	Optional By default, loopback port control is not enabled.
Configure the system to run loopback detection on all VLANs for the trunk and hybrid ports	**loopback-detection per-vlan enable**	Optional By default, the system runs loopback detection only on the default VLAN for the trunk and hybrid ports.
Display port loopback detection information	**display loopback-detection**	Optional You can use the command in any view.

CAUTION:

*•To enable loopback detection on a specific port, you must use the **loopback-detection enable** command in both system view and the specific port view.*

*•After you use the **undo loopback-detection enable** command in system view, loopback detection will be disabled on all ports.*

•The commands of loopback detection feature cannot be configured with the commands of port link aggregation at the same time.

Configuring the Ethernet Port to Run Loopback Test

You can configure the Ethernet port to run loopback test to check if it operates normally. The port running loopback test cannot forward data packets normally. The loopback test terminates automatically after a specific period.

Table 55 Configure the Ethernet port to run loopback test

Operation	Command	Remarks
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—

Table 55 Configure the Ethernet port to run loopback test

Configure the Ethernet port to run loopback test	**loopback** { **external** | **internal }**	Optional

After you use the **shutdown** command on a port, the port cannot run loopback test. You cannot use the **speed**, **duplex**, **mdi** and **shutdown** commands on the ports running loopback test. Some ports do not support loopback test, and corresponding prompts will be given when you perform loopback test on them.

Enabling the System to Test Connected Cable

You can enable the system to test the cable connected to a specific port. The test result will be returned in five minutes. The system can test these attributes of the cable: Receive and transmit directions (RX and TX), short circuit/open circuit or not, the length of the faulty cable.

Table 56 Enable the system to test connected cables

Operation	Command	Remarks
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable the system to test connected cables	**virtual-cable-test**	Required

*The **virtual-cable-test** command is not available on combo ports.*

Displaying and Debugging Ethernet Port

After the above configuration, enter the **display** commands in any view to display the running of the Ethernet port configuration, and thus verify your configuration.

Enter the **reset counters** command in user view to clear the statistics of the port.

Table 57 Display and debug Ethernet port

Operation	Command	Remarks
Display port configuration information	**display interface** [*interface-type* | *interface-type interface-number]*	You can use the commands in any view.
Display port loopback detection state	**display loopback-detection**	
Display brief configuration information about one or all ports	**display brief interface** [*interface-type interface-number]* [**|** { **begin** | **include** | **exclude }** *string]*	
Display current type-specific ports	**display port** { **hybrid** | **trunk** | **combo** | **vlan-vpn** }	
Clear the statistics of the port	**reset counters interface** [*interface-type* | *interface-type interface-number*]	After 802.1X is enabled, the port information cannot be reset.

Ethernet Port Configuration Example

Network requirements

- Switch A is connected to Switch B through trunk port GigabitEthernet1/0/1.
- Configure the default VLAN ID for the trunk port as 100.
- Allow the packets of VLAN 2, VLAN 6 through VLAN 50 and VLAN 100 to pass the port.

Network diagram

Figure 25 Network diagram for default VLAN ID configuration

Configuration procedure

The following configuration is used for Switch A. Configure Switch B in a similar way.

1 Enter port view of GigabitEthernet1/0/1.

```
[4200G] interface GigabitEthernet1/0/1
```

2 Set GigabitEthernet1/0/1 as a trunk port and allow the packets of VLAN 2, VLAN 6 through VLAN 50 and VLAN 100 to pass the port.

```
[4200G-GigabitEthernet1/0/1] port link-type trunk
[4200G-GigabitEthernet1/0/1] port trunk permit vlan 2 6 to 50 100
```

3 Create VLAN 100.

```
[4200G] vlan 100
```

4 Configure the default VLAN ID of GigabitEthernet1/0/1 as 100.

```
[4200G-GigabitEthernet1/0/1] port trunk pvid vlan 100
```

Troubleshooting Ethernet Port Configuration

Symptom: Default VLAN ID configuration failed.

Solution: Take the following steps.

1 Use the **display interface** or **display port** command to check if the port is a trunk port or a hybrid port. If not, configure it as a trunk port or a hybrid port.

2 Configure the default VLAN ID.

15 LINK AGGREGATION CONFIGURATION

Overview

Introduction to Link Aggregation

Link aggregation means aggregating several ports together to form an aggregation group, so as to implement outgoing/incoming load sharing among the member ports in the group and to enhance the connection reliability.

Depending on different aggregation modes, aggregation groups fall into three types: manual, static LACP, and dynamic LACP. Depending on whether or not load sharing is implemented, aggregation groups can be load-sharing or non-load-sharing aggregation groups.

For the member ports in an aggregation group, their basic configuration must be the same. The basic configuration includes STP, QoS, VLAN, port attributes and other associated settings.

- STP configuration, including STP status (enabled or disabled), link attribute (point-to-point or not), STP priority, maximum transmission speed, loop prevention status, root protection status, edge port or not.
- QoS configuration, including traffic limiting, priority marking, default 802.1p priority, bandwidth assurance, congestion avoidance, traffic redirection, traffic statistics, and so on.
- VLAN configuration, including permitted VLANs, and default VLAN ID.
- Port attribute configuration, including port rate, duplex mode, and link type (Trunk, Hybrid or Access).

Introduction to LACP

The purpose of link aggregation control protocol (LACP) is to implement dynamic link aggregation and deaggregation. This protocol is based on IEEE802.3ad and uses LACPDUs (link aggregation control protocol data units) to interact with its peer.

After LACP is enabled on a port, LACP notifies the following information of the port to its peer by sending LACPDUs: priority and MAC address of this system, priority, number and operation key of the port. Upon receiving the information, the peer compares the information with the information of other ports on the peer device to determine the ports that can be aggregated with the receiving port. In this way, the two parties can reach an agreement in adding/removing the port to/from a dynamic aggregation group.

Operation Key

An operation key of an aggregation port is a configuration combination generated by system depending on the configurations of the port (rate, duplex mode, other basic configuration, and management key) when the port is aggregated.

1. The selected ports in a manual/static aggregation group must have the same operation key.
2. The management key of an LACP-enable static aggregation port is equal to its aggregation group ID.
3. The management key of an LACP-enable dynamic aggregation port is zero by default.

4 The member ports in a dynamic aggregation group must have the same operation key.

Manual Aggregation Group

Introduction to manual aggregation group

A manual aggregation group is manually created. All its member ports are manually added and can be manually removed (it inhibits the system from automatically adding/removing ports to/from it). Each manual aggregation group must contain at least one port. When a manual aggregation group contains only one port, you cannot remove the port unless you remove the whole aggregation group.

LACP is disabled on the member ports of manual aggregation groups, and enabling LACP on such a port will not take effect.

Port status in manual aggregation group

A port in a manual aggregation group can be in one of the two states: selected or unselected. In a manual aggregation group, the selected ports can transceive user service packets, but the unselected ports cannot.

The selected port with the minimum port number serves as the master port of the group, and other selected ports serve as member ports of the group.

In a manual aggregation group, the system sets the ports to selected or unselected state by the following rules:

- The system sets the "most preferred" ports (that is, the ports take most precedence over other ports) to selected state, and others to unselected state. Port precedence descends in the following order: full duplex/high speed, full duplex/low speed, half duplex/high speed, half duplex/low speed.
- The system sets the ports unable to aggregate with the master port (due to some hardware limit, for example, cross-board aggregation unavailability) to unselected state.
- The system sets the ports with port attribute configuration (rate, duplex mode, and link type) different from that of the master port to unselected state.

There is a limit on the number of selected ports in an aggregation group. Therefore, if the number of the member ports that can be as selected ports in an aggregation group exceeds the maximum number supported by the device, the system will choose the ports with lower port numbers as the selected ports, and set others as unselected ports.

Requirements on ports for manual aggregation

Generally, there is no limit on the rate and duplex mode of the port you want to add to a manual aggregation group, even if it is an initially DOWN port.

In a manual aggregation group, the system never performs deaggregation and all the ports in the group keep in their current working states, even when the rate and duplex mode of a member port change. But, if the rate of the master port decreases or the duplex mode of the master port changes, packets may be lost during packet forwarding on the master port.

Static LACP Aggregation Group

Introduction to static LACP aggregation

A static LACP aggregation group is also manually created. All its member ports are manually added and can be manually removed (it inhibits the system from automatically adding/removing ports to/from it). Each static aggregation group must contain at least one port. When a static aggregation group contains only one port, you cannot remove the port unless you remove the whole aggregation group.

LACP is enabled on the member ports of static aggregation groups, and disabling LACP on such a port will not take effect. When you remove a static aggregation group, the system will remain the member ports of the group in LACP-enabled state and re-aggregate the ports to form one or more dynamic LACP aggregation groups.

Port status of static aggregation group

A port in a static aggregation group can be in one of the two states: selected or unselected. In a static aggregation group, both the selected and the unselected ports can transceive LACP protocol packets; the selected ports can transceive user service packets, but the unselected ports cannot.

In an aggregation group, the selected port with the minimum port number serves as the master port of the group, and other selected ports serve as member ports of the group.

In a static aggregation group, the system sets the ports to selected or unselected state by the following rules:

- The system sets the "most preferred" ports (that is, the ports take most precedence over other ports) to selected state, and others to unselected state. Port precedence descends in the following order: full duplex/high speed, full duplex/low speed, half duplex/high speed, half duplex/low speed.
- The system sets the following ports to unselected state: ports that are not connect to the same peer device as that of the master port, and ports that are connected to the same peer device as that of the master port but their peer ports are in aggregation groups different from the group of the peer port of the master port.
- The system sets the ports unable to aggregate with the master port (due to some hardware limit, for example, cross-board aggregation unavailability) to unselected state.
- The system sets the ports with basic port configuration different from that of the master port to unselected state.

There is a limit on the number of selected ports in an aggregation group. Therefore, if the number of the member ports that can be set as selected ports in an aggregation group exceeds the maximum number supported by the device, the system will choose the ports with lower port numbers as the selected ports, and set others as unselected ports.

Dynamic LACP Aggregation Group

Introduction to dynamic LACP aggregation group

A dynamic LACP aggregation group is automatically created by the system; it can be removed only by the system. Users cannot add/remove ports to/from it. A port can participate in dynamic link aggregation only when it is LACP-enabled. Ports can be aggregated into a dynamic aggregation group only when they are connected to the same peer device and have the same basic configuration (such as rate and duplex mode).

Besides multiple-port aggregation groups, the system is also able to create single-port aggregation groups, each of which contains only one port. LACP is enabled on the member ports of dynamic aggregation groups.

Port status of dynamic aggregation group

A port in a dynamic aggregation group can be in one of the two states: selected or unselected. In a dynamic aggregation group, both the selected and the unselected ports can transceive LACP protocol packets; the selected ports can transceive user service packets, but the unselected ports cannot.

In an aggregation group, the selected port with the minimum port number serves as the master port of the group, and other selected ports serve as member ports of the group.

There is a limit on the number of selected ports in an aggregation group. Therefore, if the number of the member ports that can be set as selected ports in an aggregation group exceeds the maximum number supported by the device, the system will negotiate with its peer end, to determine the states of the member ports according to the port IDs of the preferred device (that is, the device with smaller system ID). The following is the negotiation procedure:

1 Compare device IDs (consist of two bytes system priority and six bytes system MAC address, with the latter following the former) between the two parties. First compare the two system priorities, then the two system MAC addresses if the system priorities are equal. The device with smaller device ID will be considered as the preferred one.

2 Compare port IDs (consist of two bytes port priority and two bytes port number, with the latter following the former) on the preferred device. The comparison between two port IDs is as follows: First compare the two port priorities, then the two port numbers if the two port priorities are equal; the port with smaller port ID is more possible to become a selected port.

The port with half duplex attribute cannot receive or transmit LACP packets.

Changing the system priority of a device may change the preferred device between the two parties, and may further change the states (selected or unselected) of the member ports of dynamic aggregation groups.

Link Aggregation Attributes

Table 58 describes the link aggregation attributes of S4200-G series Ethernet switches.

Table 58 Link aggregation attributes

Aggregation mode	Switch model	Cross-board aggregation	Maximum number of member ports in an aggregation group	Maximum number of selected ports in an aggregation group
Manual	S4200-G series	Supported	Equal to the total number of ports on the switch	8
Static LACP				
Dynamic LACP				

It is recommended that you configure the same type in both local and remote switch if the number of member ports exceed the maximum number supported by the device in a link aggregation group.

Aggregation Group Categories

Depending on whether or not load sharing is implemented, aggregation groups can be load-sharing or non-load-sharing aggregation groups.

In general, the system only provides limited load-sharing aggregation resources (currently 64 load-sharing aggregation groups can be created at most), so the system needs to reasonably allocate the resources among different aggregation groups.

The system always allocates hardware aggregation resources to the aggregation groups with higher priorities. When load-sharing aggregation resources are used up by existing aggregation groups, newly-created aggregation groups will be non-load-sharing ones.

The priorities of aggregation groups for allocating load-sharing aggregation resources are as follows:

- An aggregation group containing special ports (such as 10GE port) which require hardware aggregation resources has higher priority than any aggregation group containing no special port.
- A manual or static aggregation group has higher priority than a dynamic aggregation group (unless the latter contains special ports while the former does not).
- For two aggregation groups of the same kind, the one that might gain higher speed if resources were allocated to it has higher priority than the other one. If the two groups can gain the same speed, the one with smaller master port number has higher priority than the other one.

When an aggregation group of higher priority appears, the aggregation groups of lower priorities release their hardware resources. For single-port aggregation groups, if they can transceive packets normally without occupying aggregation resources, they shall not occupy the hardware aggregation resources.

CAUTION: *A load-sharing aggregation group contains at least two selected ports, but a non-load-sharing aggregation group can only have one selected port, while others are unselected ports.*

Link Aggregation Configuration

CAUTION: *The commands of link aggregation cannot be configured with the commands of port loopback detection feature at the same time.*

Configuring a Manual Aggregation Group

You can create a manual aggregation group, or remove an existing manual aggregation group (after that, all the member ports in the group are removed from the ports).

You can manually add/remove a port to/from a manual aggregation group, and a port can only be manually added/removed to/from a manual aggregation group.

Table 59 Configure a manual aggregation group

Operation	Command	Description
Enter system view	system-view	—
Create a manual aggregation group	**link-aggregation group** *agg-id* **mode manual**	Required

Table 59 Configure a manual aggregation group (Continued)

Operation	Command	Description
Configure a description for the aggregation group	**link-aggregation group** *agg-id* **description** *agg-name*	Optional By default, an aggregation group has no description.
Enter Ethernet port view	**interface** *interface-type interface-num*	—
Add the port to the aggregation group	**port link-aggregation group** *agg-id*	Required

When creating an aggregation group:

- If the aggregation group you are creating already exists but contains no port, its type will change to the type you set.
- If the aggregation group you are creating already exists and contains ports, the possible type changes may be: changing from dynamic or static to manual, and changing from dynamic to static; and no other kinds of type change can occur.
- When you change a dynamic/static group to a manual group, the system will automatically disable LACP on the member ports. When you change a dynamic/static group to a manual group, the system will remain the member ports LACP-enabled.

When adding Ethernet ports to an aggregation group:

- You cannot add the following types of ports into an aggregation group: mirroring port, port with static MAC address configured, port with static ARP configured, port with 802.1x enabled.
- When a manual or static aggregation group contains only one port, you cannot remove the port unless you remove the whole aggregation group.

Configuring a Static LACP Aggregation Group

You can create a static LACP aggregation group, or remove an existing static aggregation group (after that, the system will re-aggregate the original member ports in the group to form one or more dynamic aggregation groups.).

You can manually add/remove a port to/from a static aggregation group, and a port can only be manually added/removed to/from a static aggregation group.

When you add an LACP-enabled port to a manual aggregation group, the system will automatically disable LACP on the port. Similarly, when you add an LACP-disabled port to a static aggregation group, the system will automatically enable LACP on the port.

Table 60 Configure a static LACP aggregation group

Operation	Command	Description
Enter system view	system-view	—
Create a static aggregation group	**link-aggregation group** *agg-id* **mode static**	Required
Configure a description for the aggregation group	**link-aggregation group** *agg-id* **description** *agg-name*	Optional By default, an aggregation group has no description.
Enter Ethernet port view	**interface** *interface-type interface-number*	—

Table 60 Configure a static LACP aggregation group (Continued)

Operation	Command	Description
Add the port to the aggregation group	**port link-aggregation group** *agg-id*	Required
Enable LACP on the port	lacp enable	Optional, the system will automatically enable LACP on the port added to a static aggregation group. The default LACP state on a port is disabled.

Configuring a Dynamic LACP Aggregation Group

A dynamic LACP aggregation group is automatically created by the system based on LACP-enabled ports. The adding and removing of ports to/from a dynamic aggregation group are automatically accomplished by LACP.

You need to enable LACP on the ports whom you want to participate in dynamic aggregation of the system, because, only when LACP is enabled on those ports at both ends, can the two parties reach agreement in adding/removing ports to/from dynamic aggregation groups.

LACP cannot be enabled on the following types of ports: mirroring port, port with static MAC address configured, port with static ARP configured, port with 802.1x enabled.

In addition, enabling LACP on a member port of a manual aggregation group will not take effect.

Table 61 Configure a dynamic LACP aggregation group

Operation	Command	Description
Enter system view	system-view	—
Configure the system priority	**lacp system-priority** *system-priority*	Optional By default, the system priority is 32,768.
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable LACP on the port	lacp enable	Required By default, LACP is disabled on a port.
Configure the port priority	**lacp port-priority** *port-priority*	Optional By default, the port priority is 32,768.
Configure a description for an dynamic aggregation group	**link-aggregation group** *agg-id* **description** *agg-name*	Optional By default, an aggregation group has no description.

Displaying and Maintaining Link Aggregation Information

After the above configuration, execute the **display** commands in any view to display link aggregation conditions and verify your configuration.

You can also execute the **reset** command in user view to clear statistics on LACP ports.

Table 62 Display and maintain link aggregation information

Operation	Command
Display summary information of all aggregation groups	display link-aggregation summary
Display detailed information of a specified aggregation group or all aggregation groups	**display link-aggregation verbose** [*agg-id*]
Display link aggregation details of a specified port or port range	**display link-aggregation interface** *interface-type interface-number* [**to** *interface-type interface-number*]
Clear LACP statistics on specified port(s) or all ports	**reset lacp statistics** [**interface** *interface-type interface-number* [**to** *interface-type interface-number]*]

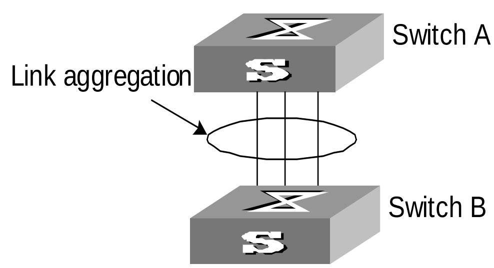
Link Aggregation Configuration Example

Network requirements

- Switch A connects to Switch B with three ports GigabitEthernet1/0/1 to GigabitEthernet1/0/3. It is required that incoming/outgoing load between the two switch can be shared among the three ports.
- Adopt three different aggregation modes to implement link aggregation on the three ports between switch A and B.

Network diagram

Figure 26 Network diagram for link aggregation configuration



Configuration procedure

The following only lists the configuration on Switch A; you must perform the similar configuration on Switch B to implement link aggregation.

1 Adopting manual aggregation mode

a Create manual aggregation group 1.

```
<S4200G> system-view
[4200G] link-aggregation group 1 mode manual
```

b Add ports GigabitEthernet1/0/1 through GigabitEthernet1/0/3 to aggregation group 1.

```
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] port link-aggregation group 1
[4200G-GigabitEthernet1/0/1] interface GigabitEthernet1/0/2
[4200G-GigabitEthernet1/0/2] port link-aggregation group 1
[4200G-GigabitEthernet1/0/2] interface GigabitEthernet1/0/3
[4200G-GigabitEthernet1/0/3] port link-aggregation group 1
```

2 Adopting static LACP aggregation mode

a Create static aggregation group 1.

```
<S4200G> system-view
[4200G] link-aggregation group 1 mode static
```

b Add ports GigabitEthernet1/0/1 through GigabitEthernet1/0/3 to aggregation group 1.

```
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] port link-aggregation group 1
[4200G-GigabitEthernet1/0/1] interface GigabitEthernet1/0/2
[4200G-GigabitEthernet1/0/2] port link-aggregation group 1
[4200G-GigabitEthernet1/0/2] interface GigabitEthernet1/0/3
[4200G-GigabitEthernet1/0/3] port link-aggregation group 1
```

3 Adopting dynamic LACP aggregation mode

a Enable LACP on ports GigabitEthernet1/0/1 through GigabitEthernet1/0/3.

```
<S4200G> system-view
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] lacp enable
[4200G-GigabitEthernet1/0/1] interface GigabitEthernet1/0/2
[4200G-GigabitEthernet1/0/2] lacp enable
[4200G-GigabitEthernet1/0/2] interface GigabitEthernet1/0/3
[4200G-GigabitEthernet1/0/3] lacp enable
```

Note that, the three LACP-enabled ports can be aggregated into a dynamic aggregation group to implement load sharing only when they have the same basic configuration (such as rate and duplex mode).

16 PORT ISOLATION CONFIGURATION

Port Isolation Overview

Introduction to Port Isolation

The port isolation function enables you to isolate the ports to be controlled on Layer 2 by adding the ports to an isolation group, through which you can improve network security and network in a more flexible way.

Currently, you can configure only one isolation group on a switch. The number of Ethernet ports an isolation group can accommodate is not limited.

The port isolation function is independent of VLAN configuration.

Port Isolation and Port Aggregation

When a member port of an aggregation group is added to an isolation group, the other ports in the same aggregation group are added to the isolation group automatically.

Port Isolation Configuration

Table 63 lists the operations to add an Ethernet ports to an isolation group.

Table 63 Configure port isolation

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-num*	—
Add the Ethernet port to the isolation group	port isolate	Required By default, an isolation group contains no port.

Displaying Port Isolation

After the above configuration, you can execute the **display** command in any view to display the information about the Ethernet ports added to the isolation group.

Table 64 Display port isolation

Operation	Command
Display the information about the Ethernet ports added to the isolation group.	display isolate port

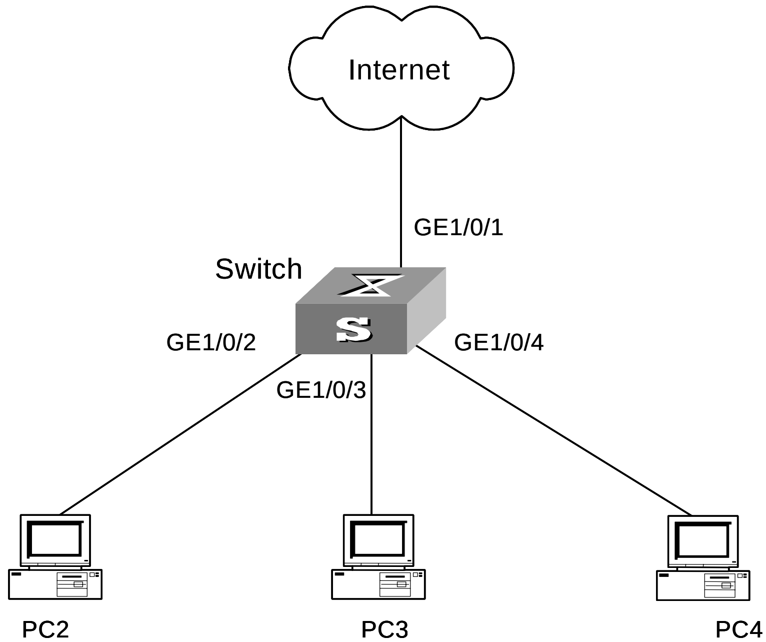
Port Isolation Configuration Example

Network requirements

- PC 2, PC 3 and PC 4 are connected to GigabitEthernet1/0/2, GigabitEthernet1/0/3, and GigabitEthernet1/0/4 ports.
- The switch connects to the Internet through GigabitEthernet1/0/1 port.
- It is desired that PC 2, PC 3 and PC 4 cannot communicate with each other.

Network diagram

Figure 27 Network diagram for port isolation configuration



Configuration procedure

1 Add GigabitEthernet1/0/2, GigabitEthernet1/0/3, and GigabitEthernet1/0/4 ports to the isolation group.

```
<S4200G>system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/2
[4200G-GigabitEthernet1/0/2] port isolate
[4200G-GigabitEthernet1/0/2] quit
[4200G] interface GigabitEthernet1/0/3
[4200G-GigabitEthernet1/0/3] port isolate
[4200G-GigabitEthernet1/0/3] quit
[4200G] interface GigabitEthernet1/0/4
[4200G-GigabitEthernet1/0/4] port isolate
[4200G-GigabitEthernet1/0/4] quit
[4200G]
```

2 Display the information about the ports in the isolation group.

```
<S4200G> display isolate port
Isolated port(s) on UNIT 1:
 GigabitEthernet1/0/2, GigabitEthernet1/0/3, GigabitEthernet1/0/4
```

17 PORT SECURITY CONFIGURATION

Port Security Configuration

Introduction to Port Security

Port security is a security mechanism that controls network access. It is an expansion to the current 802.1x and MAC address authentication. This scheme controls the incoming/outgoing packets on port by checking the MAC addresses contained in data frames, and provides multiple security and authentication modes; this greatly improves the security and manageability of the system.

The port security scheme provides the following characteristics:

1. NTK: Need to know. By means of checking the destination MAC addresses in the outbound packets of a given port, NTK can ensure that only authenticated devices can receive the data packets, and thus prevent data from being intercepted.
2. Intrusion Protection: By means of checking the source MAC addresses in the inbound packets of a given port, intrusion protection detects illegal packets and takes necessary actions when necessary. These include disconnecting ports temporarily/permanently, or filtering packets with the MAC addresses to ensure port security.
3. Device Tracking: Refers to the feature that when certain types of data packets (due to illegal intrusion, improper manner of logging on and off) are transmitted, the switch will send Trap message to help the network administrators monitor and control such actions.
4. Binding of MAC and IP addresses to ports: Binding the MAC addresses and IP addresses of authorized users to designated ports of a switch, so that only authorized users can access the ports and thereby enhances the system security.

Port Security Modes

Table 65 describes the available security modes in details:

Table 65 Description of the port security modes

Security mode	Description	Feature
autolearn	the learned MAC addresses will be changed to Security MAC addresses. This security mode will automatically change to the **secure** mode after the system has learned the maximum number of Security MAC from this port, and new Security MAC cannot be added. The packets whose original MAC addresses are not the current Security MAC addresses cannot pass the port.	In this mode, only the NTK and Intrusion Protection features take effect.
secure	In this mode, the system is disabled from learning MAC addresses from this port. Only the packets whose original MAC addresses are the configured static MAC addresses can pass the port.	
userlogin	In this mode, port-based 802.1x authentication is performed for connected users.	In this mode, the NTK and Intrusion Protection features do not take effect.

Table 65 Description of the port security modes (Continued)

Security mode	Description	Feature
userlogin-secure	The port opens only after the access user passes the 802.1x authentication. Even after the port opens, only the packets of the successfully authenticated user can pass through the port. In this mode, only one 802.1x-authenticated user is allowed to access the port. When the port changes from the normal mode to this security mode, the system automatically removes the already existing dynamic MAC address entries and authenticated MAC address entries on the port.	In these modes, only the NTK and Intrusion Protection features take effect.
userlogin-withoui	This mode is similar to the **userlogin-secure** mode, except that there can be one OUI-carried MAC address being successfully authenticated in addition to the single 802.1x-authenticated user who is allowed to access the port. When the port changes from the normal mode to this security mode, the system automatically removes the already existing dynamic/authenticated MAC address entries on the port.	
mac-authentication	In this mode, MAC address-based authentication is performed for access users.	
mac-or-userlogin-secure	In this mode, the two kinds of authentication in **mac-authentication** and **userlogin-secure** modes can be performed simultaneously. If both kinds of authentication succeed, the **userlogin-secure** mode takes precedence over the **mac-authentication** mode.	
mac-else-userlogin	In this mode, first the MAC-based authentication is performed. If this authentication succeeds, the **mac-authentication** mode is adopted, or else, the authentication in **userlogin-secure** mode is performed.	
userlogin-secure-ext	This mode is similar to the **userlogin-secure** mode, except that there can be more than one 802.1x-authenticated user on the port.	
userlogin-secure-or-mac-ext	This mode is similar to the **userlogin-secure-or-mac** mode, except that there can be more than one 802.1x-authenticated user on the port.	
mac-or-userlogin-secure-ext	This mode is similar to the **userlogin-secure-else-mac** mode, except that there can be more than one 802.1x-authenticated user on the port.	

Configuring Port Security

Table 66 Configure port security

Operation	Command	Description
Enter system view	system-view	—
Enable port security	port-security enable	Required
Set OUI value for user authentication	**port-security OUI** *OUI-value* **index** *index-value*	Optional
Enable the sending of type-specific trap messages	**port-security trap** { **addresslearned** | **intrusion** | **dot1xlogon** | **dot1xlogoff** | **dot1xlogfailure** | **ralmlogon** | **ralmlogoff** | **ralmlogfailure** }*	Optional By default, sending of trap messages is disabled.
Enter Ethernet port view	**interface** *interface-type interface-number*	—

Table 66 Configure port security (Continued)

Operation	Command	Description
Set the security mode of a port	**port-security port-mode** *mode*	Required Users can choose the optimal mode as necessary.
Set the maximum number of MAC addresses that can be accommodated by a port	**port-security max-mac-count** *count-value*	Optional By default, there is no limit on the number of MAC addresses.
Set the NTK transmission mode	**port-security ntk-mode** { **ntkonly** | **ntk-withbroadcasts** | **ntk-withmulticasts }**	Required No specific transmission mode is configured by default.
Bind the MAC and IP addresses of a legal user to a specified port	**am user-bind mac-addr** *mac-address* **ip-addr** *ip-address* [**interface** *interface-type interface-number]*	Optional Users need to specify the ports to bind while executing this command in system view, whereas in Ethernet port view, this command applies to the current port only.
Set the Intrusion Protection mode	**port-security intrusion-mode** { **disableport** | **disableport-temporarily** | **blockmac }**	Required No specific intrusion mode is configured by default.
Return to system view	quit	—
Set the timer for temporarily disabling a port	**port-security timer disableport** *timer*	Optional Defaults to 20 seconds.

The time set by the **port-security timer disableport** *timer* command is the same as the time set for temporarily disabling a port while executing the **port-security intrusion-mode** command under **disableport-temporarily** mode.

With the port security enabled, a device has the following restrictions on the 802.1x authentication and MAC address authentication in order to prevent conflictions.

1. The access control mode (set by the dot1x port-control command) is automatically set to auto.
2. The **dot1x**, **dot1x port-method**, **dot1x port-control**, and **mac-authentication** commands are inapplicable.

- Refer to the 802.1x module of *S4200G S4200G Series Ethernet Switches Operation Manual* for details on 802.1x authentication.
- You cannot add a port that configured port security feature to a link aggregation group.
- You cannot configure the **port-security port-mode** mode command on a port if the port is in a link aggregation group

Configure Security MAC

Security MAC is a special type MAC address and similar with static MAC address. One Security MAC can only be added to one port in the same VLAN. Using this feature, you can bind a MAC address with a port in the same VLAN.

Security MAC can be learned by the autolearn function of Port-Security feature, and can be configured by the command or MIB manually.

Before adding Security MAC, you may configure the port security mode to **autolearn** and then the MAC address learning method will change:

- Original dynamic MAC address will be deleted;
- If the maximum Security MAC number is not reached maximum, the new MAC address learned by the port will be added as Security MAC;
- If the maximum Security MAC number is reached maximum, the new MAC address cannot be learned by the port and the port mode will be changed from **autolearn** to **secure**

Table 67 Configure Security MAC address

Operation	Command	Description
Enter system view	system-view	-
Enable the port security	port-security enable	Required
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Set the maximum number of Security MAC allowed by the port	**port-security max-mac-count** *count-value*	Required By default, the maximum number of Security MAC is not limited
Set the port mode **to autolearn**	port-security port-mode autolearn	Required
Add Security MAC address manually	**mac-address security mac-address** [**interface** *interface-type interface-number]* **vlan** *vlan-id*	Required This command can be configured either in system view or Ethernet port view

1 **port-security port-mode autolearn** command cannot be configured with the following features at the same time:
   - •Static and black-hole MAC address;
   - •Voice VLAN feature;
   - •802.1x feature;
   - •port link aggregation;
   - •configuration of mirroring reflect port;

2 **port-security max-mac-count** *count-value* command cannot be configured with **mac-address max-mac-count** *count.*

Displaying Port Security

To display port-security related information after the above configuration, enter the following command in any view.

Table 68 Display port security

Operation	Command
Display port-security related information	**display port-security** [**interface** interface-list]
Display the configuration of Security MAC address	**display mac-address security** [**interface** *interface-type interface-number]* [**vlan** *vlan-id]* [**count]**

Table 68 Display port security (Continued)

Operation	Command
Display the information about port binding	**display am user-bind** [**interface** *interface-type interface-number* | **mac-addr** | **ip-addr]**

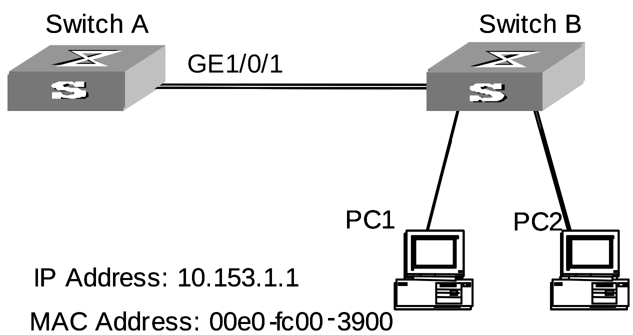
Port Security Configuration Example

Network requirements

- Enable port security on port GigabitEthernet1/0/1 of switch A, and set the maximum number of the MAC addresses accommodated by the port to 80.
- The NTK packet transmission mode of on the port is **ntk-withbroadcasts**, and the intrusion Protection mode is **disableport**.
- Connect PC1 to GigabitEthernet1/0/1 through switch B.
- Bind the MAC and IP addresses of PC1 to GigabitEthernet1/0/1.

Network diagram

Figure 28 Network diagram for port security configuration



Configuration procedure

Configure switch A as follows:

1 Enter system view.

```
<S4200G> system-view
```

2 Enable port security.

```
[4200G] port-security enable
```

3 Enter port view for GigabitEthernet1/0/1.

```
[4200G] interface GigabitEthernet1/0/1
```

4 Set the port mode to MAC authentication.

```
[4200G-GigabitEthernet1/0/1] port-security port-mode mac-authentication
```

5 Set the maximum number of MAC addresses accommodate by the port to 80.

```
[4200G-GigabitEthernet1/0/1] port-security max-mac-count 80
```

6 Set the NTK packet transmission mode to **ntk-withbroadcasts**.

```
[4200G-GigabitEthernet1/0/1] port-security ntk-mode ntk-withbroadcasts
```

7 Set the Intrusion Protection mode to **disableport**.

```
[4200G-GigabitEthernet1/0/1] port-security intrusion-mode disableport
```

8 Return to system view.

```
[4200G-GigabitEthernet1/0/1] quit
```

9 Enable the sending of intrusion trap messages.

[4200G] **port-security trap intrusion**

10 Bind the MAC and IP addresses of PC1 to GigabitEthernet1/0/1 port.

[4200G] **am user-bind mac-address 00e0-fc00-4200G ip-address 10.153.1.1 interface GigabitEthernet1/0/1**

18 MAC ADDRESS TABLE MANAGEMENT

This chapter describes the management of static, dynamic, and blackhole MAC address entries. For information about the management of multicast MAC address entries, refer to Chapter 29.

Overview

Introduction to MAC Address Table

A MAC address table is a port-based Layer 2 address table. It is the base for Ethernet switch to perform Layer 2 packet forwarding. Each entry in a MAC address table contains the following fields:

- Destination MAC address
- ID of the VLAN which a port belongs to.
- Forwarding port number.

Upon receiving a packet, a switch queries its MAC address table for the forwarding port number according to the destination MAC address carried in the packet and then forwards the packet through the port.

Entries in a MAC Address Table

Entries in a MAC address table fall into the following categories according to their characteristics and configuration methods:

- Static MAC address entry: Also known as permanent MAC address entry. This type of MAC address entries are added/removed manually and can not age out by themselves. Using static MAC address entries can reduce broadcast packets remarkably and are suitable for networks where network devices seldom change.
- Dynamic MAC address entry: This type of MAC address entries are generated by the MAC address learning mechanism and age out after the aging time.
- Blackhole MAC address entry: This type of MAC address entries are configured manually. A switch discards the packets destined for the MAC addresses contained in blackhole MAC address entries.

Table 69 lists the different types of MAC address entries and their characteristics.

Table 69 Characteristics of different types of MAC address entries

MAC address entry	Configuration method	Aging time	Reserved or not at reboot (if the configuration is saved)
Static MAC address entries	Manually configured	Unavailable	Yes
Dynamic MAC address table	Manually configured or generated by MAC address learning mechanism	Available	No
Blackhole MAC address entry	Manually configured	Unavailable	Yes

MAC Address Learning Mechanism

The MAC address learning mechanism enables a switch to acquire the MAC addresses of the network devices on the segments connected to the ports of the switch. A packet can be directly forwarded if its destination MAC address is already learnt by the switch.

The MAC address learning mechanism is implemented as follows:

- When a switch receives a packet from one of its ports (referred to as Port A), the switch extracts the source MAC address (referred to as MAC-S) of the packet and considers that the packets destined for MAC-S can be forwarded through Port A.
- If the MAC address table already contains MAC-S, the switch refreshes the aging time of the corresponding MAC address entry. Otherwise, the switch adds MAC-S and Port A as a new MAC address entry to the MAC address table.
- The switch searches the MAC address table for the destination MAC address of the received packet. If it finds a match, it directly forwards the packet, or else it broadcasts the packet in the corresponding VLAN.
- When a broadcast packet reaches the network device whose MAC address is the destination MAC address of the packet, the network device returns a packet to the switch, with its MAC address contained in the packet.
- The switch extracts the MAC address of the network device from the returned packet and adds a MAC address entry accordingly in its MAC address table. After that, the switch can directly forward other packets destined for the same network device by the newly added MAC address entry.

Among the three types of packets (unicast packets, multicast packets, and broadcast packets), the MAC address learning mechanism enables a switch to learn MAC addresses from only unicast packets.

Aging Time of MAC Address Entries

As mentioned previously, an Ethernet switch can acquire MAC addresses of network devices from its ports and add MAC address entries accordingly in its MAC address table.

The MAC address table is updated regularly. That is, the switch updates the aging time of an existing MAC address entry if it learns the same MAC address again before the specified aging time expires, and removes an existing MAC address entry if it does not learn the same MAC address again when the specified aging time expires.

Note the following when setting the aging time:

- If the aging time is too long, the number of the invalid MAC address entries maintained by the switch may be too many to make room for the MAC address table. In this case, the MAC address table cannot vary with network changes in time.
- If the aging time is too short, MAC address entries that are still valid may be removed. This results in large amount of broadcast packets wandering across the network and decreases the performance of the switches.

Aging time only applies to dynamic MAC address entries.

Limit of the Number of MAC Addresses Learnt

The MAC address learning mechanism enables an Ethernet switch to acquire the MAC addresses of the network devices on the segment connected to the ports of the switch.

By setting the maximum numbers of MAC addresses that can be learnt from individual ports, you can control the number of the MAC address entries the MAC address table can dynamically maintains. When the number of the MAC address entries learnt from a port reaches the set value, the port stops learning MAC addresses.

- The total number of static MAC addresses and blackhole MAC addresses that can be configured for a switch is 1,024.
- The number of static MAC addresses and blackhole MAC addresses depends on the maximum number of MAC address entries configured for a switch. For S4200G series switches, the maximum number of MAC addresses entries is 16K.

MAC Address Table Management

The configuration to manage a MAC address table includes:

- Configuring a MAC Address Entry and the Aging Time
- Setting the Maximum Number of MAC Addresses a Port can Learn

Configuring a MAC Address Entry and the Aging Time

You can add, modify, or remove one MAC address entry, remove all MAC address entries concerning a specific port (unicast MAC addresses only), or remove specific type of MAC address entries (such as dynamic or static MAC address entries).

Table 70 Configure a MAC address entry

Operation	Command	Description
Enter system view	system-view	—
Add/modify a MAC address entry	**mac-address** { **static** | **dynamic** | **blackhole** } *mac-address* **interface** *interface-type interface-number* **vlan** *vlan-id*	Required
Set the aging time for dynamic MAC address entries	**mac-address timer** { **aging** *seconds* | **no-aging** }	Optional The default aging time is 300 seconds. The **no-aging** keyword specifies that dynamic MAC address entries do not age out.

Setting the Maximum Number of MAC Addresses a Port can Learn

A MAC address table too big in size may decrease the forwarding performance of the switch. By setting the maximum number of MAC addresses each port can learn, you can limit the number of MAC address entries a switch maintains. A port stops learning MAC addresses if the number of MAC addresses it has learnt reaches the set value.

Table 71 Set the maximum number of MAC addresses a port can learn

Operation	Command	Description
Enter system view	system-view	—
Enter port view	**interface** *interface-type interface-number*	—
Set the maximum number of MAC addresses the port can learn	**mac-address max-mac-count** *count*	Required By default, the number of the MAC addresses a port can learn is not limited.

Disabling MAC Address learning for a VLAN

You can disable a switch from learning MAC addresses in specific VLANs to improve stability and security for the users belong to these VLANs and prevent unauthorized accesses.

Table 72 Disable MAC address learning for a VLAN

Operation	Command	Description
Enter system view	system-view	
Enter VLAN view	**vlan** *vlan-id*	
Disable the switch from learning MAC addresses in the VLAN	**mac-address max-mac-count** 0	Required By default, a switch learns MAC addresses in any VLAN.

Displaying and Maintaining a MAC Address Table

To verify your configuration, you can display information about the MAC address table by executing the **display** command in any view.

Table 73 Display and maintain the MAC address table

Operation	Command
Display information about the MAC address table	**display mac-address** [*display-option*]
Display the aging time of the dynamic MAC address entries in the MAC address table	display mac-address aging-time

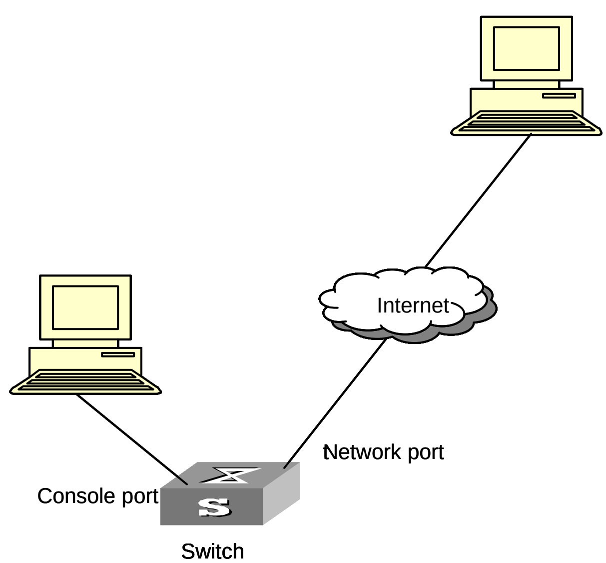
Configuration Example

Network requirements

- Log into the switch through the Console port.
- Set the aging time of the dynamic MAC address entries to 500 seconds.
- Add a static MAC address entry for GigabitEthernet1/0/2 port (assuming that the port belongs to VLAN 1), with the MAC address of 00e0-fc35-dc71.

Network diagram

Figure 29 Network diagram for MAC address table configuration



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
```

2 Add a static MAC address entry.

```
[4200G] mac-address static 00e0-fc35-dc71 interface
GigabitEthernet1/0/2 vlan 1
```

3 Set the aging time to 500 seconds.

```
[4200G] mac-address timer aging 500
```

4 Display the information about the MAC address table.

```
[4200G] display mac-address interface GigabitEthernet1/0/2
MAC ADDR            VLAN ID   STATE  PORT INDEX  AGING TIME
00-e0-fc-35-dc-71  1         Static GigabitEthernet1/0/2  NOAGED
00-e0-fc-17-a7-d6  1         Learned GigabitEthernet1/0/2  AGING
00-e0-fc-5e-b1-fb  1         Learned GigabitEthernet1/0/2  AGING
00-e0-fc-55-f1-16  1         Learned GigabitEthernet1/0/2  AGING
---  4 mac address(es) found on port GigabitEthernet1/0/2 ---
```

19 LOGGING IN THROUGH TELNET

Introduction

You can telnet to a remote switch to manage and maintain the switch. To achieve this, you need to configure both the switch and the Telnet terminal properly.

Table 74 Requirements for Telnet to a switch

Item	Requirement
Switch	The management VLAN of the switch is created and the route between the switch and the Telnet terminal is available. (Refer to the Management VLAN Configuration module for more.)
	The authentication mode and other settings are configured. Refer to Table 75 and Table 76.
Telnet terminal	Telnet is running.
	The IP address of the management VLAN of the switch is available.

Common Configuration

Table 75 lists the common Telnet configuration.

Table 75 Common Telnet configuration

Configuration		Description
VTY user interface configuration	Configure the command level available to users logging into the VTY user interface	Optional By default, commands of level 0 is available to users logging into a VTY user interface.
	Configure the protocols the user interface supports	Optional By default, Telnet and SSH protocol are supported.
VTY terminal configuration	Make terminal services available	Optional By default, terminal services are available in all user interfaces
	Set the maximum number of lines the screen can contain	Optional By default, the screen can contain up to 24 lines.
	Set history command buffer size	Optional By default, the history command buffer can contain up to 10 commands.
	Set the timeout time of a user interface	Optional The default timeout time is 10 minutes.

Telnet Configurations for Different Authentication Modes

Table 76 lists Telnet configurations for different authentication modes.

Table 76 Telnet configurations for different authentication modes

Authentication mode	Telnet configuration		Description
None	Perform common configuration	Perform common Telnet configuration	Optional Refer to Table 75.
Password	Configure the password	Configure the password for local authentication	Required
	Perform common configuration	Perform common Telnet configuration	Optional Refer to Table 75.

Table 76 Telnet configurations for different authentication modes (Continued)

Authentication mode	Telnet configuration		Description
Scheme	Specify to perform local authentication or RADIUS authentication	AAA configuration specifies whether to perform local authentication or RADIUS authentication	Optional Local authentication is performed by default. Refer to "AAA&RADIUS Configuration" for more.
	Configure user name and password	Configure user names and passwords for local/remote users	Required ■ The user name and password of a local user are configured on the switch. ■ The user name and password of a remote user are configured on the RADIUS server. Refer to user manual of RADIUS server for more.
	Manage VTY users	Set service type for VTY users	Required
	Perform common configuration	Perform common Telnet configuration	Optional Refer to Table 75.

Telnet Configuration with Authentication Mode Being None

Configuration Procedure

Table 77 Telnet configuration with the authentication mode being none

Operation	Command	Description
Enter system view	system-view	—
Enter one or more VTY user interface views	**user-interface vty** *first-number* [*last-number]*	—
Configure not to authenticate users logging into VTY user interfaces	authentication-mode none	Required By default, VTY users are authenticated after logging in.
Configure the command level available to users logging into VTY user interface	**user privilege level** *level*	Optional By default, commands of level 0 are available to users logging into VTY user interfaces.
Configure the protocols to be supported by the VTY user interface	**protocol inbound** { **all** | **ssh** | **telnet** }	Optional By default, both Telnet protocol and SSH protocol are supported.
Make terminal services available	shell	Optional By default, terminal services are available in all user interfaces.
Set the maximum number of lines the screen can contain	**screen-length** *screen-length*	Optional By default, the screen can contain up to 24 lines. You can use the **screen-length** 0 command to disable the function to display information in pages.

Table 77 Telnet configuration with the authentication mode being none

Operation	Command	Description
Set the history command buffer size	**history-command max-size** *value*	Optional The default history command buffer size is 10. That is, a history command buffer can store up to 10 commands by default.
Set the timeout time of the VTY user interface	**idle-timeout** *minutes* [*seconds* **]**	Optional The default timeout time of a user interface is 10 minutes. With the timeout time being 10 minutes, the connection to a user interface is terminated if no operation is performed in the user interface within 10 minutes. You can use the **idle-timeout** 0 command to disable the timeout function.

Note that if you configure not to authenticate the users, the command level available to users logging into a switch depends on both the ***authentication-mode*** *{* ***password*** *|* ***scheme*** *|* ***none*** *} command and the* ***user privilege level*** *level command, as listed in Table 78.*

Table 78 Determine the command level when users logging into switches are not authenticated

Scenario			Command level
Authentication mode	User type	Command	
None (**authentication-mode none**)	VTY users	The **user privilege level** *level* command not executed	Level 0
		The **user privilege level** *level* command already executed	Determined by the *level* argument

Configuration Example

Network requirements

Assume that you are a level 3 AUX user and want to perform the following configuration for Telnet users logging into VTY 0:

Do not authenticate users logging into VTY 0.

Commands of level 2 are available to users logging into VTY 0.

Telnet protocol is supported.

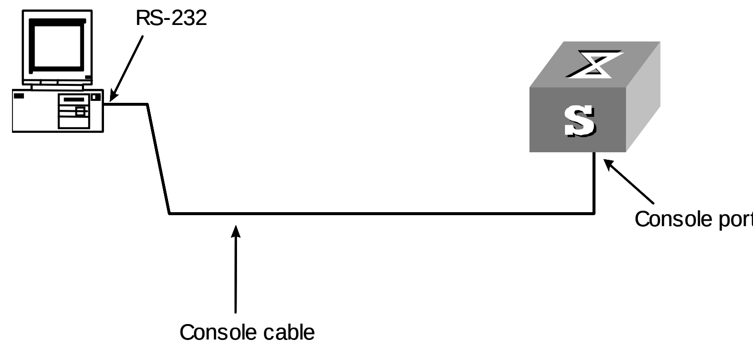
The screen can contain up to 30 lines.

The history command buffer can contain up to 20 commands.

The timeout time of VTY 0 is 6 minutes.

Network diagram

Figure 30 Network diagram for Telnet configuration (with the authentication mode being none)



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
```

2 Enter VTY 0 user interface view.

```
[4200G] user-interface vty 0
```

3 Configure not to authenticate Telnet users logging into VTY 0.

```
[4200G-ui-vty0] authentication-mode none
```

4 Specify commands of level 2 are available to users logging into VTY 0.

```
[4200G-ui-vty0] user privilege level 2
```

5 Configure Telnet protocol is supported.

```
[4200G-ui-vty0] protocol inbound telnet
```

6 Set the maximum number of lines the screen can contain to 30.

```
[4200G-ui-vty0] screen-length 30
```

7 Set the maximum number of commands the history command buffer can store to 20.

```
[4200G-ui-vty0] history-command max-size 20
```

8 Set the timeout time to 6 minutes.

```
[4200G-ui-vty0] idle-timeout 6
```

Telnet Configuration with Authentication Mode Being Password

Configuration Procedure

Table 79 Telnet configuration with the authentication mode being password

Operation	Command	Description
Enter system view	system-view	—
Enter one or more VTY user interface views	**user-interface vty** *first-number* [*last-number]*	—

Table 79 Telnet configuration with the authentication mode being password (Continued)

Operation	**Command**	**Description**
Configure to authenticate users logging into VTY user interfaces using the local password	authentication-mode password	Required
Set the local password	**set authentication password** { **cipher** | **simple }** *password*	Required
Configure the command level available to users logging into the user interface	**user privilege level** *level*	Optional By default, commands of level 0 are available to users logging into VTY user interface.
Configure the protocol to be supported by the user interface	**protocol inbound** { **all** | **ssh** | **telnet** }	Optional By default, both Telnet protocol and SSH protocol are supported.
Make terminal services available	shell	Optional By default, terminal services are available in all user interfaces.
Set the maximum number of lines the screen can contain	**screen-length** *screen-length*	Optional By default, the screen can contain up to 24 lines. You can use the **screen-length** 0 command to disable the function to display information in pages.
Set the history command buffer size	**history-command max-size** *value*	Optional The default history command buffer size is 10. That is, a history command buffer can store up to 10 commands by default.
Set the timeout time of the user interface	**idle-timeout** *minutes* [*seconds* **]**	Optional The default timeout time of a user interface is 10 minutes. With the timeout time being 10 minutes, the connection to a user interface is terminated if no operation is performed in the user interface within 10 minutes. You can use the **idle-timeout** 0 command to disable the timeout function.

Note that if you configure to authenticate the users in the password mode, the command level available to users logging into a switch depends on both the ***authentication-mode*** *{* ***password*** *|* ***scheme*** *|* ***none*** *} command and the* ***user privilege level*** *level command, as listed in Table 80*

Table 80 Determine the command level when users logging into switches are authenticated in the password mode

Scenario			**Command level**
Authentication mode	**User type**	**Command**	
Password (**authentication-mode password**)	VTY users	The **user privilege level** *level* command not executed	Level 0
		The **user privilege level** *level* command already executed	Determined by the *level* argument

Configuration Example

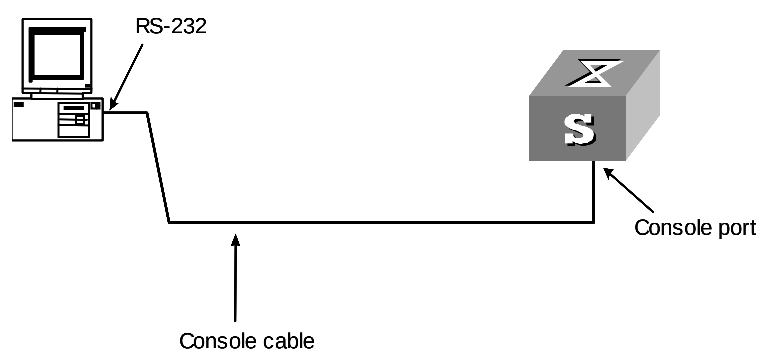
Network requirements

Assume that you are a level 3 AUX user and want to perform the following configuration for Telnet users logging into VTY 0:

- Authenticate users logging into VTY 0 using the local password.
- Set the local password to 123456 (in plain text).
- Commands of level 2 are available to users logging into VTY 0.
- Telnet protocol is supported.
- The screen can contain up to 30 lines.
- The history command buffer can contain up to 20 commands.
- The timeout time of VTY 0 is 6 minutes.

Network diagram

Figure 31 Network diagram for Telnet configuration (with the authentication mode being password)



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
```

2 Enter VTY 0 user interface view.

```
[4200G] user-interface vty 0
```

3 Configure to authenticate users logging into VTY 0 using the local password.

```
[4200G-ui-vty0] authentication-mode password
```

4 Set the local password to 123456 (in plain text).

```
[4200G-ui-vty0] set authentication password simple 123456
```

5 Specify commands of level 2 are available to users logging into VTY 0.

```
[4200G-ui-vty0] user privilege level 2
```

6 Configure Telnet protocol is supported.

```
[4200G-ui-vty0] protocol inbound telnet
```

7 Set the maximum number of lines the screen can contain to 30.

```
[4200G-ui-vty0] screen-length 30
```

8 Set the maximum number of commands the history command buffer can store to 20.

```
[4200G-ui-vty0] history-command max-size 20
```

9 Set the timeout time to 6 minutes.

```
[4200G-ui-vty0] idle-timeout 6
```

Telnet Configuration with Authentication Mode Being Scheme

Configuration Procedure

Table 81 Telnet configuration with the authentication mode being scheme

Operation		**Command**	**Description**
Enter system view		system-view	—
Configure the authentication scheme	Enter the default ISP domain view	**domain** *system*	Optional By default, the local AAA scheme is applied. If you specify to apply the local AAA scheme, you need to perform the configuration concerning local user as well. If you specify to apply an existing scheme by providing the *radius-scheme-name* argument, you need to perform the following configuration as well: ■ Perform AAA&RADIUS configuration on the switch. (Refer to "AAA&RADIUS Configuration" for more.) ■ Configure the user name and password accordingly on the AAA server. (Refer to the user manual of AAA server.)
	Configure the AAA scheme to be applied to the domain	**scheme** { **local** | **radius-scheme** *radius-scheme-name* [**local]** | **none** }	
	Quit to system view	quit	
Create a local user and enter local user view		**local-user** *user-name*	No local user exists by default.
Set the authentication password for the local user		**password** { **simple** | **cipher** } *password*	Required
Specify the service type for VTY users		**service-type telnet** [**level** *level]*	Required
Quit to system view		quit	—
Enter one or more VTY user interface views		**user-interface vty** *first-number* [*last-number]*	—
Configure to authenticate users locally or remotely		authentication-mode scheme	Required The specified AAA scheme determines whether to authenticate users locally or remotely. Users are authenticated locally by default.
Configure the command level available to users logging into the user interface		**user privilege level** *level*	Optional By default, commands of level 0 are available to users logging into the VTY user interfaces.
Configure the supported protocol		**protocol inbound** { **all** | **ssh** | **telnet** }	Optional Both Telnet protocol and SSH protocol are supported by default.
Make terminal services available		shell	Optional Terminal services are available in all use interfaces by default.

Table 81 Telnet configuration with the authentication mode being scheme (Continued)

Operation	Command	Description
Set the maximum number of lines the screen can contain	**screen-length** *screen-length*	Optional By default, the screen can contain up to 24 lines. You can use the **screen-length** 0 command to disable the function to display information in pages.
Set history command buffer size	**history-command max-size** *value*	Optional The default history command buffer size is 10. That is, a history command buffer can store up to 10 commands by default.
Set the timeout time for the user interface	**idle-timeout** *minutes* [*seconds* **]**	Optional The default timeout time of a user interface is 10 minutes. With the timeout time being 10 minutes, the connection to a user interface is terminated if no operation is performed in the user interface within 10 minutes. You can use the **idle-timeout** 0 command to disable the timeout function.

Note that if you configure to authenticate the users in the scheme mode, the command level available to users logging into a switch depends on the ***authentication-mode*** *{* ***password*** *|* ***scheme*** *|* ***none*** *} command, the* ***user privilege level*** *level command, and the* ***service-type*** *{* ***ftp*** *[* ***ftp-directory*** *directory] |* ***lan-access*** *| {* ***ssh*** *|* ***telnet*** *|* ***terminal*** *}* [* ***level*** *level] } command, as listed in* *Table 80*

Table 82 Determine the command level when users logging into switches are authenticated in the scheme mode

Scenario			
Authentication mode	**User type**	**Command**	**Command level**
Scheme (**authentication-mode scheme**)	VTY users that are AAA&RADIUS authenticated or locally authenticated	The **user privilege level** *level* command is not executed, and the **service-type** command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is not executed, and the **service-type** command specifies the available command level.	Determined by the **service-type** command
		The **user privilege level** *level* command is executed, and the **service-type** command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is executed, and the **service-type** command specifies the available command level.	Determined by the **service-type** command
	VTY users that are authenticated in the RSA mode of SSH	The **user privilege level** *level* command is not executed, and the **service-type** command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is not executed, and the **service-type** command specifies the available command level.	
		The **user privilege level** *level* command is executed, and the **service-type** command does not specify the available command level.	Determined by the **user privilege level** *level* command
		The **user privilege level** *level* command is executed, and the **service-type** command specifies the available command level.	
	VTY users that are authenticated in the password mode of SSH	The **user privilege level** *level* command is not executed, and the **service-type** command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is not executed, and the **service-type** command specifies the available command level.	Determined by the **service-type** command
		The **user privilege level** *level* command is executed, and the **service-type** command does not specify the available command level.	Level 0
		The **user privilege level** *level* command is executed, and the **service-type** command specifies the available command level.	Determined by the **service-type** command

Refer to the corresponding modules in this manual for information about AAA, RADIUS, and SSH.

Configuration Example

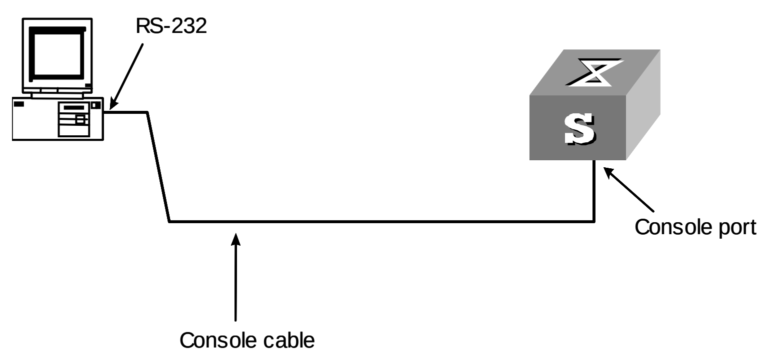
Network requirements

Assume that you are a level 3 AUX user and want to perform the following configuration for Telnet users logging into VTY 0:

- Configure the name of the local user to be “guest”.
- Set the authentication password of the local user to 123456 (in plain text).
- Set the service type of VTY users to Telnet.
- Configure to authenticate users logging into VTY 0 in scheme mode.
- The commands of level 2 are available to users logging into VTY 0.
- Telnet protocol is supported in VTY 0.
- The screen can contain up to 30 lines.
- The history command buffer can store up to 20 commands.
- The timeout time of VTY 0 is 6 minutes.

Network diagram

Figure 32 Network diagram for Telnet configuration (with the authentication mode being scheme)



Configuration procedure

1. Enter system view.

```
<S4200G> system-view
```

2. Create a local user named “guest” and enter local user view.

```
[4200G] local-user guest
```

3. Set the authentication password of the local user to 123456 (in plain text).

```
[4200G-luser-guest] password simple 123456
```

4. Set the service type to Telnet.

```
[4200G-luser-guest] service-type telnet level 2
```

5. Enter VTY 0 user interface view.

```
[4200G] user-interface vty 0
```

6. Configure to authenticate users logging into VTY 0 in the scheme mode.

```
[4200G-ui-vty0] authentication-mode scheme
```

7. Specify commands of level 2 are available to users logging into VTY 0.

```
[4200G-ui-vty0] user privilege level 2
```

8 Configure Telnet protocol is supported.

```
[4200G-ui-vty0] protocol inbound telnet
```

9 Set the maximum number of lines the screen can contain to 30.

```
[4200G-ui-vty0] screen-length 30
```

10 Set the maximum number of commands the history command buffer can store to 20.

```
[4200G-ui-vty0] history-command max-size 20
```

11 Set the timeout time to 6 minutes.

```
[4200G-ui-vty0] idle-timeout 6
```

Telnet Connection Establishment

Telneting to a Switch from a Terminal

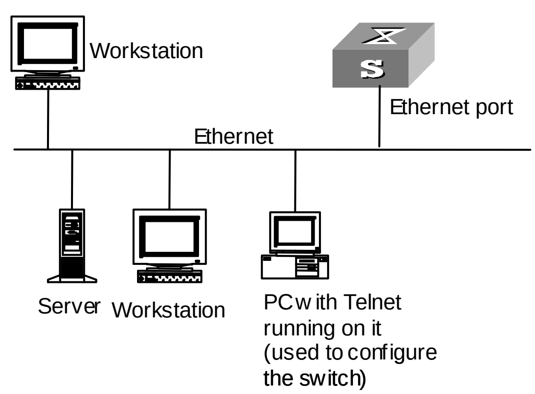
You can Telnet to a switch and then to configure the switch if the interface of the management VLAN of the switch is assigned an IP address. To assign an IP address to the interface of the management VLAN of a switch, you can log into the switch through its Console port, enter VLAN interface view, and execute the **ip address** command.

Following are procedures to establish a Telnet connection to a switch:

1 Configure the user name and password for Telnet on the switch. Refer to "Telnet Configuration with Authentication Mode Being None", "Telnet Configuration with Authentication Mode Being Password", and "Telnet Configuration with Authentication Mode Being Scheme" for more.

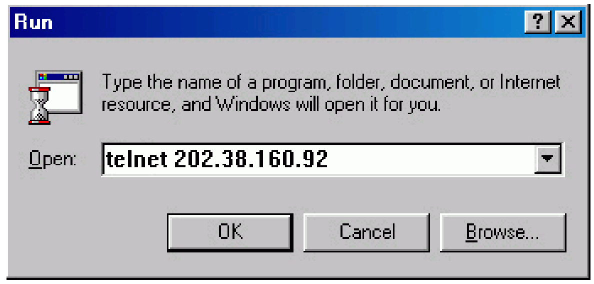
2 Connect your PC to the Switch, as shown in Figure 33. Make sure the Ethernet port to which your PC is connected belongs to the management VLAN of the switch and the route between your PC and the switch is available.

Figure 33 Network diagram for Telnet connection establishment



3 Launch Telnet on your PC, with the IP address of the management VLAN interface of the switch as the parameter, as shown in Figure 34.

Figure 34 Launch Telnet



4 Enter the password when the Telnet window displays "Login authentication" and prompts for login password. The CLI prompt (such as <S4200G>) appears if the password is correct. If all VTY user interfaces of the switch are in use, you will fail to establish the connection and receive the message that says "All user interfaces are used, please try later!". A S4200G series Ethernet switch can accommodate up to five Telnet connections at same time.

5 After successfully Telneting to a switch, you can configure the switch or display the information about the switch by executing corresponding commands. You can also type ? at any time for help.

A Telnet connection will be terminated if you delete or modify the IP address of the VLAN interface in the Telnet session.

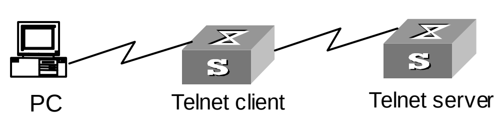
By default, commands of level 0 are available to Telnet users authenticated by password. Refer to "Command Level/Command View" in Chapter 1 for information about command hierarchy.

Telneting to Another Switch from the Current Switch

You can Telnet to another switch from the current switch. In this case, the current switch operates as the client, and the other operates as the server. If the interconnected Ethernet ports of the two switches are in the same LAN segment, make sure the IP addresses of the two management VLAN interfaces to which the two Ethernet ports belong to are of the same network segment, or the route between the two VLAN interfaces is available.

As shown in Figure 35, after Telneting to a switch (labeled as Telnet client), you can Telnet to another switch (labeled as Telnet server) by executing the **telnet** command and then to configure the later.

Figure 35 Network diagram for Telneting to another switch from the current switch



1 Configure the user name and password for Telnet on the switch operating as the Telnet server. Refer to "Telnet Configuration with Authentication Mode Being None", "Telnet Configuration with Authentication Mode Being Password", and "Telnet Configuration with Authentication Mode Being Scheme" for more.

2 Telnet to the switch operating as the Telnet client.

3 Execute the following command on the switch operating as the Telnet client:

```
<S4200G> telnet xxxx
```

Where xxxx is the IP address or the host name of the switch operating as the Telnet server. You can use the **ip host** to assign a host name to a switch.

4 Enter the password. If the password is correct, the CLI prompt (such as <S4200G>) appears. If all VTY user interfaces of the switch are in use, you will fail to establish the connection and receive the message that says "All user interfaces are used, please try later!".

5 After successfully Telneting to the switch, you can configure the switch or display the information about the switch by executing corresponding commands. You can also type ? at any time for help.

20 MSTP CONFIGURATION

MSTP Overview

Spanning tree protocol (STP) cannot enable Ethernet ports to transit their states rapidly. It costs two times of the forward delay for a port to transit to the forwarding state even if the port is on a point-to-point link or the port is an edge port. This slows down the spanning tree convergence of STP.

Rapid spanning tree protocol (RSTP) enables the spanning tree to converge rapidly, but it suffers from the same drawback as that of STP: all bridges in a LAN share one spanning tree; packets of all VLANs are forwarded along the same spanning tree, and therefore redundant links cannot be blocked by VLANs.

As well as the above two protocols, multiple spanning tree protocol (MSTP) can disbranch a ring network to form a tree-topological ring-free network to prevent packets from being duplicated and forwarded endlessly in the ring network. Besides this, MSTP can also provide multiple redundant paths for packet forwarding and balances the forwarding loads of different VLANs.

MSTP is compatible with both STP and RSTP. It overcomes the drawback of STP and RSTP. It not only enables spanning trees to converge rapidly, but also enables packets of different VLANs to be forwarded along their respective paths to provide a better load-balancing mechanism with redundant links.

MSTP Protocol Data Unit

Bridge protocol data unit (BPDU) is the protocol data unit (PDU) that STP and RSTP use.

The switches in a network transfer BPDUs between each other to determine the topology of the network. BPDUs carry the information that is needed for switches to figure out the spanning tree.

BPDUs fall into the following two categories:

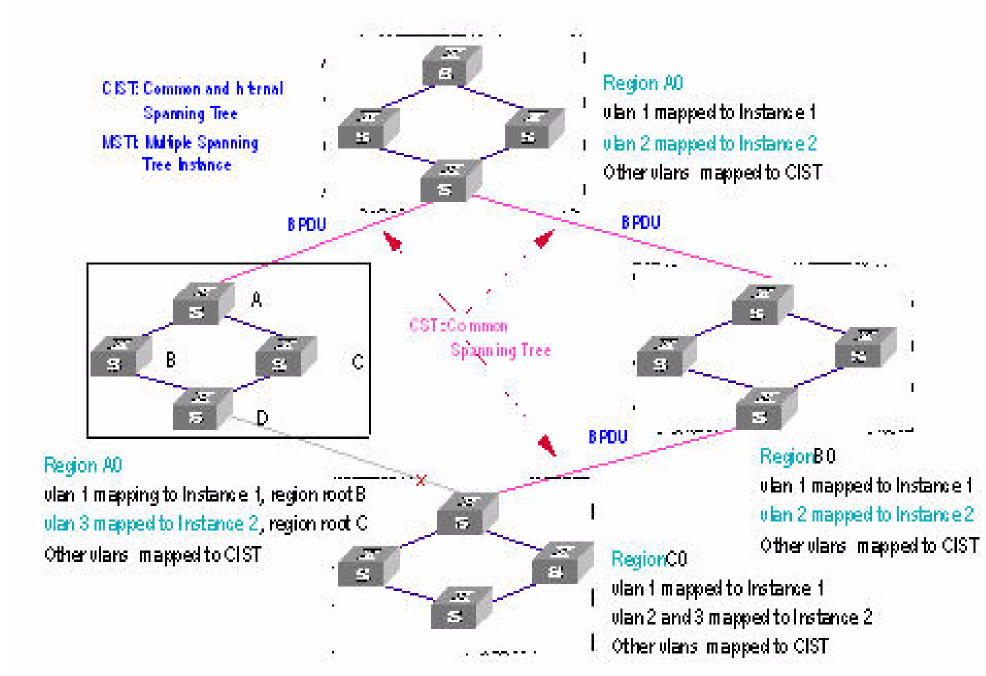
- Configuration BPDUs: BPDUs of this type are used to maintain the spanning tree topology.
- Topology change notification BPDU (TCN BPDN): BPDUs of this type are used to notify the switches of network changes.

Similar to STP and RSTP, MSTP uses BPDUs to figure out spanning trees too. In this case, the BPDUs carry MSTP configuration information of the switches.

Basic MSTP Terminologies

Figure 36 illustrates basic MSTP terms (assuming that MSTP is enabled on each switch in Figure 36).

Figure 36 Basic MSTP terminologies



MST region

An MST region (multiple spanning tree region) comprises multiple physically-interconnected MSTP-enabled switches and the corresponding network segments connected to these switches. These switches have the same region name, the same VLAN-to-spanning-tree mapping configuration and the same MSTP revision level.

A switched network can contain multiple MST regions. You can group multiple switches into one MST region by using the corresponding MSTP configuration commands. For example, all switches in region A0 shown in Figure 36 have the same MST region configuration: the same region name, the same VLAN-to-spanning-tree mappings (that is, VLAN 1 is mapped to spanning tree instance 1, VLAN 2 is mapped to spanning tree instance 2, and other VLANs are mapped to CIST), the same MSTP revision level (not shown in Figure 36).

MSTI

A multiple spanning tree instance (MSTI) refers to a spanning tree in a MST region.

Multiple spanning trees can be established in one MST region. These spanning trees are independent of each other. For example, each region in Figure 36 contains multiple spanning trees known as MSTIs (multiple spanning tree instances). Each of these spanning trees corresponds to a VLAN.

VLAN mapping table

A VLAN mapping table is a property of an MST region. It contains information about how VLANs are mapped to MSTIs. For example, in Figure 36, the information contained in the VLAN mapping table of region A0 is: VLAN 1 is mapped to MSTI 1; VLAN 2 is mapped to MSTI 2; and other VLANs are mapped to CIST. In an MST region, load balancing is achieved by the VLAN mapping table.

IST

An internal spanning tree (IST) is a spanning tree in an MST region.

ISTs together with the common spanning tree (CST) form the common and internal spanning tree (CIST) of the entire switched network. An IST is a special MSTI; it belongs to an MST region and is a branch of CIST. In Figure 36, each MST region has an IST, which is a branch of the CIST.

CST

A CST is the spanning tree in a switched network that connects all MST regions in the network. If you regard each MST region in the network as a switch, then the CST is the spanning tree generated by STP or RSTP running on the “switches”. In Figure 36, the lines in red depict the CST.

CIST

A CIST is the spanning tree in a switched network that connects all switches in the network. It comprises the ISTs and the CST. In Figure 36, the ISTs in the MST regions and the CST connecting the MST regions form the CIST.

Region root

A region root is the root of the IST or an MSTI in a MST region. Different spanning trees in an MST region may have different topologies and thus have different region roots. In region D0 shown in Figure 36, the region root of MSTI 1 is switch B, and the region root of MSTI 2 is switch C.

Common root bridge

The common root bridge is the root of the CIST. The common root bridge of the network shown in Figure 36 is a switch in region A0.

Region edge port

A region edge port is located on the edge of an MST region and is used to connect the MST region to another MST region, a STP-enabled region, or an RSTP-enabled region.

Port roles

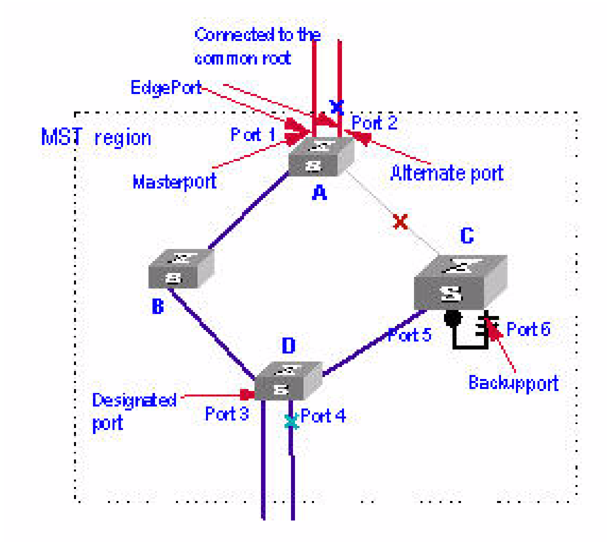
In MSTP, the following port roles exist: root port, designated port, master port, region edge port, alternate port, and backup port.

- A root port is used to forward packets to the root.
- A designated port is used to forward packets to a downstream network segment or switch.
- A master port connects a MST region to the common root. The path from the master port to the common root is the shortest path between the MST region and the common root.
- An alternate port can be a backup port of a master or root port. When it operates as a backup port of a master port, it becomes the master port if the existing master port is blocked.
- A loop occurs when two ports of a switch are connected to each other. In this case, the switch blocks one of the two ports. The blocked port is a backup port.

In Figure 37, switch A, B, C, and D form an MST region. Port 1 and port 2 on switch A connect upstream to the common root. Port 5 and port 6 on switch C form a loop. Port 3 and port 4 on switch D connect downstream to other MST regions. Figure 37 shows the roles these ports play.

- A port can play different roles in different MSTIs.
- The role a region edge port plays is consistent with the role it plays in the CIST. For example, port 1 on switch A in Figure 37 is a region edge port, and it is a master port in the CIST. So it is a master port in all MSTIs in the region.

Figure 37 Port roles



Port states

Ports can be in the following three states:

- Forwarding state: Ports in this state can forward user packets and receive/send BPDU packets.
- Learning state: Ports in this state can receive/send BPDU packets.
- Discarding state: Ports in this state can only receive BPDU packets.

Table 83 lists possible combinations of port states and port roles.

Table 83 Combinations of port states and port roles

		Port role				
		Root/ port/Master port	**Designated port**	**Region edge port**	**Alternate port**	**Backup port**
Port state	**Forwarding**	X	X	X	—	—
	Learning	X	X	X	—	—
	Discarding	X	X	X	X	X

Implementation of MSTP

MSTP divides a network into multiple MST regions at Layer 2. The CST is generated between these MST regions, and multiple spanning trees (or, MSTIs) can be generated in each MST region. As well as RSTP, MSTP uses configuration BPDUs to generate spanning trees. The only difference is that the configuration BPDUs for MSTP carry the MSTP configuration information on the switches.

Generating the CIST

Through configuration BPDU comparing, the switch that is of the highest priority in the network is chosen as the root of the CIST. In each MST region, an IST is figured out by MSTP. At the same time, MSTP regards each MST region as a switch to figure out the CST of the network. The CST, together with the ISTs, forms the CIST of the network.

Generating an MSTI

In an MST region, different MSTIs are generated for different VLANs depending on the VLAN-to-spanning-tree mappings. Each spanning tree is figured out independently, in the same way as STP/RSTP.

Implementation of STP algorithm

In the beginning, each switch regards itself as the root, and generates a configuration BPDU for each port on it as a root, with the root path cost being 0, the ID of the designated bridge being that of the switch, and the designated port being itself.

1. Each switch sends out its configuration BPDUs and operates in the following way when receiving a configuration BPDU on one of its ports from another switch:
   - If the priority of the configuration BPDU is lower than that of the configuration BPDU of the port itself, the switch discards the BPDU and does not change the configuration BPDU of the port.
   - If the priority of the configuration BPDU is higher than that of the configuration BPDU of the port itself, the switch replaces the configuration BPDU of the port with the received one and compares it with those of other ports on the switch to obtain the one with the highest priority.
2. Configuration BPDUs are compared as follows:
   - The smaller the root ID of the configuration BPDU is, the higher the priority of the configuration BPDU is.
   - For configuration BPDUs with the same root IDs, the comparison is based on the path costs. Suppose S is the sum of the root path cost and the corresponding path cost of the port. The less the S value is, the higher the priority of the configuration BPDU is.
   - For configuration BPDUs with both the same root ID and the same root path cost, the designated bridge ID, designated port ID, the ID of the receiving port are compared in turn.
3. A spanning tree is figured out as follows:
   - Selecting the root bridge

     The root bridge is selected by configuration BPDU comparing. The switch with the smallest root ID is chosen as the root bridge.
   - Selecting the root port

     For each switch (except the one chosen as the root bridge) in a network, the port that receives the configuration BPDU with the highest priority is chosen as the root port of the switch.
   - Selecting the designated port

First, the switch generates a designated port configuration BPDU for each of its port using the root port configuration BPDU and the root port path cost, with the root ID being replaced with that of the root port configuration BPDU, root path cost being replaced with the sum of the path cost of the root port configuration BPDU and the path cost of the root port, the ID of the designated bridge being replaced with that of the switch, and the ID of the designated port being replaced with that of the port.

The switch then compares the resulting configuration BPDU with the configuration BPDU received from the peer port on another switch. If the latter takes precedence over the former, the switch blocks the local port and remains the port's configuration BPDU unchanged, so that the port can only receive configuration messages and cannot forward packets. Otherwise, the switch sets the local port to the designated port, replaces the original configuration BPDU of the port with the resulting one and releases it regularly.

MSTP Implementation on Switches

MSTP is compatible with both STP and RSTP. That is, switches with MSTP employed can recognize the protocol packets of STP and RSTP and use them to generate spanning trees. In addition to the basic MSTP functions, S4200G series switches also provide the following other functions for the convenience of users to manage their switches.

- Root bridge retaining
- Root bridge backup
- Root protection
- BPDU protection
- Loop prevention
- Digest snooping
- Rapid transition

Root Bridge Configuration

Table 84 lists MSTP-related configurations about root bridges.

Table 84 Root bridge configuration

Operation	Description	Related section
MSTP configuration	Required To prevent network topology jitter caused by other related configurations, you are recommended to enable MSTP after performing other configurations.	MSTP Configuration
MST region configuration	Required	MST Region Configuration
Root bridge/secondary root bridge configuration	Required	Root Bridge/Secondary Root Bridge Configuration
Bridge priority configuration	Optional The priority of a switch cannot be changed after the switch is specified as the root bridge or a secondary root bridge.	Bridge Priority Configuration
MSTP operation mode configuration	Optional	MSTP Operation Mode Configuration
Maximum hops of MST region configuration	Optional	MST Region Maximum Hops Configuration

Table 84 Root bridge configuration (Continued)

Operation	**Description**	**Related section**
Network diameter configuration	Optional The default is recommended.	Network Diameter Configuration
MSTP time-related configuration	Optional The defaults are recommended.	MSTP Time-related Configuration
Timeout time factor configuration	Optional	Timeout Time Factor Configuration
Maximum transmitting speed configuration	Optional The default is recommended.	Maximum Transmitting Speed Configuration
Edge port configuration	Optional	Edge Port Configuration
Point-to-point link related configuration	Optional	Point-to-point Link-Related Configuration

In a network that contains switches with both GVRP and MSTP employed, GVRP packets are forwarded along the CIST. If you want to broadcast packets of a specific VLAN through GVRP, be sure to map the VLAN to the CIST when configuring the MSTP VLAN mapping table (The CIST of a network is the spanning tree instance numbered 0.)

Prerequisites The status of the switches in the spanning trees are determined. That is, the status (root, branch, or leaf) of each switch in each spanning tree instance is determined.

MST Region Configuration

Configuration procedure

Table 85 Configure an MST region

Operation	Command	Description
Enter system view	system-view	—
Enter MST region view	stp region-configuration	—
Configure a name for the MST region	**region-name** *name*	Required The default MST region name of a switch is its MAC address.
Configure the VALN mapping table for the MST region	**instance** *instance-id* **vlan** vlan-list **vlan-mapping modulo** *modulo*	Required Both commands can be used to configure VLAN mapping tables. By default, all VLANs in an MST region are mapped to spanning tree instance 0.
Configure the MSTP revision level for the MST region	**revision-level** *level*	Required The default revision level of an MST region is level 0.
Activate the configuration of the MST region manually	active region-configuration	Required
Display the configuration of the current MST region	check region-configuration	Optional
Display the currently valid configuration of the MST region	Display stp region-configuration	You can execute this command in any view.

Configuring MST region-related parameters (especially the VLAN mapping table) results in spanning trees being regenerated. To reduce network topology jitter caused by the configuration, MSTP does not regenerate spanning trees immediately after the configuration; it does this only after you perform one of the following operations, and then the configuration can really takes effect:

- Activating the new MST region-related settings by using the **active region-configuration** command
- Enabling MSTP by using the **stp enable** command

Switches belong to the same MST region only when they have the same MST region name, VLAN mapping table, and MSTP revision level.

Configuration example

1 Configure an MST region, with the name being “info”, the MSTP revision level being level 1, VLAN 2 through VLAN 10 being mapped to spanning tree instance 1, and VLAN 20 through VLAN 30 being mapped to spanning tree 2.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp region-configuration
[4200G-mst-region] region-name info
[4200G-mst-region] instance 1 vlan 2 to 10
[4200G-mst-region] instance 2 vlan 20 to 30
[4200G-mst-region] revision-level 1
[4200G-mst-region] active region-configuration
```

2 Verify the above configuration.

```
[4200G-mst-region] check region-configuration
```

```
Admin configuration
   Format selector    :0
   Region name        :info
   Revision level     :1

   Instance   Vlans Mapped
      0       11 to 19, 31 to 4094
      1       1 to 10
      2       20 to 30
```

Root Bridge/Secondary Root Bridge Configuration

MSTP can automatically choose a switch as a root bridge. You can also manually specify the current switch as a root bridge by using the corresponding commands.

Root bridge configuration

Table 86 Specify the current switch as the root bridge of a specified spanning tree

Operation	Command	Description
Enter system view	system-view	—
Specify the current switch as the root bridge of a specified spanning tree	**stp** [**instance** *instance-id]* **root primary** [**bridge-diameter** *bridgenumber*] [**hello-time** *centi-seconds]*	Required

Secondary root bridge configuration

Table 87 Specify the current switch as the secondary root bridge of a specified spanning tree

Operation	Command	Description
Enter system view	system-view	—
Specify the current switch as the secondary root bridge of a specified spanning tree	**stp** [**instance** *instance-id]* **root secondary** [**bridge-diameter** *bridgenumber*] [**hello-time** *centi-seconds*]	Required

Using the **stp root primary/stp root secondary** command, you can specify a switch as the root bridge or the secondary root bridge of the spanning tree instance identified by the *instance-id* argument. If the value of the *instance-id* argument is set to 0, the **stp root primary/stp root secondary** command specify the current switch as the root bridge or the secondary root bridge of the CIST.

A switch can play different roles in different spanning tree instances. That is, it can be the root bridges in a spanning tree instance and be a secondary root bridge in another spanning tree instance at the same time. But in one spanning tree instance, a switch cannot be the root bridge and the secondary root bridge simultaneously.

When the root bridge fails or is turned off, the secondary root bridge becomes the root bridge if no new root bridge is configured. If you configure multiple secondary root bridges for a spanning tree instance, the one with the least MAC address replaces the root bridge when the latter fails.

You can specify the network diameter and the Hello time parameters while configuring a root bridge/secondary root bridge. Refer to “Network Diameter Configuration” and “MSTP Time-related Configuration” for information about the network diameter parameter and the Hello time parameter.

*You can configure a switch as the root bridges of multiple spanning tree instances. But you cannot configure two or more root bridges for one spanning tree instance. So, do not configure root bridges for the same spanning tree instance on two or more switches using the **stp root primary** command.*

*You can configure multiple secondary root bridges for one spanning tree instance. That is, you can configure secondary root bridges for the same spanning tree instance on two or more switches using the **stp root secondary** command.*

You can also configure the current switch as the root bridge by setting the priority of the switch to 0. Note that once a switch is configured as the root bridge or a secondary root bridge, its priority cannot be modified.

Configuration example

1 Configure the current switch as the root bridge of spanning tree instance 1 and a secondary root bridge of spanning tree instance 2.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp instance 1 root primary
[4200G] stp instance 2 root secondary
```

Bridge Priority Configuration

Root bridges are selected by the bridge priorities of switches. You can make a specific switch being selected as a root bridge by set a higher bridge priority for the switch (Note that a smaller bridge priority value indicates a higher bridge priority.) A MSTP-enabled switch can have different bridge priorities in different spanning tree instances.

Configuration procedure

Table 88 Assign a bridge priority to a switch

Operation	Command	Description
Enter system view	system-view	—
Set a bridge priority for a switch	**stp** [**instance** *instance-id*] **priority** *priority*	Required The default bridge priority of a switch is 32,768.

***CAUTION:** Once you specify a switch as the root bridge or a secondary root bridge by using the **stp root primary** or **stp root secondary** command, the bridge priority of the switch is not configurable.*

During the selection of root bridge, if multiple switches have the same bridge priority, the one with the least MAC address will become the root bridge.

Configuration example

1 Set the bridge priority of the current switch to 4,096 in spanning tree instance 1.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp instance 1 priority 4096
```

MSTP Operation Mode Configuration

A MSTP-enabled switch can operate in one of the following operation modes:

- STP mode: In this mode, the protocol packets sent out of the ports of the switch are STP packets. If the switched network contains STP-enabled switches, you can configure the current MSTP-enabled switch to operate in this mode by using the **stp mode stp** command.

- RSTP mode: In this mode, the protocol packets sent out of the ports of the switch are RSTP packets. If the switched network contains RSTP-enabled switches, you can configure the current MSTP-enabled switch to operate in this mode by using the **stp mode rstp** command.
- MSTP mode: In this mode, the protocol packets sent out of the ports of the switch are MSTP packets, or STP packets if the ports have STP-enabled switches connected. In this case, the multiple spanning tree function is enabled as well.

Configuration procedure

Table 89 Configure MSTP operation mode

Operation	Command	Description
Enter system view	system-view	—
Configure the MSTP operation mode for the switch	**stp mode** { **stp** | **rstp** | **mstp** }	Required A MSTP-enabled switch operates in the MSTP mode by default.

Configuration example

1 Configure the current switch to operate in the STP mode.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp mode stp
```

MST Region Maximum Hops Configuration

The maximum hops values configured on the region roots in an MST region limit the size of the MST region.

A configuration BPDU contains a field that maintains the remaining hops of the configuration BPDU. And a switch discards the configuration BPDUs whose remaining hops are 0. After a configuration BPDU reaches a root bridge of a spanning tree in a MST region, the value of the remaining hops field in the configuration BPDU is decreased by 1 every time the configuration BPDU passes a switch. Such a mechanism disables the switches that are beyond the maximum hops from participating in spanning tree generation, and thus limits the size of an MST region.

With such a mechanism, the maximum hops configured on the switch operating as the root bridge of the IST or an MSTI in a MST region becomes the network diameter of the spanning tree, which limits the size of the spanning tree in the current MST region. The switches that are not root bridges in the MST region adopt the maximum hops settings of their root bridges.

Configuration procedure

Table 90 Configure the maximum hops for an MST region

Operation	Command	Description
Enter system view	system-view	—
Configure the maximum hops for the MST region	**stp max-hops** *hops*	Required By default, the maximum hops of an MST region is 20.

Note that only the maximum hops settings on the switches operating as region roots can limit the size of the MST region.

Configuration example

1 Configure the maximum hops of the MST region to be 30 (assuming that the current switch operates as the region root).

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp max-hops 30
```

Network Diameter Configuration

In a switched network, any two switches can communicate with each other through a path, on which there may be some other switches. The network diameter of a network is measured by the number of switches; it equals the number of the switches on the longest path (that is, the path contains the maximum number of switches).

Configuration procedure

Table 91 Configure the network diameter for a network

Operation	Command	Description
Enter system view	system-view	—
Configure the network diameter for a network	**stp bridge-diameter** *bridgenumber*	Required The default network diameter of a network is 7.

The network diameter parameter indicates the size of a network. The larger the network diameter is, the larger the network size is.

After you configure the network diameter of a switched network, A MSTP-enabled switch adjusts its Hello time, Forward delay, and Max age settings accordingly.

The network diameter setting only applies to CIST; it is invalid for MSTIs.

Configuration example

1 Configure the network diameter of the switched network to 6.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp bridge-diameter 6
```

MSTP Time-related Configuration

You can configure three MSTP time-related parameters for a switch: Forward delay, Hello time, and Max age.

- The Forward delay parameter sets the delay of state transition.

  Link problems occurred in a network results in the spanning trees being regenerated and original spanning tree structures being changed. As the newly generated configuration BPDUs cannot be propagated across the entire network immediately when the new spanning trees are generated, loops may occur if the new root ports and designated ports begin to forward packets immediately.

  This can be avoided by adopting a state transition mechanism. With this mechanism, newly selected root ports and designated ports undergo an intermediate state before they begin to forward packets. That is, it costs these ports a period (specified by the Forward delay parameter) for them to turn to the forwarding state. The period ensures that the newly generated configuration BPDUs to propagate across the entire network.

- The Hello time parameter is for link testing.

  A switch regularly sends hello packets to other switches in the interval specified by the Hello time parameter to test the links.

- The Max age parameter is used to judge whether or not a configuration BPDU is obsolete. Obsolete configuration BPDUs will be discarded.

Configuration procedure

Table 92 Configure MSTP time-related parameters

Operation	Command	Description
Enter system view	system-view	—
Configure the Forward delay parameter	**stp timer forward-delay** *centiseconds*	Required The Forward delay parameter defaults to 1,500 centiseconds (15 seconds).
Configure the Hello time parameter	**stp timer hello** *centiseconds*	Required The Hello time parameter defaults to 200 centiseconds (2 seconds).
Configure the Max age parameter	**stp timer max-age** *centiseconds*	Required The Max age parameter defaults to 2,000 centiseconds (20 seconds).

All switches in a switched network adopt the three time-related parameters configured on the CIST root bridge.

CAUTION:

- The Forward delay parameter and the network diameter are correlated. Normally, a large network diameter corresponds to a large Forward delay. A too small Forward delay parameter may result in temporary redundant paths. And a too large Forward delay parameter may cause a network unable to resume the normal state in time after changes occurred to the network. The default is recommended.
- An adequate Hello time parameter enables a switch to be aware of link problems in time without occupying too much network resources. A too large Hello time parameter may result in normal links being regarded as invalid when packets get lost on them, which in turn results in spanning trees being regenerated. And a too small Hello time parameter may result in duplicated configuration BPDUs being sent frequently, which increases the work load of the switches and wastes network resources. The default is recommended.
- As for the Max age parameter, if it is too small, network congestions may be falsely regarded as link problems, which results in spanning trees being frequently regenerated. If it is too large, link problems may be unable to be found in time, which in turn handicaps spanning trees being regenerated in time and makes the network less adaptive. The default is recommended.

As for the configuration of these three time-related parameters (that is, the Hello time, Forward delay, and Max age parameters), the following formulas must be met to prevent network jitter.

2 x (Forward delay – 1 second) >= Max age

Max age >= 2 x (Hello time + 1 second)

You are recommended to specify the network diameter of the switched network and the Hello time by using the **stp root primary** or **stp root secondary** command. After that, the three proper time-related parameters are determined automatically.

Configuration example

1 Configure the Forward delay parameter to be 1,600 centiseconds, the Hello time parameter to be 300 centiseconds, and the Max age parameter to be 2,100 centiseconds (assuming that the current switch operates as the CIST root bridge).

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp timer forward-delay 1600
[4200G] stp timer hello 300
[4200G] stp timer max-age 2100
```

Timeout Time Factor Configuration

A switch regularly sends protocol packets to its neighboring devices at the interval specified by the Hello time parameter to test the links. Normally, a switch regards its upstream switch faulty if the former does not receive any protocol packets from the latter in a period three times of the Hello time and then initiates the spanning tree regeneration process.

Spanning trees may be regenerated even in a steady network if an upstream switch continues to be busy. You can configure the timeout time factor to a larger number to avoid this. Normally, the timeout time can be four or more times of the Hello time. For a steady network, the timeout time can be five to seven times of the Hello time.

Configuration procedure

Table 93 Configure timeout time factor

Operation	Command	Description
Enter system view	system-view	—
Configure the timeout time factor for the switch	**stp timer-factor** *number*	Required The timeout time factor defaults to 3.

Configuration example

1 Configure the timeout time factor to be 6.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp timer-factor 6
```

Maximum Transmitting Speed Configuration

The maximum transmitting speed of a port specifies the maximum number of configuration BPDUs a port can transmit in a period specified by the Hello time parameter. It depends on the physical state of the port and network structure. You can configure this parameter according to the network.

Configuration procedure (in system view)

Table 94 Configure the maximum transmitting speed for specified ports in system view

Operation	Command	Description
Enter system view	system-view	—
Configure the maximum transmitting speed for specified ports	**stp interface** *interface-list* **transmit-limit** *packetnumber*	Required The maximum transmitting speed of all Ethernet ports on a switch defaults to 3.

Configuration procedure (in Ethernet port view)

Table 95 Configure the maximum transmitting speed in Ethernet port view

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure the maximum transmitting speed	**stp transmit-limit** *packetnum*	Required The maximum transmitting speed of all Ethernet ports on a switch defaults to 3.

As the maximum transmitting speed parameter determines the number of the configuration BPDUs transmitted in each Hello time, set it to a proper value to avoid MSTP from occupying too many network resources. The default is recommended.

Configuration example

1 Set the maximum transmitting speed of GigabitEthernet1/0/1 port to 5.

- Configure the maximum transmitting speed in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 transmit-limit 5
```

- Configure the maximum transmitting speed in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp transmit-limit 5
```

Edge Port Configuration

Edge ports are ports that neither directly connects to other switches nor indirectly connects to other switches through network segments. After a port is configured as an edge port, rapid transition is applicable to the port. That is, when the port changes from blocking state to forwarding state, it does not have to wait for a delay.

You can configure a port as an edge port in the following two ways.

Configuration procedure (in system view)

Table 96 Configure a port as an edge port (in system view)

Operation	Command	Description
Enter system view	system-view	—
Configure the specified ports as edge ports	**stp interface** *interface-list* **edged-port enable**	Required By default, all the Ethernet ports of a switch are non-edge ports.

Configuration procedure (in Ethernet port view)

Table 97 Configure a port as an edge port (in Ethernet port view)

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure the port as an edge port	stp edged-port enable	Required By default, all the Ethernet ports of a switch are non-edge ports.

On a switch with BPDU protection not enabled, an edge port becomes a non-edge port again once it receives a BPDU from another port.

You are recommended to configure the Ethernet ports connected directly to terminals as edge ports and enable the BPDU protection function as well. This not only enables these ports to transit to forwarding state rapidly but also secures your network.

Configuration example

1 Configure GigabitEthernet1/0/1 port as an edge port.

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 edged-port enable
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp edged-port enable
```

Point-to-point Link-Related Configuration

A point-to-point link directly connects two switches. If the roles of the two ports at the two ends of a point-to-point link meet certain criteria, the two ports can transit to the forwarding state rapidly by exchanging synchronization packets, eliminating the forwarding delay.

You can specify whether or not the link connected to a port is a point-to-point link in one of the following two ways.

Configuration procedure (in system view)

Table 98 Specify whether or not the links connected to the specified ports are point-to-point links (in system view)

Operation	Command	Description
Enter system view	system-view	—
Specify whether or not the links connected to the specified ports are point-to-point links	**stp interface** *interface-list* **point-to-point** { **force-true** | **force-false** | **auto** }	Required The **auto** keyword is adopted by default. The **force-true** keyword specifies that the links connected to the specified ports are point-to-point links. The **force-false** keyword specifies that the links connected to the specified ports are not point-to-point links. The **auto** keyword specifies to automatically determine whether or not the links connected to the specified ports are point-to-point links.

Configuration procedure (in Ethernet port view)

Table 99 Specify whether or not the link connected to a specific port is a point-to-point link (in Ethernet port view)

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Specify whether or not the link connected to the port is a point-to-point link	**stp point-to-point** { **force-true** | **force-false** | **auto** }	Required The **auto** keyword is adopted by default. The **force-true** keyword specifies that the link connected to the port is a point-to-point link. The **force-false** keyword specifies that the link connected to the port is not a point-to-point link. The **auto** keyword specifies to automatically determine whether or not the link connected to the port is a point-to-point link.

Among aggregated ports, you can only configure the links of master ports as point-to-point links.

If an autonegotiating port operates in full duplex mode after negotiation, you can configure the link of the port as a point-to-point link.

After you configure the link of a port as a point-to-point link, the configuration applies to all spanning tree instances. If the actual physical link of a port is not a point-to-point link and you forcibly configure the link as a point-to-point link, temporary loops may be incurred.

Configuration example

1 Configure the link connected to GigabitEthernet1/0/1 port as a point-to-point link.

- Configure in system view.

```
<S4200G> system-view
```

```
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 point-to-point force-true
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] b
[4200G-GigabitEthernet1/0/1] stp point-to-point force-true
```

MSTP Configuration

Configuration procedure

Table 100 Enable MSTP in system view

Operation	Command	Description
Enter system view	system-view	—
Enable MSTP	stp enable	Required MSTP is disabled by default.
Disable MSTP on specified ports	**stp interface** *interface-list* **disable**	Optional By default, MSTP is enabled on all ports after you enable MSTP in system view. To enable a switch to operate more flexibly, you can disable MSTP on specific ports. As MSTP-disabled ports do not participate in spanning tree generation, this operation saves CPU resources.

Table 101 Disable MSTP in Ethernet port view

Operation	Command	Description
Enter system view	system-view	—
Enable MSTP	stp enable	Required MSTP is disabled by default.
Enter Ethernet port view	**Interface** *interface-type interface-number*	—
Disable MSTP on the port	stp disable	Optional By default, MSTP is enabled on all ports after you enable MSTP in system view. To enable a switch to operate more flexibly, you can disable MSTP on specific ports. As MSTP-disabled ports do not participate in spanning tree generation, this operation saves CPU resources.

Other MSTP-related settings can take effect only after MSTP is enabled on the switch.

Configuration example

1 Enable MSTP on the switch and disable MSTP on GigabitEthernet1/0/1 port.

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp enable
[4200G] stp interface GigabitEthernet1/0/1 disable
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp enable
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp disable
```

Leaf Node Configuration

Table 102 lists MSTP-related configurations about leaf nodes.

Table 102 Leaf node configuration

Operation	Description	Related section
MSTP configuration	Required To prevent network topology jitter caused by other related configurations, you are recommended to enable MSTP after performing other configurations.	MSTP Configuration
MST region configuration	Required	MST Region Configuration
MSTP operation mode configuration	Optional	MSTP Operation Mode Configuration
Timeout time factor configuration	Optional	Timeout Time Factor Configuration
Maximum transmitting speed configuration	Optional The default is recommended.	Maximum Transmitting Speed Configuration
Edge port configuration	Optional	Edge Port Configuration
Path cost configuration	Optional	Path Cost Configuration
Port priority configuration	Optional	Port Priority Configuration
Point-to-point link related configuration	Optional	Point-to-point Link-Related Configuration

In a network that contains switches with both GVRP and MSTP employed, GVRP packets are forwarded along the CIST. If you want to broadcast packets of a specific VLAN through GVRP, be sure to map the VLAN to the CIST when configuring the MSTP VLAN mapping table (The CIST of a network is the spanning tree instance numbered 0.)

Prerequisites

The status of the switches in the spanning trees is determined. That is, the status (root, branch, or leaf) of each switch in each spanning tree instance is determined.

MST Region Configuration

Refer to "MST Region Configuration".

MSTP Operation Mode Configuration

Refer to "MSTP Operation Mode Configuration".

Timeout Time Factor Configuration

Refer to "Timeout Time Factor Configuration".

Maximum Transmitting Speed Configuration

Refer to "Maximum Transmitting Speed Configuration".

Edge Port Configuration

Refer to "Edge Port Configuration".

Path Cost Configuration

The path cost parameters reflects the link rates on ports. For a port on an MSTP-enabled switch, the path cost may differ with spanning tree instance. You can enable flows of different VLANs to travel along different physical links by configuring appropriate path costs on ports, so that load balancing can be achieved by VLANs.

The switch can automatically calculate the path costs of ports, but you can also manually configure them.

Standards for calculating path costs of ports

Currently, a switch can calculate the path costs of ports based on one of the following standards:

- **dot1d-1998**: Adopts the IEEE 802.1D-1998 standard to calculate the default path costs of ports.
- **dot1t**: Adopts the IEEE 802.1t standard to calculate the default path costs of ports.
- **legacy**: Adopts the standard defined by 3Com to calculate the default path costs of ports.

Table 103 Specify the standard for calculating path costs

Operation	Command	Description
Enter system view	system-view	—
Specify the standard to be used to calculate the default path costs of the links connected to the switch	**stp pathcost-standard** { **dot1d-1998** | **dot1t** | **legacy** }	Optional By default, the legacy standard is used to calculate the default path costs of ports.

Table 104 Transmission speeds and the corresponding path costs

Transmission speed	Operation mode (half-/full-duplex)	802.1D-1998	IEEE 802.1t	Standard defined by 3Com
0	—	65,535	200,000,000	200,000
10 Mbps	Half-duplex	100	2,000,000	2,000
	Full-duplex	99	1,999,999	2,000
	Aggregated link 2 ports	95	1,000,000	1,800
	Aggregated link 3 ports	95	666,666	1,600
	Aggregated link 4 ports	95	500,000	1,400
100 Mbps	Half-duplex	19	200,000	200
	Full-duplex	18	199,999	200
	Aggregated link 2 ports	15	100,000	180
	Aggregated link 3 ports	15	66,666	160
	Aggregated link 4 ports	15	50,000	140
1,000 Mbps	Full-duplex	4	20,000	20
	Aggregated link 2 ports	3	10,000	18
	Aggregated link 3 ports	3	6,666	16
	Aggregated link 4 ports	3	5,000	14

Table 104 Transmission speeds and the corresponding path costs (Continued)

Transmission speed	**Operation mode (half-/full-duplex)**	**802.1D-1998**	**IEEE 802.1t**	**Standard defined by 3Com**
10 Gbps	Full-duplex	2	2,000	2
	Aggregated link 2 ports	1	1,000	1
	Aggregated link 3 ports	1	666	1
	Aggregated link 4 ports	1	500	1

Normally, the path cost of a port operating in full-duplex mode is slightly less than that of the port operating in half-duplex mode.

When calculating the path cost of an aggregated link, the 802.1D-1998 standard does not take the number of the ports on the aggregated link into account, whereas the 802.1T standard does. The following formula is used to calculate the path cost of an aggregated link:

Path cost = 200,000,000 / link transmission speed

Here the link transmission speed is the sum of the speeds of the unblocked ports on the aggregated link, which is measured in 100 Kbps.

Configuring the path costs of ports

Table 105 Configure the path cost for specified ports in system view

Operation	**Command**	**Description**
Enter system view	system-view	—
Configure the path cost for specified ports	**stp interface** *interface-list* [**instance** instance-id] **cost** *cost*	Required A MSTP-enabled switch can calculate path costs for all its ports automatically.

Table 106 Configure the path cost for a port in Ethernet port view

Operation	**Command**	**Description**
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure the path cost for the port	**stp** [**instance** *instance-id*] **cost** *cost*	Required A MSTP-enabled switch can calculate path costs for all its ports automatically.

Changing the path cost of a port may change the role of the port and put it in state transition. If you execute the **stp cost** command with the *instance-id* argument being 0, the path cost you set is for the CIST.

Configuration example (A)

1 Configure the path cost of GigabitEthernet1/0/1 port in spanning tree instance 1 to be 2,000.

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 instance 1 cost 2000
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp instance 1 cost 2000
```

Configuration example (B)

1 Change the path cost of GigabitEthernet1/0/1 port in spanning tree instance 1 to the default one calculated with the IEEE 802.1D-1998 standard.

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] undo stp interface GigabitEthernet1/0/1 instance 1 cost
[4200G] stp pathcost-standard dot1d-1998
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] undo stp instance 1 cost
[4200G-GigabitEthernet1/0/1] quit
[4200G] stp pathcost-standard dot1d-1998
```

Port Priority Configuration

Port priority is an important criterion on determining the root port. In the same condition, a port with higher port priority is more potential to become the root port than another port with lower priority.

A port on a MSTP-enabled switch can have different port priorities and play different roles in different spanning tree instances. This enables packets of different VLANs to be forwarded along different physical paths, so that load balancing can be achieved by VLANs.

You can configure port priority in the following two ways.

Configuring port priority in system view

Table 107 Configure port priority for specified ports in system view

Operation	Command	Description
Enter system view	system-view	—
Configure port priority for specified ports	**stp interface** *interface-list* **instance** *instance-id* **port priority** *priority*	Required The default port priority is 128.

Configuring port priority in Ethernet port view

Table 108 Configure port priority for a specified port in Ethernet port view

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure port priority for the port	**stp** [**instance** *instance-id*] **port priority** *priority*	Required. The default port priority is 128.

Changing port priority of a port may change the role of the port and put the port into state transition.

A lower port priority value indicates a higher port priority. If all the ports of a switch have the same port priority value, the port priorities are determined by the port indexes. Changing the priority of a port will cause spanning tree regeneration.

You can configure port priorities according to actual networking requirements.

Configuration example

1 Configure the port priority of GigabitEthernet1/0/1 port in spanning tree instance 1 to be 16.

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 instance 1 port priority 16
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp instance 1 port priority 16
```

Point-to-point Link-Related Configuration

Refer to “Point-to-point Link-Related Configuration”.

MSTP Configuration

Refer to “MSTP Configuration”.

The mCheck Configuration

As mentioned previously, ports on an MSTP-enabled switch can operate in three modes: STP, RSTP, and MSTP. A port on an MSTP-enabled switch automatically toggles to the STP/RSTP mode when an STP-/RSTP-enabled switch is connected to it. But when the STP-/RSTP-enabled switch is disconnected from the port, the port cannot automatically toggle back to the MSTP mode and still remains in the STP/RSTP mode.

In this case, you can force the port to toggle to the MSTP mode by performing the mCheck operation on the port.

Prerequisites

MSTP runs normally on the switch.

Configuration Procedure

You can perform the mCheck operation in the following two ways.

Performing the mCheck operation in system view

Table 109 Perform the mCheck operation in system view

Operation	Command	Description
Enter system view	System-view	—
Perform the mCheck operation	**stp** [**interface** *interface-list*] **mcheck**	Required

Performing the mCheck operation in Ethernet port view

Table 110 Perform the mCheck operation in Ethernet port view

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Perform the mCheck operation	stp mcheck	Required

CAUTION: *The* ***stp mcheck*** *command takes effect only when the switch operate in MSTP mode, and does not take effect when the switch operates in STP/RSTP mode.)*

Configuration Example

1 Perform the mCheck operation on GigabitEthernet1/0/1 port (assuming that the switch operates in MSTP mode and the port operates in the STP/RSTP mode).

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 mcheck
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp mcheck
```

Protection Function Configuration

Introduction

The following protection functions are provided on MSTP-enabled switches: BPDU protection, root protection, loop prevention, and TC-BPDU attack prevention.

BPDU protection

Normally, the access ports of the devices operating on the access layer directly connect to terminals (such as PCs) or file servers. These ports are usually configured as edge ports to achieve rapid transition. But they resume non-edge ports automatically upon receiving configuration BPDUs, which causes spanning tree regeneration and network topology jitter.

Normally, no configuration BPDU will reach edge ports. But malicious users can attack a network by sending configuration BPDUs deliberately to edge ports to cause network jitter. You can prevent this type of attacks by utilizing the BPDU protection function. With this function enabled on a switch, the switch shuts down the edge ports that receive configuration BPDUs and then reports these cases to the administrator. If a port is shut down, only the administrator can restore it.

Root protection

A root bridge and its secondary root bridges must reside in the same region. A CIST and its secondary root bridges are usually located in the high-bandwidth core region. Configuration errors or attacks may result in configuration BPDUs with their priorities higher than that of a root bridge, which causes new root bridge to be elected and network topology jitter to occur. In this case, flows that should travel along high-speed links may be led to low-speed links, and network congestion may occur.

You can avoid this by utilizing the root protection function. Ports with this function enabled can only be kept as designated ports in all spanning tree instances. When a port of this type receives configuration BPDUs with higher priorities, it changes to discarding state (rather than becomes a non-designated port) and stops forwarding packets (as if it is disconnected from the link). It resumes the normal state if it does not receive any configuration BPDUs with higher priorities for a specified period.

Loop prevention

A switch maintains the states of the root port and other blocked ports by receiving and processing BPDUs from the upstream switch. These BPDUs may get lost because of network congestions and link failures. If a switch does not receive BPDUs from the upstream switch for certain period, the switch selects a new root port; the original root port becomes a designated port; and the blocked ports transit to forwarding state. This may cause loops in the network.

The loop prevention function suppresses loops. With this function enabled, a root port does not gives up its position and blocked ports remain in discarding state (do not forward packets), and thereby loops can be prevented.

TC-BPDU attack prevention

A switch removes MAC address entries and ARP entries upon receiving TC-BPDUs. If a malicious user sends a large amount of TC-BPDUs to a switch in a short period, the switch may busy itself in removing MAC address entries and ARP entries, which may decreases the performance and stability of the switch.

With the TC-BPDU prevention function enabled, the switch performs only one removing operation in a specified period (it is 10 seconds by default) after it receives a TC-BPDU. The switch also checks to see if other TC-BPDUs arrive in this period and performs another removing operation in the next period if a TC-BPDU is received. Such a mechanism prevents a switch from busying itself in performing removing operations.

CAUTION: *Among loop prevention function, root protection function, and edge port setting, only one can be valid on the same port.*

Prerequisites MSTP runs normally on the switch.

BPDU Protection Configuration

Configuration procedure

Table 111 Enable the BPDU protection function

Operation	Command	Description
Enter system view	system-view	—
Enable the BPDU protection function	stp bpdu-protection	Required The BPDU protection function is disabled by default.

Configuration example

Enable the BPDU protection function.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp bpdu-protection
```

Root Protection Configuration

Enabling the root protection function in system view

Table 112 Enable the root protection function in system view

Operation	Command	Description
Enter system view	system-view	—
Enable the root protection function on specified ports	**stp interface** *interface-list* **root-protection**	Required The root protection function is disabled by default.

Enabling the root protection function in Ethernet port view

Table 113 Enable the root protection function in Ethernet port view

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**Interface** *interface-type interface-number*	—
Enable the root protection function on current port	stp root-protection	Required The root protection function is disabled by default.

Configuration example

Enable the root protection function on GigabitEthernet1/0/1 port.

- Configure in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp interface GigabitEthernet1/0/1 root-protection
```

- Configure in Ethernet port view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp root-protection
```

Loop Prevention Configuration

You can configure the loop prevention function in the following two ways.

Enabling the loop prevention function on specified ports in system view

Table 114 Enable the loop prevention function on specified ports in system view

Operation	Command	Description
Enter system view	system-view	—
Enable the loop prevention function on specified ports	**stp interface** *interface-list* **loop-protection**	Required By default, the loop prevention function is disabled.

Enabling the loop prevention function on a port in Ethernet port view

Table 115 Enable the loop prevention function on a port in Ethernet port view

Operation	Command	Description
Enter system view	system-view	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable the loop prevention function on the current port	stp loop-protection	Required The loop prevention function is disabled by default.

Configuration example

Enable loop prevention function on GigabitEthernet1/0/1 port.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] stp loop-protection
```

TC-BPDU Attack Prevention Configuration

Configuration procedure

Table 116 Enable the TC-BPDU attack prevention function

Operation	Command	Description
Enter system view	system-view	—
Enable the TC-BPDU attack prevention function	stp tc-protection enable	Required The TC-BPDU attack prevention function is enabled by default.

Configuration example

Enable the TC-BPDU attack prevention function

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp tc-protection enable
```

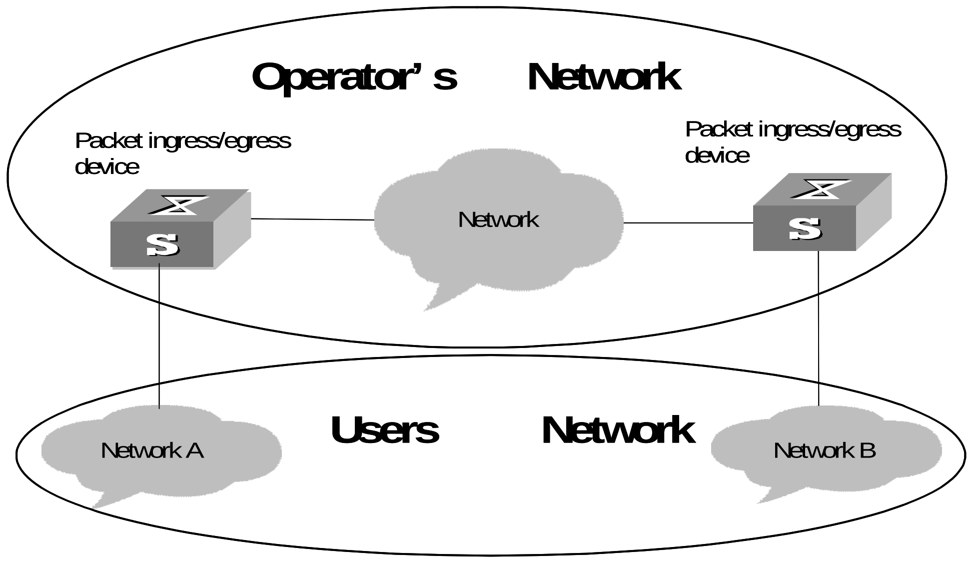
BPDU Tunnel Configuration

Introduction

The BPDU Tunnel function enables BPDUs to be transparently transmitted between geographically dispersed user networks through specified VLAN VPNs in operator’s networks, through which spanning trees can be generated across these user networks and are independent of those of the operator’s network.

As shown in Figure 38, the upper part is the operator's network, and the lower part is the user network. The operator's network comprises packet ingress/egress devices, and the user network has networks A and B. On the operator's network, configure the arriving BPDU packets at the ingress to have MAC addresses in a special format, and reconvert them back to their original formats at the egress. This is how transparent transmission is implemented on the operator's network.

Figure 38 BPDU Tunnel network hierarchy



BPDU Tunnel Configuration

Table 117 Configure the BPDU Tunnel function

Operation	Command	Description
Enter system view	**system-view**	-
Enable MSTP globally	stp enable	-
Enable the BPDU Tunnel function globally	vlan-vpn tunnel	Required
Enter Ethernet port view	**interface** *interface-type interface-number*	Make sure that you enter the Ethernet port view of the port for which you want to enable the BPDU Tunnel function.
Disable MSTP for the port	stp disable	-
Enable the VLAN VPN function for the Ethernet port	**vlan-vpn enable**	Required By default, the VLAN VPN function is disabled on all ports.

- The BPDU Tunnel function can only be enabled on devices with STP employed.
- The BPDU Tunnel function can only be enabled on access ports.
- To enable the BPDU Tunnel function, make sure the links between operator's networks are trunk links.
- As the VLAN-VPN function is unavailable on ports with 802.1x, GVRP, GMRP, STP, or NTDP employed, the BPDU Tunnel function is not applicable to these ports.

Digest Snooping Configuration

Introduction

According to IEEE 802.1s, two interconnected MSTP switches can interwork with each other through MSTIs in an MST region only when the two switches have the same MST region-related configuration. Interconnected MSTP switches determine whether or not they are in the same MST region by checking the configuration IDs of the BPDUs between them. (A configuration ID contains information such as region ID and configuration digest.)

As some partners' switches adopt proprietary spanning tree protocols, they cannot interwork with other switches in an MST region even if they are configured with the same MST region-related settings as other switches in the MST region.

This problem can be overcome by implementing the digest snooping feature. If a port on a S4200G series switch is connected to a partner's switch that has the same MST region-related configuration as its own but adopts a proprietary spanning tree protocol, you can enable digest snooping on the port. Then the S4200G series switch regards the partner's switch as in the same region; it records the configuration digests carried in the BPDUs received from the partner's switch, and put them in the BPDUs to be send to the partner's switch.. In this way, the S4200G series switches can interwork with the partners' switches in the same MST region.

Digest Snooping Configuration

Configure the digest snooping feature on a switch to enable it to interwork with other switches that adopt proprietary protocols to calculate configuration digests in the same MST region through MSTIs.

Prerequisites

The switch to be configured is connected to a partner's switch that adopts a proprietary spanning tree protocol. The MSTP network operates normally.

Configuration procedure

Table 118 Configure the digest snooping feature

Operation	Command	Description
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable the digest snooping feature	**stp config-digest-snooping**	Required The digest snooping feature is disabled on the port by default.
Return to system view	**Quit**	—
Enable the digest snooping feature globally	**stp config-digest-snooping**	Required The digest snooping feature is disabled globally by default.
Verify the above configuration	**display current-configuration**	You can execute this command in any view.

- The digest snooping feature is needed only when your S4200G series switch is connected to partner's proprietary protocol-adopted switches.
- To enable the digest snooping feature successfully, you must first enable it on all the ports of your S4200G series switch that are connected to partner's proprietary protocol-adopted switches and then enable it globally.

- To enable the digest snooping feature, the interconnected switches must be configured with exactly the same MST region-related configuration.
- The digest snooping feature must be enabled on all the ports of your S4200G switch that are connected to partners' proprietary protocol-adopted switches in the same MST region..
- To change MST region-related configuration, be sure to disable the digest snooping feature first to prevent possible broadcast storms.

Rapid Transition Configuration

Introduction

Designated ports on switches adopting RSTP or MSTP use the following two types of packets to implement rapid transition:

- Proposal packets: Packets sent by designated ports to request rapid transition
- Agreement packets: Packets used to acknowledge rapid transition requests

Both RSTP and MSTP switches can perform rapid transition operation on a designated port only when the port receives an agreement packet from the downstream switch. The difference between RSTP and MSTP switches are:

- An MSTP upstream switch sends agreement packets to the downstream switch; and an MSTP downstream switch sends an agreement packet to the upstream switch only after it receives an agreement packet from the upstream switch.
- A RSTP upstream switch does not send agreement packets to the downstream switch.

Figure 39 and Figure 40 illustrate the RSTP and MSTP rapid transition mechanisms.

Figure 39 The RSTP rapid transition mechanism

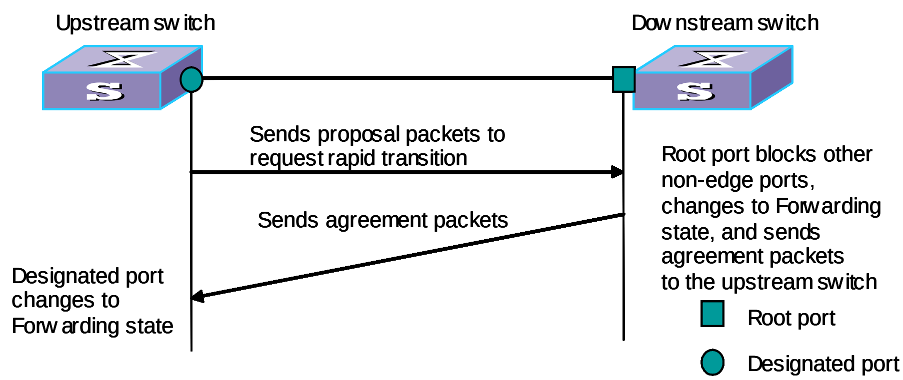
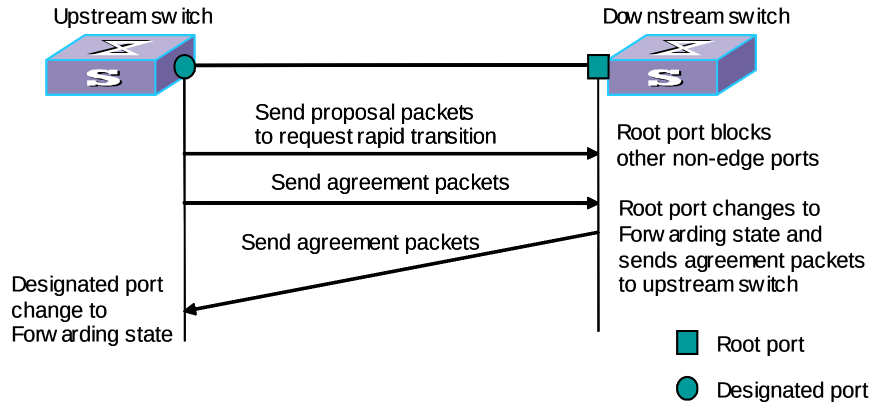


Figure 40 The MSTP rapid transition mechanism



Limitation on the combination of RSTP and MSTP exists to implement rapid transition. For example, when the upstream switch adopts RSTP, the downstream switch adopts MSTP and does not support RSTP mode, the root port on the downstream switch receives no agreement packet from the upstream switch and thus sends no agreement packets to the upstream switch. As a result, the designated port of the upstream switch fails to transit rapidly and can only change to the Forwarding state after a period twice the Forward Delay.

Some partners' switches adopt proprietary spanning tree protocols that are similar to RSTP in the way to implement rapid transition on designated ports. When a switch of this kind operates as the upstream switch of an S4200G series switch running MSTP, the upstream designated port fails to change their states rapidly.

The rapid transition feature is developed to resolve this problem. When an S4200G series switch running MSTP is connected in the upstream direction to a partner's switch running proprietary spanning tree protocol, you can enable the rapid transition feature on the ports of the S4200G series switch operating as the downstream switch. Among these ports, those operating as the root ports will then send agreement packets to their upstream ports after they receive proposal packets from the upstream designated ports, instead of waiting for agreement packets from the upstream switch. This enables designated ports of the upstream switch to change their states rapidly.

Rapid Transition Configuration

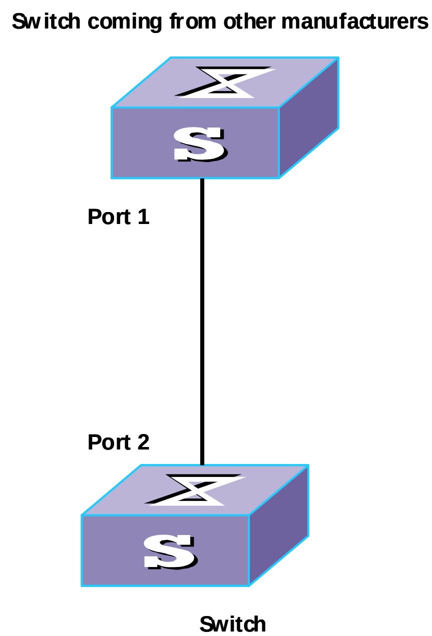
Prerequisites

As shown in Figure 41, an S4200G series switch is connected to a partner's switch. The former operates as the downstream switch, and the latter operates as the upstream switch. The network operates normally.

The upstream switch is running a proprietary spanning tree protocol that is similar to RSTP in the way to implement rapid transition on designated ports. Port 1 is a designated port.

The downstream switch is running MSTP. Port 2 is the root port.

Figure 41 Network diagram for rapid transition configuration



Configuration procedure

Table 119 Configure the rapid transition feature in system view

Operation	Command	Description
Enter system view	**system-view**	—
Enable the rapid transition feature	**stp interface** *interface-type interface-number* **no-agreement-check**	Required By default, the rapid transition feature is disabled on a port.

- Configure in Ethernet port view.

Table 120 Configure the rapid transition feature in Ethernet port view

Operation	Command	Description
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable the rapid transition feature	**stp no-agreement-check**	Required By default, the rapid transition feature is disabled on a port.

Enable the rapid transition feature on root ports or alternate ports only.

MSTP Displaying and Debugging

You can verify the above configurations by executing the **display** commands in any view.

Execute the **reset** command in user view to clear MSTP statistics. Execute the **debugging** command in user view to debug the MSTP module.

Table 121 Display and debug MSTP

Operation	Command
Display spanning tree-related information about the current switch	**display stp** [**instance** *instance-id* **]** [**interface** *interface-list* **|** **slot** *slot-number*] [**brief**]
Display region configuration	display stp region-configuration
Clear MSTP-related statistics	**reset stp** [**interface** *interface-list*]

MSTP Implementation Example

Network requirements

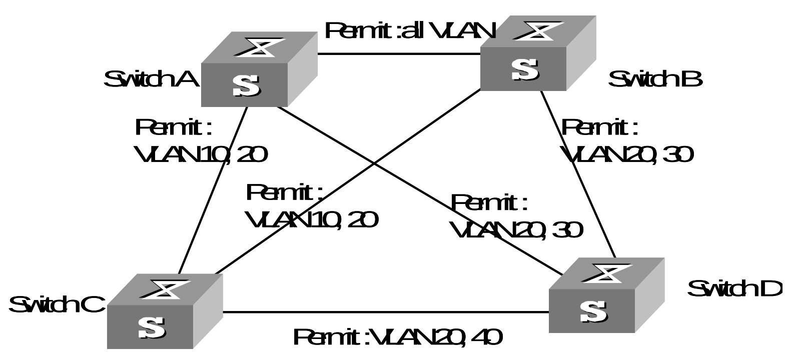
Implement MSTP in the network shown in Figure 42 to enable packets of different VLANs to be forwarded along different spanning tree instances. The detailed configurations are as follows:

- All switches in the network belong to the same MST region.
- Packets of VLAN 10, VLAN 30, VLAN 40, and VLAN 20 are forwarded along spanning tree instance 1, instance 3, instance 4, and instance 0 respectively.

In this network, Switch A and Switch B operate on the distribution layer; Switch C and Switch D operate on the access layer. VLAN 10 and VLAN 30 are limited in the distribution layer and VLAN 40 is limited in the access layer. Switch A and Switch B are configured as the root bridges of spanning tree instance 1 and spanning tree instance 3 respectively. Switch C is configured as the root bridge of spanning tree instance 4.

Network diagram

Figure 42 Network diagram for implementing MSTP



The Permit: shown in Figure 42 means the corresponding link permits packets of specific VLANs.

Configuration procedure

1 Configure Switch A.

a Enter MST region view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp region-configuration
```

b Configure the MST region.

```
[4200G-mst-region] region-name example
[4200G-mst-region] instance 1 vlan 10
[4200G-mst-region] instance 3 vlan 30
[4200G-mst-region] instance 4 vlan 40
[4200G-mst-region] revision-level 0
```

c Activate the settings of the MST region.

```
[4200G-mst-region] active region-configuration
```

d Specify Switch A as the root bridge of spanning tree instance 1.

```
[4200G] stp instance 1 root primary
```

2 Configure Switch B.

a Enter MST region view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp region-configuration
```

b Configure the MST region.

```
[4200G-mst-region] region-name example
[4200G-mst-region] instance 1 vlan 10
[4200G-mst-region] instance 3 vlan 30
[4200G-mst-region] instance 4 vlan 40
[4200G-mst-region] revision-level 0
```

c Activate the settings of the MST region.

```
[4200G-mst-region] active region-configuration
```

d Specify Switch B as the root bridge of spanning tree instance 3.

```
[4200G] stp instance 3 root primary
```

3 Configure Switch C.

a Enter MST region view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp region-configuration
```

b Configure the MST region.

```
[4200G-mst-region] region-name example
[4200G-mst-region] instance 1 vlan 10
[4200G-mst-region] instance 3 vlan 30
[4200G-mst-region] instance 4 vlan 40
[4200G-mst-region] revision-level 0
```

a Activate the settings of the MST region.

```
[4200G-mst-region] active region-configuration
```

b Specify Switch C as the root bridge of spanning tree instance 4.

```
[4200G] stp instance 4 root primary
```

4 Configure Switch D.

a Enter MST region view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] stp region-configuration
```

b Configure the MST region.

```
[4200G-mst-region] region-name example
[4200G-mst-region] instance 1 vlan 10
[4200G-mst-region] instance 3 vlan 30
[4200G-mst-region] instance 4 vlan 40
[4200G-mst-region] revision-level 0
```

c Activate the settings of the MST region.

```
[4200G-mst-region] active region-configuration
```

21 802.1X CONFIGURATION

Introduction to 802.1x

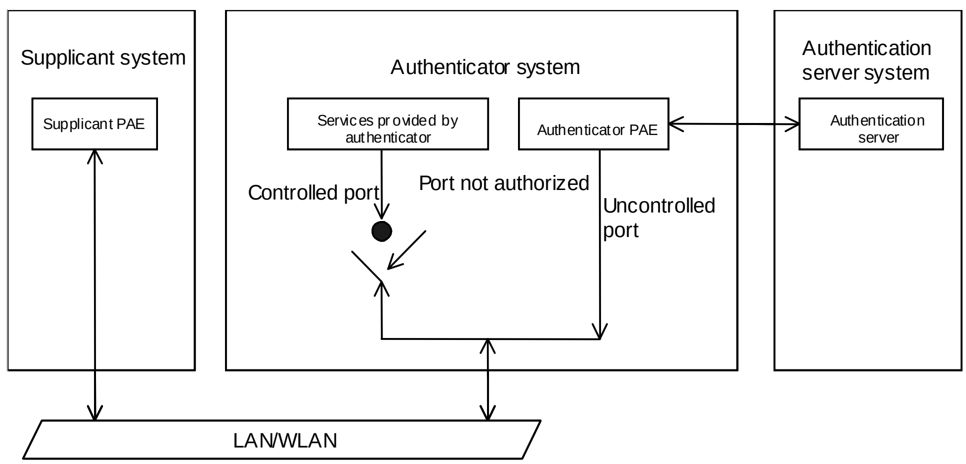
The 802.1x protocol (802.1x for short) was developed by IEEE802 LAN/WAN committee to address security issues of wireless LANs. It was then used in Ethernet as a common access control mechanism for LAN ports to address mainly authentication and security problems.

802.1x is a port-based network access control protocol. It authenticates and controls devices requesting for access in terms of the ports of LAN access control devices. With the 802.1x protocol employed, a user-side device can access the LAN only when it passes the authentication. Those failing to pass the authentication are denied when accessing the LAN, as if they are disconnected from the LAN.

Architecture of 802.1x Authentication

802.1x adopts a client/server architecture with three entities: a supplicant system, an authenticator system, and an authentication server system, as shown in Figure 43.

Figure 43 Architecture of 802.1x authentication



- The supplicant system is an entity residing at one end of the LAN segment and is authenticated by the authenticator system connected to the other end of the LAN segment. The supplicant system is usually a user terminal device. An 802.1x authentication is initiated when a user launches client program on the supplicant system. Note that the client program must support the EAPoL (extensible authentication protocol over LANs).
- The authenticator system authenticates the supplicant system. The authenticator system is usually an 802.1x-supported network device (such as a S4200G series switch). It provides the port (physical or logical) for the supplicant system to access the LAN.
- The authentication server system is an entity that provides authentication service to the authenticator system. Normally in the form of a RADIUS server, the authentication server system serves to perform AAA (authentication, authorization, and accounting) . It also stores user information, such as user name, password, the VLAN a user belongs to, priority, and the ACLs (access control list) applied.

PAE

A PAE (port access entity) is responsible for the implementation of algorithm and protocol-related operations in the authentication mechanism.

The authenticator system PAE authenticates the supplicant systems when they log into the LAN and controls the authorizing state (on/off) of the controlled ports according to the authentication result.

The supplicant system PAE responds to the authentication requests received from the authenticator system and submits user authentication information to the authenticator system. It can also send authentication and disconnection requests to the authenticator system PAE.

Controlled port and uncontrolled port

The Authenticator system provides ports for supplicant systems to access a LAN. A port of this kind is divided into a controlled port and an uncontrolled port.

- The uncontrolled port can always send and receive packets. It mainly serves to forward EAPoL packets to ensure that a supplicant system can send and receive authentication requests.
- The controlled port can be used to pass service packets when it is in authorized state. It is blocked when not in authorized state. In this case, no packets can pass through it.
- Controlled port and uncontrolled port are two properties of a access port. Packets reaching an access port are visible to both the controlled port and uncontrolled port of the access port.

The valid direction of a controlled port

When a controlled port is in unauthorized state, you can configure it to be a unidirectional port, which sends packets to supplicant systems only.

By default, a controlled port is a unidirectional port.

IV. The way a port is controlled

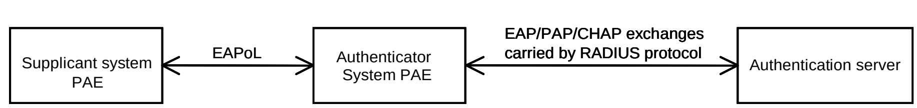
A port of a S4200G series switch can be controlled in the following two ways.

- Port-based authentication. When a port is controlled in this way, all the supplicant systems connected to the port can access the network without being authenticated after one supplicant system among them passes the authentication. And when the authenticated supplicant system goes offline, the others are denied as well.
- MAC address-based authentication. All supplicant systems connected to a port have to be authenticated individually in order to access the network. And when a supplicant system goes offline, the others are not affected.

The Mechanism of an 802.1x Authentication System

IEEE 802.1x authentication system uses extensible authentication protocol (EAP) to exchange information between the supplicant system and the authentication server.

Figure 44 The mechanism of an 802.1x authentication system



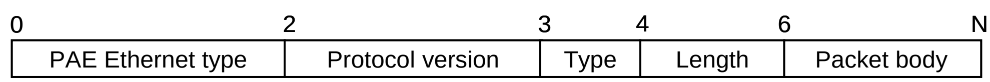
- EAP protocol packets transmitted between the supplicant system and the authenticator system are encapsulated as EAPoL packets.
- EAP protocol packets transmitted between the supplicant system PAE and the RADIUS server can either be encapsulated as EAPoR (EAP over RADIUS) packets or be terminated at system PAEs (The system PAEs then communicate with RADIUS servers through PAP (password authentication protocol) or CHAP (challenge-handshake authentication protocol) protocol packets.)
- When a supplicant system passes the authentication, the authentication server passes the information about the supplicant system to the authenticator system. The authenticator system in turn determines the state (authorized or unauthorized) of the controlled port according to the instructions (accept or reject) received from the RADIUS server.

Encapsulation of EAPoL Messages

The format of an EAPoL packet

EAPoL is a packet encapsulation format defined in 802.1x. To enable EAP protocol packets to be transmitted between supplicant systems and authenticator systems through LANs, EAP protocol packets are encapsulated in EAPoL format. Figure 45 illustrates the structure of an EAPoL packet.

Figure 45 The format of an EAPoL packet



In an EAPoL packet:

- The PAE Ethernet type field holds the protocol identifier. The identifier for 802.1x is 888E.
- The Protocol version field holds the version of the protocol supported by the sender of the EAPoL packet.
- The Type field can be one of the following:

  00: Indicates that the packet is an EAP-packet, which carries authentication information.

  01: Indicates that the packet is an EAPoL-start packet, which initiates authentication.

  02: Indicates that the packet is an EAPoL-logoff packet, which sends logging off requests.

  03: Indicates that the packet is an EAPoL-key packet, which carries key information packets.

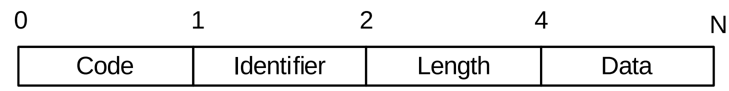
  04: Indicates that the packet is an EAPoL-encapsulated-ASF-Alert packet, which is used to support the alerting messages of ASF (alert standard forum).
- The Length field indicates the size of the Packet body field. A value of 0 indicates that the Packet Body field does not exist.
- The Packet body field differs with the Type field.

Note that EAPoL-Start, EAPoL-Logoff, and EAPoL-Key packets are only transmitted between the supplicant system and the authenticator system. EAP-packets are encapsulated by RADIUS protocol to allow them successfully reach the authentication servers. Network management-related information (such as alarming information) is encapsulated in EAPoL-Encapsulated-ASF-Alert packets, which are terminated by authenticator systems.

The format of an EAP packet

For an EAPoL packet with the Type value being EAP-packet, the corresponding Packet body is an EAP packet. Its format is illustrated in Figure 46.

Figure 46 The format of an EAP packet

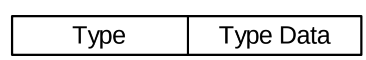


In an EAP packet:

- The Code field specifies the EAP packet type, which can be Request, Response, Success, or Failure.
- The Identifier field is used to match a Response packets with the corresponding Request packet.
- The Length field indicates the size of an EAP packet, which includes the Code, Identifier, Length, and Data fields.
- The Data field differs with the Code field.

A Success or Failure packet, whose format is shown in Figure 47, does not contain the Data field, so has the Length field of 4.

Figure 47 Data fields



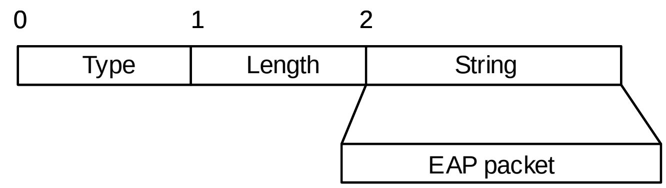
In a Success or Failure packet, the Type field specifies the EAP authentication type. A Type value of 1 indicates Identity and that the packet is used to query the identity of the peer. A type value of 4 represents MD5-Challenge (similar to PPP CHAP) and indicates that the packet includes query information.

Newly added fields for EAP authentication

Two fields, EAP-message and Message-authenticator, are added to a RADIUS protocol packet for EAP authentication. (Refer to the Introduction to RADIUS protocol section in the *AAA and RADIUS Operation Manual* for format of a RADIUS protocol packet.)

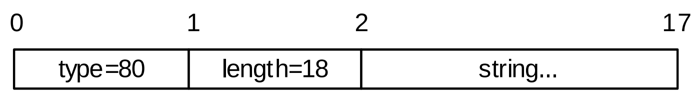
The EAP-message field, shown in Figure 48, is used to encapsulate EAP packets. The maximum size of the string field is 253 bytes. EAP packets with their size larger than 253 bytes are fragmented and stored in multiple EAP-message fields. The type code of the EAP-message field is 79.

Figure 48 The format of an EAP-message field



The Message-authenticator field, as shown in Figure 49, is used to prevent unauthorized interception of access requesting packets during authentications using CHAP, EAP, and so on. A packet with the EAP-message field must also have the Message-authenticator field, otherwise the packet is regarded as invalid and is discarded.

Figure 49 The format of an Message-authenticator field



802.1x Authentication Procedure

An S4200G series switch can authenticate supplicant systems in EAP terminating mode or EAP relay mode.

EAP relay mode

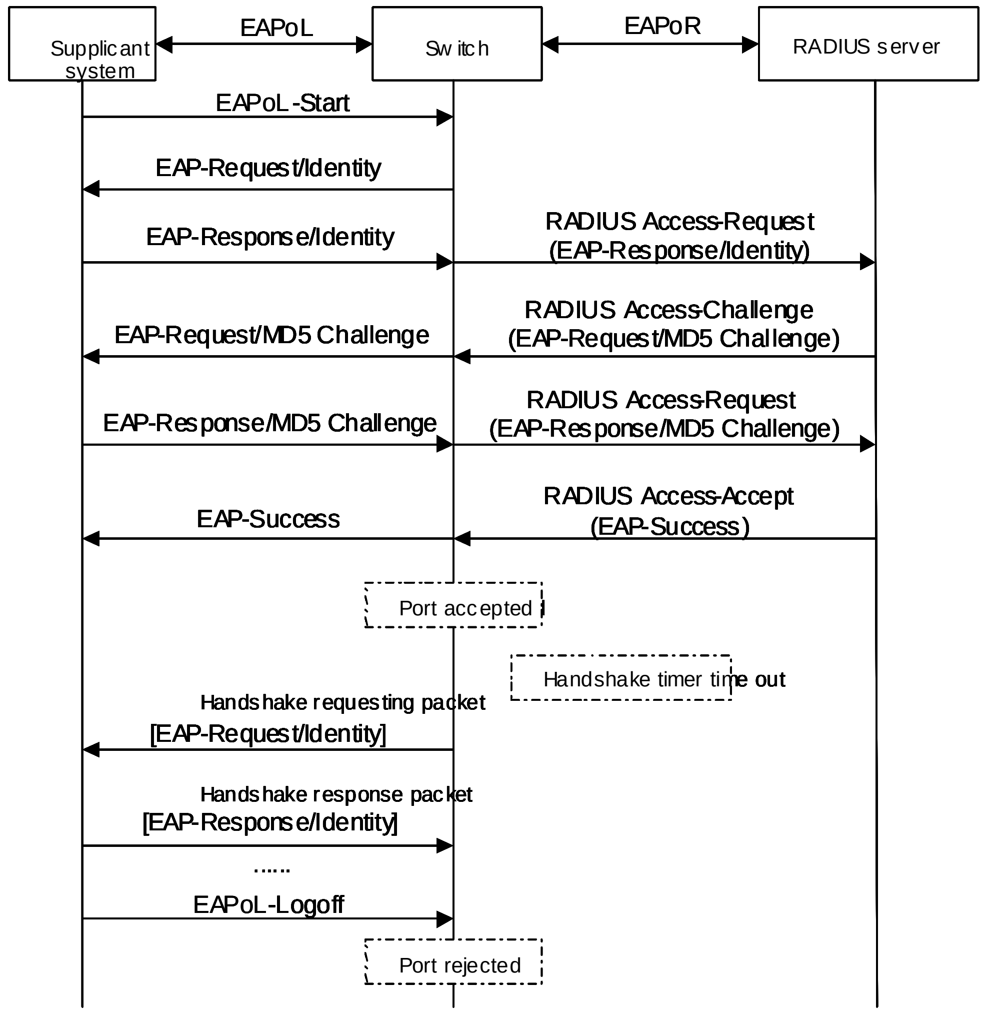
This mode is defined in 802.1x. In this mode, EAP-packets are encapsulated in higher level protocol (such as EAPoR) packets to allow them successfully reach the authentication server. This mode normally requires the RADIUS server to support the two newly-added fields: the EAP-message field (with a value of 79) and the Message-authenticator field (with a value of 80).

Three authentication ways, EAP-MD5, EAP-TLS (transport layer security), and PEAP (protected extensible authentication protocol), are available for the EAP relay mode.

- EAP-MD5 authenticates the supplicant system. The RADIUS server sends MD5 keys (contained in EAP-request/MD5 challenge packets) to the supplicant system, which in turn encrypts the passwords using the MD5 keys.
- EAP-TLS authenticates both the supplicant system and the RADIUS server by checking their security licenses to prevent data from being stolen.
- PEAP creates and uses TLS security channels to ensure data integrity and then performs new EAP negotiations to verify supplicant systems.

Figure 50 describes the basic EAP-MD5 authentication procedure.

Figure 50 802.1x authentication procedure (in EAP relay mode)



The detailed procedure is as follows.

- A supplicant system launches an 802.1x client to initiate an access request through the sending of an EAPoL-start packet to the switch, with its user name and password provided. The 802.1x client program then forwards the packet to the switch to start the authentication process.
- Upon receiving the authentication request packet, the switch sends an EAP-request/identity packet to ask the 802.1x client for the user name.
- The 802.1x program responds by sending an EAP-response/identity packet to the switch with the user name included. The switch then encapsulates the packet in a RADIUS Access-Request packet and forwards it to the RADIUS server.
- Upon receiving the user name from the switch, the RADIUS server retrieves the user name, finds the corresponding password by matching the user name in its database, encrypts the password using a randomly-generated key, and sends the key to the switch through an RADIUS access-challenge packet. The switch then sends the key to the 802.1x client.
- Upon receiving the key (encapsulated in an EAP-request/MD5 challenge packet) from the switch, the client program encrypts the password of the supplicant system with the key and sends the encrypted password (contained in an EAP-response/MD5 challenge packet) to the RADIUS server through the switch. (The encryption is irreversible.)

- The RADIUS server compares the received encrypted password (contained in a RADIUS access-request packet) with the locally-encrypted password. If the two match, it will then send feedbacks (through a RADIUS access-accept packet and an EAP-success packet) to the switch to indicate that the supplicant system is authorized.
- The switch changes the state of the corresponding port to accepted state to allow the supplicant system access the network.
- The supplicant system can also terminate the authenticated state by sending EAPoL-Logoff packets to the switch. The switch then changes the port state from accepted to rejected.

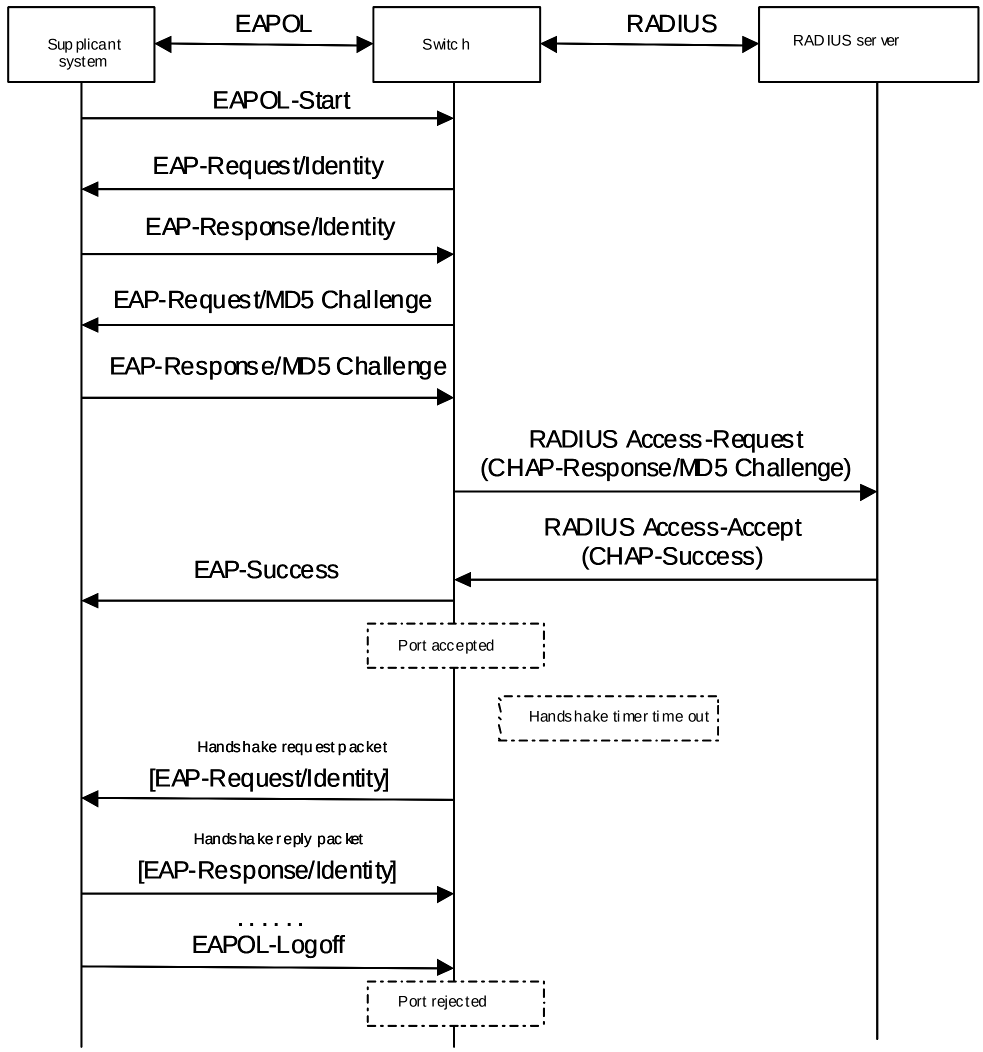
In EAP relay mode, packets are not modified during transmission. Therefore if one of the three ways are used (that is, PEAP, EAP-TLS, or EAP-MD5) to authenticate, ensure that the authenticating ways used on the supplicant system and the RADIUS server are the same. However for the switch, you can simply enable the EAP relay mode by using the ***dot1x authentication-method eap*** *command.*

EAP terminating mode

In this mode, packet transmission is terminated at authenticator systems and the EAP packets are converted to RADIUS packets. Authentication and accounting are accomplished through RADIUS protocol.

In this mode, PAP or CHAP is employed between the switch and the RADIUS server. The authentication procedure (assuming that CHAP is employed between the switch and the RADIUS server) is illustrated in Figure 51.

Figure 51 802.1x authentication procedure (in EAP terminating mode)



The authentication procedure in EAP terminating mode is the same as that in the EAP relay mode except that the randomly-generated key in the EAP terminating mode is generated by the switch, and that it is the switch that sends the user name, the randomly-generated key, and the supplicant system-encrypted password to the RADIUS server for further authentication.

802.1x Timer

In 802.1 x authentication, the following timers are used to ensure that the supplicant system, the switch, and the RADIUS server interact in an orderly way:

- Transmission timer: This timer sets the tx-period and is triggered by the switch when the switch sends a request/identity packet to a supplicant system. The switch sends another request/identity packet to the supplicant system if the supplicant system fails to send a reply packet to the switch when this timer times out.
- Supplicant system timer: This timer sets the supp-timeout period and is triggered by the switch when the switch sends a request/challenge packet to a supplicant system. The switch sends another request/challenge packet to the supplicant system if the supplicant system fails to respond when this timer times out.
- Authentication server timer: This timer sets the server-timeout period. The switch sends another authentication request packet if the authentication server fails to respond when this timer times out.

- Handshake timer (handshake-period): This timer sets the handshake-period and is triggered after a supplicant system passes the authentication. It sets the interval to for a switch to send handshake request packets to online users. If you set the number of retries to N by using the dot1x retry command, an online user is considered offline when the switch does not receive response packets from it in a period N times of the handshake-period.
- Quiet-period timer: This timer sets the quiet-period. When a supplicant system fails to pass the authentication, the switch quiets for the set period before it processes another authentication request re-initiated by the supplicant system.

802.1x Implementation on an S4200G Series Switch

In addition to the earlier mentioned 802.1x features, an S4200G series switch is also capable of the following:

- Cooperating with a CAMS server to check supplicant systems for dual-network adapters, and so on.
- Checking client version
- Implementing the Guest VLAN function

CAMS server is a service management system developed by 3Com. It can cooperate with network devices to carry out functions such as AAA and permission management. It enables a network to operate in the desired way and enables you to manage a network in a easy way. It also ensures network security.

Checking the supplicant system

An S4200G series switch checks:

- Whether or not a supplicant system logs in through more than one network cards (that is, whether or not more than one network adapters are active in a supplicant system when the supplicant system logs in).

Chekcing the client version

With the 802.1x client-version-checking function enabled, a switch will check the version and validity of an 802.1x client to prevent unauthorized users or users with earlier versions of 802.1x from logging in.

This function makes the switch to send version-requesting packets again if the 802.1x client fails to send version-reply packet to the switch before the version-checking timer times out.

The client-version-checking function needs the support of 3Com's 802.1x client program.

The Guest VLAN function

The Guest VLAN function enables supplicant systems that do not pass the authentication to access a LAN in a restrained way.

With the Guest VLAN function enabled, supplicant systems that do not have 802.1x client installed can access specific network resources. They can also upgrade their 802.1x clients without being authenticated.

With this function enabled:

- The switch broadcasts active authentication packets to all 802.1x-enabled ports.

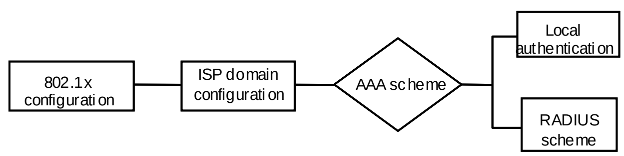
- After the maximum number of authentication retries have been made and there are still ports that have not sent any response back, the switch will then add these ports into the Guest VLAN.
- When the maximum number of authentication retries is reached, the switch adds the ports that do not return response packets to Guest VLAN.
- Users belonging to the Guest VLAN can access the resources of the Guest VLAN without being authenticated. But they need to be authenticated before accessing external resources.

Normally, the Guest VLAN function is coupled with the dynamic VLAN delivery function.

802.1x Configuration

802.1x provides a solution for authenticating users. To implement this solution, you need to execute 802.1x-related commands. You also need to configure AAA schemes on switches and to specify the authentication scheme (RADIUS authentication scheme or local authentication scheme).

Figure 52 802.1x configuration



- 802.1x users use domain names to associate with the ISP domains configured on switches
- Configure the AAA scheme (a local authentication scheme or the RADIUS scheme) to be adopted in the ISP domain.
- If you specify to use the RADIUS scheme, that is to say the supplicant systems are authenticated by a remote RADIUS server, you need to configure the related user names and passwords on the RADIUS server and perform RADIUS client-related configuration on the switches.
- If you specify to adopt a local authentication scheme, you need to configure user names and passwords manually on the switches. Users can pass the authentication through 802.1x client if they provide the user names and passwords that match with those stored in the switches.
- You can also specify to adopt RADIUS authentication scheme, with a local authentication scheme as a backup. In this case, the local authentication scheme is adopted when the RADIUS server fails.

Refer to the *AAA and RADIUS Operation Manual* for detailed information about AAA configuration.

Basic 802.1x Configuration

To utilize 802.1x features, you need to perform basic 802.1x configuration.

Prerequisites

- Configure ISP domain and its AAA scheme, specify the authentication scheme (RADIUS or a local scheme) .
- Ensure that the service type is configured as **lan-access** (by using the **service-type** command) for local authentication scheme.

Configuring Basic 802.1x Functions

Table 122 Configure basic 802.1x functions

Operation	Command	Description
Enter system view	system-view	—
Enable 802.1x globally	dot1x	Required By default, 802.1x is disabled globally.
Enable 802.1x for specified ports	Use the following command in system view: **dot1x** [**interface** *interface-list*]	Required By default, 802.1x is disabled for all ports.
	Use the following command in port view: dot1x	
Set port access control mode for specified ports	**dot1x port-control** { **authorized-force** | **unauthorized-force** | **auto** } [**interface** *interface-list*]	Optional By default, an 802.1x-enabled port operates in an **auto** mode.
Set port access method for specified ports	**dot1x port-method** { **macbased** | **portbased** } [**interface** *interface-list*]	Optional The default port access method is MAC-address-based (that is, the **macbased** keyword is used by default).
Set authentication method for 802.1x users	**dot1x authentication-method** { **chap** | **pap** | **eap }**	Optional By default, a switch performs CHAP authentication in EAP terminating mode.

CAUTION:

802.1x-related configurations can all be performed in system view. Port access control mode and port access method can also be configured in port view.

If you perform a configuration in system view and do not specify the interface-list argument, the configuration applies to all ports. Configurations performed in Ethernet port view apply to the current Ethernet port only and the interface-list argument is not needed in this case.

802.1x configurations take effect only after you enable 802.1x both globally and for specified ports.

Timer and Maximum User Number Configuration

Table 123 Configure 802.1x timers and the maximum number of users

Operation	Command	Description
Enter system view	system-view	-
Configure the maximum number of concurrent on-line users for specified ports	In system view: **dot1x max-user** *user-number* [**interface** *interface-list*]	Optional By default, up to 256 concurrent on-line users are allowed on each port.
	In port view: **dot1x max-user** *user-number*	
Configure the maximum retry times to send request packets	**dot1x retry** *max-retry-value*	Optional By default, the maximum retry times to send a request packet is 2. That is, the authenticator system sends a request packet to a supplicant system for up to two times by default.

Table 123 Configure 802.1x timers and the maximum number of users (Continued)

Operation	Command	Description
Configure 802.1x timers	**dot1x timer** { **handshake-period** *handshake-period-value* | **quiet-period** *quiet-period-value* | **tx-period** *tx-period-value* | **supp-timeout** *supp-timeout-value* | **server-timeout** *server-timeout-value* | **ver-period** *ver-period-value* }	Optional The default values of 802.1x timers are as follows: handshake-period-value: 15 seconds quiet-period-value: 60 seconds tx-period-value: 30 seconds supp-timeout-value: 30 seconds server-timeout-value: 100 seconds ver-period-value: 30 seconds
Trigger the quiet-period timer	dot1x quiet-period	Optional By default, a quiet-period timer is disabled.

As for the ***dot1x max-user*** *command, if you execute it in system view without specifying the interface-list argument, the command applies to all ports. You can also use this command in port view. In this case, this command applies to the current port only and the interface-list argument is not needed.*

As for the configuration of 802.1x timers, the default values are recommended.

Advanced 802.1x Configuration

Advanced 802.1x configurations, as listed below, are all optional.

- CAMS cooperation configuration, including multiple network adapters detecting, proxy detecting, and so on.
- Client version checking configuration
- Static IP address checking configuration
- Guest VLAN configuration

Prerequisites

Configuration of basic 802.1x

Configuring Proxy Checking

This function needs the support of 802.1x client program and CAMS, as listed below.

- The 802.1x clients must be able to check whether multiple network cards, proxy servers, or IE proxy servers are used on the user devices.
- On CAMS, enable the function that forbids clients from using multiple network cards, a proxy server, or an IE proxy.

By default, the use of multiple network cards, proxy server, and IE proxy are allowed on 802.1x client. If you specify CAMS to disable use of multiple network cards, proxy server, and IE proxy, CAMS sends messages to 802.1x client to request the latter to disable the use of multiple network cards, proxy server, and IE proxy when a user passes the authentication.

Table 124 Configure user proxy checking

Operation	Command	Description
Enter system view	system-view	—
Enable user checking and control for users logging in through proxies	**dot1x supp-proxy-check** { **logoff | trap }** [**interface** *interface-list*]	Optional

The proxy checking function needs the support of 3Com's 802.1x client program.

*The configuration listed in Table 124 takes effect only when it is performed on CAMS as well as on the switch and the client version checking function is enabled on the switch (by the **dot1x version-check** command).*

Configuring Client Version Checking

Table 125 Configure client version checking

Operation	Command	Description
Enter system view	system-view	
Enable 802.1x client version checking	**dot1x version-check** [**interface** *interface-list* **]**	Required By default, 802.1x client version checking is disabled on a port.
Configure the maximum number of retires to send version checking request packets	**dot1x retry-version-max** *max-retry-version-value*	Optional Defaults to 3.
Configure the client-version-checking period timer	**dot1x timer ver-period** *ver-period-value*	Optional The default *ver-period-value* is 30 seconds

*As for the **dot1x version-user** command, if you execute it in system view without specifying the interface-list argument, the command applies to all ports. You can also use this command in port view. In this case, this command applies to the current port only and the interface-list argument is not needed.*

Enabling DHCP-triggered Authentication

Table 126 Enable DHCP-triggered authentication

Operation	Command	Description
Enter system view	system-view	
Enable DHCP-triggered authentication	dot1x dhcp-launch	Optional By default, DHCP-triggered authentication is disabled.

Configuring Guest VLAN

Table 127 Configure Guest VLAN

Operation	Command	Description
Enter system view	system-view	
Configure port access method	**dot1x port-method** { **macbased** | **portbased** }	Optional The default port access method is MAC-address-based. That is, the **macbased** keyword is used by default.
Enable the Guest VLAN function	**dot1x guest-vlan** *vlan-id* [**interface** *interface-list*]	Required By default, the Guest VLAN function is disabled.

CAUTION:

The Guest VLAN function is available only when the switch operates in a port-based authentication mode.

Only one Guest VLAN can be configured for each switch.

Supplicant systems that are not authenticated, fail to pass the authentication, or are offline belong to Guest VLANs.

Displaying and Debugging 802.1x

You can verify the 802.1x-related configuration by executing the **display** command in any view.

You can clear 802.1x-related statistics information by executing the **reset** command in user view.

Table 128 Display and debug 802.1x

Operation	Command
Display the configuration, session, and statistics information about 802.1x.	**display dot1x** [**sessions** | **statistics]** [**interface** *interface-list*]
Clear 802.1x-related statistics information	**reset dot1x statistics** [**interface** *interface-list*]

Configuration Example

802.1x Configuration Example

Network requirements

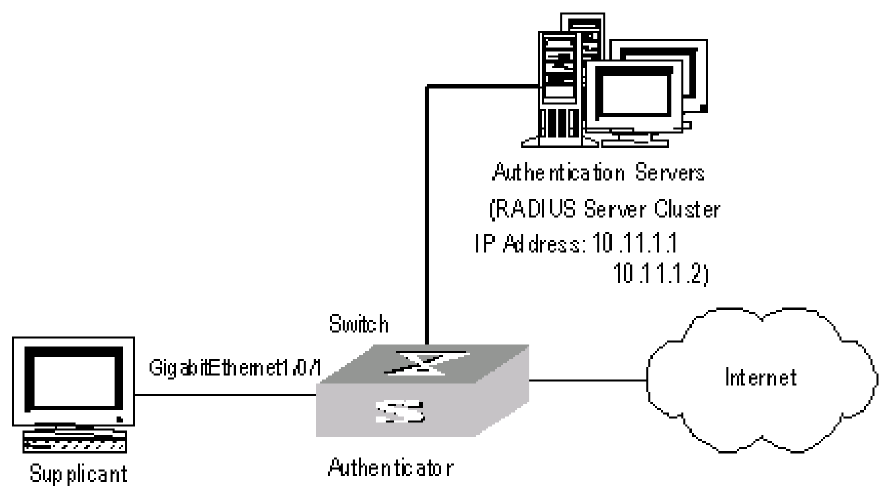
- Authenticate users on all ports to control their accesses to the Internet. The switch operates in MAC address-based access control mode. The access control mode is MAC-address-based.
- All supplicant systems that pass the authentication belong to the default domain named aabbcc.net. The domain can accommodate up to 30 users. As for authentication, a supplicant system is authenticated locally if the RADIUS server fails. And as for accounting, a supplicant system is disconnected by force if the RADIUS server fails. The name of an authenticated supplicant system is not suffixed with the domain name. A connection is terminated if the total size of the data passes through it during a period of 20 minutes is less than 2,000 bytes. All connected clients belong to the same default domain: aabbcc.net, which accommodates up to 30 clients. Authentication is performed either on the RADIUS server, or locally (in case that the RADIUS server fails to respond). A client is disconnected in one of the following two situations: RADIUS accounting fails; the connected user has not included the domain name in the username, and there is a continuous below 2000 bytes of traffic for over 20 minutes.
- The switch is connected to a server comprising of two RADIUS servers whose IP addresses are 10.11.1.1 and 10.11.1.2. The RADIUS server with an IP address of 10.11.1.1 operates as the primary authentication server and the secondary accounting server. The other operates as the secondary authentication server and primary accounting server. The password for the switch and the authentication RADIUS servers to exchange message is name. And the password for the switch and the accounting RADIUS servers to exchange message is money. The switch sends another packet to the RADIUS servers again if it sends a packet to the RADIUS server and does not receive response for 5 seconds with a maximum number of retries of 5. And the switch sends a real-time accounting packet to the RADIUS servers once in every 15 minutes. A user name is sent to the RADIUS servers with the domain name truncated. Connected to the switch is a server group comprised of two RADIUS servers whose IP addresses are 10.11.1.1 and 10.11.1.2 respectively, with the former being the primary authentication and the secondary counting server, and the latter the secondary authentication and the primary counting server. Configure the interaction password between the switch

and the authenticating RADIUS server to be name, and money for interaction between the switch and the counting RADIUS. Configure the waiting period for the switch to resend packets to the RADIUS server to be 5 seconds, that is, if after 5 seconds the RADIUS still has not sent any responses back, the switch will resend packets. Configure the number of times that a switch resends packets to the RADIUS server to be 5. Configure the switch to send real-time counting packets to the RADIUS server every 15 minutes with the domain names removed from the user name beforehand.

- The user name and password for local 802.1x authentication are localuser and localpass (in plain text) respectively. The idle disconnecting function is enabled.

Network diagram

Figure 53 Network diagram for AAA configuration with 802.1x and RADIUS enabled



Configuration procedure

Following configuration covers the major AAA/RADIUS configuration commands. You can refer to AAA&RADIUS Operation Manual for the information about these commands. Configuration on the client and the RADIUS servers is omitted.

1 Enable 802.1x globally.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] dot1x
```

2 Enable 802.1x for GigabitEthernet1/0/1 port.

```
[4200G] dot1x interface GigabitEthernet 1/0/1
```

3 Set the access control method to be MAC-address-based (can be omitted as MAC-address-based is the default configuration).

```
[4200G] dot1x port-method macbased interface GigabitEthernet 1/0/1
```

4 Create a RADIUS scheme named radius1 and enter RADIUS scheme view.

```
[4200G] radius scheme radius1
```

5 Assign IP addresses to the primary authentication and accounting RADIUS servers.

```
[4200G-radius-radius1] primary authentication 10.11.1.1
[4200G-radius-radius1] primary accounting 10.11.1.2
```

6 Assign IP addresses to the secondary authentication and accounting RADIUS server.

```
[4200G-radius-radius1] secondary authentication 10.11.1.2
[4200G-radius-radius1] secondary accounting 10.11.1.1
```

7 Set the password for the switch and the authentication RADIUS servers to exchange messages.

```
[4200G -radius-radius1] key authentication name
```

8 Set the password for the switch and the accounting RADIUS servers to exchange messages.

```
[4200G-radius-radius1] key accounting money
```

9 Set the interval and the number of retries for the switch to send packets to the RADIUS servers. Set the timer and the number of times that a switch will resend packets to the RADIUS server

```
[4200G-radius-radius1] timer 5
[4200G-radius-radius1] retry 5
```

10 Set the timer for the switch to send real-time accounting packets to the RADIUS servers.

```
[4200G-radius-radius1] timer realtime-accounting 15
```

11 Specify to send user names to the RADIUS servers with the domain name truncated. Configure to send the user name to the RADIUS server with the domain name removed beforehand.

```
[4200G-radius-radius1] user-name-format without-domain
[4200G-radius-radius1] quit
```

12 Create the default user domain named aabbcc.net and enter user domain view.

```
[4200G] domain default enable aabbcc.net
```

13 Specify to adopt the RADIUS scheme named radius1 as the RADIUS scheme of the user domain.

14 Specify radius 1 as the RADIUS scheme.

```
[4200G-isp-aabbcc.net] scheme radius-scheme radius1 local
```

15 Specify the maximum number of users the user domain can accommodate to 30. Configure the domain capacity to be 30.

```
[4200G-isp-aabbcc.net] access-limit enable 30
```

16 Enable the idle disconnecting function and set the related parameters.

```
[4200G-isp-aabbcc.net] idle-cut enable 20 2000
```

17 Create a local access user account.

```
[4200G] local-user localuser
[4200G-luser-localuser] service-type lan-access
[4200G-luser-localuser] password simple localpass
```

22 HABP CONFIGURATION

Introduction to HABP

With 802.1x enabled, a switch authenticates and then authorizes 802.1x-enabled ports. Packets can be forwarded only by authorized ports. If ports connected to the switch are not authenticated and authorized by 802.1x, their received packets will be filtered. This means that users can no longer manage the attached switches. To address this problem, 3Com authentication bypass protocol (HABP) has been developed.

An HABP packet carries the MAC addresses of the attached switches with it. It can bypass the 802.1x authentications when traveling between HABP-enabled switches, through which management devices can obtain the MAC addresses of the attached switches and thus the management of the attached switches is feasible.

An HABP packet encapsulates the MAC address of the connected switch to a given port. This allows HABP packets to bypass 802.1x authentication and to be forwarded between HABP-enabled switches. Therefore, the management devices can get the MAC addresses of their attached switches to manage them effectively.

HABP is implemented by HABP server and HABP client. Normally, an HABP server sends HABP request packets regularly to HABP clients to collect the MAC addresses of the attached switches. HABP clients respond to the HABP request packets and forward the HABP request packets to lower-level switches. HABP servers usually reside on management devices and HABP clients usually on attached switches.

For ease of switch management, it is recommended that you enable HABP for 802.1x-enabled switches.

HABP Server Configuration

With the HABP server launched, a management device sends HABP request packets regularly to the attached switches to collect their MAC addresses. You need also to configure the interval on the management device for an HABP server to send HABP request packets.

Table 129 Configure an HABP server

Operation	Command	Description
Enter system view	system-view	-
Enable HABP	habp enable	Required HABP is enabled by default.
Configure the current switch to be an HABP server	**habp server vlan** *vlan-id*	Required By default, a switch operates as an HABP client after you enable HABP on the switch, and if you want to use the switch as a management switch, you must configure the switch to be an HABP server.
Configure the interval to send HABP request packets.	**habp timer** *interval*	Optional The default interval for an HABP server to send HABP request packets is 20 seconds.

HABP Client Configuration

HABP clients reside on switches attached to HABP servers. After you enable HABP for a switch, the switch operates as an HABP client by default. So you only need to enable HABP on a switch to make it an HABP client.

Table 130 Configure an HABP client

Operation	Command	Description
Enter system view	system-view	-
Enable HABP	habp enable	Optional HABP is enabled by default. And a switch operates as an HABP client after you enable HABP for it.

Displaying and Debugging HABP

You can verify your HABP-related configuration by execute the **display** command in any view.

Table 131 Display and debug HABP

Operation	Command
Display HABP configuration and status information	display habp
Display the MAC address table maintained by HABP	display habp table
Display statistics on HABP traffic	display habp traffic
Display HABP debugging information	display debugging habp

23 AAA&RADIUS CONFIGURATION

Overview

Introduction to AAA

AAA is shortened from the three security functions: authentication, authorization and accounting. It provides a uniform framework for you to configure the three security functions to implement the network security management.

The network security mentioned here mainly refers to access control. It mainly controls:

- Which users can access the network,
- Which services the users having access right can enjoy, and
- How to perform accounting for the users who are using network resources.

Accordingly, AAA provides the following services:

Authentication

AAA supports the following authentication methods:

- None authentication: Users are trusted and are not authenticated. Generally, this method is not recommended.
- Local authentication: User information (including user name, password, and attributes) is configured on this device. Local authentication is fast and requires lower operational cost. But the information storage capacity is limited by device hardware.
- Remote authentication: Users are authenticated remotely through the RADIUS protocol (both standard and extended RADIUS protocols can be used). This device (for example, a S4200G series switch) acts as the client to communicate with the RADIUS server.

Authorization

AAA supports the following authorization methods:

- Direct authorization: Users are trusted and directly authorized.
- Local authorization: Users are authorized according to the related attributes configured for their local accounts on the device.
- RADIUS authorization: Users are authorized after they pass the RADIUS authentication. The authentication and authorization of RADIUS protocol are bound together, and you cannot perform RADIUS authorization alone without RADIUS authentication.

Accounting

AAA supports the following accounting methods:

- None accounting: No accounting is performed for users.
- Remote accounting: User accounting is performed on the remote RADIUS server.

Generally, AAA adopts the client/server structure, where the client acts as the managed resource and the server stores user information. This structure has good scalability and facilitates the centralized management of user information.

Introduction to ISP Domain

An Internet service provider (ISP) domain is a group of users who belong to the same ISP. For a user name in the format of *userid@isp-name*, the *isp-name* following the @ character is the ISP domain name. The access device uses *userid* as the user name for authentication, and *isp-name* as the domain name.

In a multi-ISP environment, the users connected to the same access device may belong to different domains. Since the users of different ISPs may have different attributes (such as different compositions of user name and password, different service types/rights), it is necessary to distinguishes the users by setting ISP domains.

You can configure a set of ISP domain attributes (including AAA policy, RADIUS scheme, and so on) for each ISP domain independently in ISP domain view.

Introduction to RADIUS

AAA is a management framework. It can be implemented by not only one protocol. But in practice, the most commonly used protocol for AAA is RADIUS.

What is RADIUS

RADIUS (remote authentication dial-in user service) is a distributed information interacting protocol in client/server structure. It can prevent unauthorized access to the network and is commonly used in network environments where both high security and remote user access service are required.

The RADIUS service involves three components:

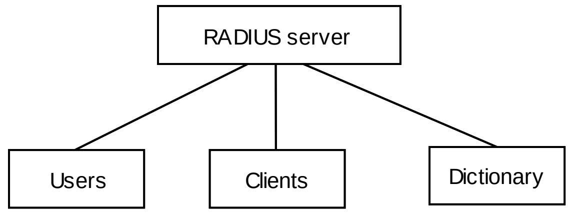
- Protocol: Based on the UDP/IP layer, RFC 2865 and 2866 define the frame format and message transfer mechanism of RADIUS, and define 1812 as the authentication port and 1813 as the accounting port.
- Server: The RADIUS server runs on a computer or workstation at the center. It stores and maintains the information on user authentication and network service access.
- Client: The RADIUS clients run on the dial-in access server device. They can be deployed anywhere in the network.

RADIUS is based on client/server model. Acting as a RADIUS client, the switch passes user information to a designated RADIUS server, and makes processing (such as connecting/disconnecting users) depending on the responses returned from the server. The RADIUS server receives user's connection requests, authenticate users, and return all required information to the switch.

Generally, the RADIUS server maintains the following three databases (as shown in Figure 54):

- Users: This database stores information about users (such as user name, password, adopted protocol and IP address).
- Clients: This database stores the information about RADIUS clients (such as shared keys).
- Dictionary: This database stores the information used to interpret the attributes and attribute values of the RADIUS protocol.

Figure 54 Databases in RADIUS server

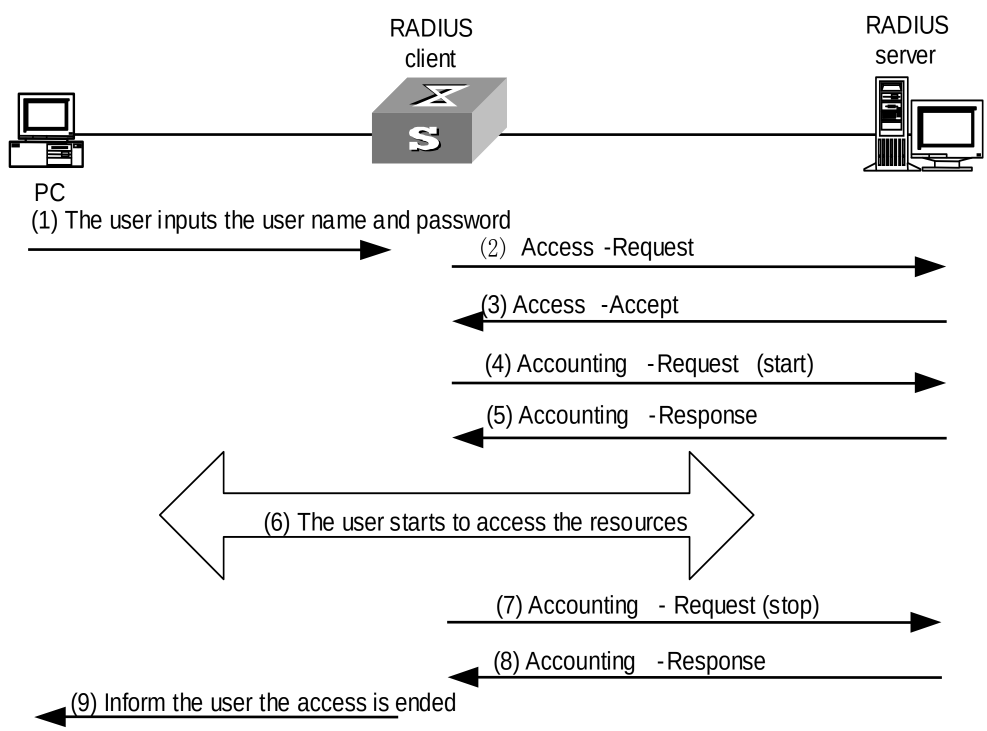


In addition, the RADIUS server can act as the client of some other AAA server to provide the authentication or accounting proxy service.

Basic message exchange procedure of RADIUS

The messages exchanged between a RADIUS client (a switch, for example) and the RADIUS server are verified by using a shared key. This enhances the security. The RADIUS protocol combines the authentication and authorization processes together by sending authorization information in the authentication response message. Figure 55 depicts the message exchange procedure between user, switch and RADIUS server.

Figure 55 Basic message exchange procedure of RADIUS



The basic message exchange procedure of RADIUS is as follows:

1 The user enters the user name and password.

2 The RADIUS client receives the user name and password, and then sends an authentication request (Access-Request) to the RADIUS server.

3 The RADIUS server compares the received user information with that in the Users database to authenticate the user. If the authentication succeeds, it sends back an authentication response (Access-Accept), which contains the information of user's rights, to the RADIUS client. If the authentication fails, it returns an Access-Reject response.

4 The RADIUS client accepts or denies the user depending on the received authentication result. If it accepts the user, the RADIUS client sends a start-accounting request (Accounting-Request, with the Status-Type filed set to "start") to the RADIUS server.

5 The RADIUS server returns a start-accounting response (Accounting-Response).

6 The use starts to access the resources.

7 The RADIUS client sends a stop-accounting request (Accounting-Request, with the Status-Type field set to "stop") to the RADIUS server.

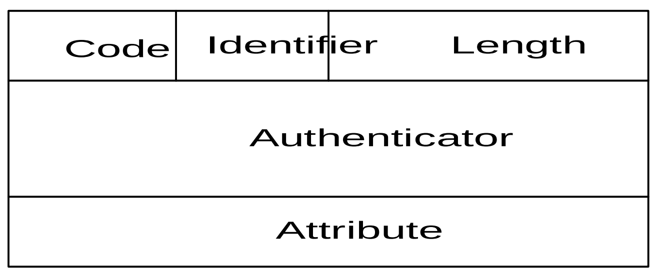
8 The RADIUS server returns a stop-accounting response (Accounting-Response).

9 The resource access of the user is ended.

RADIUS packet structure

RADIUS uses UDP to transmit messages. It ensures the correct message exchange between RADIUS server and client through the following mechanisms: timer management, retransmission, and backup server. Figure 56 depicts the structure of the RADIUS packets.

Figure 56 RADIUS packet structure



1 The Code field decides the type of the RADIUS packet, as shown in Table 132.

Table 132 Description on major values of the Code field

Code	Packet type	Packet description
1	Access-Request	Direction: client->server. The client transmits this packet to the server to determine if the user can access the network. This packet carries user information. It must contain the User-Name attribute and may contain the following attributes: NAS-IP-Address, User-Password and NAS-Port.
2	Access-Accept	Direction: server->client. The server transmits this packet to the client if all the attribute values carried in the Access-Request packet are acceptable (that is, the user passes the authentication).
3	Access-Reject	Direction: server->client. The server transmits this packet to the client if any attribute value carried in the Access-Request packet is unacceptable (that is, the user fails the authentication).

Table 132 Description on major values of the Code field (Continued)

Code	Packet type	Packet description
4	Accounting-Request	Direction: client->server. The client transmits this packet to the server to request the server to start or end the accounting (whether to start or to end the accounting is determined by the Acct-Status-Type attribute in the packet). This packet carries almost the same attributes as those carried in the Access-Request packet.
5	Accounting-Response	Direction: server->client. The server transmits this packet to the client to notify the client that it has received the Accounting-Request packet and has correctly recorded the accounting information.

2 The Identifier field (one byte) identifies the request and response packets. It is subject to the Attribute field and varies with the received valid responses, but keeps unchanged during retransmission.

3 The Length field (two bytes) specifies the total length of the packet (including the Code, Identifier, Length, Authenticator and Attribute fields). The bytes beyond the length will be regarded as padding characters and are ignored upon receiving the packet. If the received packet is shorter than the value of this field, it will be discarded.

4 The Authenticator field (16 bytes) is used to verify the packet returned from the RADIUS server; it is also used in the password hiding algorithm. There are two kinds of authenticators: Request and Response.

5 The Attribute field contains special authentication, authorization, and accounting information to provide the configuration details of a request or response packet. This field is represented by a field triplet (Type, Length and Value):

- The Type field (one byte) specifies the type of the attribute. Its value ranges from 1 to 255. Table 133 lists the attributes that are commonly used in RADIUS authentication and authorization.
- The Length field (one byte) specifies the total length of the Attribute field in bytes (including the Type, Length and Value fields).
- The Value field (up to 253 bytes) contains the information about the attribute. Its content and format are determined by the Type and Length fields.

Table 133 RADIUS attributes

Value of the Type field	Attribute type	Value of the Type field	Attribute type
1	User-Name	23	Framed-IPX-Network
2	User-Password	24	State
3	CHAP-Password	25	Class
4	NAS-IP-Address	26	Vendor-Specific
5	NAS-Port	27	Session-Timeout
6	Service-Type	28	Idle-Timeout
7	Framed-Protocol	29	Termination-Action
8	Framed-IP-Address	30	Called-Station-Id
9	Framed-IP-Netmask	31	Calling-Station-Id
10	Framed-Routing	32	NAS-Identifier
11	Filter-ID	33	Proxy-State
12	Framed-MTU	34	Login-LAT-Service

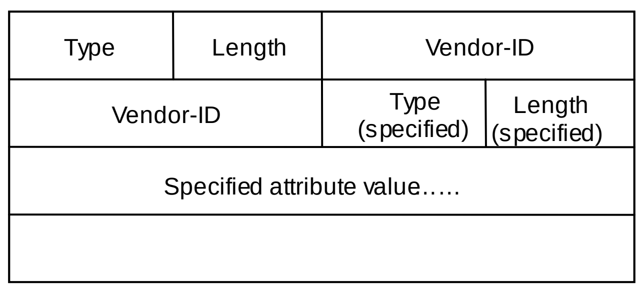
Table 133 RADIUS attributes (Continued)

Value of the Type field	Attribute type	Value of the Type field	Attribute type
13	Framed-Compression	35	Login-LAT-Node
14	Login-IP-Host	36	Login-LAT-Group
15	Login-Service	37	Framed-AppleTalk-Link
16	Login-TCP-Port	38	Framed-AppleTalk-Network
17	(unassigned)	39	Framed-AppleTalk-Zone
18	Reply_Message	40-59	(reserved for accounting)
19	Callback-Number	60	CHAP-Challenge
20	Callback-ID	61	NAS-Port-Type
21	(unassigned)	62	Port-Limit
22	Framed-Route	63	Login-LAT-Port

The RADIUS protocol takes well scalability. Attribute 26 (Vender-Specific) defined in this protocol allows a device vendor to extend RADIUS to implement functions that are not defined in standard RADIUS.

Figure 57 depicts the structure of attribute 26. The Vendor-ID field representing the code of the vendor occupies four bytes. The first byte is 0, and the other three bytes are defined in RFC1700. Here, the vendor can encapsulate multiple customized sub-attributes (containing Type, Length and Value) to obtain extended RADIUS implementation.

Figure 57 Part of the RADIUS packet containing extended attribute



Configuration Tasks

Table 134 Configuration tasks

Configuration task		Description	Related section
AAA configuration	Create an ISP domain	Required	Creating an ISP Domain
	Configure the attributes of the ISP domain	Optional	Configuring the Attributes of an ISP Domain
	Configure an AAA scheme for the ISP domain	Required	Configuring an AAA Scheme for an ISP Domain. If local authentication is adopted, also refer to Configuring the Attributes of a Local User. If RADIUS authentication is adopted, also refer to RADIUS Configuration.
	Configure the attributes of a local user	Optional	Configuring the Attributes of a Local User
	Cut down user connections forcibly	Optional	Cutting Down User Connections Forcibly
RADIUS configuration	Create a RADIUS scheme	Required	Creating a RADIUS Scheme
	Configure RADIUS authentication/authorization servers	Required	Configuring RADIUS Authentication/Authorization Servers
	Configure RADIUS accounting servers	Required	Configuring RADIUS Accounting Servers
	Configure shared keys for RADIUS packets	Optional	Configuring Shared Keys for RADIUS Packets
	Configure the maximum number of transmission attempts of RADIUS requests	Optional	Configuring the Maximum Number of Transmission Attempts of RADIUS Requests
	Configure the supported RADIUS server type	Optional	Configuring the Supported RADIUS Server Type
	Configure the status of RADIUS servers	Optional	Configuring the Status of RADIUS Servers
	Configure the attributes for data to be sent to RADIUS servers	Optional	Configuring the Attributes for Data to be Sent to RADIUS Servers
	Configure a local RADIUS authentication server	Optional	Configuring a Local RADIUS Authentication Server
	Configure the timers for RADIUS servers	Optional	Configuring the Timers of RADIUS Servers
	Configure whether or not to send trap message when RADIUS server is down	Optional	Configuring Whether or not to Send Trap Message When RADIUS Server is Down
	Configure the user re-authentication upon device restart function	Optional	Configuring the User Re-Authentication Upon Device Restart Function

AAA Configuration

The goal of AAA configuration is to protect network devices against unauthorized access and at the same time provide network access services to legal users. If you need to use ISP domains to implement AAA management on access users, you can configure the ISP domains.

Configuration Prerequisites

If you want to adopt remote AAA method, you must create a RADIUS scheme. You can reference a configured RADIUS scheme in ISP domains to implement remote AAA services. For the configuration of RADIUS scheme, refer to "RADIUS Configuration".

Creating an ISP Domain

Table 135 Create an ISP domain

Operation	Command	Description
Enter system view	system-view	—
Create an ISP domain and enter its view, enter the view of an existing ISP domain, or configure the default ISP domain	**domain** { *isp-name* | **default** { **disable** | **enable** *isp-name* **}** }	Required The default ISP domain is "system".

Configuring the Attributes of an ISP Domain

Table 136 Configure the attributes of an ISP domain

Operation	Command	Description
Enter system view	system-view	—
Create an ISP domain or enter the view of an existing ISP domain	**domain** *isp-name*	Required
Activate/deactivate the ISP domain	**state** { **active** | **block** }	Optional By default, once an ISP domain is created, it is in the **active** state and all the users in this domain are allowed to access the network.
Set the maximum number of access users that can be contained in the ISP domain	**access-limit** { **disable** | **enable** *max-user-number* **}**	Optional After an ISP domain is created, the number of access users it can contain is unlimited by default.
Set the user idle-cut function	**idle-cut** { **disable** | **enable** *minute flow* }	Optional By default, user idle-cut function is disabled.
Open/close the accounting-optional switch	**accounting optional**	Optional By default, once an ISP domain is created, the accounting-optional switch is closed.
Set the messenger function	**messenger time** { **enable** *limit interval* | **disable** *}*	Optional By default, the messenger function is disabled.
Set the self-service server location function	**self-service-url** { **disable** | **enable** *url-string* }	Optional By default, the self-service server location function is disabled.

CAUTION:

- On an S4200G series switch, each access user belongs to an ISP domain. You can configure up to 16 ISP domains on the switch. When a user logs in, if no ISP domain name is carried in the user name, the switch assumes that the user belongs to the default ISP domain.
- When charging a user, if the system does not find any available accounting server or fails to communicate with any accounting server, it will not disconnect the user as long as the **accounting optional** command has been executed.
- The self-service server location function must cooperate with a self-service-supported RADIUS server (such as CAMS). Through self-service, users can manage and control their accounts or card numbers by themselves. A server installed with the self-service software is called a self-service server.

3Com's CAMS Server is a service management system used to manage networks and secure networks and user information. Cooperating with other network devices (such as switches) in a network, the CAMS Server implements the AAA (authentication, authorization and accounting) services and rights management

Configuring an AAA Scheme for an ISP Domain

You can configure an AAA scheme in one of the following two ways:

Configuring a bound AAA scheme

You can use the **scheme** command to specify an AAA scheme. If you specify a RADIUS scheme, the authentication, authorization and accounting will be uniformly implemented by the RADIUS server specified in the RADIUS scheme. In this way, you can specify only one scheme to implement all the three AAA functions and do not need to specify different schemes for authentication, authorization and accounting respectively

Table 137 Configure a bound AAA scheme

Operation	Command	Description
Enter system view	system-view	-
Create an ISP domain or enter the view of an existing ISP domain	**domain** *isp-name*	Required
Configure an AAA scheme for the ISP domain	**scheme { local | none | radius-scheme** *radius-scheme-name* **[local]** }	Required By default, the ISP domain uses the **local** AAA scheme.
Configure an RADIUS scheme for the ISP domain	**radius-scheme** *radius-scheme-name*	Optional This command has the same effect as the **scheme radius-scheme** command.

CAUTION: *You can execute the **scheme** command with the radius-scheme-name argument to adopt an already configured RADIUS scheme to implement all the three AAA functions. If you adopt the local scheme, only the authentication and authorization functions are implemented, the accounting function cannot be implemented.*

- If you execute the **scheme radius-scheme** *radius-scheme-name* **local** command, the local scheme becomes the secondary scheme in case the RADIUS server does not response normally. That is, if the communication between the switch and the RADIUS server is normal, no local authentication is performed; otherwise, local authentication is performed.

- If you execute the **scheme local** command, the local scheme is adopted as the primary scheme. In this case, only local authentication is performed, no RADIUS authentication is performed.
- If you execute the **scheme none** command, no authentication is performed.

Configuring separate AAA schemes

You can use the **authentication**, **authorization**, and **accounting** commands to specify a scheme for each of the three AAA functions (authentication, authorization and accounting) respectively. The following gives the implementations of this separate way for the services supported by AAA.

- For terminal users

Authentication: RADIUS, local, RADIUS-local or none.

Authorization: none.

Accounting: RADIUS or none.

You can configure combined authentication, authorization and accounting schemes by using the above implementations.

- For FTP users
- Only authentication is supported for FTP users.
- Authentication: RADIUS, local, or RADIUS-local.

Perform the following configuration in ISP domain view.

Table 138 Configure separate AAA schemes

Operation	Command	Description
Enter system view	system-view	—
Create an ISP domain or enter the view of an existing ISP domain	**domain** *isp-name*	Required
Configure an authentication scheme for the ISP domain	**authentication** { **radius-scheme** *radius-scheme-name* [**local]** | **local** | **none }**	Optional By default, no separate authentication scheme is configured.
Allow users in current ISP domain to access the network services without being authorized	**authorization none**	Optional By default, no separate authorization scheme is configured.
Configure an accounting scheme for the ISP domain	**accounting** { **none** | **radius-scheme** *radius-scheme-name* }	Optional By default, no separate accounting scheme is configured.

- If a bound AAA scheme is configured as well as the separate authentication, authorization and accounting schemes, the separate ones will be adopted in precedence.
- RADIUS scheme and local scheme do not support the separation of authentication and authorization. Therefore, pay attention when you make authentication and authorization configuration for a domain: if the **scheme radius-scheme** or **scheme local** command is executed, the **authorization none** command is executed, while the **authentication** command is not executed, the authorization information returned from the RADIUS or local scheme still takes effect.

Configuring Dynamic VLAN Assignment

The dynamic VLAN assignment feature enables a switch to dynamically add the switch ports of successfully authenticated users to different VLANs according to the attributes assigned by the RADIUS server, so as to control the network resources that different users can access.

Currently, the switch supports the RADIUS authentication server to assign the following two types of VLAN IDs: integer and string.

- Integer: If the RADIUS server assigns integer type of VLAN IDs, you can set the VLAN assignment mode to integer on the switch (this is also the default mode on the switch). Then, upon receiving an integer ID assigned by the RADIUS authentication server, the switch adds the port to the VLAN whose VLAN ID is equal to the assigned integer ID. If no such a VLAN exists, the switch first creates a VLAN with the assigned ID, and then adds the port to the newly created VLAN.
- String: If the RADIUS server assigns string type of VLAN IDs, you can set the VLAN assignment mode to string on the switch. Then, upon receiving a string ID assigned by the RADIUS authentication server, the switch compares the ID with existing VLAN names on the switch. If it finds a match, it adds the port to the corresponding VLAN. Otherwise, the VLAN assignment fails and the user cannot pass the authentication.

In actual applications, to use this feature together with Guest VLAN, you should better set port control to port-based mode; if you set port control to MAC-address-based mode, each port can be connected to only one user.

Table 139 Configure dynamic VLAN assignment

Operation	Command	Description
Enter system view	system-view	—
Create an ISP domain and enter its view	**domain** *isp-name*	—
Set the VLAN assignment mode to integer	vlan-assignment-mode integer	By default, the VLAN assignment mode is integer.
Set the VLAN assignment mode to string	vlan-assignment-mode string	You can select between this operation and the above operation.
Create a VLAN and enter its view	**vlan** *vlan_id*	—
Set a VLAN name for VLAN assignment	**name** *string*	This operation is required if the VLAN assignment mode is set to string.

CAUTION: *In string mode, if the VLAN ID assigned by the RADIUS server is a character string containing only digits (for example, 1024), the switch first regards it as an integer VLAN ID: the switch transforms the string to an integer value and judges if the value is in the valid VLAN ID range; if it is, the switch adds the authenticated port to the VLAN with the integer value as the VLAN ID (VLAN 1024, for example).*

- To implement dynamic VLAN assignment on a port where both MSTP and 802.1x are enabled, you must set the MSTP port to an edge port.

Configuring the Attributes of a Local User

When **local** scheme is chosen as the AAA scheme, you should create local users on the switch and configure the relevant attributes.

The local users are users set on the switch, with each user uniquely identified by a user name. To make a user who is requesting network service pass through the local authentication, you should add an entry in the local user database on the switch for the user.

Table 140 Configure the attributes of a local user

Operation	Command	Description
Enter system view	system-view	—
Add a local user and enter local user view	**local-user** *user-name*	Required By default, there is no local user in the system.
Set a password for the specified user	**password** { **simple** | **cipher }** *password*	Optional
Set the password display mode of all local users	**local-user password-display-mode** { **cipher-force** | **auto }**	Optional By default, the password display mode of all access users is **auto**, indicating the passwords of access users are displayed in the modes set with the **password** command.
Set the state of the specified user	**state** { **active** | **block }**	Optional By default, the local users are in the **active** state once they are created, that is, they are allowed to request network services.
Authorize the user to access the specified type(s) of service(s)	**service-type** { **ftp** | **lan-access** | { **telnet** | **ssh** | **terminal }*** [**level** *level]* }	Required By default, the system does not authorize the user to access any service.
Set the priority level of the user	**level** *level*	Optional By default, the priority level of the user is 0.
Set the attributes of the user whose service type is lan-access	**attribute** { **ip** *ip-address* | **mac** *mac-address* | **idle-cut** *second* | **access-limit** *max-user-number* | **vlan** *vlan-id* | **location** { **nas-ip** *ip-address* **port** *port-number* | **port** *port-number }* }*	Optional If the user is bound to a remote port, you must specify the **nas-ip** parameter (the following *ip-address* is 127.0.0.1 by default, representing this device). If the user is bound to a local port, you do not need to specify the **nas-ip** parameter.

CAUTION:

- After the **local-user password-display-mode cipher-force** command is executed, all passwords will be displayed in cipher mode even through you specify to display user passwords in plain text by using the **password** command.
- If the configured authentication method (local or RADIUS) requires a user name and a password, the command level that a user can access after login is determined by the priority level of the user. For SSH users, when they use RSA shared keys for authentication, the commands they can access are determined by the levels set on their user interfaces.

- If the configured authentication method is none or requires a password, the command level that a user can access after login is determined by the level of the user interface

Cutting Down User Connections Forcibly

Table 141 Cut down user connection forcibly

Operation	Command	Description
Enter system view	system-view	—
Cut down user connections forcibly	**cut connection** { **all** | **access-type** { **dot1x** | **mac-authentication** } | **domain** *domain-name* | **interface** *interface-type interface-number* | **ip** *ip-address* | **mac** *mac-address* | **radius-scheme** *radius-scheme-name* | **vlan** *vlan-id* | **ucibindex** *ucib-index* | **user-name** *user-name* **}**	Required

RADIUS Configuration

The RADIUS protocol configuration is performed on a RADIUS scheme basis. In an actual network environment, you can either use a single RADIUS server or two RADIUS servers (primary and secondary servers with the same configuration but different IP addresses) in a RADIUS scheme. After creating a new RADIUS scheme, you should configure the IP address and UDP port number of each RADIUS server you want to use in this scheme. These RADIUS servers fall into two types: authentication/authorization, and accounting. And for each kind of server, you can configure two servers in a RADIUS scheme: primary server and secondary server. A RADIUS scheme has the following attributes: IP addresses of the primary and secondary servers, shared keys, and types of the RADIUS servers.

In an actual network environment, you can configure the above parameters as required. But you should configure at least one authentication/authorization server and one accounting server, and at the same time, you should keep the RADIUS service port settings on the switch consistent with those on the RADIUS servers.

Actually, the RADIUS protocol configuration only defines the parameters used for information exchange between the switch and the RADIUS servers. To make these parameters take effect, you must reference the RADIUS scheme configured with these parameters in an ISP domain view. For specific configuration commands, refer to “AAA Configuration”.

Creating a RADIUS Scheme

The RADIUS protocol configuration is performed on a RADIUS scheme basis. You should first create a RADIUS scheme and enter its view before performing other RADIUS protocol configurations.

Table 142 Create a RADIUS scheme

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.

CAUTION: *A RADIUS scheme can be referenced by multiple ISP domains simultaneously.*

Configuring RADIUS Authentication/Authorization Servers

Table 143 Configure RADIUS authentication/authorization server

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Set the IP address and port number of the primary RADIUS authentication/authorization server	**primary authentication** *ip-address* [*port-number*]	Required By default, the IP address and UDP port number of the primary server are 0.0.0.0 and 1812 respectively.
Set the IP address and port number of the secondary RADIUS authentication/authorization server	**secondary authentication** *ip-address* [*port-number*]	Optional By default, the IP address and UDP port number of the secondary server are 0.0.0.0 and 1812 respectively.

CAUTION:

- The authentication response sent from the RADIUS server to the RADIUS client carries the authorization information. Therefore, no separate authorization server can be specified.
- In an actual network environment, you can either specify two RADIUS servers as the primary and secondary authentication/authorization servers respectively, or specify only one server as both the primary and secondary authentication/authorization servers.
- The IP address and port number of the primary authentication server used by the default RADIUS scheme "system" are 127.0.0.1 and 1645.

Configuring RADIUS Accounting Servers

Table 144 Configure RADIUS accounting server

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Set the IP address and port number of the primary RADIUS accounting server	**primary accounting** *ip-address* [*port-number*]	Required By default, the IP address and UDP port number of the primary accounting server are 0.0.0.0 and 1813.
Set the IP address and port number of the secondary RADIUS accounting server	**secondary accounting** *ip-address* [*port-number*]	Optional By default, the IP address and UDP port number of the secondary accounting server are 0.0.0.0 and 1813.
Enable stop-accounting packet buffering	stop-accounting-buffer enable	Optional By default, stop-accounting packet buffering is enabled.
Set the maximum number of transmission attempts of the buffered stop-accounting packets.	**retry stop-accounting** *retry-times*	Optional By default, the system tries at most 500 times to transmit a buffered stop-accounting request.

Table 144 Configure RADIUS accounting server (Continued)

Operation	Command	Description
Set the maximum number of continuous no-response real-time accounting requests	**retry realtime-accounting** *retry-times*	Optional By default, the switch is allowed to continuously send at most 10 real-time accounting requests if it gets no response.

CAUTION:

- In an actual network environment, you can either specify two RADIUS servers as the primary and secondary accounting servers respectively, or specify only one server as both the primary and secondary accounting servers. In addition, because RADIUS adopts different UDP ports to transceive the authentication/authorization packets and the accounting packets, you must set a port number for accounting different from that set for authentication/authorization.
- Stop-accounting requests are critical to billing and will eventually affect the charges of the users; they are important for both the users and the ISP. Therefore, the switch should do its best to transmit them to the RADIUS accounting server. If the RADIUS server does not respond to such a request, the switch should first buffer the request on itself, and then retransmit the request to the RADIUS accounting server until it gets a response, or the maximum number of transmission attempts is reached (in this case, it discards the request).
- You can set the maximum number of real-time accounting request attempts that bring no response. If the switch makes all the allowed real-time accounting request attempts but does not get any answer, it cuts down the connection of the user.
- The IP address and the port number of the default primary accounting server “system” are 127.0.0.1 and 1646.
- Currently, RADIUS does not support the accounting of FTP users.

Configuring Shared Keys for RADIUS Packets

The RADIUS client and server adopt MD5 algorithm to encrypt the RADIUS packets exchanged with each other. The two parties verify the validity of the exchanged packets by using the shared keys that have been set on them, and can accept and respond to the packets sent from each other only if both of them have the same shared keys.

Table 145 Configure shared keys for RADIUS packets

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named “system” has already been created in the system.
Set a shared key for the RADIUS authentication/authorization packets	**key authentication** *string*	Required By default, the shared key for the RADIUS authentication/authorization packets is “3Com”.
Set a shared key for the RADIUS accounting packets	**key accounting** *string*	Required By default, the shared key for the RADIUS accounting packets is “3Com”.

***CAUTION:** You must set the share keys separately for the authentication/authorization packets and the accounting packets if the authentication/authorization server and the accounting server are different devices and the shared keys on the two servers are also different.*

Configuring the Maximum Number of Transmission Attempts of RADIUS Requests

The communication in RADIUS is unreliable because this protocol adopts UDP packets to carry data. Therefore, it is necessary for the switch to retransmit a RADIUS request if it gets no response from the RADIUS server after the response timeout timer expires. If the maximum number of transmission attempts is reached and the switch still receives no answer, the switch considers that the request fails.

Table 146 Configure the maximum transmission attempts of RADIUS request

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Set the maximum number of transmission attempts of RADIUS requests	**retry** *retry-times*	Optional By default, the system tries three times to transmit a RADIUS request.

Configuring the Supported RADIUS Server Type

Table 147 Configure the supported RADIUS server type

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Specify the type of RADIUS server supported by the switch	**server-type** { **3Com** | **standard** }	Optional By default, the switch supports the standard type of RADIUS server. The type of RADIUS server in the default RADIUS scheme "system" is **3Com**.

Configuring the Status of RADIUS Servers

For the primary and secondary servers (authentication/authorization servers, or accounting servers) in a RADIUS scheme:

When the switch fails to communicate with the primary server due to some server trouble, the switch will actively exchange packets with the secondary server.

After the time the primary server keeps in the block state exceeds the time set with the **timer quiet** command, the switch will try to communicate with the primary server again when it receives a RADIUS request. If the primary server recovers, the switch immediately restores the communication with the primary server instead of communicating with the secondary server, and at the same time restores the status of the primary server to the active state while keeping the status of the secondary server unchanged.

When both the primary and secondary servers are in active or block state, the switch sends packets only to the primary server.

Table 148 Set the status of RADIUS servers

Operation	**Command**	**Description**
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Set the status of the primary RADIUS authentication/authorization server	**state primary authentication** { **block** | **active** }	Optional By default, all the RADIUS servers in a user-defined RADIUS scheme are in the **active** state; and the RADIUS servers in the default RADIUS scheme "system" are in the **block** state.
Set the status of the primary RADIUS accounting server	**state primary accounting** { **block** | **active** }	
Set the status of the secondary RADIUS authentication/authorization server	**state secondary authentication** { **block** | **active** }	
Set the status of the secondary RADIUS accounting server	**state secondary accounting** { **block** | **active** }	

Configuring the Attributes for Data to be Sent to RADIUS Servers

Table 149 Configure the attributes for data to be sent to the RADIUS servers

Operation	**Command**	**Description**
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Set the format of the user names to be sent to RADIUS servers	**user-name-format** { **with-domain** | **without-domain** }	Optional By default, the user names sent from the switch to RADIUS servers carry ISP domain names.
Set the units of measure for data flows sent to RADIUS servers	**data-flow-format data** { **byte** | **giga-byte** | **kilo-byte** | **mega-byte }** **packet** { **giga-packet** | **kilo-packet** | **mega- packet** | **one-packet** }	Optional By default, in a RADIIUS scheme, the unit of measure for data is byte and that for packets is one-packet.
Set the source IP address used by the switch to send RADIUS packets	RADIUS scheme view **nas-ip** *ip-address* System view **radius nas-ip** *ip-address*	Optional By default, no source IP address is specified; and the IP address of the outbound interface is used as the source IP address.

CAUTION:

- Generally, the access users are named in the *userid@isp-name* format. Where, *isp-name* behind the @ character represents the ISP domain name, by which the device determines which ISP domain it should ascribe the user to. However, some old RADIUS servers cannot accept the user names that carry ISP domain names. In this case, it is necessary to remove the domain names carried in the user names before sending the user names to the RADIUS server. For this reason, the **user-name-format** command is designed for you to specify whether or not ISP domain names are carried in the user names sent to the RADIUS server.

- For a RADIUS scheme, if you have specified that no ISP domain names are carried in the user names, you should not adopt this RADIUS scheme in more than one ISP domain. Otherwise, such errors may occur: the RADIUS server regards two different users having the same name but belonging to different ISP domains as the same user (because the usernames sent to it are the same).
- In the default RADIUS scheme “system”, no ISP domain names are carried in the user names by default

Configuring a Local RADIUS Authentication Server

Table 150 Configure local RADIUS authentication server

Operation	Command	Description
Enter system view	system-view	—
Create a local RADIUS authentication server	**local-server nas-ip** *ip-address* **key** *password*	Required By default, a local RADIUS authentication server has already been created, whose NAS-IP and key are 127.0.0.1 and **3Com** respectively.

CAUTION:

- When you use the local RADIUS authentication server function, the UDP port number for the authentication/authorization service must be 1645, the UDP port number for the accounting service is 1646, and the IP addresses of the servers must be set to the addresses of the switch.
- The packet encryption key set by the **local-server** command with the **key** password parameter must be identical with the authentication/authorization packet encryption key set by the **key authentication** command in RADIUS scheme view.
- The switch supports up to 16 local RADIUS authentication servers (including the default local RADIUS authentication server).

Configuring the Timers of RADIUS Servers

If the switch gets no response from the RADIUS server after sending out a RADIUS request (authentication/authorization request or accounting request) and waiting for a period of time, it should retransmit the packet to ensure that the user can obtain the RADIUS service. This wait time is called response timeout time of RADIUS servers; and the timer in the switch system that is used to control this wait time is called the response timeout timer of RADIUS servers.

For the primary and secondary servers (authentication/authorization servers, or accounting servers) in a RADIUS scheme:

When the switch fails to communicate with the primary server due to some server trouble, the switch will actively exchange packets with the secondary server.

After the time the primary server keeps in the block state exceeds the time set with the **timer quiet** command, the switch will try to communicate with the primary server again when it has a RADIUS request. If the primary server recovers, the switch immediately restores the communication with the primary server instead of communicating with the secondary server, and at the same time restores the primary server to the active state while keeping the state of the secondary server unchanged.

To charge the users in real time, you should set the interval of real-time accounting. After the setting, the switch sends the accounting information of online users to the RADIUS server at regular intervals.

Table 151 Set the timers of RADIUS server

Operation	Command	Description
Enter system view	system-view	—
Create a RADIUS scheme and enter its view	**radius scheme** *radius-scheme-name*	Required By default, a RADIUS scheme named "system" has already been created in the system.
Set the response timeout time of RADIUS servers	**timer response-timeout** *seconds*, or **timer** *second*	Optional By default, the response timeout timer of RADIUS servers expires in three seconds.
Set the wait time for the primary server to restore the active state	**timer quiet** *minutes*	Optional By default, the primary server waits five minutes before restoring the active state.
Set the real-time accounting interval	**timer realtime-accounting** *minutes*	Optional By default, the real-time accounting interval is 12 minutes.

Configuring Whether or not to Send Trap Message When RADIUS Server is Down

Table 152 Configure whether or not to send trap message when RADIUS server is down

Operation	Command	Description
Enter system view	system-view	—
Enable the sending of trap message when RADIUS authentication or accounting server is down	**radius trap** { **authentication-server-down** | **accounting-server-down** }	Optional By default, the switch does not send trap message when its RADIUS server is down.

This configuration takes effect on all RADIUS schemes.

A device considers its RADIUS server as being down if it has tried the configured maximum times to send packets to the RADIUS server but does not receive any response.

Configuring the User Re-Authentication Upon Device Restart Function

The function applies to the environment where the RADIUS authentication/accounting server is CAMS.

In an environment with a CAMS server, if the switch reboots after an exclusive user (a user whose concurrent online number is set to 1 on the CAMS) gets authenticated and authorized and begins being charged, the switch will give a prompt that the user has already been online when the user re-logs onto the network before CAMS performs online user detection, and the user cannot get authenticated. In this case, the user can access the network again only after the CAMS administrator manually removes the online information of the user.

The user re-authentication upon device restart function is designed to resolve the above problem. After this function is enabled, every time the switch restarts:

1. The switch generates an Accounting-On packet, which mainly contains the following information: NAS-ID, NAS-IP address (source IP address), and session ID.
2. The switch sends the Accounting-On packet to CAMS at regular intervals.
3. Once the CAMS receives the Accounting-On packet, it sends a response to the switch. At the same time it finds and deletes the original online information of the users who access the network through the switch before the restart according to the information contained in this packet (NAS-ID, NAS-IP address and session ID), and ends the accounting of the users based on the last accounting update packet.
4. Once the switch receives the response from the CAMS, it stops sending other Accounting-On packets.
5. If the switch does not receives any response from the CAMS after the number of the Accounting-On packets it has sent reaches the configured maximum number, it does not send any more Accounting-On packets.

The switch can automatically generate the main attributes (NAS-ID, NAS-IP address and session ID) in the Accounting-On packets. However, you can also manually configure the NAS-IP address with the ***nas-ip*** *command. If you choose to manually configure the attribute, be sure to configure an appropriate and legal IP address. If this attribute is not configured, the switch will automatically use the IP address of the VLAN interface as the NAS-IP address.*

Table 153 Enable the user re-authentication upon device restart function

Operation	Command	Description
Enter system view	system-view	—
Enter RADIUS scheme view	**radius scheme** *radius-scheme-name*	—
Enable the user re-authentication upon device restart function	**accounting-on enable** [**send** *times* | **interval** *interval*]	By default, this function is disabled, and the system can send at most 15 Accounting-On packets consecutively at intervals of three seconds.

Displaying AAA&RADIUS Information

After the above configurations, you can execute the **display** commands in any view to view the operation of AAA and RADIUS and verify your configuration.

You can use the reset command in user view to clear the corresponding statistics.

Table 154 Display AAA information

Operation	Command
Display the configuration information about one specific or all ISP domains	**display domain** [*isp-name*]
Display the information about specified or all user connections	**display connection** [**access-type** { **dot1x** | **mac-authentication** } | **domain** *isp-name* | **interface** *interface-type interface-number* | **ip** *ip-address* | **mac** *mac-address* | **radius-scheme** *radius-scheme-name* | **vlan** *vlan-id* | **ucibindex** *ucib-index* | **user-name** *user-name* **]**
Display the information about specified or all local users	**display local-user** [**domain** *isp-name* | **idle-cut** { **disable** | **enable** } | **vlan** *vlan-id* | **service-type** { **ftp** | **lan-access** | **ssh** | **telnet** | **terminal }** | **state** { **active** | **block** } | **user-name** *user-name*]

Table 155 Display RADIUS protocol information

Operation	Command
Display the statistics about local RADIUS authentication server	display local-server statistics
Display the configuration information about one specific or all RADIUS schemes	**display radius** [*radius-scheme-name*]
Display the statistics about RADIUS packets	display radius statistics
Display the buffered no-response stop-accounting request packets	**display stop-accounting-buffer** { **radius-scheme** *radius-server-name* | **session-id** *session-id* | **time-range** *start-time stop-time* | **user-name** *user-name* }
Delete the buffered no-response stop-accounting request packets	**reset stop-accounting-buffer** { **radius-scheme** *radius-server-name* | **session-id** *session-id* | **time-range** *start-time stop-time* | **user-name** *user-name* }
Clear the statistics about the RADIUS protocol	reset radius statistics

AAA&RADIUS Configuration Example

Remote RADIUS Authentication of Telnet/SSH Users

The configuration procedure for the remote authentication of SSH users through RADIUS server is similar to that of Telnet users. The following description only takes the remote authentication of Telnet users as example

Network requirements

In the network environment shown in Figure 58, you are required to configure the switch so that the Telnet users logging into the switch are authenticated by the RADIUS server.

- A RADIUS server with IP address 10.110.91.164 is connected to the switch. This server will be used as the authentication server.
- On the switch, set the shared key it uses to exchange packets with the authentication RADIUS server to “expert”.

You can use a CAMS server as the RADIUS server. If you use a third-party RADIUS server, you can select standard or **3Com** as the server type in the RADIUS scheme.

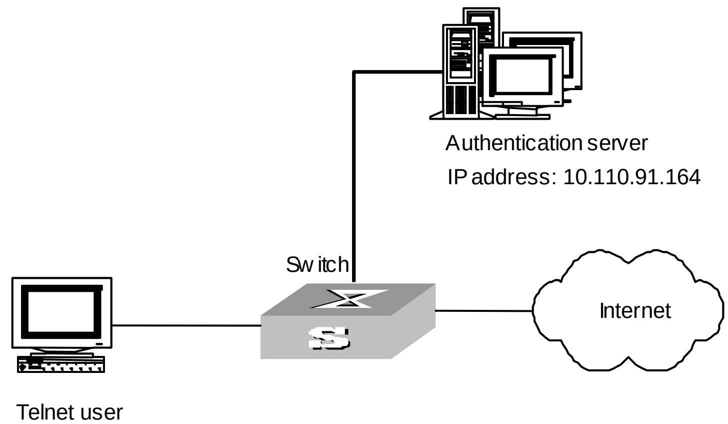
On the RADIUS server:

- Set the shared key it uses to exchange packets with the switch to “expert”.
- Set the port number for authentication.
- Add Telnet user names and login passwords.

The Telnet user name added to the RADIUS server must be in the format of *userid@isp-name* if you have configure the switch to include domain names in the user names to be sent to the RADIUS server.

Network diagram

Figure 58 Remote RADIUS authentication of Telnet users



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G]
```

2 Adopt AAA authentication for Telnet users

```
[4200G] user-interface vty 0 4
[4200G-ui-vty0-4] authentication-mode scheme
```

3 Configure an ISP domain.

```
[4200G] domain cams
[4200G-isp-cams] access-limit enable 10
[4200G-isp-cams] quit
```

4 Configure a RADIUS scheme.

```
[4200G] radius scheme cams
[4200G-radius-cams] accounting optional
[4200G-radius-cams] primary authentication 10.110.91.164 1812
[4200G-radius-cams] key authentication expert
[4200G-radius-cams] server-type 3Com
[4200G-radius-cams] user-name-format with-domain
[4200G-radius-cams] quit
```

5 Associate the ISP domain with the RADIUS scheme.

```
[4200G] domain cams
[4200G-isp-cams] scheme radius-scheme cams
```

A Telnet user logging into the switch by a name in the format of *userid* @cams belongs to the cams domain and will be authenticated according to the configuration of the cams domain.

Local Authentication of FTP/Telnet Users

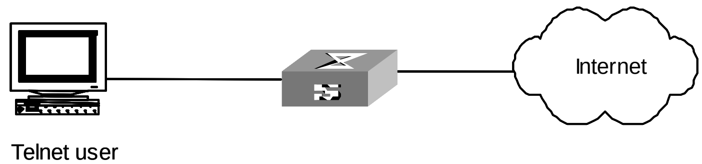
The configuration procedure for the local authentication of FTP users is similar to that of Telnet users. The following description only takes the local authentication of Telnet users as example.

Network requirements

In the network environment shown in Figure 59, you are required to configure the switch so that the Telnet users logging into the switch are authenticated locally.

Network diagram

Figure 59 Local authentication of Telnet users



Configuration procedure

1 Method 1: Using a local authentication scheme

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G]
```

b Adopt AAA authentication for Telnet users.

```
[4200G] user-interface vty 0 4
[4200G-ui-vty0-4] authentication-mode scheme
```

c Create and configure a local user named telnet.

```
[4200G] local-user telnet
[4200G-luser-telnet] service-type telnet
[4200G-luser-telnet] password simple 3Com
[4200G-luser-telnet] attribute idle-cut 300 access-limit 5
[4200G] domain system
[4200G-isp-system] scheme local
```

A Telnet user logging into the switch with the name telnet@system belongs to the system domain and will be authenticated according to the configuration of the system domain.

2 Method 2: using a local RADIUS server

This method is similar to the remote authentication method described in “Remote RADIUS Authentication of Telnet/SSH Users”. You only need to change the server IP address, the authentication password, and the UDP port number for authentication service in configuration step “Configure a RADIUS scheme” in “Remote RADIUS Authentication of Telnet/SSH Users”to 127.0.0.1, 3Com, and 1645 respectively, and configure local users.

Troubleshooting AAA&RADIUS Configuration

The RADIUS protocol is at the application layer in the TCP/IP protocol suite. This protocol prescribes how the switch and the RADIUS server of the ISP exchange user information with each other.

Symptom 1: User authentication/authorization always fails.

Possible reasons and solutions:

- The user name is not in the userid@isp-name format, or no default ISP domain is specified on the switch—Use the correct user name format, or set a default ISP domain on the switch.
- The user is not configured in the database of the RADIUS server—Check the database of the RADIUS server, make sure that the configuration information about the user exists.
- The user input an incorrect password—Be sure to input the correct password.
- The switch and the RADIUS server have different shared keys—Compare the shared keys at the two ends, make sure they are identical.
- The switch cannot communicate with the RADIUS server (you can determine by pinging the RADIUS server from the switch)—Take measures to make the switch communicate with the RADIUS server normally.

Symptom 2: RADIUS packets cannot be sent to the RADIUS server.

Possible reasons and solutions:

The communication links (physical/link layer) between the switch and the RADIUS server is disconnected/blocked—Take measures to make the links connected/unblocked.

None or incorrect RADIUS server IP address is set on the switch—Be sure to set a correct RADIUS server IP address.

One or all AAA UDP port settings are incorrect—Be sure to set the same UDP port numbers as those on the RADIUS server.

Symptom 3: The user passes the authentication and gets authorized, but the accounting information cannot be transmitted to the RADIUS server.

Possible reasons and solutions:

- The accounting port number is not properly set—Be sure to set a correct port number for RADIUS accounting.
- The switch requests that both the authentication/authorization server and the accounting server use the same device (with the same IP address), but in fact they are not resident on the same device—Be sure to configure the RADIUS servers on the switch according to the actual situation.

24 CENTRALIZED MAC ADDRESS AUTHENTICATION CONFIGURATION

Centralized MAC Address Authentication Overview

Centralized MAC address authentication is port-/MAC address-based authentication used to control user permissions to access a network. Centralized MAC address authentication can be performed without client-side software. With this type of authentication employed, a switch authenticates a user upon detecting the MAC address of the user for the first time.

Centralized MAC address authentication can be implemented in the following two modes:

- MAC address mode, where user MAC servers as both user name and password.
- Fixed mode, where user names and passwords are configured on the switch in advance. In this case, a user uses the previously configured user name and password to log into the switch.

As for S4200G series Ethernet switches, authentication can be performed locally or on a RADIUS server.

1. When a RADIUS server is used for authentication, the switch serves as a RADIUS client. Authentication is carried out through the cooperation of switches and the RADIUS server.
   - In MAC address mode, a switch sends user MAC addresses detected to the RADIUS serve as both user names and passwords. The rest handling procedures are the same as that of 802.1x.
   - In fixed mode, a switch sends the user name and password previously configured for the user to be authenticated to the RADIUS server and inserts the MAC address of the user in the calling-station-id field of the RADIUS packet. The rest handling procedures are the same as that of 802.1x.
   - A host can access a network if it passes the authentication performed by the RADIUS server.
2. When authentications are performed locally, users are authenticated by switches. In this case,
   - For MAC address mode, the MAC addresses configured to be both user names and passwords need to be in the format of HH-HH-HH, for example, 00-e0-fc-00-01-01.
   - For fixed mode, configure the user names and passwords as that for fixed mode.
   - The service type of a local user needs to be configured as lan-access.

Centralized MAC Address Authentication Configuration

The following sections describe centralized MAC address authentication configuration tasks:

- Enabling Centralized MAC Address Authentication Globally and for a Port
- Configuring Centralized MAC Address Authentication Mode
- Configuring a User Name and Password to be used in Fixed Mode

- Configuring the ISP Domain for MAC Address Authentication Users
- Configuring the Timers Used in Centralized MAC Address Authentication

The configuration of the maximum number of learned MAC addresses (refer to the ***mac-address max-mac-count*** *command) is unavailable for the ports with centralized MAC address authentication enabled. Similarly, the centralized MAC address authentication is unavailable for the ports with the maximum number of learned MAC addresses configured.*

Enabling Centralized MAC Address Authentication Globally and for a Port

Table 156 Enable centralized MAC address authentication

Operation	Command	Description
Enter system view	system-view	—
Enable centralized MAC address authentication globally	mac-authentication	Required By default, centralized MAC address authentication is globally disabled.
Enable centralized MAC address authentication for specified ports	**mac-authentication interface** *interface-list*	Required By default, centralized MAC address authentication is disabled on a port.

Centralized MAC address authentication configuration takes effect on a port only after you enable centralized MAC address authentication globally.

Configuring Centralized MAC Address Authentication Mode

Table 157 Configure centralized MAC address authentication mode

Operation	Command	Description
Enter system view	system-view	—
Configure centralized MAC address authentication mode	**mac-authentication authmode { usernameasmacaddress | usernamefixed }**	Required The **usernameasmacaddress** keyword specifies the centralized MAC address authentication mode to be the MAC address mode. The **usernamefixed** keyword specifies the centralized MAC address authentication mode to be the fixed mode. By default, the MAC address mode is adopted.

Configuring a User Name and Password to be used in Fixed Mode

When the fixed mode is adopted, you need to configure the user names and passwords.

Table 158 Configure a user name and password to be used in fixed mode

Operation	Command	Description
Enter system view	system-view	—
Configure a user name	**mac-authentication authusername** *username*	Optional The default user name used in the fixed mode is mac, with the corresponding password not configured.
Configure a password	**mac-authentication authpassword** *password*	Required

Configuring the ISP Domain for MAC Address Authentication Users

Table 159 lists the operations to configure the ISP domain for centralized MAC address authentication users.

Table 159 Configure the ISP domain for MAC address authentication users

Operation	Command	Description
Enter system view	system-view	—
Configure the ISP domain for MAC address authentication users	**mac-authentication domain** *isp-name*	Required By default, the default domain is used as the ISP domain.

Configuring the Timers Used in Centralized MAC Address Authentication

The following timers are used in centralized MAC address authentication:

- Offline detect timer, which sets the time interval for a switch to test whether a user goes offline. Upon detecting a user is offline, a switch notifies the RADIUS server of the user to trigger the RADIUS server to stop the accounting on the user.
- Quiet timer, which sets the quiet period for a switch. After a user fails to pass the authentication performed by a switch, the switch quiets for a specific period (the quiet period) before it authenticates users again.
- Server timeout timer. During authentication, the switch prohibits the user from accessing the network through the corresponding port if the connection between the switch and RADIUS server times out.

Table 160 lists the operations to configure the timers used in centralized MAC address authentication.

Table 160 Configure the timers used in centralized MAC address authentication

Operation	Command	Description
Enter system view	system-view	
Configure a timer used in centralized MAC address authentication	**mac-authentication timer** { **offline-detect** *offline-detect-value* | **quiet** *quiet-value* | **server-timeout** *server-timeout-value* }	Optional The defaults of the timers used in centralized MAC address authentication are as follows: Offline- detect timer: 300 seconds Quiet timer: 1 minute Server timeout timer: 100 seconds

Displaying and Debugging Centralized MAC Address Authentication

After the above configuration, you can execute the **display** command in any view to display system running of centralized MAC address authentication configuration, and to verify the effect of the configuration.

Table 161 Display and debug centralized MAC address authentication

Operation	Command	Description
Display global or port information about centralized MAC address authentication	**display mac-authentication** [**interface** *interface-list]*	This command can be executed in any view.

Centralized MAC Address Authentication Configuration Example

Centralized MAC address authentication configuration is similar to 802.1x. In this example, the differences between the two lie in the following:

Centralized MAC address authentication needs to be enabled both globally and for port.

In MAC address mode, Mac address of locally authenticated user is used as both user name and password.

In MAC address mode, MAC address of user authenticated by RADIUS server need to be configured as both user name and password on the RADIUS server.

The following section describes how to enable centralized MAC address authentication globally and for a port, and how to configure a local user. For other related configuration, refer to the configuration examples in Chapter 21.

1 Enable centralized MAC address authentication for GigabitEthernet 1/0/2 port.

```
<S4200G> system-view
[4200G] mac-authentication interface GigabitEthernet 1/0/2
```

2 Configure centralized MAC address authentication mode as MAC address mode.

```
[4200G] mac-authentication authmode usernameasmacaddress
```

3 Add a local user.

a Configure the user name and password.

```
[4200G] local-user 00-e0-fc-01-01-01
[4200G-luser-00-e0-fc-01-01-01] password simple 00-e0-fc-01-01-01
```

b Set service type of the local user to lan-access.

```
[4200G-luser-00-e0-fc-01-01-01] service-type lan-access
```

4 Enable centralized MAC address authentication globally.

```
[4200G] mac-authentication
```

5 Configure the domain name for centralized MAC address authentication users as aabbcc163.net.

```
[4200G] mac-authentication domain aabbcc163.net
```

For domain-related configuration, refer to Chapter 21.

25 ARP CONFIGURATION

Introduction to ARP

Address resolution protocol (ARP) is used to resolve IP addresses into MAC addresses.

Necessity of the Address Resolution

IP address is used on the network layer and cannot be used directly for communication, because network devices can only identify MAC addresses. To enable packets travel on the network layer to reach the destination host, the MAC address of the host is required. Therefore, before sending a packet, the sender needs to resolve the IP address of the destination into the corresponding MAC address.

ARP Packet Structure

ARP packets are classified into ARP request packets and ARP reply packets. Table 162 illustrates the structure of these two types of ARP packets.

- As for an ARP request packet, all the fields except the hardware address of the receiver field are set. The hardware address of the receiver is what the sender request for.
- As for an ARP reply packets, all the fields are set.

Table 162 Structure of an ARP request/reply packet

<table>
<tr><td colspan="2">Hardware type (16 bits)</td></tr>
<tr><td colspan="2">Protocol type (16 bits)</td></tr>
<tr><td>Length of hardware address</td><td>Length of protocol address</td></tr>
<tr><td colspan="2">Operator (16 bits)</td></tr>
<tr><td colspan="2">IP Address of the sender</td></tr>
<tr><td colspan="2">Hardware address of the sender</td></tr>
<tr><td colspan="2">IP Address of the receiver</td></tr>
<tr><td colspan="2">Hardware address of the receiver</td></tr>
</table>

Table 163 describes the fields of an ARP packet.

Table 163 Description on the fields of an ARP packet

Field	Description
Hardware Type	Identifies the type of the hardware interface. Refer to Table 164 for the information about the field values.
Protocol type	Identifies the type of the protocol used by the sending device. In TCP/IP, it is usually EtherType.
Length of the hardware address	Hardware address length (in bytes)
Length of protocol address	Protocol address length (in bytes)
Operator	Indicates the type of a data packets, which can be: 1: ARP request packets 2: ARP reply packets 3: RARP request packets 4: RARP reply packets
Hardware address of the sender	Hardware address of the sender
IP address of the sender	IP address of the sender

Table 163 Description on the fields of an ARP packet (Continued)

Field	Description
Hardware address of the receiver	For an ARP request packet, this field is null. For an ARP reply packet, this field carries the hardware address of the receiver.
IP address of the receiver	IP address of the receiver

Table 164 Description on the values of the hardware type field

Type	Description
1	Ethernet
2	Experimental Ethernet
3	X.25
4	Proteon ProNET
5	Chaos
6	IEEE802.X
7	ARC network

ARP Table

In an Ethernet, the MAC addresses of two hosts must be available for the two hosts to communicate with each other. Each host in an Ethernet maintains an IP address-to-MAC address mapping table known as ARP mapping table, as illustrated in Figure 60. An entry of an ARP mapping table contains the IP address and the MAC address of a host recently communicating with the local host.

Figure 60 An ARP table

	IF index	Physical address	IP address	Type
Entry 1				
Entry 2				
Entry 3				
Entry 4				
Entry 5				
…				
Entry n				

Table 165 describes the APR mapping table fields.

Table 165 Description on the fields of an ARP table

Field	Description
IF index	Index of the physical interface/port on the device owning the physical address and IP address contained in the entry
Physical address	Physical address of the device, that is, the MAC address
IP address	IP address of the device
Type	Entry type, which can be: 1: An entry falling out of the following three cases 2: Invalid entry 3: Dynamic entry 4: Static entry

ARP Implementation Procedure

The ARP mapping table of a host is empty when the host is just started up. And when a dynamic ARP mapping entry is not in use for a specified period of time, it is removed from the ARP mapping table so as to save the memory space and shorten the interval for the switch to look up entries in the ARP mapping table.

- Suppose there are two hosts on the same network segment: Host A and Host B. The IP address of Host A is IP_A and that of Host B is IP_B. To send a packet to Host B, Host A checks its own ARP mapping table first to see if the ARP entry corresponding to IP_B exists. If yes, Host A encapsulates the IP packet into a frame with the MAC address of Host B inserted to it and sends it to Host B.
- If the corresponding MAC address is not found in the ARP mapping table, Host A adds the packet in the transmission queue, creates an ARP request packet and broadcasts it throughout the Ethernet. As mentioned earlier, the ARP request packet contains the IP address of Host B, the IP address of Host A, and the MAC address of Host A. Since the ARP request packet is broadcasted, all hosts on the network segment can receive it. However, only the requested host (namely, Host B) processes the request.
- Host B appends the IP address and the MAC address carried in the request packet (that is, the IP address and the MAC address of the sender, Host A) to its ARP mapping table and then sends a ARP reply packet to the sender (Host A), with its MAC address inserted to the packet. Note that the ARP reply packet is a unicast packet instead of a broadcasted packet.
- Upon receiving the ARP reply packet, Host A extracts the IP address and the corresponding MAC address of Host B from the packet, adds them to its ARP mapping table, and then transmits all the packets in the queue with their destination being Host B.

Normally, ARP performs address resolution automatically, without the intervention of the administrator.

Introduction to Gratuitous ARP

The following are the characteristics of gratuitous ARP packets:

- Both source and destination IP addresses carried in a gratuitous ARP packet are the local addresses, and the source MAC address carried in it is the local MAC addresses.
- If a device finds that the IP addresses carried in a received gratuitous packet conflict with those of its own, it returns an ARP response to the sending device to notify of the IP address conflict.

By sending gratuitous ARP packets, a network device can:

- Determine whether or not IP address conflicts exist between it and other network devices.
- Trigger other network devices to update its hardware address stored in their caches.

When the gratuitous ARP packet learning function is enabled on a switch and the switch receives a gratuitous ARP packet, the switch updates the existing ARP entry (contained in the cache of the switch) that matches the received gratuitous ARP packet using the hardware address of the sender carried in the gratuitous ARP packet. A switch operates like this whenever it receives a gratuitous ARP packet.

ARP Configuration

ARP entries in an S4200G series Ethernet switch are classified into static entries and dynamic entries, as described in Table 166.

Table 166 ARP entries

ARP entry	Generation Method	Maintenance Mode
Static ARP entry	Manually configured	Manual maintenance
Dynamic ARP entry	Dynamically generated	ARP entries of this type age with time. The aging period is set by the ARP aging timer.

Adding a Static ARP Mapping Entry Manually

Table 167 Add a static ARP mapping entry manually

Operation	Command	Description
Enter system view	system-view	
Add a static ARP mapping entry manually	**arp static** *ip-address mac-address* [*vlan-id interface-type interface-number*]	Required The ARP mapping table is empty when a switch is just started. And the address mapping entries are created by ARP.

CAUTION:

Static ARP mapping entries are valid as long as the Ethernet switch operates. But operations that invalidate ARP entries, such as changing/removing VLAN interfaces, removing VLANs, or removing ports from VLANs, may cause the corresponding ARP entries being removed automatically.

As for the ***arp static*** *command, the value of the vlan-id argument must be the ID of an existing VLAN, and the port identified by the interface-type and interface-number arguments must belong to the VLAN.*

Configuring the ARP Aging Timer for Dynamic ARP Entries

The ARP aging timer applies to all dynamic ARP mapping entries.

Table 168 Configure the ARP aging timer for dynamic ARP entries

Operation	Command	Description
Enter system view	system-view	
Configure the ARP aging timer	**arp timer aging** *aging-time*	Optional By default, the ARP aging timer is set to 20 minutes.

Enabling the ARP Entry Checking Function

When multiple hosts share one multicast MAC address, you can specify whether or not to create multicast MAC address ARP entries for MAC addresses learned by performing the operations listed in Table 169.

Table 169 Enable the ARP entry checking function

Operation	Command	Description
Enter system view	system-view	
Enable the ARP entry checking function (that is, disable the switch from creating multicast MAC address ARP entries for MAC addresses learned)	arp check enable	Optional By default, the ARP entry checking function is enabled.

Gratuitous ARP Packet Learning configuration

Configuring Sending of Gratuitous ARP Packets

Sending of gratuitous ARP packets is enabled as long as an S4200G series switch operates. And no command is for this function.

Configuring the Gratuitous ARP packet Learning Function

Table 170 lists the operations to configure the gratuitous ARP packet learning function.

Table 170 Configure the gratuitous ARP packet learning function

Operation	Command	Description
Enter system view	system-view	
Enable the gratuitous ARP packet learning function	gratuitous-arp-learning enable	Required By default, the gratuitous ARP packet learning function is enabled.

Displaying and Debugging ARP

After the above configuration, you can execute the **display** command in any view to display the running of the ARP configuration, and to verify the effect of the configuration.

Execute the **debugging** command in user view to debug ARP configuration. Execute the **reset** command in user view to clear ARP mapping entries.

Table 171 Display and debug ARP

Operation	Command	Remark
Display specific ARP mapping table entries	**display arp** [**static** | **dynamic** | *ip-address*]	This command can be executed in any view.
Display the ARP mapping entries related to a specified string in a specified way	**display arp** [**dynamic** | **static** | *ip-address]* | { **begin** | **include** | **exclude** } *text*	This command can be executed in any view.
Display the number of the ARP mapping entries of the specified type	**display arp count** [[**dynamic** | **static]** | { **begin** | **include** | **exclude }** ***text*** | *ip-address* ***]***	This command can be executed in any view. If you execute this command with no argument specified, the number of all types of ARP mapping entries is displayed.

Table 171 Display and debug ARP

Operation	Command	Remark
Display the setting of the ARP aging timer	display arp timer aging	This command can be executed in any view.
Clear ARP mapping entries	**reset arp** [**dynamic** | **static** | **interface** *interface-type interface-number]*	-

26 ACL CONFIGURATION

ACL Overview

An access control list (ACL) is used primarily to identify traffic flows. In order to filter data packets, a series of match rules must be configured on the network device to identify the packets to be filtered. After the specific packets are identified, and based on the predefined policy, the network device can permit/prohibit the corresponding packets to pass.

ACLs classify packets based on a series of match conditions, which can be the source addresses, destination addresses and port numbers carried in the packets.

The packet match rules defined by ACLs can be referenced by other functions that need to differentiate traffic flows, such as the definition of traffic classification rules in QoS.

According to the application purpose, ACLs fall into the following four types:

- Basic ACL: rules are made based on the L3 source IP addresses only.
- Advanced ACL: rules are made based on the L3 and L4 information such as the source and destination IP addresses of the data packets, the type of protocol over IP, protocol-specific features, and so on.
- Layer 2 ACL: rules are made based on the Layer 2 information such as the source and destination MAC address information, VLAN priority, Layer 2 protocol, and so on.

ACL Application on the Switch

ACLs activated directly on the hardware

In the switch, an ACL can be directly activated on the switch hardware for packet filtering and traffic classification in the data forwarding process. In this case, the match order of multiple rules in an ACL is determined by the hardware of the switch, and any user-defined match order, even if it is configured when the ACL is defined, will not work.

ACLs are directly activated on the switch hardware in the following situations: the switch references ACLs to implement the QoS functions, and the forwards data through ACLs.

ACL referenced by the upper-level modules

The switch also uses ACLs to filter packets processed by software and implements traffic classification. In this case, there are two types of match orders for the rules in an ACL: **config** (user-defined match order) and **auto** (the system performs automatic ordering, namely according “depth-first” order). In this scenario, you can specify the match order for multiple rules in an ACL. You cannot modify the match order for an ACL once you have specified it. You can specify a new the match order only after all the rules are deleted from the ACL.

ACLs are referenced by software to control login users.

ACL Match Order

An ACL may contain a number of rules, and each rule specifies a different packet range. This brings about the issue of match order when packets are matched.

An ACL supports the following four types of match orders:

- Configured order: ACL rules are matched according to the configured order.
- Automatic ordering: ACL rules are matched according to "depth-first" order.

"Depth-first" order is described as follows:

- The "depth-first" ordering of rules in IP ACLs (basic and advanced ACLs) is implemented based on the lengths of the source IP address masks and the destination IP address masks. The rule with the longest masks is first matched, and then comes the rule with the second longest masks, and so on. In the ordering, the lengths of the source IP address masks are compared first; if the source IP address masks have the same length, the lengths of the destination IP address masks are compared. For example, the rule of which the source IP address mask is 255.255.255.0 precedes the rule of which the source IP address mask is 255.255.0.0 in the match order.

ACLs Based on Time Ranges

A Time-range-based ACL enables you to implement ACL control over packets by differentiating the time ranges.

A time range can be specified in each rule in an ACL. If the time range specified in a rule is not configured, the system will give a prompt message and allow the rule to be successfully created. However, the rule does not take effect immediately. It takes effect only when the specified time range is configured and the system time is within the time range.

There is no hardware clock on the 4200G. The date and time will be reset to 23:55:00 2000/04/01 when the system is rebooted or power cycled. If you are using time based ACLs, the clock must be set using the clock command in user view after a reboot or power cycle. In an environment that requires exact time, you must use NTP (Network Time Protocol) to obtain and set the current date and time of the Ethernet switch.

Types of ACLs Supported by the Ethernet Switch

The following types of ACLs are supported by the Ethernet switch:

- Basic ACL
- Advanced ACL
- Layer 2 ACL

Configuring Time Ranges

A number of time sections can be configured under the same time range name, and there is an "OR" relationship among these sections.

The time range configuration tasks include configuring periodic time sections and configuring absolute time sections. A periodic time section appears as a period of time in a day of the week, while an absolute time section appears in the form of "the start time to the end time".

Configuration Procedure

Table 172 Configure a time range

Operation	Command	Description
Enter system view	system-view	-
Create a time range	**time-range** *time-name* { *start-time* **to** *end-time days-of-the-week* [**from** *start-time start-date]* [**to** *end-time end-date*] | **from** *start-time start-date* [**to** *end-time end-date*] | **to** *end-time end-date* }	Required
Display a time range or time ranges	**display time-range** { **all** | *time-name }*	Optional The **display** command can be executed in any view

If only a periodic time section is defined in a time range, the time range is active only within the defined periodic time section.

If only an absolute time section is defined in a time, the time range is active only within the defined absolute time section.

If both a periodic time section and an absolute time section are defined in a time range, the time range is active only when the periodic time range and the absolute time range are both matched. Assume that a time range defines an absolute time section from 00:00 January 1, 2004 to 23:59 December 31, 2004, and a periodic time section from 12:00 to 14:00 every Wednesday. This time range is active only from 12:00 to 14:00 every Wednesday in 2004.

If the start time is specified, the time range starts on the current date and ends on the end date.

If the end date is note specified, the time range is from the date of configuration till the largest date available in the system.

Configuration Example

Define a time range that will be active from 8:00 to 18:00 Monday through Friday.

```
<S4200G> system-view
[4200G] time-range test 8:00 to 18:00 working-day
[4200G] display time-range test
Current time is 13:27:32 4/16/2005 Saturday
Time-range : test ( Inactive )
 08:00 to 18:00 working-day
```

Defining Basic ACLs

A basic ACL defines rules only based on the L3 source IP addresses to analyze and process data packets.

The value range for basic ACL numbers is 2,000 to 2,999.

Configuration Preparation

Before configuring an ACL rule containing time range arguments, you need to configure define the corresponding time ranges. For the configuration of time ranges, refer to ?Advanced ACL.

The value of the source IP address information in the rule has been defined.

Configuration Procedure

Table 173 Define a basic ACL rule

Operation	Command	Description
Enter system view	system-view	-
Enter basic ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	By the default, the match order is **config**
Define an rule	**rule** [*rule-id*] { **permit** | **deny** } [**fragment**] [**source** { *sour-addr sour-wildcard* | **any** }] [**time-range** *time-name]*	Required
Define the description information of the ACL	**description** *text*	Optional
Display ACL information	**display acl** { **all** | *acl-number* }	Optional The **display** command can be executed in any view

In the case that you specify the rule ID when defining a rule:

- If the rule corresponding to the specified rule ID already exists, you will edit the rule, and the modified part in the rule will replace the original content, while other parts remain unchanged.
- If the rule corresponding to the specified rule ID does not exists, you will create and define a new rule.
- The content of a modified or created rule must not be identical with the content of any existing rule; otherwise the rule modification or creation will fail, and the system will prompt that the rule already exists.

If you do not specify a rule ID, you will create and define a new rule, and the system will assign an ID for the rule automatically.

Configuration Example

Configure ACL 2000 to deny packets whose source IP address is 1.1.1.1.

```
<S4200G> system-view
[4200G] acl number 2000
[4200G-acl-basic-2000] rule deny source 1.1.1.1 0
[4200G-acl-basic-2000] display acl 2000
Basic ACL  2000, 1 rule
Acl's step is 1
rule 0 deny source 1.1.1.1 0 (0 times matched)
```

Defining Advanced ACLs

Advanced ACLs define classification rules according to the source and destination IP addresses of packets, the type of protocol over IP, and protocol-specific features such as TCP/UDP source and destination ports, TCP flag bit, ICMP protocol type, code, and so on.

The value range for advanced ACL numbers is 3,000 to 3,999.

Advanced ACLs support analysis and processing of three packet priority levels: type of service (ToS) priority, IP priority and differentiated services codepoint Priority (DSCP).

Using advanced ACLs, you can define classification rules that are more accurate, more abundant, and more flexible than those defined with basic ACLs.

Configuration Preparation

Before configuring an ACL rule containing time range arguments, you need to configure define the corresponding time ranges. For the configuration of time ranges, refer to ?Advanced ACL.

The values of source and destination IP addresses, the type of protocol over IP, and protocol-specific features in the rule have been defined.

Configuration Procedure

Table 174 Configure an advanced ACL rule

Operation	Command	Description
Enter system view	system-view	-
Enter advanced ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	By the default, the match order is **config**
Define an rule	**rule** [*rule-id*] { **permit** | **deny** } *rule-string*	Required
Define the comment string of the ACL rule	**rule** *rule-id* **comment** *text*	Optional
Define the description information of the ACL	**description** *text*	Optional
Display ACL information	**display acl** { **all** | *acl-number* }	Optional The **display** command can be executed in any view

In the case that you specify the rule ID when defining a rule:

- If the rule corresponding to the specified rule ID already exists, you will edit the rule, and the modified part in the rule will replace the original content, while other parts remain unchanged.
- If the rule corresponding to the specified rule ID does not exists, you will create and define a new rule.
- The content of a modified or created rule must not be identical with the content of any existing rule; otherwise the rule modification or creation will fail, and the system will prompt that the rule already exists.

If you do not specify a rule ID, you will create and define a new rule, and the system will assign an ID for the rule automatically.

rule-string: rule information, which can be combination of the parameters given in Table 175. Table 175 describes the specific parameters. You must configure the *protocol* argument in the rule information before you can configure other arguments.

Table 175 Rule information

Parameter	Type	Function	Description
protocol	Protocol type	Type of protocol over IP	When expressed in numerals, the value range is 1 to 255 When expressed with a name, the value can be GRE, ICMP, IGMP, IP, IPinIP, OSPF, TCP, and UDP
source { *sour-addr sour-wildcard* | **any** }	Source address information	Specifies the source address information in the rule	*sour-addr sour-wildcard* is used to specify the source address of the packet, expressed in dotted decimal notation **any** represents any source address

Table 175 Rule information (Continued)

Parameter	Type	Function	Description
destination { *dest-addr* *dest-wildcard* | **any** }	Destination address information	Specifies the destination address information in the rule	*dest-addr dest-wildcard* is used to specify the destination address of the packet, expressed in dotted decimal notation **any** represents any destination address
precedence precedence	Packet precedence	Packet priority	Value range: 0 to 7
tos *tos*	Packet precedence	ToS priority	Value range: 0 to 15
dscp *dscp*	Packet precedence	DSCP priority	Value range: 0 to 63
fragment	Fragment information	Specifies that the rule is effective for non-initial fragment packets	-
time-range *time-name*	Time range information	Specifies the time range in which the rule is active	-

If the protocol type is TCP or UDP, you can also define the following information:

Table 176 TCP/UDP-specific rule information

Parameter	Type	Function	Description
source-port *operator port1* [*port2*]	Source port(s)	Defines the source port information of UDP/TCP packets	The value of *operator* can be lt (less than), gt (greater than), eq (equal to), neq (not equal to) or range (within the range of) Only the "range" operator requires two port numbers as the operands, and other operators require only one port number as the operand *port1* and *port2*: TCP/UDP port number(s), expressed with name(s) or numerals; when expressed with numerals, the value range is 0 to 65,535
destination-port *operator port1* [*port2*]	Destination port(s)	Defines the destination port information of UDP/TCP packets	
established	"TCP connection established" flag	Specifies that the rule will match TCP connection packets with the **ack** or **rst** flag	TCP-specific argument

If the protocol type is ICMP, you can also define the following information:

Table 177 ICMP-specific rule information

Parameter	Type	Function	Description
icmp-type *icmp-type icmp-code*	Type and message code information of ICMP packets	Specifies the type and message code information of ICMP packets in the rule	*icmp-type*: ICMP message type, ranging 0 to 255 *icmp-code*: ICMP message code, ranging 0 to 255

If the protocol type is ICMP, you can also directly input the ICMP message name after the **icmp-type** argument. Table 178 describes some common ICMP messages.

Table 178 ICMP messages

Name	ICMP TYPE	ICMP CODE
echo	Type=8	Code=0
echo-reply	Type=0	Code=0
fragmentneed-DFset	Type=3	Code=4
host-redirect	Type=5	Code=1
host-tos-redirect	Type=5	Code=3
host-unreachable	Type=3	Code=1
information-reply	Type=16	Code=0
information-request	Type=15	Code=0
net-redirect	Type=5	Code=0
net-tos-redirect	Type=5	Code=2
net-unreachable	Type=3	Code=0
parameter-problem	Type=12	Code=0
port-unreachable	Type=3	Code=3
protocol-unreachable	Type=3	Code=2
reassembly-timeout	Type=11	Code=1
source-quench	Type=4	Code=0
source-route-failed	Type=3	Code=5
timestamp-reply	Type=14	Code=0
timestamp-request	Type=13	Code=0
ttl-exceeded	Type=11	Code=0

Configuration Example

Configure ACL 3000 to permit ICMP packets to pass.

```
<S4200G> system-view
[4200G] acl number 3000
[4200G-acl-adv-3000] rule 0 permit icmp
[4200G-acl-adv-3000] display acl 3000
Advanced ACL  3000, 1 rule
Acl's step is 1
rule 0 permit icmp (0 times matched)
```

Defining Layer 2 ACLs

Layer 2 ACLs define rules based on the Layer 2 information such as the source and destination MAC address information, VLAN priority and Layer 2 protocol to process packets.

The value range for Layer 2 ACL numbers is 4,000 to 4,999.

Configuration Preparation

Before configuring an ACL rule containing time range arguments, you need to configure define the corresponding time ranges. For the configuration of time ranges, refer to ?Advanced ACL.

The values of the source and destination MAC addresses, VLAN priority and Layer 2 protocol in the rule have been defined.

Configuration Tasks

Table 179 Configure a Layer 2 ACL rule

Operation	Command	Description
Enter system view	system-view	-
Create or enter layer 2 ACL view	**acl number** *acl-number* [**match-order** { **config** | **auto** }]	By the default, the match order is **config**
Define an rule	**rule** [*rule-id*] { **permit** | **deny }** *rule-string*	Required
Define the comment string of the ACL rule	**rule** *rule-id* **comment** *text*	Optional
Define the description information of the ACL	**description** *text*	Optional
Display ACL information	**display acl** { **all** | *acl-number* }	Optional The **display** command can be executed in any view

In the case that you specify the rule ID when defining a rule:

- If the rule corresponding to the specified rule ID already exists, you will edit the rule, and the modified part in the rule will replace the original content, while other parts remain unchanged.
- If the rule corresponding to the specified rule ID does not exists, you will create and define a new rule.
- The content of a modified or created rule must not be identical with the content of any existing rule; otherwise the rule modification or creation will fail, and the system will prompt that the rule already exists.

If you do not specify a rule ID, you will create and define a new rule, and the system will assign an ID for the rule automatically.

rule-string: rule information, which can be combination of the parameters given in Table 180. Table 180 describes the specific parameters.

Table 180 Rule information

Parameter	Type	Function	Description
format-type	Link layer encapsulation type	Defines the link layer encapsulation type in the rule	*format-type*: the value can be 802.3/802.2, 802.3, ether_ii, or snap
lsap *lsap-code lsap-wildcard*	lsap field	Defines the lsap field in the rule	*lsap-code*: the encapsulation format of data frames, a 16-bit hexadecimal number *lsap-wildcard*: mask of the lsap value, a 16-bit hexadecimal number used to specify the mask bit
source { *source-addr source-mask* | *vlan-id* }*	Source MAC address information	Specifies the source MAC address range in the rule	*source-addr*: source MAC address, in the format of H-H-H *source- mask*: source MAC address mask, in the format of H-H-H *vlan-id*: source VLAN ID, in the range of 1 to 4,094
dest *dest-addr dest-mask*	Destination MAC address information	Specifies the destination MAC address range in the rule	*dest-addr*: destination MAC address, in the format of H-H-H *dest- mask*: destination MAC address mask, in the format of H-H-H

Table 180 Rule information (Continued)

Parameter	Type	Function	Description
cos *vlan-pri*	Priority	Defines the 802.1p priority of the rule	*vlan-pri*: VLAN priority, in the range of 0 to 7
time-range *time-name*	Time range information	Specifies the time range in which the rule is active	*time-name*: specifies the name of the time range in which the rule is active; a string of 1 to 32 characters
type *protocol-type protocol-mask*	Protocol type of Ethernet frames	Defines the protocol type of Ethernet frames	*protocol-type*: protocol type *protocol-mask*: protocol type mask

Configuration Example

Configure ACL 4000 to deny packets whose 802.1p priority is 3.

```
<S4200G> system-view
[4200G] acl number 4000
[4200G-acl-ethernetframe-4000] rule deny cos 3
[4200G-acl-ethernetframe-4000] display acl 4000
Ethernet frame ACL  4000, 1 rule
Acl's step is 1
rule 0 deny cos excellent-effort(0 times matched)
```

Applying ACLs on Ports

By applying ACLs on ports, you can enable the packet filtering.

- You can filter inbound packets on each port. Inbound packets refer to packets received on a port.

Configuration Preparation

Before applying an ACL on a port, you must define the ACL first. For the ACL configuration of time ranges, refer to Defining Basic ACLs, Defining Advanced ACLs, and Defining Layer 2 ACLs.

Configuration Procedure

Table 181 Apply an ACL on a port

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Apply an ACL on a port	**packet-filter inbound** *acl-rule*	Required

The ACLs applied on a port can combinations of different types of ACLs. Table 182 describes the ACL combinations.

Table 182 Combined application of ACLs

Combination mode	Form of *acl-rule*
Apply all rules in an IP type ACL separately	**ip-group** *acl-number*
Apply one rule in an IP type ACL separately	**ip-group** *acl-number* **rule** *rule*
Apply all rules in a Link type ACL separately	**link-group** *acl-number*
Apply one rule in a Link type ACL separately	**link-group** *acl-number* **rule** *rule*
Apply one rule in an IP type ACL and one rule in a Link type ACL simultaneously	**ip-group** *acl-number* **rule** *rule* **link-group** *acl-number* **rule** *rule*

Configuration Example

Apply ACL 2100 in the inbound direction on GigabitEthernet 1/0/1 to filter packets.

```
<S4200G> system-view
[4200G] interface gigabitethernet 1/0/1
[4200G-GigabitEthernet1/0/1] packet-filter inbound ip-group 2100
```

Displaying and Debugging ACL Configuration

After the about-mentioned configuration, you can use the **display** command in any view to view the ACL running information, so as to verify configuration result.

Table 183 Display and debug ACL configuration

Operation	Command	Description
Display the configured ACL rule(s)	**display acl** { **all** | *acl-number* }	The **display** command can be executed in any view
Display a time range or time ranges	**display time-range** { **all** | *time-name* }	The **display** command can be executed in any view
Display the application information of packet filtering	**display packet-filter** { **interface** *interface-type interface-num* | **unitid** *unit-id* }	The **display** command can be executed in any view

The matched information displayed by the **display acl** command is the matched information process by the software of the switch. You can use the **display qos-interface traffic-statistic** command to view the statistics information of data forwarded by the hardware of the switch.

ACL Configuration Examples

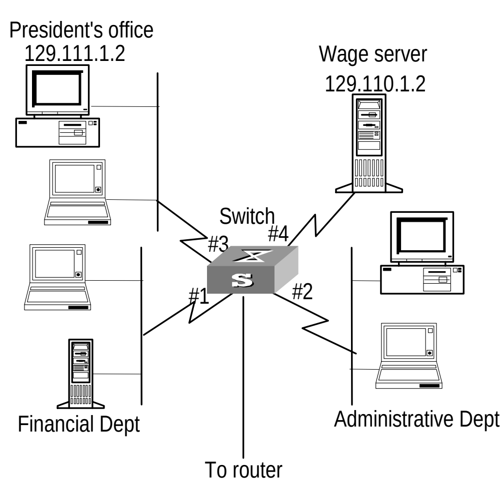
Advanced ACL Configuration Example

Network requirements

Different departments are interconnected on the intranet through the ports of the Switch. The wage query server of the financial department is accessed through GigabitEthernet1/0/1 (the subnet address is 129.110.1.2). It is required that an ACL be correctly configured to prohibit access to the wage server by other departments during the working hours (8:00 to 18:00).

Network diagram

Figure 61 Network diagram for advanced ACL configuration



Configuration procedure

Only the commands related to the ACL configuration are listed below.

1 Define a time range that contain a periodic time section from 8:00 to 18:00.

```
<S4200G> system-view
[4200G] time-range test 8:00 to 18:00 working-day
```

2 Define an ACL on traffic to the wage server. Enter advanced ACL view of ACL 3000.

```
[4200G] acl number 3000
```

3 Define an ACL rule for access to the wage server by other departments.

```
[4200G-acl-adv-3000] rule 1 deny ip source any destination 129.110.1.2
0.0.0.0 time-range test
[4200G-acl-adv-3000] quit
```

4 Apply the ACL on the port. Apply ACL 3000 on the port.

```
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] packet-filter inbound ip-group 3000
```

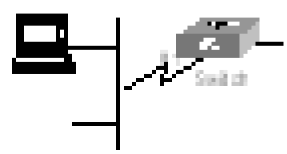
Basic ACL Configuration Example

Network requirements

Through basic ACL configuration, packets from the host with the source IP address of 10.1.1.1 (the host is connected to the switch through Ethernet1/0/1) are to be filtered within the time range from 8:00 to 18:00 everyday.

Network diagram

Figure 62 Network diagram for basic ACL configuration



Configuration procedure

Only the commands related to the ACL configuration are listed below.

1 Define the time range. Define the time range from 8:00 to 18:00.

```
<S4200G> system-view
[4200G] time-range test 8:00 to 18:00 daily
```

2 Define an ACL for packets with the source IP address of 10.1.1.1 Enter basic ACL view of ACL 2000.

```
[4200G] acl number 2000
```

3 Define an access rule for the source IP address of 10.1.1.1

```
[4200G-acl-basic-2000] rule 1 deny source 10.1.1.1 0 time-range test
[4200G-acl-basic-2000] quit
```

4 Apply the ACL on the port. 1Apply ACL 2000 on the port.

```
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] packet-filter inbound ip-group 2000
```

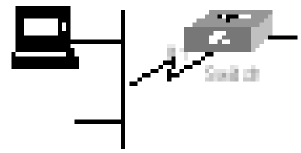
Layer 2 ACL Configuration Example

Network requirements

Through Layer 2 ACL configuration, packets with the source MAC address of 00e0-fc01-0101 and destination MAC address of 00e0-fc01-0303 are to be filtered within the time range from 8:00 to 18:00 everyday.

Network diagram

Figure 63 Network diagram for Layer 2 ACL configuration



Configuration procedure

Only the commands related to the ACL configuration are listed below.

1 Define the time range. Define the time range from 8:00 to 18:00.

```
<S4200G> system-view
[4200G] time-range test 8:00 to 18:00 daily
```

2 Define an ACL for packets with the source MAC address of 00e0-fc01-0101 and destination MAC address of 00e0-fc01-0303. Enter Layer 2 ACL view of ACL 4000.

```
[4200G] acl number 4000
```

3 Define a traffic classification rule for packets with the source MAC address of 00e0-fc01-0101 and destination MAC address of 00e0-fc01-0303.

```
[4200G-acl-ethernetframe-4000] rule 1 deny source 00e0-fc01-0101
ffff-ffff-ffff dest 00e0-fc01-0303 ffff-ffff-ffff time-range test
[4200G-acl-ethernetframe-4000] quit
```

4 Active the ACL. Active ACL 4000.

```
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] packet-filter inbound link-group 4000
```

27 QOS CONFIGURATION

Introduction to QoS

QoS (Quality of Service) is a concept generally existing in occasions with service supply and demand. It evaluates the ability to meet the need of the customers in service. Generally, the evaluation is not to grade precisely. Its purpose is to analyze the conditions when the service is the best and the conditions when the service still needs improvement and then to make improvements in the specified aspects.

In internet, QoS evaluates the ability of the network to deliver packets. The evaluation on QoS can be based on different aspects because the network provides various services. Generally speaking, QoS is the evaluation on the service ability to support the core requirements such as delay, delay variation and packet loss ratio in the packet delivery.

Traffic

Traffic means service traffic, that is, all the packets passing the switch.

Traffic Classification

Traffic classification means to identify packets conforming to certain characters according to certain rules.

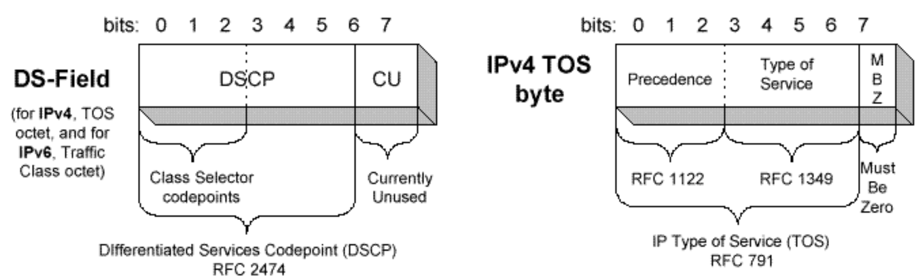
A classification rule is a filter rule configured to meet your management requirements. It can be very simple. For example, you can use a classification rule to identify traffic with different priorities according to the ToS field in the IP packet header. It can be very complicated too. For example, you can use a classification rule to identify the packets according to the combination of link layer (Layer 2), network layer (Layer 3) and transport layer (Layer 4) information including MAC addresses, IP protocols, source addresses, destination addresses, the port numbers of applications and so on.

Classification is generally based on the information in the packet header and rarely based on the packet content.

Precedence

1 IP precedence, ToS precedence and DSCP precedence

Figure 64 DS fields and ToS bytes



The ToS field in an IP header contains 8 bits:

- The first three bits indicate IP precedence in the range of 0 to 7.
- Bit 3 to bit 6 indicate ToS precedence in the range of 0 to 15.

- RFC2474 re-defines the ToS field in the IP packet header, which is called the DS field. The first six (bit 0-bit 5) bits of the DS field indicate DSCP precedence in the range of 0 to 63.The first three bits in DSCP precedence are class selector codepoints, bit 4 and bit 5 indicate drop precedence, and bit 6 is zero indicating that the device sets the service class with the DS model.
- The last two bits (bit 6 and bit 7) are reserved bits.

The precedence values of the IP packet indicate 8 different service classes.

Table 184 Description on IP Precedence

IP Precedence (decimal)	IP Precedence (binary)	Description
0	000	routine
1	001	priority
2	010	immediate
3	011	flash
4	100	flash-override
5	101	critical
6	110	internet
7	111	network

The DiffServ network defines four traffic classes:

- Expedited Forwarding (EF) class: In this class, packets can be forwarded regardless of link share of other traffic. The class is suitable for preferential services with low delay, low packet loss ratio, low variation and assured bandwidth (such as virtual leased line);
- Assured forwarding (AF) class: This class is further divided into four subclasses (AF1/2/3/4) and a subclass is further divided into three drop priorities, so the AF service level can be segmented. The QoS rank of the AF class is lower than that of the EF class;
- Class selector (CS) class: This class comes from the IP TOS field and includes 8 classes;
- Best Effort (BE) class: This class is a special class without any assurance in the CS class. The AF class can be degraded to the BE class if it exceeds the limit. Current IP network traffic belongs to this class by default.

Table 185 Description on DSCP values

Key word	DSCP value (decimal)	DSCP value (binary)
ef	46	101110
af11	10	001010
af12	12	001100
af13	14	001110
af21	18	010010
af22	20	010100
af23	22	010110
af31	26	011010
af32	28	011100
af33	30	011110
af41	34	100010

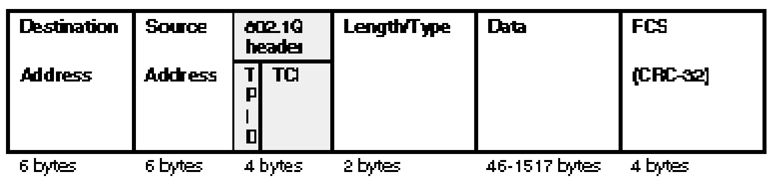
Table 185 Description on DSCP values (Continued)

Key word	DSCP value (decimal)	DSCP value (binary)
af42	36	100100
af43	38	100110
cs1	8	001000
cs2	16	010000
cs3	24	011000
cs4	32	100000
cs5	40	101000
cs6	48	110000
cs7	56	111000
default (be)	0	000000

2 802.1p priority

802.1p priority lies in Layer 2 packet headers and is applicable to occasions where the Layer 3 packet header does not need analysis but QoS must be assured in Layer 2.

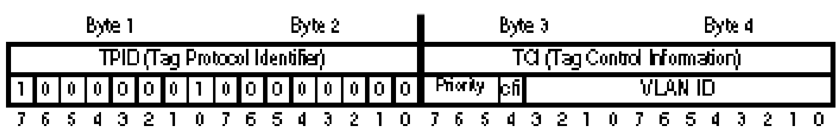
Figure 65 An Ethernet frame with a 802.1Q tag header



As shown in Figure 65, each host supporting 802.1Q protocol adds a 4-bit 802.1Q tag header after the source address of the former Ethernet frame header when sending packets.

The 4-bit 802.1Q tag header contains a 2-bit Tag Protocol Identifier (TPID) whose value is 8100 and a 2-bit Tag Control Information (TCI). TPID is a new class defined by IEEE to indicate a packet with an 802.1Q tag. Figure 66 describes the detailed contents of an 802.1Q tag header.

Figure 66 802.1Q tag headers



In Figure 66, the 3-bit priority field in TCI is 802.1p priority in the range of 0 to 7.The 3 bits specify the precedence of the frame.8 classes of precedence are used to determine which packet is sent preferentially when the switch is congested.

Table 186 Description on 802.1p priority

IP Precedence (decimal)	IP Precedence (binary)	Description
0	000	best-effort
1	001	background
2	010	spare

Table 186 Description on 802.1p priority (Continued)

IP Precedence (decimal)	IP Precedence (binary)	Description
3	011	excellent-effort
4	100	controlled-load
5	101	video
6	110	voice
7	111	network-management

The precedence is called 802.1p priority because the related applications of this precedence are defined in detail in the 802.1p specification.

Priority Remark

The priority remark function is to use ACL rules in traffic identifying and remark the priority for the packets matching with the ACL rules.

Packet Filter

Packet filter means filtering the service traffic. For example, in the operation of dropping packets, the service traffic matching with the traffic classification rule is dropped and the other traffic is permitted. The Ethernet switch adopts a complicated traffic classification rule to filter the packets based on much information and to drop these useless, unreliable, and doubtful packets. Therefore, the network security is enhanced.

The two critical steps in the packet filter operation are:

1. Classify the inbound packets to the port by the set classification rule.
2. Perform the filter-drop operation on the classified packets.

The packet filter function can be implemented by applying ACL rules on the port. Refer to the description in the *ACL* module for detailed configurations.

TP and TS

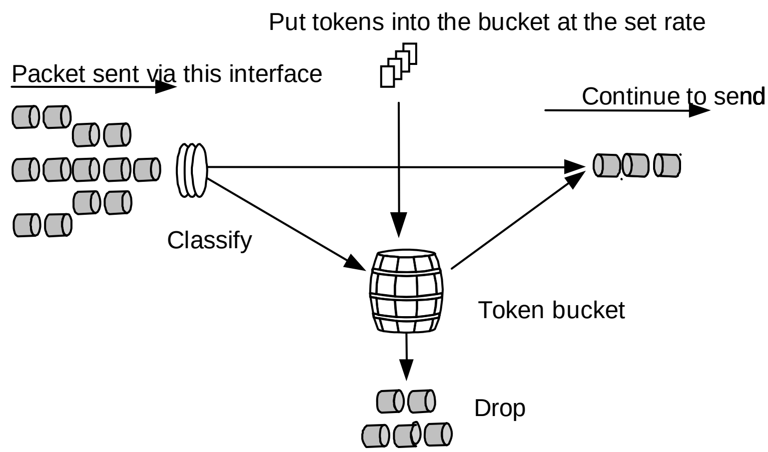
The network will be made more congested by plenty of continuous burst packets if the traffic of each user is not limited. The traffic of each user must be limited in order to make better use of the limited network resources and provide better service for more users. For example, the traffic can only get its committed resources in an interval to avoid network congestion caused by excess bursts.

TP (traffic policing) and TS (traffic shaping) is each a kind of traffic control policy to limit the traffic and its resource usage by supervising the traffic specification. The regulation policy is implemented according to the evaluation result on the premise of knowing whether the traffic exceeds the specification when TP or TS is performed. The token bucket is generally adopted in the evaluation of traffic specification.

Traffic evaluation and the token bucket

The token bucket can be considered as a container with a certain capacity to hold tokens. The system puts tokens into the bucket at the set rate. When the token bucket is full, the extra tokens will overflow and the number of tokens in the bucket stops increasing.

Figure 67 Evaluate the traffic with the token bucket



1 Evaluate the traffic with the token bucket

The evaluation for the traffic specification is based on whether the number of tokens in the bucket can meet the need of packet forwarding. If the number of tokens in the bucket is enough to forward the packets (generally, one token is associated with a 1-bit forwarding authority), the traffic is conforming to the specification, and otherwise the traffic is nonconforming or excess.

When the token bucket evaluates the traffic, its parameter configurations include:

- Average rate: The rate at which tokens are put into the bucket, namely, the permitted average rate of the traffic. It is generally set to committed information rate (CIR).
- Burst size: The capacity of the token bucket, namely, the maximum traffic size that is permitted in every burst. It is generally set to committed burst size (CBS). The set burst size must be bigger than the maximum packet length.

One evaluation is performed on each arriving packet. In each evaluation, if the number of tokens in the bucket is enough, the traffic is conforming to the specification and you must take away some tokens whose number is corresponding to the packet forwarding authority; if the number of tokens in the bucket is not enough, it means that too many tokens have been used and the traffic is excess.

2 Complicated evaluation

You can set two token buckets in order to evaluate more complicated conditions and implement more flexible regulation policies. For example, TP includes 4 parameters:

- CIR
- CBS
- PIR (Peak Information Rate)
- EBS (Excess Burst Size)

Two token buckets are used in this evaluation. Their rates of putting tokens into the buckets are CIR and PIR respectively, and their sizes are CBS and EBS respectively (the two buckets are called C bucket and E bucket respectively for short), representing different permitted burst levels. In each evaluation, you can implement different regulation policies in different conditions, including "enough tokens in C bucket", "insufficient tokens in C bucket but enough tokens in E bucket" and "insufficient tokens in both C bucket and E bucket".

TP

The typical application of TP is to supervise the specification of certain traffic into the network and limit it within a reasonable range, or to punish the extra traffic. Therefore, the network resources and the interests of the operators are protected. For example, you can limit HTTP packets within 50% of the network bandwidth. If the traffic of a certain connection is excess, TP can choose to drop the packets or to reset the priority of the packets.

TP is widely used in policing the traffic into the network of internet service providers (ISP).TP can classify the policed traffic and perform pre-defined policing actions according to different evaluation results. These actions include:

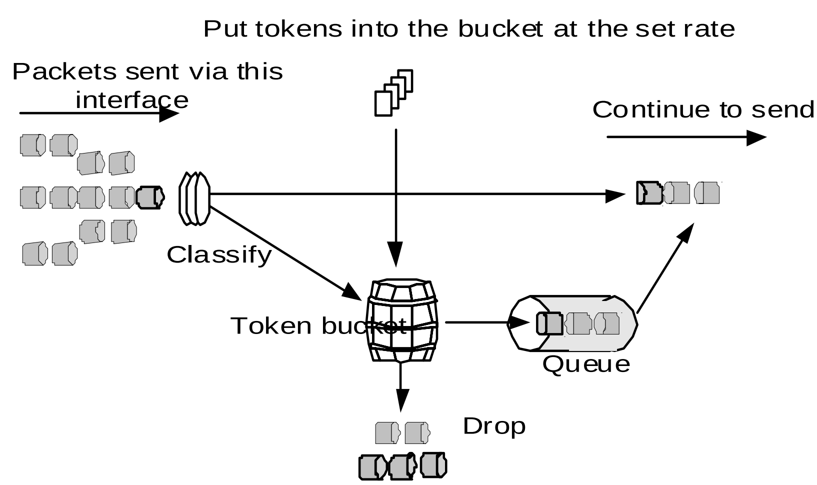
- Forward: Forward the packet whose evaluation result is "conforming" or mark DSCP precedence for Diff-Serv packets and then forward them.
- Drop: Drop the packet whose evaluation result is "nonconforming".
- Modify the precedence and forward: Modify the priority of the packets whose evaluation result is "partly-conforming" and forward them.
- Enter the next-rank policing: TP can be piled up rank by rank and each rank polices more detailed objects.

TS

TS is a measure to regulate the output rate of traffic actively. Its typical application is to control local traffic output based on the TP indexes of downstream network nodes.

The major difference between TS and TP is that the packets to be dropped in TP are cached in TS—usually in buffers or queues, as shown in Figure 68. When there are enough tokens in the token bucket, the cached packets are sent out evenly. Another difference between TP and TS is that TS may increase the delay while TP hardly increases the delay.

Figure 68 Diagram for TS



For example, if the device A sends packets to the device B. The device B will perform TP on packets from the device A to drop the packets beyond the specification.

In order to avoid meaningless packet loss, you can perform TS on the packets on the egress of the device A and cache the packets beyond the TP specification in the device A. When the next packets can be sent, the packets cached in the buffer queues will be taken out and sent. In this way, all the packets sent to the device B conforms to the traffic specification of the device B.

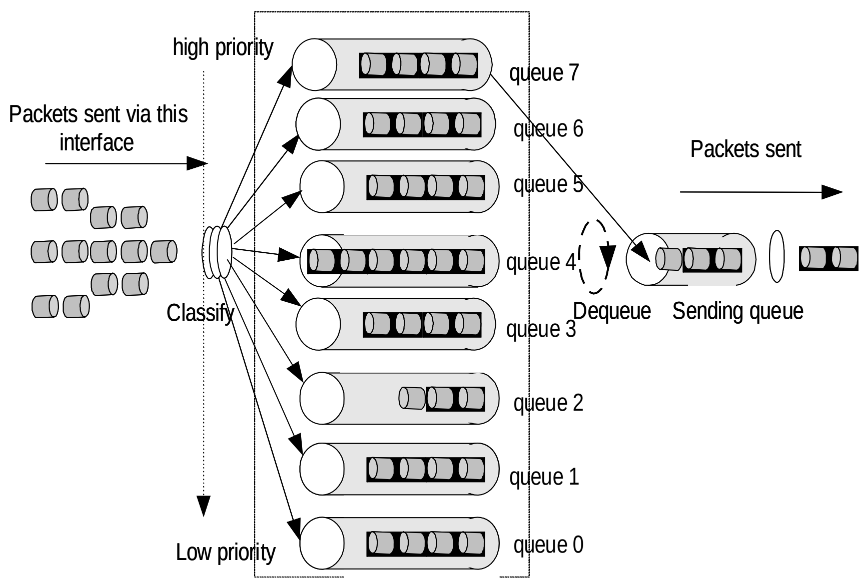
Redirect You can re-specify the forwarding port of packets as required by your own QoS policy.

Queue Scheduling When the network is congested, the problem that many packets compete for resources must be solved, usually in the way of queue scheduling.

In the following section, SP (Strict-Priority) queues, WRR (Weight Round Robin) queues and SDWRR (Shaped Deficit WRR) queues are introduced.

1 SP queue

Figure 69 Diagram for SP queues



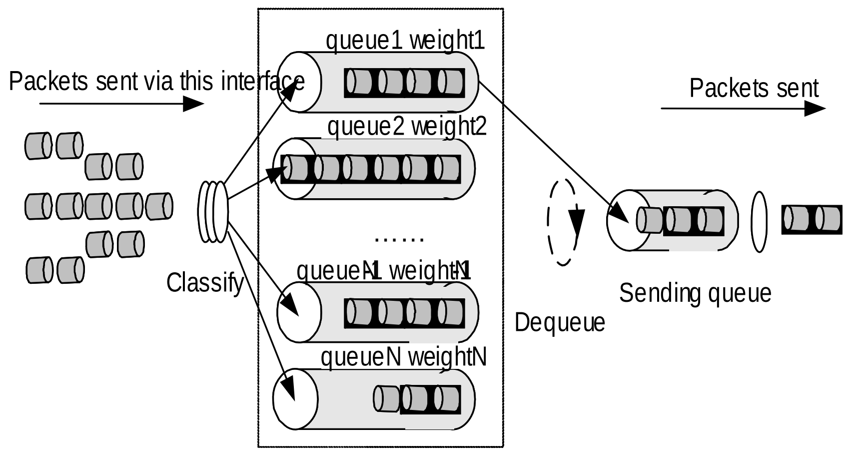
SP queue-scheduling algorithm is specially designed for critical service applications. An important feature of critical services is that they demand preferential service in congestion in order to reduce the response delay. Assume that there are 8 output queues on the port and the preferential queue classifies the 8 output queues on the port into 8 classes, which are queue7, queue6, queue5, queue4, queue3, queue2, queue1, and queue0. Their priorities decrease in order.

In the queue scheduling, SP sends packets in the queue with higher priority strictly following the priority order from high to low. When the queue with higher priority is empty, packets in the queue with lower priority are sent. You can put critical service packets into the queues with higher priority and put non-critical service (such as e-mail) packets into the queues with lower priority. In this case, critical service packets are sent preferentially and non-critical service packets are sent when critical service groups are not sent.

The disadvantage of SP queue is that: if there are packets in the queues with higher priority for a long time in congestion, the packets in the queues with lower priority will be “starved to death” because they are not served.

2 WRR queue

Figure 70 Diagram for WRR



3 WRR queue-scheduling algorithm schedules all the queues in turn and every queue can be assured of a certain service time. Assume there are 8 priority queues on the port. WRR configures a weight value for each queue, which are w7, w6, w5, w4, w3, w2, w1, and w0. The weight value indicates the proportion of obtaining resources. On a 100M port, configure the weight value of WRR queue-scheduling algorithm to 50, 50, 30, 30, 10, 10, 10 and 10 (corresponding to w7, w6, w5, w4, w3, w2, w1, and w0 in order). In this way, the queue with the lowest priority can get 5Mbps bandwidth at least, and the disadvantage of SP queue-scheduling that the packets in queues with lower priority may not get service for a long time is avoided. Another advantage of WRR queue is that: though the queues are scheduled in order, the service time for each queue is not fixed, that is to say, if a queue is empty, the next queue will be scheduled. In this way, the bandwidth resources are made full use of. SDWRR queue

Comparing with WRR queue, SDWRR queue further optimizes the delay and variation for different queues.

For example, configure the weight value of queue0 and queue1 to 5 and 3 respectively. The processing procedures of WRR and SDWRR are as follows:

- WRR: The packets whose weight value is 3 in queue1 are scheduled only after the packets whose weight value is 5 in the queue0 are scheduled. If there is a wide difference between the weight values of two queues, the queue with high weight value will cause great delay and variation for the queue with low weight value.
- SDWRR: Two queues are scheduled in turn. Packets whose weight value is 1 in queue0 are scheduled first, and then packets whose weight value is 1 in queue1 are scheduled. The procedure is repeated until the scheduling for one queue is over, and then SDWRR will schedule packets with the left weight values in the other queue. The detailed scheduling sequence is described in Table 187.

Table 187 Queue-scheduling sequence of SDWRR

Scheduling algorithm	Queue-scheduling sequence	Description
WRR	0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1	0 indicates packets in queue0 1 indicates packets in queue1
SDWRR	0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0	

Traffic-based Traffic Statistics

The function of traffic-based traffic statistics is to use ACL rules in traffic identifying and perform traffic statistics on the packets matching with the ACL rules. You can get the statistics of the packets you are interested in through this function.

VLAN Tag Remark

The function of VLAN tag remark is to use ACL rules in traffic identifying and perform VLAN tag remark operation on the packets matching with the ACL rules. The VLAN ID of corresponding packets can be modified as you require.

The policy VLAN feature can be implemented through the VLAN tag remark function.

Priority Mapping

When the packet enters the switch, the switch will assign a series of parameters (including 802.1p priority, DSCP precedence, local precedence, drop precedence and so on) to it according to the priorities that the switch supports and the corresponding specifications.

Among the parameters, the definitions of local precedence and drop precedence are as follows:

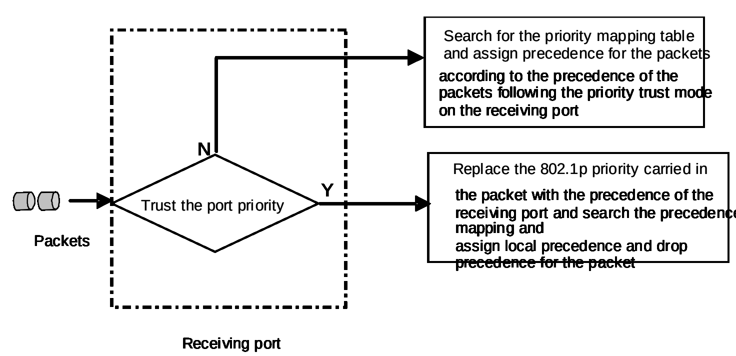
- Local precedence: Local precedence is the precedence that the device assigns to packets locally and it is corresponding to the queue of the outbound port.
- Drop precedence: Drop precedence is an argument that is referred to when the operation of dropping packets is performed. 1 matches with red packets and 0 matches with green packets.

The device provides two types of priority trust modes:

- Trusting the packet priority
- Trusting the port priority

The priority mapping process of packets on the device is described in Figure 71:

Figure 71 Diagram for the priority mapping process



You can select the priority trust mode of the port as you require.

In the mode of trusting the packet precedence, the switch can trust the following priorities as you configure:

- Trust the 802.1p priority of the packets
- Trust the DSCP precedence of the packets

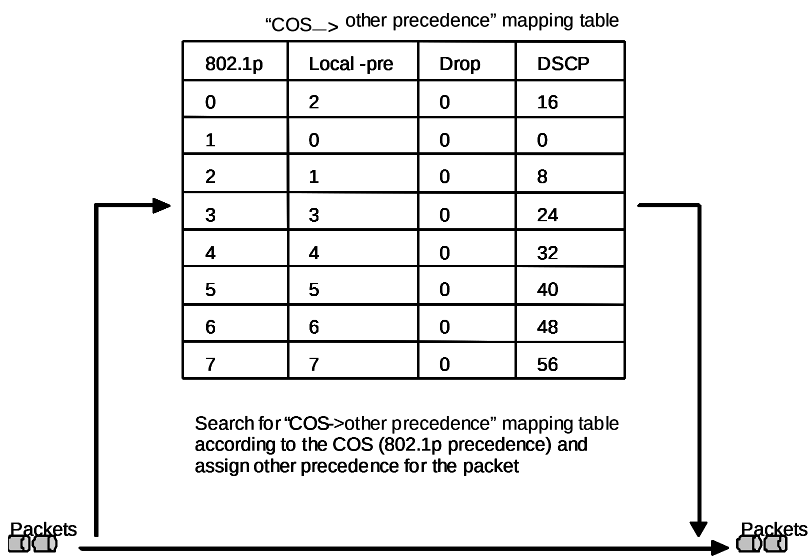
Trusting the 802.1p priority of the Packets

You can specify whether to replace the precedence carried in the packet with the mapped precedence when you configure to trust the 802.1p priority of the packet:

- In the default mode, the switch does not replace the precedence carried in the packet with the mapped precedence.
- In the automap mode, the switch replaces the precedence carried in the packet with the mapped precedence.

If the packet does not carry any precedence, the switch will perform the corresponding mapping by using the port precedence to search for the "COS->other priority mapping table".

Figure 72 The mapping process of trusting 802.1p priority



802.1p	Local -pre	Drop	DSCP
0	2	0	16
1	0	0	0
2	1	0	8
3	3	0	24
4	4	0	32
5	5	0	40
6	6	0	48
7	7	0	56

Trusting the DSCP Precedence of the Packets

You can specify whether to replace the precedence carried in the packet with the mapped precedence when you configure to trust the DSCP precedence of the packet:

- In the default mode, the switch does not replace the precedence carried in the packet with the mapped precedence.
- In the automap mode, the switch replaces the precedence carried in the packet with the mapped precedence.
- In the remap mode, the switch firstly gets new DSCP precedence by the "DSCP--> DSCP" mapping relationship, and then searches for the "DSCP-->other precedence" mapping table through the new DSCP precedence and replaces the precedence carried in the packet with the mapped precedence.

Figure 73 The mapping process of trusting the DSCP precedence in the default mode and automap mode

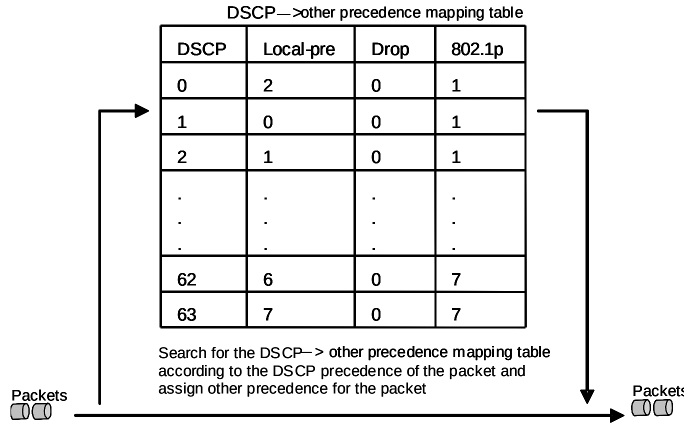
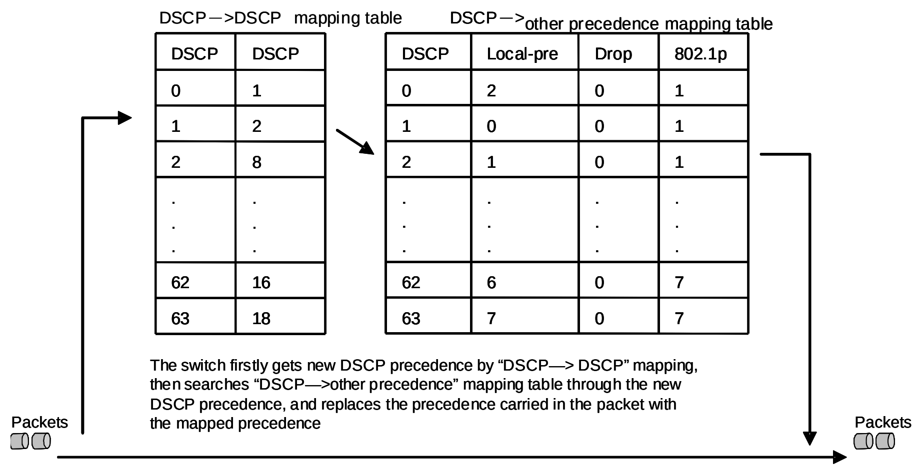


Figure 74 The mapping process of trusting the DSCP precedence in the remap mode



QoS Supported by Switch 4200G

Table 188 The QoS functions supported by S4200G and related commands

QoS	Specification	Related command	Link
Priority mapping	—	**priority** *priority-level* **priority-trust** **qos cos-drop-precedence-map** **qos cos-dscp-map** **qos cos-local-precedence-map** **qos dscp-cos-map** **qos dscp-drop-precedence-map** **qos dscp-dscp-map** **qos dscp-local-precedence-map**	Configuring Priority Mapping
TP	—	traffic-limit	Configuring TP
TS	—	traffic-shape	Configuring TS
Queue-scheduling	SDWRR and SP are supported	queue-scheduler	Configuring Queue-scheduling

Table 188 The QoS functions supported by S4200G and related commands (Continued)

QoS	Specification	Related command	Link
Traffic statistics	Supported	traffic-statistic	Configuring Traffic Statistics
Set the priority of protocol packets	Supported	protocol-priority	Setting the Precedence of Protocol Packet

Configuring Priority Mapping

Refer to Priority Mapping for introduction to priority mapping.

Setting to Trust the Port Precedence

In the mode of trusting the port precedence, the switch will replace the 802.1p priority carried in the packet with the precedence of the receiving port and then assign the local precedence for the packet according to the precedence of the receiving port.

Configuration prerequisites

- The priority trust mode is specified to trusting the port precedence
- The port that needs port precedence configuration is specified.
- The precedence value of the specified port is specified.

Configuration procedure

Table 189 Setting to trust the port precedence

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Set to trust the port precedence	undo priority-trust	Optional The switch trusts the port precedence by default.
Set the port precedence	**priority** *priority-level*	Optional The value of the port precedence is 0 by default.

Configuration example

Set to trust the port precedence and specify the precedence of the GigabitEthernet1/0/1 port to 7.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] undo priority-trust
[4200G-GigabitEthernet1/0/1] priority 7
```

Setting to Trust the 802.1p priority of the Packets

Refer to Trusting the 802.1p priority of the Packets for the description on trusting the 802.1p priority of the packets.

You can modify the “COS-->other precedence” mapping relationship as required.

Table 190 The “COS-->other precedence” mapping table and its default value

802.1p	Local-pre	Drop	DSCP
0	2	0	16
1	0	0	0
2	1	0	8
3	3	0	24
4	4	0	32
5	5	0	40
6	6	0	48
7	7	0	56

Configuration prerequisites

- The priority trust mode is specified to trusting the 802.1p priority of the packets
- The value of the “COS-->other precedence” mapping table is specified

Configuration procedure

Table 191 Setting to trust the 802.1p priority of the packets

Operation	Command	Description
Enter system view	system-view	-
Modify the "COS->Local-pre" mapping relationship	**qos cos-local-precedence-map** *cos0-map-local-prec cos1-map-local-prec cos2-map-local-prec cos3-map-local-prec cos4-map-local-prec cos5-map-local-prec cos6-map-local-prec cos7-map-local-prec*	Optional Refer to Table 190 The "COS-->other precedence" mapping table and its default value for the default value
Modify the "COS->Drop-precedence" mapping relationship	**qos cos-drop-precedence-map** *cos0-map-drop-prec cos1-map-drop-prec cos2-map-drop-prec cos3-map-drop-prec cos4-map-drop-prec cos5-map-drop-prec cos6-map-drop-prec cos7-map-drop-prec*	
Modify the "COS->DSCP-precedence" mapping relationship	**qos cos-dscp-map** *cos0-map-dscp cos1-map-dscp cos2-map-dscp cos3-map-dscp cos4-map-dscp cos5-map-dscp cos6-map-dscp cos7-map-dscp*	
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Set to trust the 802.1p priority of the packets	**priority-trust cos** [**automap**]	Required In the default mode, the switch does not replace the precedence carried in the packet with the mapped priority. In the automap mode, the switch replaces the precedence carried in the packet with the mapped precedence.
Display the "COS-->Drop-precedence" mapping relationship	display qos cos-drop-precedence-map	Optional You can execute the **display** command in any view
Display the "COS-->Local-precedence" mapping relationship	display qos cos-local-precedence-map	
Display the "COS-->DSCP" mapping relationship	display qos cos-dscp-map	

Configuration example

Set to trust the 802.1p priority of the packets and adopt the default value in the "COS->other precedence" mapping table. Specify the precedence of GigabitEthernet1/0/1 to 7.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] priority-trust cos
[4200G-GigabitEthernet1/0/1] priority 7
```

Setting to Trust the DSCP Precedence of the Packets

Refer to Trusting the DSCP Precedence of the Packets for the description on trusting the DSCP precedence of the packets.

You can modify the “DSCP-->other precedence” mapping relationship as required.

Table 192 The “DSCP-->other precedence” mapping table and its default value

DSCP	Local-pre	Drop	802.1p
0 to 7	0	1	1
8 to 15	1	1	2
16 to 23	2	1	0
24 to 31	3	1	3
32 to 39	4	0	4
40 to 47	5	0	5
48 to 55	6	0	6
56 to 63	7	0	7

The switch also provides a DSCP->DSCP mapping table. When the remap mode is selected, the switch will firstly obtain a new DSCP precedence by mapping the DSCP precedence of the packet, and then search for the DSCP->other priority mapping table according to the new DSCP precedence and assign other precedence for the packets.

Table 193 The “DSCP-->DSCP” mapping table and its default value

DSCP	New DSCP
0	0
1	1
.	.
.	.
.	.
61	61
62	62
63	63

Configuration prerequisites

- The priority trust mode is specified to trusting the DSCP precedence of the packets
- The mode adopted in trusting the DSCP precedence: automap, remap or the default mode is specified
- The value of the “DSCP-->other precedence” mapping table is specified
- If the remap mode is adopted, the value of the DSCP->DSCP mapping table needs specifying

Configuration procedure

Table 194 Setting to trust the DSCP precedence of the packets

Operation	Command	Description
Enter system view	system-view	-
Modify the "DSCP->Local-pre" mapping relationship	**qos dscp-local-precedence-map** *dscp-list* : *local-precedence*	Optional Refer to for the Table 192 and Table 193 for the default value.
Modify the "DSCP->Drop precedence" mapping relationship	**qos dscp-drop-precedence-map** *dscp-list* : *drop-precedence*	
Modify the "DSCP-->801.1p precedence" mapping relationship	**qos dscp-cos-map** *dscp-list* : *cos-value*	
Modify the "DSCP-->DSCP precedence" mapping relationship	**qos dscp-dscp-map** *dscp-list* : *dscp-value*	
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Set to trust the DSCP precedence of the packets	**priority-trust dscp** [**automap** | **remap**]	Required In the default mode, the switch does not replace the precedence carried in the packet with the mapped priority. In the automap mode, the switch replaces the precedence carried in the packet with the mapped precedence. In the remap mode, the switch firstly gets new DSCP precedence by the "DSCP--> DSCP" mapping relationship, then searches for the "DSCP-->other precedence" mapping table through the new DSCP precedence, and replaces the precedence carried in the packet with the mapped precedence.
Display the "DSCP-->Drop-precedence" mapping relationship	display qos dscp-drop-precedence-map	Optional You can execute the **display** command in any view
Display the "DSCP-->Local-precedence" mapping relationship	display qos dscp-local-precedence-map	
Display the "DSCP-->DSCP" mapping relationship	display qos dscp-dscp-map	
Display the "DSCP-->COS" mapping relationship	display qos dscp-cos-map	

Configuration example

Set to trust the DSCP precedence of the packets in the default mode and the DSCP->other priority mapping mode adopts the default value.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] priority-trust dscp
```

Configuring TP

Refer to T for the introduction to TP.

Configuration Prerequisites

- ACL rules used for traffic identifying are defined. Refer to the *ACL* module in the book for defining ACL rules
- The limit rate for TP, the actions for the packets within the specified traffic and the actions for the packets beyond the specified traffic have been specified.
- Whether statistics is performed on TP is determined
- The ports that needs this configuration is specified

Configuration Procedure of TP

Table 195 Configuring TP

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Use ACL rules in traffic identifying, perform traffic policing for the packets matching with the ACL rules and set traffic policing parameters.	**traffic-limit inbound** *acl-rule target-rate*	-
Display the parameter configurations of traffic policing	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-limit**	Optional You can execute the **display** command in any view
Display all the QoS settings of the port	**display qos-interface** { *interface-type interface-num* | *unit-id* } **all**	

acl-rule: Issued ACL rules which can be the combination of various ACL rules. The way of combination is described in Table 196.

Table 196 The ways of issuing combined ACLs

The way of combination	The form of *acl-rule*
Issue all the rules in an IP ACL separately	**ip-group** *acl-number*
Issue a rule in an IP ACL separately	**ip-group** *acl-number* **rule** *rule*
Issue all the rules in a Link ACL separately	**link-group** *acl-number*
Issue a rule in a Link ACL separately	**link-group** *acl-number* **rule** *rule*
Issue a rule in an IP ACL and a rule in a Link ACL at the same time	**ip-group** *acl-number* **rule** *rule* **link-group** *acl-number* **rule** *rule*

Displaying the Statistics of TP

Table 197 Clearing the statistics of TP

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Clear the statistics of the TP matching with the specified ACL rules	**reset traffic-limit inbound** *acl-rule*	Required The clearing function is effective only when the TP statistics function is configured

Table 197 Clearing the statistics of TP

Display the statistics of TP	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-limit**	Required The statistics of TP includes the bytes of the packets within the limited rate and the bytes of the packets beyond the limited rate. When the statistics count reaches the upper threshold, the switch will restart statistics. It is recommended to use the **display** command to display within 30 seconds after the **reset** command is executed

Configuration Example

- The GigabitEthernet1/0/1 of the switch is accessed into the 10.1.1.1/24 network segment
- Perform TP on the packets from the 10.1.1.1/24 network segment and the rate of TP is set to100kbps
- The packets within the specified traffic are forwarded after their DSCP precedence is marked as 16, and the packets beyond the traffic are forwarded after their DSCP precedence is marked as 56

Configuration procedure

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] acl number 2000
[4200G-acl-basic-2000] rule permit source 10.1.1.1 0.0.0.255
[4200G-acl-basic-2000] rule deny source any
[4200G-acl-basic-2000] quit
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] traffic-limit inbound ip-group 2000 100
```

Configuring TS

Refer to T for the introduction to TS.

Configuration Prerequisites

- Whether the TS is performed on all the traffic on the port or the specified output queues on the port is determined
- The max rate and burst size of the port in the TS are specified
- The ports that needs this configuration is specified

Configuration Procedure

Table 198 Configuring TS

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	TS cannot be performed on the piled ports

Table 198 Configuring TS

Start TS and send the packets at a even rate	**traffic-shape** [**queue** *queue-id*] *max-rate burst-size*	Required The switch supports two forms of TS: ■ TS for all the traffic on the port. The function can be implemented when the **queue** *queue-id* keyword is not specified in the **traffic** command ■ The function of TS for the specified output queues can be implemented when the **queue** *queue-id* keyword is specified in the **traffic-shape** command.
Display the parameter configurations of TS	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-shape**	Optional You can execute the **display** command in any view
Display all the QoS settings of the port	**display qos-interface** { *interface-type interface-num* | *unit-id* } **all**	

Configuration Example

Perform TS on all the traffic on the GigabitEthernet1/0/1. Set the max rate to 650kbps and the burst size to 12kbytes.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] traffic-shape 650 12
```

Configuring Queue-scheduling

Refer to Queue Scheduling for the introduction to queue scheduling.

Configuration Prerequisites

- The queue-scheduling algorithm is specified: which queues adopt the SDWRR queue-scheduling algorithm and which queues adopts the SP queue-scheduling algorithm
- If the SDWRR queue-scheduling algorithm is adopted, the queues and their weights in WRR scheduling group1 and WRR scheduling group2 must be specified

Configuration Procedure of the SP Queue Scheduling

Table 199 Configuring the SP queue scheduling

Operation	Command	Description
Enter system view	system-view	-
Set the SP queue-scheduling algorithm	**undo queue-scheduler** [*queue-id*] &<1-8>	Optional All the output queues on the ports of the switch adopt the SP queue-scheduling algorithm by default
Display the queue-scheduling mode and related parameters on the switch	display queue-scheduler	Optional You can execute the **display** command in any view

Configuration Procedure of the SDWRR Queue Scheduling

Table 200 Configuring the SDWRR queue scheduling

Operation	Command	Description
Enter system view	system-view	-
Set the SDWRR queue-scheduling algorithm and its parameters	**queue-scheduler wrr** { **group1** { *queue-id queue-weight* } &<1-8> | **group2** { *queue-id queue-weight* } &<1-8> }*	Required
Display the queue-scheduling mode and related parameters on the switch	display queue-scheduler	Optional You can execute the **display** command in any view

Configuration Example

- Set the queue-scheduling mode of queue0 to queue5 to the SDWRR queue scheduling, and that of queue6 and queue7 to the default SP queue scheduling
- Queue3, queue4, and queue5 join in the WRR scheduling group1, with the weight of 20, 20, and 30 respectively
- Queue0, queue1, and queue2 join in the WRR scheduling group2, with the weight of 20, 20, and 40 respectively

Configuration procedure:

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] queue-scheduler wrr group1 3 20 4 20 5 30 group2 0 20 1 20 2 40
```

Configuring Traffic Statistics

Refer to Traffic-based Traffic Statistics for the introduction to traffic statistics.

Configuration Prerequisites

- ACL rules used for traffic identifying are defined. Refer to the *ACL* module in the book for defining ACL rules
- The ports that needs this configuration are specified

Configuration Procedure of Traffic Statistics

Table 201 Configuring traffic statistics

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Use the ACL rules in traffic identifying and perform traffic statistics on the packets matching with the ACL rules.	**traffic-statistic inbound** *acl-rule*	Required
Display the traffic statistics.	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-statistic**	Optional You can execute the **display** command in any view
Display all the QoS settings of the port	**display qos-interface** { *interface-type interface-num* | *unit-id* } **all**	

acl-rule: Issued ACL rules which can be the combination of various ACL rules. The way of combination is described Table 202.

Table 202 The ways of issuing combined ACLs

The way of combination	The form of ***acl-rule***
Issue all the rules in an IP ACL separately	**ip-group** *acl-number*
Issue a rule in an IP ACL separately	**ip-group** *acl-number* **rule** *rule*
Issue all the rules in a Link ACL separately	**link-group** *acl-number*
Issue a rule in a Link ACL separately	**link-group** *acl-number* **rule** *rule*
Issue a rule in an IP ACL and a rule in a Link ACL at the same time	**ip-group** *acl-number* **rule** *rule* **link-group** *acl-number* **rule** *rule*

Clearing the Traffic Statistics

Table 203 Clearing the traffic statistics

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Clear the statistics of the traffic matching with the specified ACL rules	**reset traffic-statistic inbound** *acl-rule*	Required The function of clearing is effective only when the traffic statistics function is configured

Configuration Example

- The GigabitEthernet1/0/1 of the switch is accessed into the 10.1.1.1/24 network segment
- Perform traffic statistics on packets form the 10.1.1.1/24 network segment

Configuration procedure:

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] acl number 2000
[4200G-acl-basic-2000] rule permit source 10.1.1.1 0.0.0.255
[4200G-acl-basic-2000] rule deny source any
[4200G-acl-basic-2000] quit
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] traffic-statistic inbound ip-group 2000
```

Setting the Precedence of Protocol Packet

The protocol packet carries its own precedence. You can modify the precedence of the protocol packet through setting its precedence. And then you can match the precedence with the corresponding QoS action to perform the corresponding QoS operation on the protocol packet.

Configuration Prerequisites

- The protocol type whose precedence needs modification is specified
- The precedence value after modification is specified

Configuration Procedure

Table 204 Setting the precedence of the protocol packet

Operation	Command	Description
Enter system view	system-view	-

Table 204 Setting the precedence of the protocol packet

Set the precedence of the protocol packet	**protocol-priority protocol-type** *protocol-type* { **ip-precedence** *ip-precedence* | **dscp** *dscp-value* }	Required You can modify the IP precedence or DSCP precedence of the protocol packet Only the precedence of TELNET, SNMP, and ICMP protocol packets is supported currently
Display the precedence of the protocol packet	display protocol-priority	Optional You can execute the **display** command in any view

Configuration Example

Set the IP precedence of the ICMP protocol packet to 3.

The configuration procedure is as follows:

```
<S4200G> system-view
[4200G] protocol-priority protocol-type icmp ip-precedence 3
[4200G] display protocol-priority
```

Displaying and Maintaining QoS

After finishing the configurations mentioned above, you can execute the **display** command in any view to check the running state of QoS after the configuration. You can verify the effects of the configurations by checking the information on display.

Table 205 Displaying and maintaining QoS

Operation	Command
Display the parameter configurations of the mirroring group	**display mirroring-group** { *group-id* | **all** | **local** | **remote-destination** | **remote-source** }
Display the precedence of the protocol packet	display protocol-priority
Display the “COS-->Drop-precedence” mapping relationship	display qos cos-drop-precedence-map
Display the “COS-->DSCP” mapping relationship	display qos cos-dscp-map
Display the “COS-->Local-precedence” mapping relationship	display qos cos-local-precedence-map
Display the “DSCP-->802.1p priority” mapping relationship	display qos dscp-cos-map
Display the “DSCP-->Drop-precedence” mapping relationship	display qos dscp-drop-precedence-map
Display the “DSCP-->DSCP” mapping relationship	display qos dscp-dscp-map
Display the “DSCP-->Local-precedence” mapping relationship	display qos dscp-local-precedence-map
Display all the QoS settings of the port	**display qos-interface** { *interface-type interface-num* | *unit-id* } **all**
Display the parameter configurations of traffic mirroring	**display qos-interface** { *interface-type interface-num* | *unit-id* } **mirrored-to**
Display the priority mapping mode of the switch	**display qos-interface** { *interface-type interface-num* | *unit-id* } **priority-trust**

Table 205 Displaying and maintaining QoS (Continued)

Operation	Command
Display the parameter configurations of traffic policing	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-limit**
Display the parameter configurations of TS	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-shape**
Display the traffic statistics	**display qos-interface** { *interface-type interface-num* | *unit-id* } **traffic-statistic**
Display the queue scheduling mode and related parameters on the switch	display queue-scheduler

QoS Configuration Example

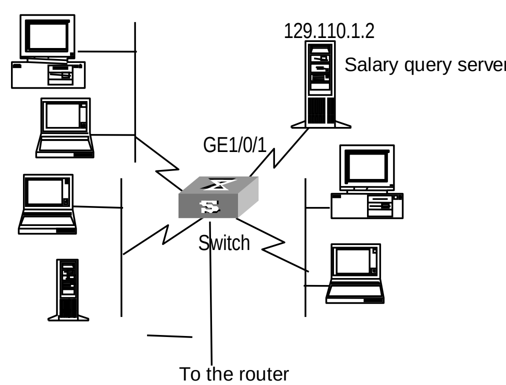
Configuration Example of TP and Limiting Rate on the Port

I.Network requirement

The enterprise network interworks all the departments through the ports of the Ethernet switch. The salary query server is accessed through the GigabitEthernet1/0/1 whose subnet address is 129.110.1.2.The network requirements are to limit the average rate of outbound traffic within 640kbps and set the precedence of packets exceeding the specification to 4.

Network diagram

Figure 75 QoS configuration example



Configuration procedure

Only the commands related with QoS/ACL configurations are listed in the following configurations.

1 Define the outbound traffic of the salary query server

a Enter ACL 3000 view.

```
<S4200G> system-view
[4200G] acl number 3000
```

b Define ACL 3000 rules.

```
[4200G-acl-adv-3000] rule 1 permit ip source 129.110.1.2 0.0.0.0
destination any
[4200G-acl-adv-3000] rule deny ip source any destination any
```

[4200G-acl-adv-3000] **quit**

2 Limit the outbound traffic of the salary query server

a Limit the average rate of outbound traffic within 640kbps and set the precedence of packets exceeding the specification to 4.

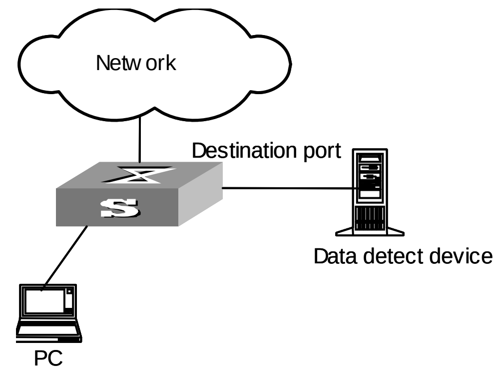
```
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] traffic-limit inbound ip-group 3000 640
exceed remark-dscp 4
```

28 CONFIGURATION FOR MIRRORING FEATURES

Mirroring Features

Mirroring refers to the process of copying packets that meet the specified rules to a destination port. Generally, a destination port is connected to a data detect device, which users can use to analyze the mirrored packets for monitoring and troubleshooting the network.

Figure 76 Mirroring



Traffic Mirroring

Uses ACLs to identify traffic flows and mirror packets that match to the destination port.

Port Mirroring

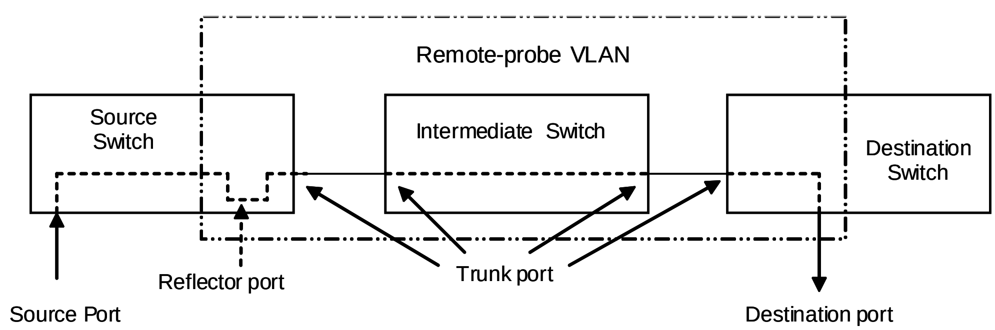
Port mirroring refers to the process of copying the packets received or sent by the specified port to the destination port.

Remote Port Mirroring—RSPAN

Remote switched port analyzer (RSPAN) refers to remote port mirroring. It eliminates the limitation that the mirrored port and the mirroring port must be located on the same switch. This feature makes it possible for the mirrored port and the mirroring port to be located across several devices in the network, and facilitates the network administrator to manage remote switches.

The application of RSPAN is illustrated in Figure 76:

Figure 77 RSPAN application



There are three types of switches with the RSPAN enabled.

- Source switch: the switch to which the monitored port belongs.

- Intermediate switch: the switch between the source and the destination switch on the network.
- Destination switch: the switch to which the destination port for remote mirroring belongs.

Table 206 describes how the ports on various switches are involved in the mirroring operation.

Table 206 Ports involved in the mirroring operation

Switch	Ports involved	Function
Source switch	Source port	Port to be mirrored; copy user data packets to the specified reflector port through local port mirroring. There can be more than one source port.
	Reflector port	Receive user data packets that are mirrored on a local port.
	Trunk port	Send mirrored packets to the intermediate switch or the destination switch.
Intermediate switch	Trunk port	Send mirrored packets to the destination switch. Two Trunk ports are necessary for the intermediate switch to be connected to devices that are connected to the source switch and the destination switch.
Destination switch	Trunk port	Receive remote mirrored packets.
	Destination port	Monitor remote mirrored packets

To implement remote port management, you need to define a special VLAN, called Remote-probe VLAN, on all the three types of switches. All mirrored packets will be transferred to the mirrored ports of the destination switch from the source switch using this VLAN. Thus, the destination switch can monitor the port packets sent from the remote ports of the source switch. Remote-probe VLAN has the following features:

- The ports connecting the devices and in remote-probe VLAN must be of trunk type.
- The default VLAN, management VLAN, and super VLAN cannot be configured as remote-probe VLAN.

CAUTION: *You are not recommended to perform any of the following operations on the remote-probe VLAN:*

Configuring a source port to the remote-probe VLAN that is used by the local mirroring group

Configuring a Layer 3 interface

Running other protocol packets, or bearing other service packets;

Using remote-probe VLAN as a special type of VLAN, such as sub VLAN, voice VLAN or protocol VLAN

MAC-Based Mirroring

In MAC-based mirroring, the device mirrors the following packets to the destination port.

- Packets whose source MAC addresses match the specified MAC addresses
- Packets whose destination MAC addresses match the specified MAC addresses

VLAN-Based Mirroring

In VLAN-based mirroring, the device mirrors all packets received by the ports that belong to the VLAN to the destination port.

Mirroring Supported by Switch 4200G

Table 207 Mirroring functions supported by S4200G and related command

Function	Specifications	Related command	Link
Mirroring	Supports traffic mirroring	monitor-port mirrored-to	Configuring Traffic Mirroring
	Supports port mirroring	mirroring-group **mirroring-group mirroring-port** mirroring-group monitor-port monitor-port mirroring-port	Configuring Port Mirroring
	Supports remote port mirroring	mirroring-group **mirroring-group mirroring-port** **mirroring-group monitor-port** **mirroring-group reflector-port** **mirroring-group remote-probe vlan**	Configuring RSPAN
	Supports MAC-based mirroring	**mirroring-group mirroring-mac**	Configuring MAC-Based Mirroring
	Supports VLAN-based mirroring	**mirroring-group mirroring-vlan**	Configuring VLAN-Based Mirroring

Mirroring Configuration

For mirroring features, see “Mirroring Features”.

Configuring Traffic Mirroring

Configuration prerequisites

- ACLs for identifying traffics have been defined. For defining ACLs, see the description on the ACL module in this manual.
- The destination port has been defined.
- The port on which to perform this configuration has been determined.

Configuration procedure

Table 208 Configure traffic mirroring

Operation	Command	Description
Enter system view	system-view	-
Enter Ethernet port view of the destination port	**interface** *interface-type interface-number*	-
Define the current port as the destination port	monitor-port	Required
Exit current view	quit	-
Enter Ethernet port view of traffic mirroring configuration	**interface** *interface-type interface-number*	-
Reference ACLs for identifying traffic flows and perform traffic mirroring for packets that match.	**mirrored-to inbound** *acl-rule* **monitor-interface**	Required
Display the parameter settings of traffic mirroring	**display qos-interface** { *interface-type interface-num* | *unit-id* } **mirrored-to**	Optional The **display** command can be executed in any view
Display all QoS settings of a port	**display qos-interface** { *interface-type interface-num* | *unit-id* } **all**	

acl-rule: applied ACL rules, which can be the combination of different types of ACL rules. Table 209 describes the ACL combinations.

Table 209 Combined application of ACLs

Combination mode	Form of *acl-rule*
Apply all rules in an IP type ACL separately	**ip-group** *acl-number*
Apply one rule in an IP type ACL separately	**ip-group** *acl-number* **rule** *rule*
Apply all rules in a Link type ACL separately	**link-group** *acl-number*
Apply one rule in a Link type ACL separately	**link-group** *acl-number* **rule** *rule*
Apply one rule in an IP type ACL and one rule in a Link type ACL simultaneously	**ip-group** *acl-number* **rule** *rule* **link-group** *acl-number* **rule** *rule*

Configuration example

- GigabitEthernet1/0/1 on the switch is connected to the 10.1.1.1/24 network segment.
- Mirror the packets from the 10.1.1.1/24 network segment to GigabitEthernet1/0/7, the destination port.

Configuration procedure:

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] acl number 2000
[4200G-acl-basic-2000] rule permit source 10.1.1.1 0.0.0.255
[4200G-acl-basic-2000] rule deny source any
[4200G-acl-basic-2000] quit
[4200G] interface gigabitEthernet1/0/7
[4200G-GigabitEthernet1/0/7] monitor-port
[4200G-GigabitEthernet1/0/7] quit
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] mirrored-to inbound ip-group 2000
monitor-interface
```

Configuring Port Mirroring

Configuration prerequisites

- The source port is specified and whether the packets to be mirrored are inbound or outbound is specified: **inbound**: only mirrors the packets received using the port; **outbound**: only mirrors the packets sent by the port; **both:** mirrors the packets received and sent by the port at the same time.
- The destination port is specified.
- The group number of the mirroring group is specified.

Configuring port mirroring in Ethernet port view

Table 210 Configure port mirroring in Ethernet port view (1)

Operation	Command	Description
Enter system view	system-view	-
Create a port mirroring group	**mirroring-group** *group-id* **local**	Required
Enter Ethernet port view of the destination port	**interface** *interface-type interface-number*	-
Define the current port as the destination port	monitor-port	Required The destination port of mirroring group 1 is configured in this mode.
Exit current view	quit	-
Enter Ethernet port view of the source port	**interface** *interface-type interface-number*	-
Configure the source port and specify the direction of the packets to be mirrored	**mirroring-port** { **inbound** | **outbound** | **both** }	Required The source port of mirroring group 1 is configured in this mode.
Display parameter settings of the mirroring	**display mirroring-group** { **all** | **local }**	Optional The **display** command can be executed in any view

Table 211 Configure port mirroring in Ethernet port view (2)

Operation	Command	Description
Enter system view	system-view	-
Create a port mirroring group	**mirroring-group** *group-id* **local**	Required
Enter Ethernet port view of the destination port	**interface** *interface-type interface-number*	-
Define the current port as the destination port	**mirroring-group** *group-id* **monitor-port**	Required
Exit current view	quit	-
Enter Ethernet port view of the source port	**interface** *interface-type interface-number*	-
Configure the source port and specify the direction of the packets to be mirrored	**mirroring-group** *group-id* **mirroring-port** { **both** | **inbound** | **outbound** }	Required
Display parameter settings of the mirroring	**display mirroring-group** { **all** | **local }**	Required The **display** command can be executed in any view

Configuring port mirroring in system view

Table 212 Configure port mirroring in system view

Operation	Command	Description
Enter system view	system-view	-
Create a port mirroring group	**mirroring-group** *group-id* **local**	Required
Configure the destination port	**mirroring-group** *group-id* **monitor-port** *monitor-port*	Required
Configure the source port and specify the direction of the packets to be mirrored	**mirroring-group** *group-id* **mirroring-port** *mirroring-port-list* { **both** | **inbound** | **outbound** }	Required
Display parameter settings of the mirroring	**display mirroring-group** { **all** | **local }**	Optional The **display** command can be executed in any view

Configuration Example

- The source port is GigabitEthernet1/0/1. Mirror all packets received and sent using this port.
- The destination port is GigabitEthernet1/0/7.

Configuration procedure:

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] mirroring-group 1 local
[4200G] interface gigabitEthernet1/0/7
[4200G-GigabitEthernet1/0/7] monitor-port
[4200G-GigabitEthernet1/0/7] quit
[4200G] interface gigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] mirroring-port both
```

Configuring MAC-Based Mirroring

In MAC-based mirroring configuration, the MAC address you enter must be a static MAC address that already exists in the MAC address entries. With the MAC-based mirroring configured, the device mirrors the following packets to the destination port:

- Packets whose source MAC addresses match the specified MAC addresses
- Packets whose destination MAC addresses match the specified MAC addresses

Configuration prerequisites

- The MAC address you enter must be a static MAC address that already exists in the MAC address entries.
- The destination port is specified.

Configuration procedure

Table 213 Configure MAC-based mirroring

Operation	Command	Description
Enter system view	system-view	-
Define a MAC-based local mirroring group	**mirroring-group** *group-id* **local**	Required
Configure MAC-based mirroring	**mirroring-group** *group-id* **mirroring-mac** *mac* **vlan** *vlan-id*	Required
Enter Ethernet port view of the destination port	**interface** *interface-type interface-number*	-
Define the current port as the destination port	**mirroring-group** *group-id* **monitor-port**	Required
Display parameter settings of the mirroring	**display mirroring-group** { *group-id* | **all** | **local** }	Optional command can be executed in any view

Configuration example

- Configure MAC-based mirroring to mirror the packets matching the MAC address 00e0-fc01-0101 to the destination port.
- The destination port is GigabitEthernet1/0/2.

Configuration procedure:

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] mac-address static 00e0-fc01-0101 interface gigabitethernet
1/0/1 vlan 2
[4200G] mirroring-group 1 local
[4200G] mirroring-group 1 mirroring-mac 00e0-fc01-0101 vlan 2
[4200G] interface gigabitethernet 1/0/2
[4200G-GigabitEthernet1/0/2] mirroring-group 1 monitor-port
```

Configuring VLAN-Based Mirroring

VLAN-based mirroring allows you to mirror packets received by all ports that belong to the VLAN to the destination port.

Configuration prerequisites

- The ID of the VLAN to be configured with VLAN-based mirroring has been determined.
- The destination port is specified.

Configuration procedure

Table 214 Configure VLAN-based mirroring

Operation	Command	Description
Enter system view	system-view	-
Define a VLAN-based local mirroring group	**mirroring-group** *group-id* **local**	Required
Configure VLAN-based mirroring	**mirroring-group** *group-id* **mirroring-vlan** *vlan-id* **inbound**	Required
Enter Ethernet port view of the destination port	**interface** *interface-type interface-number*	-
Define the current port as the destination port	**mirroring-group** *group-id* **monitor-port**	Required
Display the parameter settings of the mirroring	**display mirroring-group** { *group-id* | **all** | **local** }	Required The **display** command can be executed in any view

Configuration example

- Configure VLAN-based mirroring to mirror the packets received by all ports in VLAN 2.
- The destination port is GigabitEthernet1/0/2.

Configuration procedure:

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] mirroring-group 1 local
[4200G] mirroring-group 1 mirroring-vlan 2 inbound
[4200G] interface gigabitethernet 1/0/2
[4200G-GigabitEthernet1/0/2] mirroring-group 1 monitor-port
```

Configuring RSPAN

The RSPAN feature of S4200G allows for MAC-based and VLAN-based remote mirroring.

You can implement MAC-based and VLAN-based remote mirroring by performing MAC-based and VLAN-based configurations on the remote source mirroring group of the source switch.

Configuration prerequisites

- The source switch, intermediate switch, and the destination switch have been determined.
- The source port, the reflector port, the destination port, and the Remote-probe VLAN have been determined.
- The direction of the packets to be monitored has been determined.
- Intermediate switch and source switch support the function of MAC-learning-disabled-based-on-VLAN, which also is enabled for Remote-probe VLAN.
- If you are configuring MAC-based remote mirroring, verify that the MAC address you enter is a static MAC address that already exists in the MAC address entries.
- If you are configuring VLAN-based remote mirroring, determine the corresponding VLAN ID.

Configuring RSPAN on the source switch

Table 215 Configure RSPAN on the source switch

Operation	Command	Description
Enter system view	system-view	-
Create a remote-probe VLAN and enter VLAN view	**vlan** *vlan-id*	*vlan-id* is the ID of the remote-probe VLAN.
Define the current VLAN as a remote-probe VLAN	remote-probe vlan enable	Required
Exit current view	quit	-
Enter Ethernet port view of Trunk ports	**interface** *interface-type interface-number*	-
Configure Trunk port to permit packets from the Remote-probe VLAN	**port trunk permit vlan** *remote*-probe-*vlan-id*	Required
Exit current view	quit	-
Configure a remote source mirroring group	**mirroring-group** *group-id* **remote-source**	Required
Configure a source port for remote mirroring	**mirroring-group** *group-id* **mirroring-port** *mirroring-port-list* { **both** | **inbound** | **outbound** }	Required
Configure MAC-based mirroring	**mirroring-group** *group-id* **mirroring-mac** *mac* **vlan** *vlan-id*	Optional
Configure VLAN-based mirroring	**mirroring-group** *group-id* **mirroring-vlan** *vlan-id* **inbound**	Optional
Configure a remote reflector port	**mirroring-group** *group-id* **reflector-port** *reflector-port*	Required After a port is configured as a reflector port, the device does not allow you to perform any of the following configurations: ● Configuring broadcast storm suppression on the port ● Configuring the **vlan-vpn enable** command on the port ● Enabling STP on the port
Configure the remote-probe VLAN for the remote source mirroring group	**mirroring-group** *group-id* **remote-probe vlan** *remote-probe-vlan-id*	Required
Display the configuration of the remote source mirroring group	display mirroring-group remote-source	Optional The **display** command can be executed in any view

Configuring RSPAN on the intermediate switch

Table 216 Configure RSPAN on the intermediate switch

Operation	Command	Description
Enter system view	system-view	-
Create a remote-probe VLAN and enter VLAN view	**vlan** *vlan-id*	*vlan-id* is the ID of the Remote-probe VLAN.
Exit current view	quit	-
Enter Ethernet port view of Trunk port	**interface** *interface-type interface-number*	-

Table 216 Configure RSPAN on the intermediate switch (Continued)

Operation	Command	Description
Configure Trunk port to permit packets from the remote-probe VLAN	**port trunk permit vlan** *remote-probe-vlan-id*	Required This configuration is necessary for ports on the intermediate switch that are connected to the source switch or the destination switch.

Configuring RSPAN on the destination switch

Table 217 Configure RSPAN on the destination switch

Operation	Command	Description
Enter system view	system-view	-
Create a remote-probe VLAN and enter VLAN view	**vlan** *vlan-id*	v*lan-id* is the ID of the Remote-probe VLAN.
Define the current VLAN as a remote-probe VLAN	remote-probe vlan enable	Required
Exit the current view	quit	-
Enter Ethernet port view of Trunk port	**interface** *interface-type interface-number*	-
Configure Trunk port to permit packets from the remote-probe VLAN	**port trunk permit vlan** *remote*-probe-*vlan-id*	Required
Exit current view	quit	-
Configure the remote destination mirroring group	**mirroring-group** *group-id* **remote-destination**	Required
Configure the destination port for remote mirroring	**mirroring-group** *group-id* **monitor-port** *monitor-port*	Required STP cannot be enabled on destination port for remote mirroring. After you configure a port as the destination port for remote mirroring, the switch does not allow you to change the port type or default VLAN ID of the port.
Configure the remote-probe VLAN for the remote destination mirroring group	**mirroring-group** *group-id* **remote-probe vlan** *remote-probe-vlan-id*	Required
Display the configuration of the remote destination mirroring group	display mirroring-group remote-destination	Optional The **display** command can be executed in any view

Configuration example

- Switch A is connected to the data detect device using GigabitEthernet1/0/2.
- GigabitEthernet1/0/1, the Trunk port of Switch A, is connected to GigabitEthernet 1/0/1, the Trunk port of Switch B.
- GigabitEthernet1/0/2, the Trunk port of Switch B, is connected to GigabitEthernet 1/0/1, the Trunk port of Switch C.
- GigabitEthernet1/0/2, the port of Switch C, is connected to PC1.

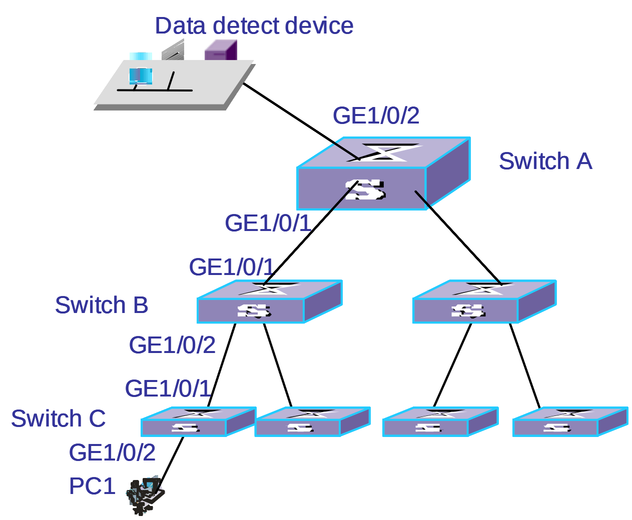
The purpose is to monitor and analyze the packets sent to PC1 using the data detect device.

To meet the requirement above by using the RSPAN function, perform the following configuration:

- Define VLAN10 as remote-probe VLAN.
- Define Switch A as the destination switch; configure Ethernet1/0/2, the port that is connected to the data detect device, as the destination port for remote mirroring. Disable the STP function on GigabitEthernet1/0/2.
- Define Switch B as the intermediate switch.
- Define Switch C as the source switch, GigabitEthernet1/0/2 as the source port for remote mirroring, and GigabitEthernet1/0/5 as the reflector port. Set GigabitEthernet1/0/5 to an Access port, with STP disabled.

Network diagram

Figure 78 Network diagram for RSPAN



The configuration procedure is as follows:

1 Configure Switch C.

```
<S4200G> system-view
[4200G] vlan 10
[4200G-vlan10] remote-probe vlan enable
[4200G-vlan10] quit
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] port trunk permit vlan 10
[4200G-GigabitEthernet1/0/1] quit
[4200G] mirroring-group 1 remote-source
[4200G] mirroring-group 1 mirroring-port gigabitethernet1/0/2 outbound
[4200G] mirroring-group 1 reflector-port gigabitethernet1/0/5
[4200G] mirroring-group 1 remote-probe vlan 10
[4200G] display mirroring-group remote-source
mirroring-group 1:    type: remote-source    status: active    mirroring
port:         GigabitEthernet1/0/2  outbound    mirroring mac:
mirroring vlan:    reflector port: GigabitEthernet1/0/5    remote-probe
vlan: 10
```

2 Configure Switch B.

```
<S4200G> system-view
[4200G] vlan 10
[4200G-vlan10] quit
```

```
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] port trunk permit vlan 10
[4200G-GigabitEthernet1/0/1] quit
[4200G] interface gigabitethernet1/0/2
[4200G-GigabitEthernet1/0/2] port trunk permit vlan 10
```

3 Configure Switch A.

```
<S4200G> system-view
[4200G] vlan 10
[4200G-vlan10] remote-probe vlan enable
[4200G-vlan10] quit
[4200G] interface gigabitethernet1/0/1
[4200G-GigabitEthernet1/0/1] port trunk permit vlan 10
[4200G-GigabitEthernet1/0/1] quit
[4200G] mirroring-group 1 remote-destination
[4200G] mirroring-group 1 monitor-port gigabitethernet1/0/2
[4200G] mirroring-group 1 remote-probe vlan 10
[4200G] display mirroring-group remote-destination
mirroring-group 1:    type: remote-destination    status: active
monitor port: GigabitEthernet1/0/2    remote-probe vlan: 10
```

Displaying and Debugging Mirroring

After the above-mentioned configuration, you can use the **display** command in any view to view the mirroring running information, so as to verify configuration result.

Table 218 Display and debug mirroring

Operation	Command
Display parameter settings of a mirroring group	**display mirroring-group** { *group-id* | **all** | **local** | **remote-destination** | **remote-source** }
Display parameter settings of traffic mirroring	**display qos-interface** { *interface-type interface-num* | *unit-id* } **mirrored-to**

29 IGMP SNOOPING CONFIGURATION

Overview of IGMP Snooping

IGMP Snooping Fundamentals

IGMP Snooping (Internet Group Management Protocol Snooping) is a multicast control mechanism running on Layer 2 switch. It is used to manage and control multicast groups.

When the IGMP messages transferred from the hosts to the router pass through the Layer 2 switch, the switch uses IGMP Snooping to analyze and process the IGMP messages.

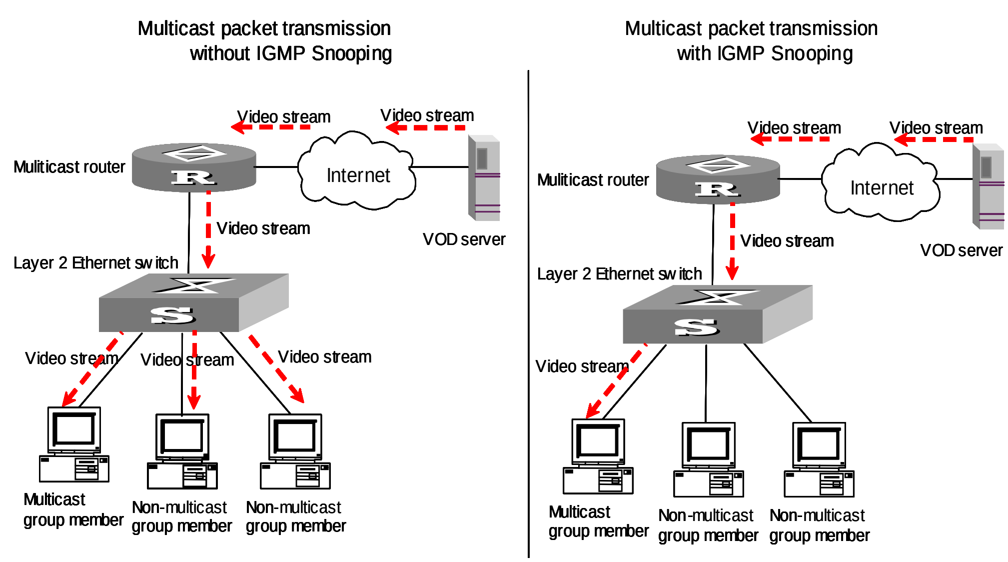
Table 219 IGMP message processing on the switch

Received message type	Sender	Receiver	Switch processing
IGMP host report message	Host	Switch	Add the host to the corresponding multicast group.
IGMP leave message	Host	Switch	Remove the host from the multicast group.

By listening to IGMP messages, the switch establishes and maintains MAC multicast address tables at data link layer, and uses the tables to forward the multicast packets delivered from the router.

As shown in Figure 79, multicast packets are broadcasted at Layer 2 when IGMP Snooping is disabled and multicasted (not broadcasted) at Layer 2 when IGMP Snooping is enabled.

Figure 79 Multicast packet transmission with or without IGMP Snooping



IGMP Snooping Fundamentals

IGMP Snooping terminologies

Before going on, we first describe the following terms involved in IGMP Snooping:

- Router port: the switch port directly connected to the multicast router.
- Multicast member port: a switch port connected to a multicast group member (a host in a multicast group).
- MAC multicast group: a multicast group identified by a MAC multicast address and maintained by the switch.

The following three timers are closely associated with IGMP snooping.

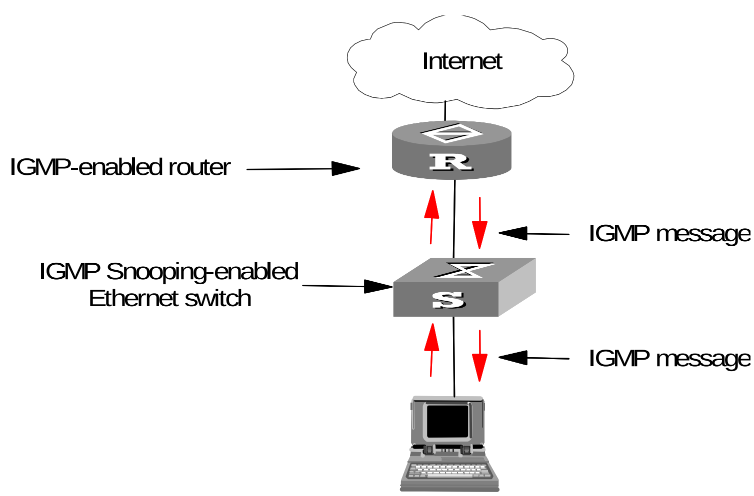
Table 220 IGMP Snooping timers

Timer	Setting	Message normally received before timeout	Timeout action on the switch
Router port aging timer	Aging time of the router port	IGMP general query message	Consider that this port is not a router port any more.
Multicast member port aging timer	Aging time of the multicast member ports	IGMP report message	Send an IGMP group-specific query message to the multicast member port.
Query response timer	Query response timeout time	IGMP report message	Remove the port from the member port list of the multicast group.

Layer 2 multicast with IGMP Snooping

The switch runs IGMP Snooping to listen to IGMP messages and map the hosts and the ports that connect the hosts to the corresponding multicast group addresses.

Figure 80 IGMP Snooping implementation



To implement Layer 2 multicast, the switch processes four different types of IGMP messages it received, as shown in Table 221.

Table 221 IGMP Snooping messages

Message	Sender	Receiver	Purpose	Switch action
IGMP general query message	Multicast router and multicast switch	Multicast member switch and host	Query if the multicast groups contain any member	Check if the message comes from the original router port • If yes, reset the aging timer of the router port. • If not, notify the multicast router that a member is in a multicast group and start the aging timer for the router port.
IGMP group-specific query message	Multicast router and multicast switch	Multicast member switch and host	Query if a specific multicast group contains any member	Send a group-specific query message to the IP multicast group being queried.
IGMP host report message	Host	Multicast router and multicast switch	Apply for joining a multicast group, or respond to an IGMP query message	Check if the IP multicast group has a corresponding MAC multicast group • If yes, check if the port exists in the MAC multicast group. – If yes, add the IP multicast group address to the MAC multicast group table. – If not, add the port to the MAC multicast group, trigger the aging timer of the port and check if the corresponding IP multicast group exists. If yes, add the port to the IP multicast group. If not, create an IP multicast group and add the port to it. • If not: Create a MAC multicast group and notify the multicast router that a member is ready to join the multicast group. Add the port to the MAC multicast group and start the aging timer of the port. Add all router ports in the VLAN owning this port to the forward port list of the MAC multicast group. Add the port to the IP multicast group.
IGMP leave message	Host	Multicast router and multicast switch	Notify the multicast router and multicast switch that the host is leaving its multicast group.	Multicast router and multicast switch send group-specific query packet(s) to the port receiving the leave message to check if the port has any member, and start the corresponding query response timer. • If no response is received from the port before the timer times out, the switch will check whether the port corresponds to a single MAC multicast group. ● If yes, remove the corresponding MAC multicast group and IP multicast group. ● If no, remove only those entries that correspond to this port in the MAC multicast group, and remove the corresponding IP multicast group entries. • If no response is received from the multicast group before the timer times out, notify the router to remove this multicast group node from the multicast tree.

IGMP Snooping Configuration

The following sections describe the IGMP Snooping configuration tasks.

- Enabling IGMP Snooping
- Configuring Timers
- Enabling IGMP Fast Leave Processing
- Configuring IGMP Snooping Filtering ACL
- Configuring to Limit Port Multicast Group Number
- Configuring Multicast VLAN

Among them, enabling IGMP Snooping is required, while others are optional (you can determine whether or not to perform these tasks according to your needs).

Enabling IGMP Snooping

You can use the command here to enable IGMP Snooping so that it can establish and maintain MAC multicast forwarding tables at layer 2.

Table 222 Enable IGMP Snooping

Operation	Command	Description
Enter system view	**system-view**	—
Enable IGMP Snooping globally	**igmp-snooping enable**	Required IGMP Snooping is disabled globally.
Enter VLAN view	**vlan** *vlan-id*	—
Enable IGMP Snooping on the VLAN	**igmp-snooping enable**	Required By default, IGMP Snooping is disabled on the VLAN.

CAUTION: *Although both Layer 2 and Layer 3 multicast protocols can run on the same switch simultaneously, they cannot run simultaneously on a VLAN and its corresponding VLAN interface.*

IGMP Snooping functions on a VLAN only when it is first enabled globally in system view and then enabled in the VLAN view.

Configuring Timers

This configuration task is to manually configure the aging time of the router port, the aging time of the multicast member ports, and the query response timeout time.

- If the switch receives no general query message from a router within the aging time of the router port, the switch removes the router port from the port member lists of all MAC multicast groups.
- If the Ethernet switch receives no IGMP report message within the maximum query response time of a member port, it will remove the port from the multicast group.
- If the Ethernet switch receives no IGMP report message from a member port when the query response time times out, it sends group-specific query to the port and triggers the query response timer of the corresponding IP multicast group.

Table 223 Configure timers

Operation	Command	Description
Enter system view	**system-view**	—
Configure the aging time of the router port	**igmp-snooping router-aging-time** *seconds*	Optional By default, the aging time of the router port is 105 seconds.
Configure the query response timeout time	**igmp-snooping max-response-time** *seconds*	Optional By default, the query response timeout time is 10 seconds.
Configure the aging time of multicast member ports	**igmp-snooping host-aging-time** *seconds*	Optional By default, the aging time of multicast member ports is 260 seconds.

Enabling IGMP Fast Leave Processing

Normally, when receiving an IGMP Leave message, IGMP Snooping does not immediately remove the port from the multicast group, but sends a group-specific query message. If no response is received in a given period, it then removes the port from the multicast group.

If IGMP fast leave processing is enabled, when receiving an IGMP Leave message, IGMP Snooping immediately removes the port from the multicast group. When a port has only one user, enabling IGMP fast leave processing on the port can save bandwidth.

Table 224 Enable the IGMP fast leave processing

Operation	Command	Description
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable IGMP fast leave processing	**igmp-snooping fast-leave vlan** *vlan-id* [**to** *vlan-id*]	Optional By default this function is disabled.

Configuring IGMP Snooping Filtering ACL

You can configure multicast filtering ACLs globally or on the switch ports connected to user ends so as to use the IGMP Snooping filter function to limit the multicast streams that the users can access. With this function, you can treat different VoD users in different ways by allowing them to access the multicast streams in different multicast groups.

In practice, when a user orders a multicast program, an IGMP report message is generated. When the message arrives at the switch, the switch examines the multicast filtering ACL configured on the access port to determine if the port can join the corresponding multicast group or not. If yes, it adds the port to the forward port list of the multicast group. If not, it drops the IGMP report message and does not forward the corresponding data stream to the port. In this way, you can control the multicast streams that users can access.

Table 225 Configure IGMP Snooping filtering ACL

Operation	Command	Description
Enter system view	**system-view**	—
Enable IGMP Snooping filter in system view	**igmp-snooping group-policy** *acl-number* **vlan** *vlan-id*	Optional *acl-number* is the number of a basic ACL; *vlan-id* is a VLAN ID. By default, this function is not enabled.
Enter Ethernet port view	**interface** *interface-type interface-number*	
Configure an IGMP Snooping filtering ACL on the port	**igmp-snooping group-policy** *acl-number* **vlan** *vlan-id*	Optional *acl-number* is the number of a basic ACL; *vlan-id* is a VLAN ID. By default, no ACL is configured on any port.

Configuring to Limit Port Multicast Group Number

With a limit imposed on the number of multicast groups on a given port, users can no longer have as many multicast groups as they want, and thereby, control the port bandwidth effectively.

Table 226 Configure to limit port multicast group number

Operation	Command	Description
Enter system view	**system-view**	-
Enter Ethernet port view	**interface** *interface-type interface-number*	-
Set a limit to port multicast group number on a given port	**igmp-snooping group-limit** [**vlan** *vlan-list* | **overflow-replace**]	Optional The number of port multicast group is not limited by default

Configuring Multicast VLAN

In old multicast mode, when users in different VLANs order the same multicast group, the multicast stream is copied to each of the VLANs. This mode wastes a lot of bandwidth.

By configuring a multicast VLAN, adding switch ports to the multicast VLAN and enabling IGMP Snooping, you can make users in different VLANs share the same multicast VLAN. This saves bandwidth since multicast streams are transmitted only within the multicast VLAN, and also guarantees security because the multicast VLAN is isolated from user VLANs.

Multicast VLAN is mainly used in Layer 2 switching, but you must make corresponding configuration on the Layer 3 switch.

Table 227 Configure multicast VLAN on Layer 3 switch

Operation	Command	Description
Enter system view	system-view	—
Create a VLAN and enter the VLAN view	**vlan** *vlan-id*	*vlan-id* is a VLAN ID.
Exit the VLAN view	quit	—
Create a VLAN interface and enter the VLAN interface view	**interface vlan-interface** *vlan-id*	—
Enable IGMP	igmp enable	Required
Exit the VLAN interface view	quit	—
Enter the view of the Ethernet port connected to the Layer 2 switch	**interface** *interface-type interface-number*	—
Define the port as a trunk or hybrid port	**port link-type** { **trunk** | **hybrid** }	Required
Specify the VLANs to be allowed to pass through the Ethernet	**port hybrid vlan** *vlan-id-list* { **tagged** | **untagged** }	Required The multicast VLAN defined on the Layer 2 switch must be included and set as tagged.
	port trunk pvid vlan *vlan-id*	

Table 228 Configure multicast VLAN on Layer 2 switch

Operation	Command	Description
Enter system view	system-view	—
Enable IGMP Snooping globally	igmp-snooping enable	Required
Enter VLAN view	**vlan** *vlan-id*	*vlan-id* is a VLAN ID.
Enable IGMP Snooping on the VLAN	igmp-snooping enable	Required
Enable multicast VLAN	service-type multicast	Required
Exit the VLAN view	quit	—
Enter the view of the Ethernet port connected to the Layer 3 switch	**interface** *interface-type interface-number*	—
Define the port as a trunk or hybrid port	**port link-type** { **trunk** | **hybrid** }	—
Specify the VLANs to be allowed to pass through the Ethernet	**port hybrid vlan** *vlan-id-list* { **tagged** | **untagged** }	The multicast VLAN must be included and set as tagged.
	port trunk pvid vlan *vlan-id*	
Enter the view of the Ethernet port connected to a user device	**interface** *interface-type interface-number*	*interface-type interface-number* are the interface type and interface number.
Exit the current view	quit	—
Define the port as a hybrid port	**port link-type hybrid**	Required
Specify the VLANs to be allowed to pass the port	**port hybrid vlan** *vlan-id-list* { **tagged** | **untagged** }	Required The multicast VLAN must be included and set as untagged.

- You cannot set the isolate VLAN as a multicast VLAN.
- One port can belong to only one multicast VLAN.
- The port connected to a user end can only be as set as a hybrid port.

Displaying Information About IGMP Snooping

You can execute the following **display** commands in any view to display information about IGMP Snooping.

Table 229 Display information about IGMP Snooping

Operation	Command	Description
Display the current IGMP Snooping configuration	display igmp-snooping configuration	You can execute the **display** commands in any view.
Display IGMP Snooping message statistics	display igmp-snooping statistics	
Display IP and MAC multicast groups in one or all VLANs	**display igmp-snooping group** [**vlan** *vlanid*]	
Clear IGMP Snooping statistics	reset igmp-snooping statistics	You can execute the **reset** command in user view.

IGMP Snooping Configuration Example

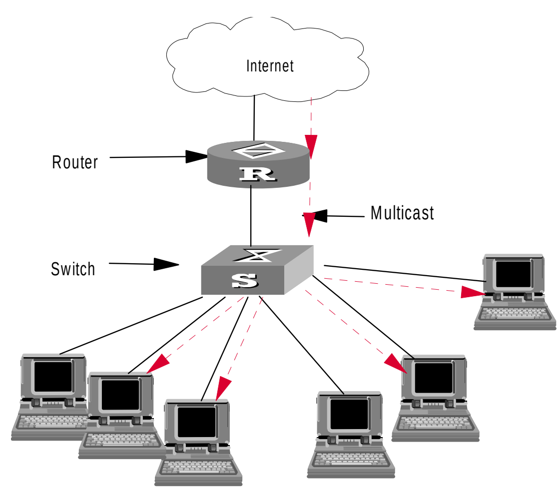
Example 1 Configure IGMP Snooping on a switch.

Network requirements

Connect the router port on the switch to the router, and other non-router ports which belong to VLAN 10 to user PCs. Enable IGMP Snooping on the switch.

Network diagram

Figure 81 Network diagram for IGMP Snooping configuration



Configuration procedure

1 Enable IGMP Snooping in system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] igmp-snooping enable
```

2 Enable IGMP Snooping on VLAN 10 where no Layer 3 multicast protocol is enabled.

```
[4200G] vlan 10
[4200G-vlan10] igmp-snooping enable
```

Example 2

Configure multicast VLAN on Layer 2 and Layer 3 switches.

Network requirements

Table 230 describes the network devices involved in this example and the configurations you should make on them.

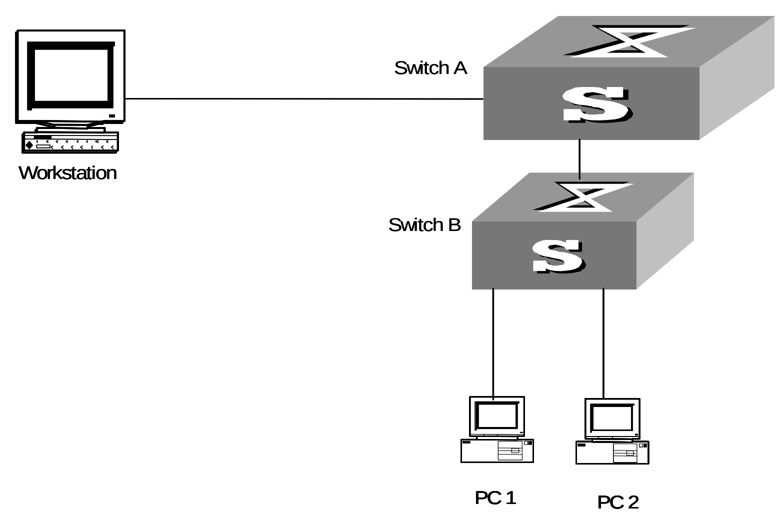
Table 230 Network devices and their configurations

Device		Description
Switch A	Layer 3 switch	The interface IP address of VLAN 20 is 168.10.1.1. The GigabitEthernet1/0/1 port is connected to the workstation and belongs to VLAN 20.
		VLAN 10 is the multicast VLAN.
		The GigabitEthernet1/0/10 port is connected to Switch B.
Switch B	Layer 2 switch	VLAN 2 contains the GigabitEthernet1/0/1 port and VLAN 3 contains the GigabitEthernet1/0/2 port. The two ports are connected to PC1 and PC2 respectively.
		The GigabitEthernet1/0/10 port is connected to Switch A.
PC 1	User 1	PC1 is connected to the GigabitEthernet1/0/1 port on Switch B.
PC 2	User 2	It is connected to the GigabitEthernet1/0/2 port on Switch B.

Configure a multicast VLAN, so that the users in VLAN 2 and VLAN 3 can receive multicast streams through the multicast VLAN.

Network diagram

Figure 82 Network diagram for multicast VLAN configuration



Configuration procedure

The following configuration is based on the prerequisite that the devices are properly connected and all the required IP addresses are already configured.

1 Configure Switch A:

a Set the interface IP address of VLAN 20 to 168.10.1.1 and enable the PIM DM protocol on the VLAN interface.

```
<Switch A> system-view
[ Switch A] multicast routing-enable
[ Switch A] vlan 20
[ Switch A-vlan20] interface vlan-interface 20
[ Switch A-Vlan-interface20] ip address 168.10.1.1 255.255.255.0
[ Switch A-Vlan-interface20] pim dm
[ Switch A-Vlan-interface20] quit
```

b Configure VLAN 10.

```
[ Switch A] vlan 10
[ Switch A-vlan10] quit
```

c Define the GigabitEthernet 1/0/10 port as a hybrid port, add the port to VLAN 2, VLAN 3 and VLAN 10, and configure the port to include VLAN tags in its outbound packets for VLAN 2, VLAN 3 and VLAN 10.

```
[ Switch A] interface GigabitEthernet 1/0/10
[ Switch A-GigabitEthernet 1/0/10] port link-type hybrid
[ Switch A-GigabitEthernet 1/0/10] port hybrid vlan 2 3 10 tagged
[ Switch A-GagabitEthernet 1/0/10] quit
```

d Enable PIM DM and IGMP on VLAN 10.

```
[ Switch A] multicast routing-enable
[ Switch A] interface Vlan-interface 10
[ Switch A-Vlan-interface10] pim dm
[ Switch A-Vlan-interface10] igmp enable
```

2 Configure Switch B:

a Enable IGMP Snooping globally.

```
<Switch B> system-view
[ Switch B] igmp-snooping enable
```

b Configure VLAN 10 as a multicast VLAN and enable IGMP Snooping on it.

```
[ Switch B] vlan 10
[ Switch B-vlan10] service-type multicast
[ Switch B-vlan10] igmp-snooping enable
[ Switch B-vlan10] quit
```

c Define the GigabitEthernet 1/0/10 port as a hybrid port, add the port to VLAN 2, VLAN 3 and VLAN 10, and configure the port to include VLAN tags in its outbound packets for VLAN 2, VLAN 3 and VLAN 10.

```
[ Switch B] interface GigabitEthernet 1/0/10
[ Switch B-GigabitEthernet 1/0/10] port link-type hybrid
[ Switch B-GigabitEthernet 1/0/10] port hybrid vlan 2 3 10 tagged
[ Switch B-GigabitEthernet 1/0/10] quit
```

d Define the GigabitEthernet 1/0/1 port as a hybrid port, add the port to VLAN 2 and VLAN 10, and configure the port exclude VLAN tags from its outbound packets for VLAN 2 and VLAN 10, VLAN 2 as the default VLAN of the port.

```
[ Switch B] interface GigabitEthernet 1/0/1
[ Switch B-GigabitEthernet 1/0/1] port link-type hybrid
[ Switch B-GigabitEthernet 1/0/1] port hybrid vlan 2 10 untagged
[ Switch B-GigabitEthernet 1/0/1] port hybrid pvid vlan 2
```

```
[ Switch B-GigabitEthernet 1/0/1] quit
```

e Define the GigabitEthernet 1/0/2 port as a hybrid port, add the port to VLAN 3 and VLAN 10, and configure the port to exclude VLAN tags in its outbound packets for VLAN 3 and VLAN 10, and set VLAN 3 as the default VLAN of the port.

```
[ Switch B] interface GigabitEthernet 1/0/1
[ Switch B-GigabitEthernet 1/0/2] port link-type hybrid
[ Switch B-GigabitEthernet 1/0/2] port hybrid vlan 3 10 untagged
[ Switch B-GigabitEthernet 1/0/2] port hybrid pvid vlan 3
[ Switch B-GigabitEthernet 1/0/2] quit
```

Troubleshooting IGMP Snooping

Symptom: Multicast function does not work on the switch.

Solution:

The reason may be:

1 IGMP Snooping is not enabled.

- Use the **display current-configuration** command to check the status of IGMP Snooping.
- If IGMP Snooping is disabled, check whether it is disabled globally or on the corresponding VLAN. If it is disabled globally, use the **igmp-snooping enable** command in both system view and VLAN view to enable it both globally and on the corresponding VLAN. If it is only disabled on the VLAN, use the **igmp-snooping enable** command in VLAN view to enable it on the corresponding VLAN.

2 Multicast forwarding table set up by IGMP Snooping is wrong.

- Use the **display igmp-snooping group** command to check if the multicast groups are expected ones.
- If a multicast group created by IGMP Snooping is not correct, contact your technical support personnel.
- Continue with step 3 if the this step does not work.

If it is not the reason, the possible reason may be:

3 Multicast forwarding tables do not match.

- Use the **display mac-address vlan** *vlanid* command in any view to check if the MAC multicast forwarding table established under the specified VLAN is consistent with that established by IGMP Snooping.

If they are not consistent, contact your technical support personnel.

30 ROUTING PORT JOIN TO MULTICAST GROUP CONFIGURATION

Routing Port Join to Multicast Group Configuration

Introduction

Normally, an IGMP host responds to IGMP query messages of the multicast router. In case of response failure, the multicast router may consider that there is no multicast member on this network segment and cancel the corresponding path.

To avoid such a problem, you can configure an interface of the switch as a multicast group member. When the interface receives IGMP query packets, it will respond, thus ensuring that the network segment of the interface can normally receive multicast packets.

Configuring Routing Port to Join to Multicast Group

Table 231 Configure routing port to join to multicast group

Operation	Command	Description
Enter system view	**system-view**	—
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Configure a routing port to join to the specified multicast group	**igmp host-join** *group-address* **vlan** *vlan-id*	Optional *group-address* is the IP address of a multicast group.

By default, a routing port does not join any multicast group. Note that the Ethernet port must belong to the VLAN; otherwise, your configuration cannot take effect.

31 MULTICAST MAC ADDRESS ENTRY CONFIGURATION

Introduction

In Layer 2 multicast, the system can add multicast forwarding entries dynamically through Layer 2 multicast protocol. However, you can also statically bind a port to a multicast address entry by configuring a multicast MAC address manually.

Generally, when receiving a multicast packet whose multicast address has not yet been registered on the switch, the switch broadcasts the packet in the VLAN. However, you can configure a static multicast MAC address entry to avoid this case.

Configuring a Multicast MAC Address Entry

Table 232 describes how to configure a multicast MAC address entry.

Table 232 Configure a multicast MAC address entry

Operation	Command	Description
Enter system view	system-view	—
Add a multicast MAC address entry	**mac-address multicast** *mac-address* **interface** *interface-list* **vlan** *vlan-id*	Required *mac-address* must be a multicast MAC address. *vlan-id* is the ID of the VLAN to which the port belongs.
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Add a multicast MAC address entry.	**mac-address multicast** *mac-address* **vlan** *vlan-id*	Optional This command is used in Ethernet port view. It has the same effect as the above **mac-address multicast interface vlan** command used in system view with the same port specified.

You can use the corresponding **undo** command to cancel the configuration.

CAUTION:

- If the multicast MAC address entry you are creating already exists, the system gives you a prompt.
- The switch will not learn a manually added multicast MAC address by IGMP Snooping. The **undo mac-address multicast** command can only remove manually created multicast MAC address entries and cannot remove those learned by the switch.
- To add a port to a manually created multicast MAC address entry, first remove the entry, and then re-create the entry and specify the port as the forward port of the entry.
- The system does not support the configuration of multicast MAC address on an IRF port. If you do this, the system will give you a prompt that the multicast MAC address configuration fails.

- You cannot enable port aggregation on a port where you have configured a multicast MAC address; and you cannot configure a multicast MAC address on an aggregation port.

Displaying Multicast MAC Address Configuration

You can use the following **display** command in any view to display the multicast MAC address entry/entries you configured manually.

Table 233 Display the multicast MAC address entry/entries manually configured

Operation	Command	Description
Display the multicast MAC address entry/entries manually configured	**display mac-address multicast static** [*mac-address* **]** [**vlan** *vlan-id* **]**	You can use the **display** command in any view.

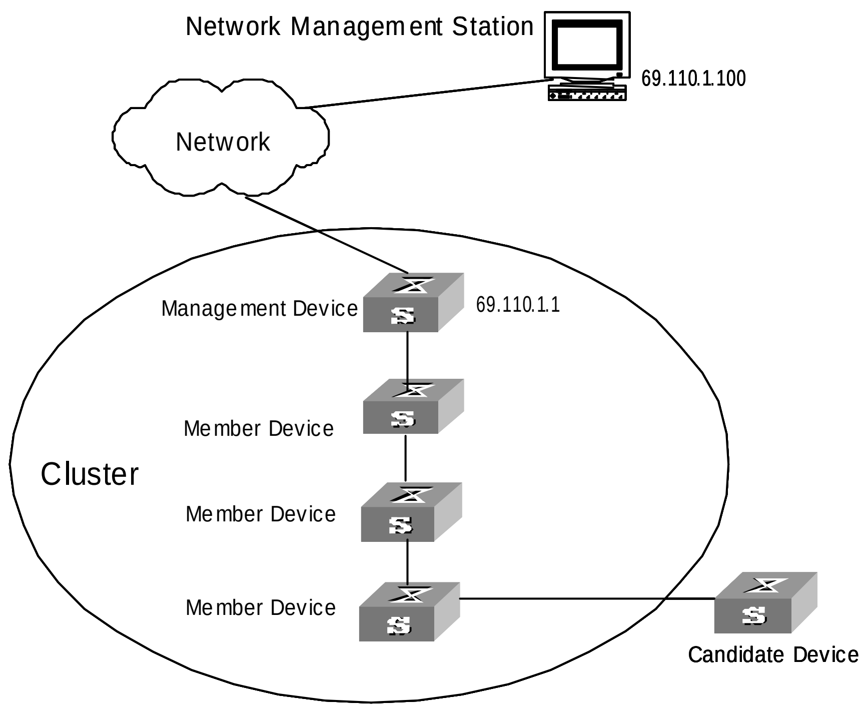
32 CLUSTER CONFIGURATION

Cluster Overview

Introduction to Cluster

A cluster is implemented through HGMP V2. By employing HGMP V2, a network administrator can manage multiple switches using the public IP address of a switch known as a management device. The switches under the management of the management device are member devices. The management device, along with the member devices, forms a cluster. Normally, a cluster member device is not assigned a public IP address. Management and maintenance operations intended for the member devices in a cluster are redirected by the management device. Figure 83 illustrates a typical cluster implementation.

Figure 83 A cluster implementation



HGMP V2 offers the following advantages:

- The procedures to configure multiple switches remarkably simplified. When the management device is assigned a public IP address, you can configure/manage a specific member device on the management device instead of logging into it in advance.
- Functions of topology discovery and display provided, which assist network monitoring and debugging
- Software upgrading and parameter configuring can be performed simultaneously on multiple switches.
- Free of topology and distance limitations
- Saving IP address resource

HGMP V2 provides the following functions:

- Topology discovery: HGMP V2 implements NDP (neighbor discovery protocol) to discover the information about the directly connected neighbor devices, including device type, software/hardware version, connecting port and so on. The information such as device ID, port mode (duplex or half duplex), product version, and BootROM version can also be given.
- Topology information collection: HGMP V2 implements NTDP (neighbor topology discovery protocol) to collect the information about device connections and candidate devices within a specified hop range.
- Member recognition: A management device can locate and recognize the member devices in the cluster and then deliver configuration and management commands to them.
- Member management: You can add a device to a cluster or remove a device from a cluster on the management device. You can also configure management device authentication and handshake interval for a member device on the management device.

Cluster-related configurations are described in the following sections.

Cluster Roles

According to their functions and status in a cluster, switches in the cluster play different roles. You can specify the role a switch plays. A switch also changes its role according to specific rules.

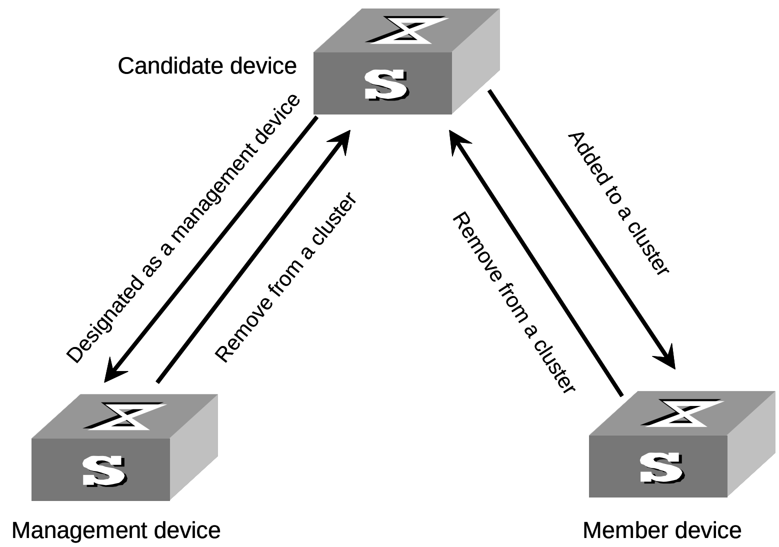
Following three cluster roles exist: management device, member device, and candidate device.

Table 234 Cluster role

Role	Configurations	Functions
Management device	■ Configured with a public IP address. ■ Receiving management commands from the public network and processing the received commands	■ Providing management interfaces for all switches in the cluster ■ Managing member devices by redirecting commands ■ Forwarding commands to the intended member devices ■ Neighbor discovery, topology information collection, cluster management, cluster state maintenance, and proxies
Member device	Normally, a member device is not configured with a public IP address.	■ Cluster member ■ Neighbor discovery, being managed by the management device, running commands forwarded by proxies, and failure/log reporting.
Candidate device	Normally, a candidate device is not configured with a public IP address.	A candidate device is a switch that does not belong to any cluster, although it can be added to a cluster.

Figure 84 shows the role changing rule.

Figure 84 Role changing rule



- Each cluster has one (and only one) management device. A management device collects NDP/NTDP information to discover and determine candidate devices, which can be then added into the cluster through manual configurations.
- A candidate device becomes a member device after being added to a cluster.
- A member device becomes a candidate device after being removed from the cluster.

Introduction to NDP

NDP is the protocol for discovering the information about the adjacent nodes. NDP operates on the data link layer, so it supports different network layer protocols.

NDP is used to discover the information about directly connected neighbors, including the device type, software/hardware version, and connecting port of the adjacent devices. It can also provide the information concerning device ID, port address, hardware platform and so on.

A device with NDP enabled maintains an NDP information table. Each entry in an NDP table ages with time. You can also clear the current NDP information manually to have adjacent information collected again.

A device with NDP enabled broadcasts NDP packets regularly through all its ports that are in up state. An NDP packet carries the holdtime, which indicates the period for the receiving devices to keep the information the packet carries. Receiving devices only store the information carried in the received NDP packets rather than forward them. The corresponding data entry in the NDP table is updated when the information carried in a received NDP packet if the received information differs from the existing one, otherwise, only the holdtime of the corresponding entry is updated.

Introduction to NTDP

NTDP is a protocol for network topology information collection. NTDP provides the information about the devices that can be added to clusters and collects the topology information within the specified hops for cluster management.

Based on the NDP information table created by NDP, NTDP transmits and forwards NTDP topology collection request to collect the NDP information and neighboring connection information of each device in a specific network range for the management device or the network administrator to implement needed functions.

Upon detecting a change occurred on a neighbor, a member device informs the management device of the change through handshake packets. The management device then collects the specified topology information through NTDP. Such a mechanism enables topology changes to be tracked in time.

As for NTDP implementing, you need to perform configurations on the management device, the member devices, and the candidate devices as follows:

On the management device, enable NTDP both globally and for specific ports, and configure the NTDP settings.

On each member device and candidate device, enable NTDP both globally and for specific ports. As member devices and candidate devices adopt the NTDP settings configured for the management device, NTDP setting configurations are not needed.

Introduction to Cluster Roles

A cluster has one (and only one) management device. Note the following when creating a cluster:

- You need to designate the management device first. The management device of a cluster is the portal of the cluster. That is, any operations performed in external networks and intended for the member devices of a cluster, such as accessing, configuring, managing, and monitoring, can only be implemented through the management device.
- The management device of a cluster recognizes and controls all the member devices in the cluster, no matter where they are located on the network or how they are connected.
- The management device collects topology information about all the member and candidate devices to provide useful information for users to establish a cluster.
- A management device manages and monitors the devices in the cluster by collecting and processing NDP/NTDP packets. NDP/NTDP packets contain network topology information.

All the above-mentioned operations need the support of the cluster function.

You need to enable the cluster function and configure cluster parameters on a management device. However, you only need to enable the cluster function on the member devices and candidate devices.

You can also configure an FTP/TFTP server for a cluster on the management device. In this case, the communications between a member device in the cluster and an external server are carried out by the management device. For clusters with no FTP/TFTP server configured, the management device operates as the public FTP/TFTP server.

Management Device Configuration

Management device configuration involves:

- Enabling NDP globally and for specific ports
- Configuring NDP-related parameters
- Enable NTDP globally and for a specific port
- Configuring NTDP-related parameters
- Enable the cluster function
- Configuring cluster parameters
- Configuring internal-external interaction

Enabling NDP Globally and for Specific Ports

Table 235 Enable NDP globally and for a specific port

Operation	Command	Description
Enter system view	system-view	—
Enable NDP globally	ndp enable	Required
Enable NDP for specified ports	**ndp enable interface** *port-list*	Optional
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable NDP for the Ethernet port	ndp enable	Required

Configuring NDP-related Parameters

Table 236 Configure NDP-related parameters

Operation	Command	Description
Enter system view	system-view	—
Configure the holdtime of NDP information	**ndp timer aging** *aging-in-seconds*	Required
Configure the interval to send NDP packets	**ndp timer hello** *seconds*	Required

Enabling NTDP Globally and for Specific Ports

Table 237 Enable NTDP globally and for specific ports

Operation	Command	Description
Enter system view	system-view	—
Enable NTDP globally	ntdp enable	Required
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable NTDP for the Ethernet port	ntdp enable	Required

Configuring NTDP-related Parameters

Table 238 Configure NTDP-related parameters

Operation	Command	Description
Enter system view	system-view	—
Configure the range topology information within which is to be collected	**ntdp hop** *hop-value*	Optional
Configure the hop delay to forward topology-collection request packets	**ntdp timer hop-delay** *time*	Optional
Configure the port delay to forward topology collection request packets	**ntdp timer port-delay** *time*	Optional
Configure the interval to collect topology information	**ntdp timer** *interval-in-minutes*	Optional
Quit system view.	Quit	—
Start topology information collection	ntdp explore	Optional

Enabling the Cluster Function

Table 239 Enable the cluster function

Operation	Command	Description
Enter system view	system-view	—
Enable the cluster function globally	cluster enable	Required

Configuring Cluster Parameters

Configuring cluster parameters manually

Table 240 Configure cluster parameters manually

Operation	Command	Description
Enter system view	system-view	—
Specify the management VLAN	**management-vlan** *vlan-id*	This is to specify the management VLAN on the switch
Enter cluster view	cluster	—
Configure an IP address pool for the cluster	**ip-pool** *administrator-ip-address* { *ip-mask* | *ip-mask-length* }	Optional
Configure a cluster with the current switch as the management device	**build** *name*	Optional The *name* argument is the name to be assigned to the cluster.
Configure a multicast MAC address for the cluster	**cluster-mac** *H-H-H*	Optional This is to set a multicast MAC address for the cluster.
Set the interval for the management device to send multicast packets	**cluster-mac syn-interval** *time-interval*	Optional
Configure the holdtime for a switch	**holdtime** *seconds*	Optional The default holdtime is 60 seconds.
Set the interval to send handshake packets	**timer** *interval*	Optional The default interval to send handshake packets is 10 seconds.
Configure to perform VLAN check for the communications within a cluster	port-tagged management-vlan	Optional
Quit cluster view	Quit	—

Configuring a cluster automatically

Table 241 Configure a cluster automatically

Operation	Command	Description
Enter system view	**system-view**	—
Enter cluster view	**cluster**	Required
Configure a cluster automatically	**auto-build** [**recover**]	Required This is to set up a cluster based on your instructions.

Configuring Internal-External Interaction

Table 242 Configure internal-external interaction

Operation	Command	Description
Enter system view	system-view	
Enter cluster view	cluster	Required
Configure an FTP server for the cluster	**ftp-server** *ip-address*	Optional
Configure a TFTP server for the cluster	**tftp-server** *ip-address*	Optional
Configure a log host for the cluster	**logging-host** *ip-address*	Optional
Configure an SNMP host for the cluster	**snmp-host** *ip-address*	Optional

Member Device Configuration

Member device configuration involves:

- Enabling NDP globally and for specific ports
- Enabling NTDP globally and for specific ports
- Enabling the cluster function
- Specifying the cluster FTP/TFTP server

Enabling NDP Globally and for Specific Ports

Table 243 Enable NDP globally and for specific ports

Operation	Command	Description
Enter system view	system-view	—
Enable NDP globally	ndp enable	Required
Enable NDP for specified ports	**ndp enable interface** *port-list*	Optional
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable NDP for the port	ndp enable	Required

Enabling NTDP Globally and for Specific Ports

Table 244 Enable NTDP globally and for specific ports

Operation	Command	Description
Enter system view	system-view	—
Enable system NTDP	ntdp enable	Required
Enter Ethernet port view	**interface** *interface-type interface-number*	—
Enable NTDP for the port	ntdp enable	Required

Specifying the cluster FTP/TFTP server

Table 245 Specify the cluster FTP/TFTP server

Operation	Command	Description
Establish a connection with the cluster FTP server	ftp cluster	Optional
Download a file from the cluster TFTP server	**tftp cluster get** *source-file [destination-file]*	Optional
Upload a file to the cluster TFTP server	**tftp cluster put** *source-file [destination-file]*	Optional

Intra-Cluster Configuration

Table 246 Configure a cluster

Operation	Command	Description
Enter system view	system-view	—
Enter cluster view	cluster	—
Add a candidate device to a cluster	**add-member** [*member-number*] **mac-address** *H-H-H* [**password** *password*]	This is to add a new member.
Remove a member device from the cluster	**delete-member** *member-number*	Optional This is to remove a member device from the cluster.
Reboot a specified member device	**reboot member** { *member-number* | **mac-address** *H-H-H }* [**eraseflash** *]*	Optional
Quit cluster view	Quit	—
Quit system view	Quit	—
Switch between the management device and a member device	**cluster switch-to** { *member-number* | **mac-address** *H-H-H* | **administrator** }	Optional This is to switch to the member device identified by the *member-num* or *H-H-H* argument.

Displaying and Maintaining a Cluster

You can view the configuration of a cluster using the **display** commands, which can be executed in any view.

Table 247 Display and maintain cluster configurations

Operation	Command	Remark
Display the global NDP configuration (including the interval to send NDP packets and the holdtime)	display ndp	Optional This command can be executed in any view.
Display the information about the neighbors discovered by NDP and connected to specified ports	**display ndp interface** *port-list*	Optional This command can be executed in any view.
Display the global NTDP information	display ntdp	Optional This command can be executed in any view.
Display device information collected through NTDP	**display ntdp device-list** [**verbose**]	Optional This command can be executed in any view.

Table 247 Display and maintain cluster configurations (Continued)

Operation	Command	Remark
Display state and statistics information about a cluster	display cluster	Optional This command can be executed in any view.
Display the information about the candidate devices of a cluster	**display cluster candidates** [**mac-address** *H-H-H* | **verbose**]	Optional This command can be executed in any view.
Display the information about the cluster members	**display cluster members** [*member-number* | **verbose**]	Optional This command can be executed in any view.
Clear the NDP statistics on a port	**reset ndp statistics** [**interface** *port-list]*	

HGMP V2 Configuration Example

Network requirements

Three switches form a cluster, in which:

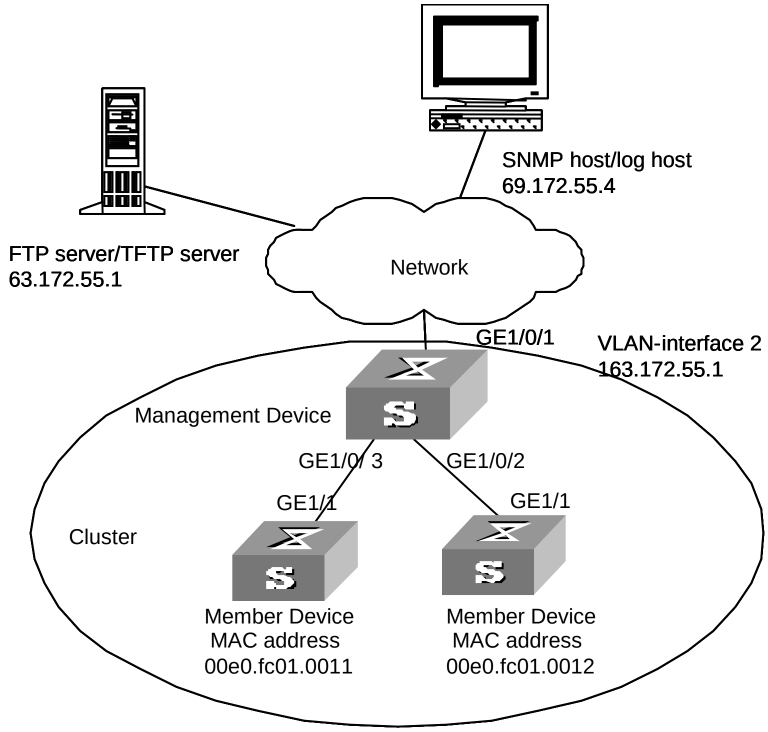
- The management device is an S4200G series switch.
- The rest are member devices.

The S4200G series switch operates as the management device of the cluster. Other detailed information about the cluster is as follows.

- The two member devices are connected to GigabitEthernet1/0/2 and GigabitEthernet1/0/3 ports of the management device.
- The management device is connected to the external network through its GigabitEthernet1/0/1 port.
- GigabitEthernet1/0/1 port of the management device belongs to VLAN2, whose interface IP address is 163.172.55.1.
- All the devices in the cluster use the same FTP server and TFTP server.
- The FTP server and TFTP server share one IP address: 63.172.55.1.
- The SNMP site and log host share one IP address: 69.172.55.4.

Network diagram

Figure 85 Network diagram for HGMP cluster configuration



Configuration procedure

1 Configure the management device.

a Enable NDP globally and for GigabitEthernet1/0/2 and GigabitEthernet1/0/3 ports.

```
[4200G] ndp enable
[4200G] interface GigabitEthernet 1/0/2
[4200G-GigabitEthernet1/0/2] ndp enable
[4200G-GigabitEthernet1/0/2] quit
[4200G] interface GigabitEthernet 1/0/3
[4200G-GigabitEthernet1/0/3] ndp enable
[4200G-GigabitEthernet1/0/3] quit
```

b Configure the holdtime of NDP information to be 200 seconds.

```
[4200G] ndp timer aging 200
```

c Configure the interval to send NDP packets to be 70 seconds.

```
[4200G] ndp timer hello 70
```

d Enable NTDP globally and for GigabitEthernet1/0/2 and GigabitEthernet1/0/3 ports.

```
[4200G] ntdp enable
[4200G] interface GigabitEthernet 1/0/2
[4200G-GigabitEthernet1/0/2] ntdp enable
[4200G-GigabitEthernet1/0/2] quit
[4200G] interface GigabitEthernet 1/0/3
[4200G-GigabitEthernet1/0/3] ntdp enable
[4200G-GigabitEthernet1/0/3] quit
```

e Configure the hop count to collect topology to be 2.

```
[4200G] ntdp hop 2
```

f Configure the delay time for topology-collection request packets to be forwarded on member devices to be 150 ms.

```
[4200G] ntdp timer hop-delay 150
```

g Configure the delay time for topology-collection request packets to be forwarded through the ports of member devices to be 15 ms.

```
[4200G] ntdp timer port-delay 15
```

h Configure the interval to collect topology information to be 3 minutes.

```
[4200G] ntdp timer 3
```

i Enable the cluster function.

```
[4200G] cluster enable
```

j Enter cluster view.

```
[4200G] cluster
[4200G-cluster]
```

k Configure an IP address pool for the cluster. The IP address pool contains eight IP addresses, starting from 172.16.0.1.

```
[4200G-cluster] ip-pool 172.16.0.1 255.255.255.248
```

l Specify a name (aaa) for the cluster and create the cluster.

```
[4200G-cluster] build aaa
[ aaa_0.S4200G-cluster]
```

m Add the attached two switches to the cluster.

```
[ aaa_0.S4200G-cluster] add-member 1 mac-address 00e0-fc01-0011
[ aaa_0.S4200G-cluster] add-member 17 mac-address 00e0-fc01-0012
```

n Configure the holdtime of the member device information to be 100 seconds.

```
[ aaa_0.S4200G-cluster] holdtime 100
```

o Configure the interval to send handshake packets to be 10 seconds.

```
[ aaa_0.S4200G-cluster] timer 10
```

p Configure the FTP Server, TFTP Server, Log host and SNMP host for the cluster.

```
[ aaa_0.S4200G-cluster] ftp-server 63.172.55.1
[ aaa_0.S4200G-cluster] tftp-server 63.172.55.1
[ aaa_0.S4200G-cluster] logging-host 69.172.55.4
[ aaa_0.S4200G-cluster] snmp-host 69.172.55.4
```

2 Configure the member devices (taking one member as an example)

a Enable NDP globally and for GigabitEthernet1/1 port.

```
[4200G] ndp enable
[4200G] interface GigabitEthernet 1/1
[4200G-GigabitEthernet1/1] ndp enable
```

b Enable NTDP globally and for GigabitEthernet1/1 port.

```
[4200G] ntdp enable
[4200G] interface GigabitEthernet 1/1
[4200G-GigabitEthernet1/1] ntdp enable
```

c Enable the cluster function.

```
[4200G] cluster enable
```

After adding the two switches to the cluster, perform the following configurations on the management device.

d Establish a connection with the cluster FTP server.

```
<aaa_1.S4200G> ftp cluster
```

e Download the file named aaa.txt from the cluster TFTP server.

```
<aaa_1.S4200G> tftp cluster get aaa.txt
```

f Upload the file named bbb.txt to the cluster TFTP server.

```
<aaa_1.S4200G> tftp cluster put bbb.txt
```

Upon the completion of the above configurations, you can execute the ***cluster switch-to*** *{ member-number |* ***mac-address*** *H-H-H } command on the management device to switch to member device view to maintain and manage a member device. You can then execute the* ***cluster switch-to administrator*** *command to resume the management device view.*

You can also reboot a member device by executing the ***reboot member*** *{ member-number |* ***mac-address*** *H-H-H } [* ***eraseflash*** *] command on the management device. For detailed information about these configurations, refer to the preceding description in this chapter.*

After the above configuration, you can check cluster member log and SNMP trap messages through the SNMP host.

33 SNMP CONFIGURATION

SNMP Overview

By far, the simple network management protocol (SNMP) has gained the most extensive application in the computer networks. SNMP has been put into use and widely accepted as an industry standard in practice. It is used for ensuring the transmission of the management information between any two nodes. In this way, network administrators can easily search and modify the information on any node on the network. In the meantime, they can locate faults promptly and implement the fault diagnosis, capacity planning and report generating.

SNMP adopts the polling mechanism and provides the most basic function set. It is most applicable to the small-sized, fast-speed and low-cost environment. It only requires the connectionless transport layer protocol UDP; and is thus widely supported by many other products.

SNMP Operation Mechanism

SNMP can be divided into two parts, namely, Network Management Station and Agent:

Network management station (NMS) is the workstation for running the client program. At present, the commonly used NM platforms include Quidview, Sun NetManager and IBM NetView.

Agent is the server software operated on network devices.

The NMS can send GetRequest, GetNextRequest and SetRequest messages to the Agent. Upon receiving the requests from the NMS, Agent will perform Read or Write operation according to the message types, generate and return the Response message to the NMS.

Agent will send Trap message on its own initiative to the NMS to report the events whenever the device encounters any abnormalities such as restarting the device.

SNMP Versions

Currently SNMP Agent of the device supports SNMP V3, and is compatible with SNMP V1 and SNMP V2C.

SNMP V3 adopts user name and password authentication.

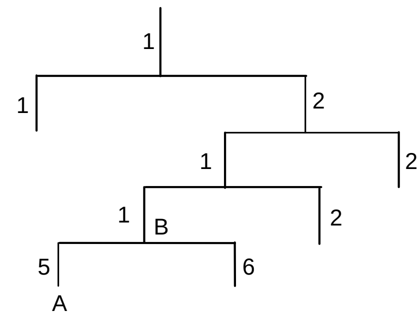
SNMP V1 and SNMP V2C adopt community name authentication. The SNMP packets failing to pass community name authentication are discarded. The community name is used to define the relation between SNMP NMS and SNMP Agent. The community name can limit access to SNMP Agent from SNMP NMS, functioning as a password. You can define the following features related to the community name.

- Define MIB view of subsets of all MIB objects which a community can access.
- Set read-only or read-write right to access MIB objects for the community. The read-only community can only query device information while the read-write community can configure the device.

MIBs Supported by the Device

The management variable in the SNMP packet describes management objects of a device. To uniquely identify the management objects of the device in SNMP messages, SNMP adopts the hierarchical naming scheme to identify the managed objects. It is like a tree, and each tree node represents a managed object, as shown in Figure 86. Thus the object can be identified with the unique path starting from the root.

Figure 86 Architecture of the MIB tree



The management information base (MIB) is used to describe the hierarchical architecture of the tree and it is the set defined by the standard variables of the monitored network device. In Figure 86, the managed object B can be uniquely specified by a string of numbers {1.2.1.1}. The number string is the Object Identifier of the managed object.

The common MIBs supported by the system are listed in Table 248.

Table 248 Common MIBs

MIB attribute	MIB content	References
Public MIB	MIB II based on TCP/IP network device	RFC1213
	BRIDGE MIB	RFC1493
		RFC2675
	RIP MIB	RFC1724
	RMON MIB	RFC2819
	Ethernet MIB	RFC2665
	OSPF MIB	RFC1253
	IF MIB	RFC1573

Table 248 Common MIBs (Continued)

MIB attribute	MIB content	References
Private MIB	DHCP MIB DHCP MIB QACL MIB ADBM MIB IGMP Snooping MIB RSTP MIB VLAN MIB Device management Interface management	—
	QACL MIB	—
	ADBM MIB	—
	RSTP MIB	—
	VLAN MIB	—
	Device management	—
	Interface management	—

Configuring SNMP Basic Functions

The configuration of SNMP V3 configuration is different from that of SNMP V1 and SNMP V2C, therefore SNMP basic function configurations for different versions are introduced respectively. For specific configurations, refer to Table 249 and Table 250.

Table 249 Configure SNMP basic functions for SNMP V1 and SNMP V2C

Operation	Command	Description
Enter system view	system-view	—
Enable SNMP Agent	snmp-agent	Optional By default, SNMP Agent is disabled. To enable SNMP Agent, you can execute this command or those commands used to configure SNMP Agent features.
Set system information	**snmp-agent sys-info** { **contact** *sys-contact* | **location** *sys-location* | **version** { { **v1** | **v2c** | **v3 }*** | **all }** }	Required By default, the contact information for system maintenance is "R&D Beijing, 3Com", the system location is "Beijing China", and the SNMP version is SNMP V3.

Table 249 Configure SNMP basic functions for SNMP V1 and SNMP V2C (Continued)

Operation			Command	Description
Set a community name and access authority	Direct configuration	Set a community name	**snmp-agent community** { **read** | **write** } *community-name* [**acl** *acl-number* | **mib-view** *view-name*]	Required ■ Direct configuration for SNMP V1 and SNMP V2C is based on community name. ■ Indirect configuration. The added user is equal to the community name for SNMPV1 and SNMPV2C. ■ You can choose either of them as needed.
	Indirect configuration	Set an SNMP group	**snmp-agent group** { **v1** | **v2c** } *group-name* [**read-view** *read-view*] [**write-view** *write-view*] [**notify-view** *notify-view*] [**acl** *acl-number*]	
		Add a new user for an SNMP group	**snmp-agent usm-user** { **v1** | **v2c** } *user-name group-name* [**acl** *acl-number]*	
Set the maximum size of SNMP packets that the Agent can send/receive			**snmp-agent packet max-size** *max-size*	Optional By default, it is 1,500 bytes.
Set the device engine ID			**snmp-agent local-engineid** *engineid*	Optional By default, the device engine ID is "Enterprise Number + device information".
Create or update the view information			**snmp-agent mib-view** { **included** | **excluded** } *view-name oid-tree*	Optional By default, the view name is ViewDefault and OID is 1.

Table 250 Configure SNMP basic functions (SNMP V3)

Operation	Command	Description
Enter system view	system-view	—
Enable SNMP Agent	snmp-agent	Required By default, SNMP Agent is disabled.
Set system information	**snmp-agent sys-info** { **contact** *sys-contact* | **location** sys-*location* | **version** { { **v1** | **v2c** | **v3** }* | **all** } }	Optional By default, the contact information for system maintenance is "R&D Beijing, 3Com.", the system location is "Beijing China", and the SNMP version is SNMP V3.
Set an SNMP group	**snmp-agent group v3** *group-name* [**authentication** | **privacy**] [**read-view** *read-view*] [**write-view** *write-view*] [**notify-view** *notify-view*] [**acl** *acl-number*]	Required
Add a new user for an SNMP group	**snmp-agent usm-user v3** *user-name group-name* [**authentication-mode** { **md5** | **sha** } *auth-password* [**privacy-mode des56** *priv-password*]] [**acl** *acl-number]*	Required

Table 250 Configure SNMP basic functions (SNMP V3) (Continued)

Operation	Command	Description
Set the size of SNMP packet that the Agent can send/receive	**snmp-agent packet max-size** *byte-count*	Optional By default, it is 1,500 bytes.
Set the device engine ID	**snmp-agent local-engineid** *engineid*	Optional By default, the device engine ID is "Enterprise Number + device information".
Create or update the view information	**snmp-agent mib-view** { **included** | **excluded** } *view-name oid-tree*	Optional By default, the view name is ViewDefault and OID is 1.

Configuring Trap

Trap is the information that the managed device initially sends to the NMS without request. Trap is used to report some urgent and important events (for example, the managed device is rebooted).

Configuration Prerequisites

Complete SNMP basic configuration.

Configuration Tasks

Table 251 Configure Trap

<table>
<tr><th colspan="2">Operation</th><th>Command</th><th>Description</th></tr>
<tr><td colspan="2">Enter system view</td><td>system-view</td><td>—</td></tr>
<tr><td colspan="2">Enable the device to send Trap packets</td><td>snmp-agent trap enable [configuration | flash | standard [authentication | coldstart | linkdown | linkup | warmstart]* | system |]</td><td rowspan="4">Optional
By default, the port is enabled to send Trap packets.</td></tr>
<tr><td rowspan="3">Enable the port to send Trap packets</td><td>Enter port view</td><td>interface interface-type interface-number</td></tr>
<tr><td>Enable the port to send Trap packets</td><td>enable snmp trap updown</td></tr>
<tr><td>Quit to system view</td><td>quit</td></tr>
<tr><td colspan="2">Set Trap target host address</td><td>snmp-agent target-host trap address udp-domain { ip-addr } [udp-port port-number] params securityname security-string [v1 | v2c | v3 {authentication | privacy }]</td><td>Required</td></tr>
<tr><td colspan="2">Set the source address to send Trap packets</td><td>snmp-agent trap source interface-type interface-number</td><td>Optional</td></tr>
<tr><td colspan="2">Set the information queue length of Trap packet sent to destination host</td><td>snmp-agent trap queue-size size</td><td>Optional
The default value I s 100.</td></tr>
<tr><td colspan="2">Set aging time for Trap packets</td><td>snmp-agent trap life seconds</td><td>Optional
The default aging time for Trap packets is 120 seconds.</td></tr>
</table>

Setting the Logging Function for Network Management

Table 252 Set the logging function for network management

Operation	Command	Description
Enter system view	system-view	—
Set the logging function for network management	**snmp-agent log** { **set-operation** | **get-operation** | **all** }	Optional; By default, the logging function for SNMP is disabled.

*You can use the **display logbuffer** command to display logging information for the get and set operations sent from NMS.*

Displaying SNMP

After the above configuration is completed, execute the **display** command in any view to view the running of SNMP, and to verify the configuration.

Table 253 Display SNMP

Operation	Command
Display system information of the current SNMP device	**display snmp-agent sys-info** [**contact** | **location** | **version**]*
Display SNMP packet statistics information	display snmp-agent statistics
Display the engine ID of the current device	**display snmp-agent** { **local-engineid** | **remote-engineid** }
Display group information about the device	**display snmp-agent group** [*group-name*]
Display SNMP user information	**display snmp-agent usm-user** [**engineid** *engineid* | **username** *user-name* | **group** *group-name]*
Display Trap list information	display snmp-agent trap-list
Display the currently configured community name	**display snmp-agent community** [**read** | **write**]
Display the currently configured MIB view	**display snmp-agent mib-view** [**exclude** | **include** | **viewname** *view-name*]

SNMP Configuration Example

SNMP Configuration Example

Network requirements

- An NMS and an Ethernet switch are connected through the Ethernet. The IP address of the NMS is 10.10.10.1 and that of the VLAN interface on the switch is 10.10.10.2.
- Perform the following configuration on the switch: setting the community name and access authority, administrator ID, contact and switch location, and enabling the switch to sent trap packet.

Network diagram

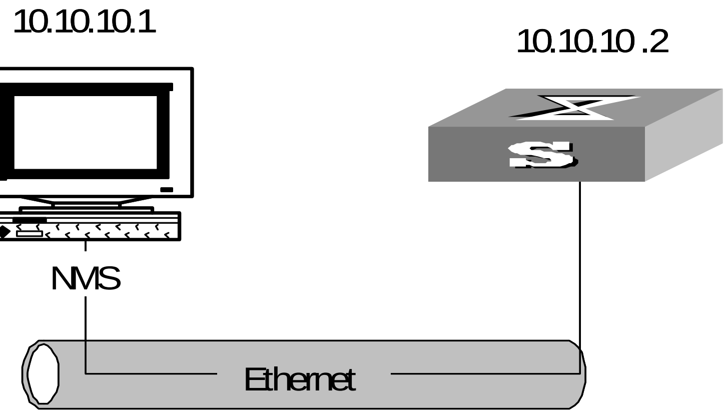


Figure 87 Network diagram for SNMP

Network procedure

1 Set the community name, group name and user.

```
<S4200G> system-view
[4200G] snmp-agent sys-info version all
[4200G] snmp-agent community write public
[4200G] snmp-agent mib-view include internet 1.3.6.1
[4200G] snmp-agent group v3 managev3group write-view internet
[4200G] snmp-agent usm-user v3 managev3user managev3group
```

2 Set the VLAN interface 2 as the interface used by network management. Add port GigabitEthernet1/0/2 to the VLAN 2. This port will be used for network management. Set the IP address of VLAN interface 2 as 10.10.10.2.

```
[4200G] vlan 2
[4200G-vlan2] port GigabitEthernet 1/0/2
[4200G-vlan2] quit
[4200G] interface Vlan-interface 2
[4200G-Vlan-interface2] ip address 10.10.10.2 255.255.255.0
```

3 Enable the SNMP agent to send Trap packets to the NMS whose IP address is 10.10.10.1. The SNMP community is public.

```
[4200G] snmp-agent trap enable standard authentication
[4200G] snmp-agent trap enable standard coldstart
[4200G] snmp-agent trap enable standard linkup
[4200G] snmp-agent trap enable standard linkdown
[4200G] snmp-agent target-host trap address udp-domain 10.10.10.1
udp-port 5000 params securityname public
```

Configuring NMS

The Ethernet Switch supports 3Com's Quidview NMS. SNMP V3 adopts user name and password authentication. In [Quidview Authentication Parameter], you need to set a user name, choose security level, and set authorization mode, authorization password, encryption mode, encryption password respectively according to different security levels. In addition, you must set timeout time and retry times.

Users can query and configure the Ethernet switch through the NMS. For more about it, refer to the manuals of 3Com's NM products.

NM configuration must be consistent with device configuration; otherwise, you will fail to perform the related operations.

34 RMON CONFIGURATION

Introduction to RMON

Remote monitoring (RMON) is a kind of management information base (MIB) defined by Internet Engineering Task Force (IETF) and is a most important enhancement made to MIB II standards. RMON is mainly used to monitor the data traffic across a network segment or even the entire network, and is currently a commonly used network management standard.

An RMON system comprises of two parts: the network management station (NMS) and the agents running on each network device. RMON agents operate on network monitors or network probes to collect and keep track of the statistics of the traffic across the network segments to which their ports connect such as the total number of the packets on a network segment in a specific period of time and the total number of packets that are sent to a specific host successfully.

RMON is fully based on simple network management protocol (SNMP) architecture. It is compatible with the current SNMP, so that you can implement RMON without modifying SNMP. RMON enables SNMP to monitor remote network devices more effectively and actively, thus providing a satisfactory means of monitoring the operation of the subnet. With RMON, the communication traffic between NMS and agents is reduced, thus facilitating the management of large-scale internets.

Working Mechanism of RMON

RMON allows multiple monitors. It collects data in one of the following two ways:

- Using the dedicated RMON probe. When an ROM system operates in this way, the NMS directly obtains management information from the RMON probes and controls the network resources. In this case, all information in the RMON MIB can be obtained.
- Embedding RMON agents into network devices (such as routers, switches and hubs) directly to make the latter capable of RMON probe functions. When an RMON system operates in this way, the NMS collects network management information by exchanging information with the SNMP agents using the basic SNMP commands. However, this way depends on device resources heavily and an NMS operating in this way can only obtain four groups of information (instead of all the information in the RMON MIB). The four groups are alarm group, event group, history group and statistics group.

An S3100 series switch implements RMON in the second way. Through the RMON-capable SNMP agents running on the network monitors, an NMS can obtain the information about the total traffic, error statistics and performance statistics of the network segments to which the ports of the managed network devices are connected. Thus, the NMS can further manage the networks.

Commonly Used RMON Groups

Event group

The event group is used to define the indexes of events and the processing methods of the events. The events defined in an event group are mainly used in alarm group and extended alarm group to trigger alarms.

You can specify a network device to act in one of the following ways in response to an event:

- Logging the event
- Sending trap messages to the NMS
- Logging the event and sending trap messages to the NMS

Alarm group

RMON alarm management enables monitors on specific alarm variables (such as the statistics of a port). When the value of a monitored variable exceeds the threshold, an alarm event is generated, which triggers the network device to act in the set way. Events are defined in event groups.

With an alarm entry defined in an alarm group, a network device performs the following operations accordingly:

- Sampling the defined alarm variables (alarm-variable) once in each specified period (sampling-time)
- Comparing the sampled value with the set thresholds and triggering the corresponding events if the former exceeds the latter

Extended alarm group

With extended alarm entry, you can perform operations on the samples of an alarm variable and then compare the operation result with the set threshold, thus implement more flexible alarm functions.

With an extended alarm entry defined in an extended alarm group, the network devices perform the following operations accordingly:

- Sampling the alarm variables referenced in the defined extended alarm expressions once in each specified period
- Performing operations on sampled values according to the defined operation formulas
- Comparing the operation result with the set thresholds and triggering corresponding events if the former exceeds the latter.

History group

History group contains the records of statistical network values collected periodically and is stored temporarily for later retrieval. A history group can provide the history data of the statistics on network segment traffic, error packets, broadcast packets, utilization and collision times.

With the history data management function, you can configure network devices such as collecting history data, collecting periodically the data of a specific port and saving them.

Statistics group

Statistics group contains the statistics of each monitored port on a network device. An entry in a statistics group is an accumulated value counting from the time when the corresponding event is defined.

The statistics include the number of the following items: collisions, packets with cyclic redundancy check (CRC) errors, undersize (or oversize) packets, broadcast packets, multicast packets, and received bytes and packets.

With the RMON statistics management function, you can monitor the usage of a port and make statistics on the errors occurred when the ports are being used.

RMON Configuration

Prerequisites

Before performing RMON configuration, make sure the SNMP agents are correctly configured. For the information about SNMP agent configuration, refer to the "Configuring Basic SNMP Functions" part in *SNMP Configuration Operation Manual*.

Configuring RMON

Table 254 Configure RMON

Operation	Command	Description
Enter system view	system-view	-
Add an event entry	**rmon event** *event-entry* [**description** *string*] { **log** | **trap** *trap-community* | **log-trap** *log-trapcommunity* | **none** } [**owner** *text*]	Optional
Add an alarm entry	**rmon alarm** *entry-number alarm-variable sampling-time* { **delta** | **absolute** } **rising-threshold** *threshold-value1 event-entry1* **falling-threshold** *threshold-value2 event-entry2* [**owner** *text*]	Optional Before adding an alarm entry, you need to use the **rmon event** command to define the event referenced by the alarm entry.
Add an extended alarm entry	**rmon prialarm** *entry-number prialarm-formula prialarm-des sampling-timer* { **delta** | **absolute** | **changeratio** } **rising_threshold** *threshold-value1 event-entry1* **falling_threshold** *threshold-value2 event-entry2* **entrytype** { **forever** | **cycle** *cycle-period* } [**owner** *text*]	Optional Before adding an extended alarm entry, you need to use the **rmon event** command to define the event referenced by the extended alarm entry.
Enter Ethernet port view	**interface gigabitethernet** *interface-number*	-
Add a history control entry	**rmon history** *entry-number* **buckets** *number* **interval** *sampling-interval* [**owner** *text*]	Optional
Add a statistics entry	**rmon statistics** *entry-number* [**owner** *text*]	Optional

- The **rmon alarm** and **rmon prialarm** commands take effect on existing nodes only.
- For each port, only one RMON statistics entry can be created. That is, if an RMON statistics entry is already created for a given port, creation of another entry with a different index for the same port will not succeed.

Displaying and Debugging RMON

After the above configuration, you can execute the **display** command in any view to display the RMON running status, and verify the effect of the configuration.

Table 255 Display and debug RMON

Operation	Command
Display RMON statistics	**display rmon statistics** [*interface-type interface-number* | **unit** *unit-number*]
Display RMON history information	**display rmon history** [*interface-type interface-number* | **unit** *unit-number*]
Display RMON alarm information	**display rmon alarm** [*entry-number*]
Display extended RMON alarm information	**display rmon prialarm** [*prialarm-entry-number*]
Display RMON events	**display rmon event** [*event-entry*]
Display RMON event logs	**display rmon eventlog** [*event-entry*]

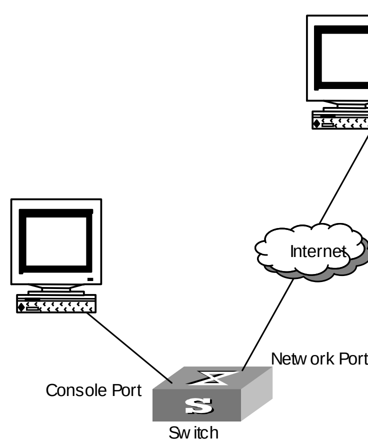
RMON Configuration Example

Network requirements

- Ensure that the SNMP agents are correctly configured before performing RMON configuration.
- The switch to be tested has a configuration terminal connected to its console port and is connected to a remote NMS through Internet. Create an entry in the Ethernet statistics table to make statistics on the Ethernet port performance for network management.

Network diagram

Figure 88 Network diagram for RMON configuration



Configuration procedures

1 Configure RMON.

```
<S4200G> system-view
[4200G] interface GigabitEthernet1/0/1
[4200G-GigabitEthernet1/0/1] rmon statistics 1 owner user1-rmon
```

2 Display RMON configuration.

```
[4200G-GigabitEthernet1/0/1] display rmon statistics
GigabitEthernet1/0/1
Statistics entry 1 owned by user1-rmon is VALID.
  Interface : GagabitEthernet1/0/1<ifIndex.4227817>
  etherStatsOctets         : 0         , etherStatsPkts          : 0
  etherStatsBroadcastPkts  : 0         , etherStatsMulticastPkts : 0
  etherStatsUndersizePkts  : 0         , etherStatsOversizePkts  : 0
  etherStatsFragments      : 0         , etherStatsJabbers       : 0
  etherStatsCRCAlignErrors : 0         , etherStatsCollisions    : 0
  etherStatsDropEvents (insufficient resources): 0
  Packets received according to length:
  64     : 0         ,  65-127  : 0         ,  128-255  : 0
  256-511: 0         ,  512-1023: 0         ,  1024-1518: 0
```

35 NTP CONFIGURATION

Introduction to NTP

Network time protocol (NTP) is a time synchronization protocol defined by RFC1305. It is used for time synchronization among a set of distributed time servers and clients. NTP is based on user datagram protocol (UDP).

NTP is intended for time synchronization of all devices that have clocks in a network, so that the clocks of all devices can keep consistent. This enables the applications that require unified time.

A network running NTP not only can be synchronized by other clock sources, but also can serve as a clock source to synchronize other clocks. Besides, it can negotiate with other network devices by exchanging NTP packet to reach the time for them to synchronize to.

Applications of NTP

NTP is mainly applied to synchronizing the clocks of all the network devices in a network. For example:

- In network management, the analysis of the log information and debugging information collected from different devices is meaningful and valid only when network devices that generate the information adopts the same time.
- The accounting system requires that the clocks of all the network devices be consistent.
- Some functions, such as restarting all the network devices in a network simultaneously require that they adopt the same time.
- When multiple systems cooperate to handle a rather complex event, to ensure a correct execution order, they must adopt the same time.
- To perform incremental backup operations between a backup server and a host, you must make sure they adopt the same time.

As setting the system time manually in a network with many devices leads to a lot of workload and cannot ensure the accuracy, it is unfeasible for an administrator to perform the operation. However, an administrator can synchronize the devices in a network with required accuracy by performing NTP configuration.

NTP benefits from the following advantages:

- Defining the accuracy of clocks by strata to synchronize the time of all the devices in a network quickly
- Supporting access control and MD5 authentication
- Sending protocol packets in unicast, multicast or broadcast mode

The accuracy of a clock is determined by its stratum, which ranges from 1 to 16. The stratum of the reference clock ranges from 1 to 15. The accuracy descends with the increasing of stratum number. The clocks with the stratum of 16 are in unsynchronized state and cannot serve as reference clocks.

The local clock of an S4200G series switch cannot operate as a reference clock. And an S4200G series switch can serve as a time server only when it is synchronized.

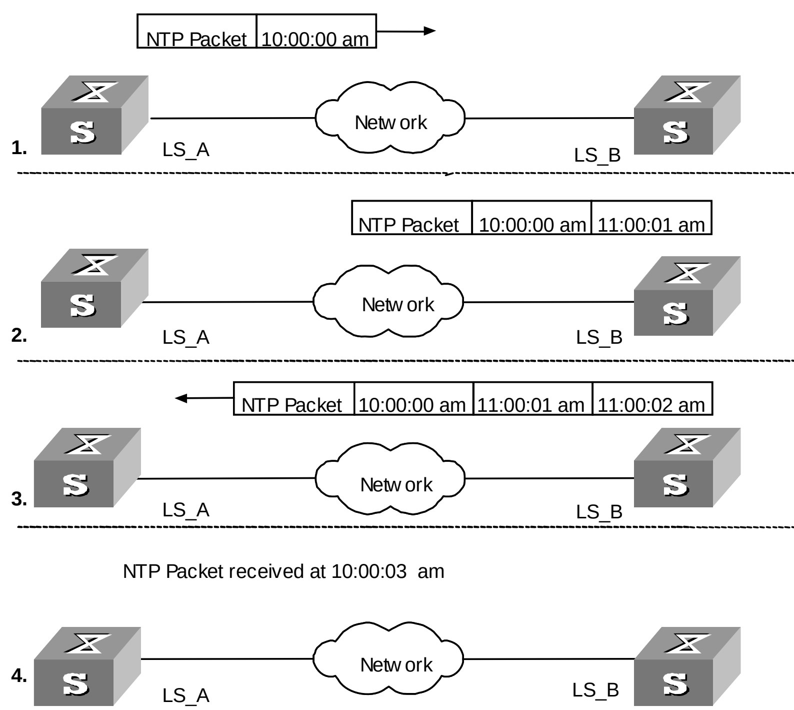
Working Principle of NTP

The working principle of NTP is shown in Figure 89.

In Figure 89, The Ethernet switch A (LS_A) is connected to the Ethernet switch B (LS_B) through their Ethernet ports. Both of them have system clocks of their own, and they need to synchronize the clocks of each other through NTP. For ease of understanding, suppose that:

- Before the system clocks of LS_A and LS_B are synchronized, the clock of LS_A is set to 10:00:00am, and the clock of LS_B is set to 11:00:00am.
- LS_B serves as the NTP time server, that is, the clock of LS_A will be synchronized to that of LS_B.
- It takes one second for a packet sent by one switch to reach the other.

Figure 89 Working principle of NTP



The procedures of synchronizing system clocks are as follows:

- LS_A sends an NTP packet to LS_B, with the timestamp identifying the time when it is sent (that is, 10:00:00am, noted as T_1) carried.
- When the packet arrives at LS_B, LS_B inserts its own timestamp, which identifies 11:00:01am (noted as T_2) into the packet.
- Before this NTP packet leaves LS_B, LS_B inserts its own timestamp once again, which identifies 11:00:02am (noted as T_3).
- When receiving the response packet, LS_A inserts a new timestamp, which identifies 10:00:03am (noted as T_4), into it.

At this time, LS_A has enough information to calculate the following two parameters:

- The delay for an NTP packet to make a round trip between LS_A and LS_B: delay = $(T_4 - T_1) - (T_3 - T_2)$.
- The time offset of LS_A with regard to LS_B: offset = $((T_2 - T_1) + (T_3 - T_4))/2$.

LS_A can then set its own clock according to the above information to synchronize its clock to that of LS_B.

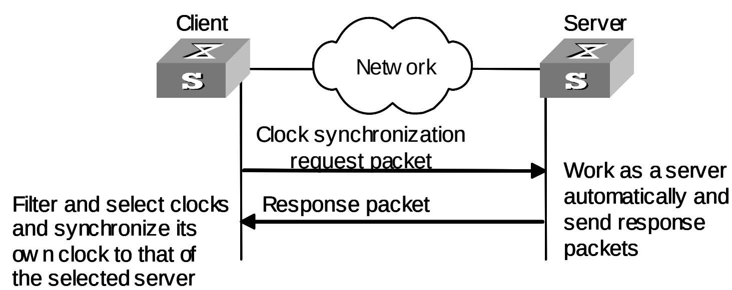
For the detailed information, refer to RFC1305.

NTP Implementation Mode

To accommodate networks of different structures and switches in different network positions, NTP can operate in multiple modes, as described in the following.

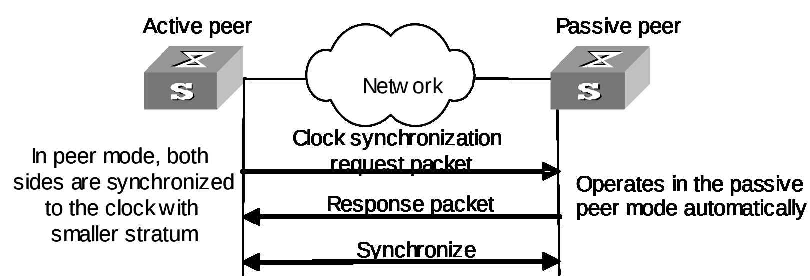
Client/Server mode

Figure 90 NTP implementation mode: client/Sever mode



Peer mode

Figure 91 NTP implementation mode: peer mode

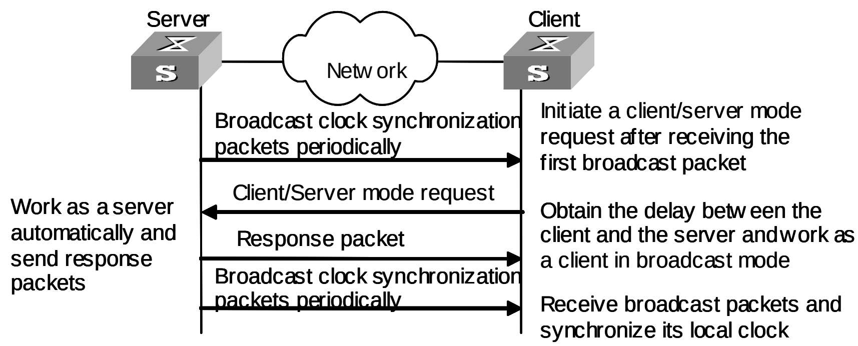


In peer mode, the active peer sends clock synchronization packets first, and its peer works as a passive peer automatically.

If both of the peers have reference clocks, the one with smaller stratum is adopted.

Broadcast mode

Figure 92 NTP implementation mode: broadcast mode



Multicast mode

Figure 93 NTP implementation mode: multicast mode

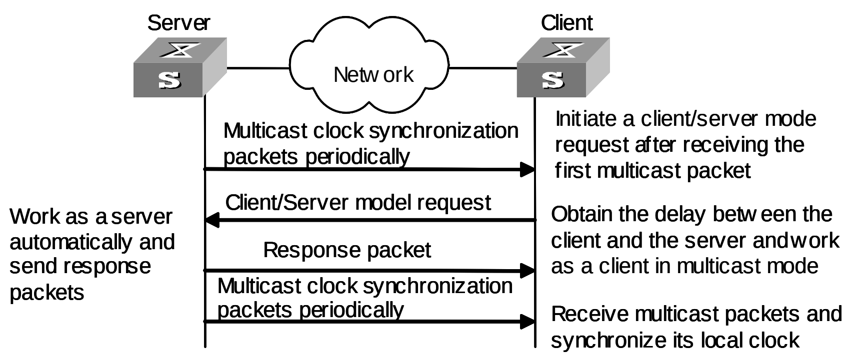


Table 256 describes how the above mentioned NTP modes are implemented on an S4200G series switch.

Table 256 NTP implementation modes on an S4200G series switch

NTP implementation mode	Configuration on S4200G switches
Client/Server mode	Configure the S4200G switch to operate in the NTP server mode. In this case, the remote server operates as the local time server, and the S4200G switch operates as the client.
Peer mode	Configure the S4200G switch to operate in NTP peer mode. In this case, the remote server operates as the peer of the S4200G switch, and the S4200G switch operates as the active peer.
Broadcast mode	■ Configure the S4200G switch to operate in NTP broadcast server mode. In this case, the S4200G switch broadcast NTP packets through the VLAN interface configured on it. ■ Configure the S4200G switch to operate in NTP broadcast client mode. In this case, the S4200G receives broadcast NTP packets through the VLAN interface configured on it.

Table 256 NTP implementation modes on an S4200G series switch (Continued)

NTP implementation mode	Configuration on S4200G switches
Multicast mode	■ Configure the S4200G to operate in NTP multicast server mode. In this case, the S4200G switch sends multicast NTP packets through the VLAN interface configure on it. ■ Configure the S4200G switch to operate in NTP multicast client mode. In this case, the S4200G switch receives multicast NTP packets through the VLAN interface configure on it.

CAUTION: *An S4200G series switch can operate in NTP peer mode, NTP broadcast server mode or NTP multicast server mode only after it is synchronized.*

NTP Implementation Mode Configuration

A switch can operate in the following NTP modes:

- NTP server mode
- NTP peer mode
- NTP broadcast server mode
- NTP broadcast client mode
- NTP multicast server mode
- NTP multicast client mode

Prerequisites

When an S4200G switch operates in NTP server mode or NTP peer mode, you need to perform configuration on the client or the active peer only. When an S4200G switch operates in NTP broadcast mode or NTP multicast mode, you need to perform configurations on both the server side and the client side.

Configuring NTP Implementation Modes

Table 257 Configure NTP implementation modes

Operation	Command	Description
Enter system view	system-view	—
Configure the maximum number of dynamic NTP sessions	ntp-service max-dynamic-sessions	Optional By default, the maximum number of dynamic NTP sessions is 100.
Configure to operate in NTP server mode	**ntp-service unicast-server** *remote-ip* [**authentication-keyid** *key-id* | **priority** | **source-interface Vlan-interface** *vlan-interface-number* | **version** *number]**	Optional By default, the authentication is not performed, the *number* argument is set to 3, and a NTP server is not preferred.
Configure to operate in NTP peer mode	**ntp-service unicast-peer** *remote-ip* [**authentication-keyid** *key-id* | **priority** | **source-interface Vlan-interface** *vlan-interface-number* | **version** *number*]*	Optional By default, the authentication is not performed, the *number* argument is set to 3, and a peer is not preferred.
Enter VLAN interface view	**interface vlan-interface** *vlan-id*	—

Table 257 Configure NTP implementation modes (Continued)

Operation	Command	Description
Configure to operate in NTP broadcast client mode	**ntp-service broadcast-client**	Optional
Configure to operate in NTP broadcast server mode	**ntp-service broadcast-server** [**authentication-keyid** *key-id* | **version** *number*]*	Optional By default, the *number* argument is set to 3.
Configure to operate in NTP multicast client mode	**ntp-service multicast-client** [*ip-address*]	Optional By default, the multicast IP address is 224.0.1.1.
Configure to operate in NTP multicast server mode	**ntp-service multicast-server** [*ip-address*] [**authentication-keyid** *keyid* | **ttl** *ttl-number* | **version** *number]**	Optional By default, the multicast IP address is 224.0.1.1 and the *ttl-number* argument is set to 16.
Display the status information of NTP service	display ntp-service status	These commands can be executed in any view.
Display the session information maintained by the NTP service	**display ntp-service sessions** [**verbose]**	

NTP server mode

When an S4200G series switch operates in NTP server mode,

- The remote server identified by the *remote-ip* argument operates as the NTP time server. The S4200G series switch operates as the client, whose clock is synchronized to the NTP server. (In this case, the clock of the NTP server is not synchronized to the local client.)
- When the *remote-ip* argument is an IP address of a host, it cannot be a broadcast or a multicast address, neither can it be the IP address of a reference clock.

NTP peer mode

When an S4200G series switch operates in NTP peer mode,

- The remote server identified by the *remote-ip* argument operates as the peer of the S4200G series switch, and the S4200G series switch operates as the active peer. The clock of the S4200G series switch can be synchronized to the remote server or be used to synchronize the clock of the remote server.
- When the *remote-ip* argument is an IP address of a host, it cannot be a broadcast or a multicast address, neither can it be the IP address of a reference clock.

NTP broadcast server mode

When an S4200G series switch operates in NTP broadcast server mode, it broadcasts a clock synchronization packet periodically. The devices which are configured to be in the NTP broadcast client mode will response this packet and start the clock synchronization procedure.

NTP multicast server mode

When an S4200G series switch operates in NTP multicast server mode, it multicasts a clock synchronization packet periodically. The devices which are configured to be in the NTP multicast client mode will response this packet and start the clock synchronization procedure. In this mode, the switch can accommodate up to 1024 multicast clients.

- The total number of the servers and peers configured for a switch can be up to 128.
- After the configuration, the S4200G series switch does not establish connections with the peer if it operates in NTP server mode. Whereas if it operates in any of the other modes, it establishes connections with the peer.
- If an S4200G series switch operates as a passive peer in peer mode, NTP broadcast client mode, or NTP multicast client mode, the connections it establishes with the peers are dynamic. If it operates in other modes, the connections it establishes with the peers are static.

Access Control Permission Configuration

Access control permission to NTP server is a security measure that is of the minimum extent. Authentication is more reliable comparing to it.

An access request made to an NTP server is matched from the highest permission to the lowest, that is, in the order of **peer**, **server**, **synchronization**, and **query**.

Table 258 Configure the access control permission to the local NTP server

Operation	Command	Description
Enter system view	system-view	—
Configure the access control permission to the local NTP server	**ntp-service access** { **peer** | **server** | **synchronization** | **query** } *acl-number*	Optional By default, the access control permission to the local NTP server is **peer**.

NTP Authentication Configuration

For the networks with higher security requirements, you can specify to perform authentications when enabling NTP. With the authentications performed on both the client side and the server side, the client is synchronized only to the server that passes the authentication. This improves network security.

Prerequisites

NTP authentication configuration involves:

- Configuring NTP authentication on the client
- Configuring NTP authentication on the server

Note the following when performing NTP authentication configuration:

- If the NTP authentication is not enabled on a client, the client can be synchronized to a server regardless of the NTP authentication configuration performed on the server (assuming that the related configurations are performed).
- You need to couple the NTP authentication with a trusted key.
- The configurations performed on the server and the client must be the same.
- A client with NTP authentication enabled is only synchronized to a server that can provide a trusted key.

Configuring NTP Authentication

Configuring NTP authentication on the client

Table 259 Configure NTP authentication on the client

Operation	Command	Description
Enter system view	system-view	—
Enable NTP authentication globally	ntp-service authentication enable	Required By default, the NTP authentication is disabled.
Configure the NTP authentication key	**ntp-service authentication-keyid** *key-id* **authentication-model md5** *value*	Required By default, the NTP authentication key is not configured.
Configure the specified key to be a trusted key	**ntp-service reliable authentication-keyid** *key-id*	Required By default, no trusted authentication key is configured.
Associate the specified key with the corresponding NTP server	NTP server mode: **ntp-service unicast-server** *remote-ip* **authentication-keyid** *key-id*	■ In NTP server mode and NTP peer mode, you need to associate the specified key with the corresponding NTP server on the client. ■ You can associate the NTP server with the authentication key while configuring the switch to operate in a specific NTP mode. You can also associate them using this command after configuring the NTP mode where the switch is to operate in.
	Peer mode: **ntp-service unicast-peer** *remote-ip* **authentication-keyid** *key-id*	

- NTP authentication requires that the authentication keys configured for the server and the client are the same. Besides, the authentication keys must be trusted keys. Otherwise, the client cannot be synchronized with the server.
- In NTP server mode and NTP peer mode, you need to associate the specified key with the corresponding NTP server/active peer on the client/passive peer. In these two modes, multiple servers/active peers may be configured for a client/passive peer, and a client/passive choose the server/active peer to synchronize to by the authentication key.

Configuring NTP authentication on the server

Table 260 Configure NTP authentication on the server

Operation	Command	Description
Enter system view	system-view	—
Enable NTP authentication	**ntp-service authentication enable**	Required By default, NTP authentication.
Configure NTP authentication key	**ntp-service authentication-keyid** *key-id* **authentication-model md5** *value*	Required By default, NTP authentication key is not configured.
Configure the specified key to be a trusted key	**ntp-service reliable authentication-keyid** *key-id*	Required By default, an authentication key is not a trusted key.
Enter VLAN interface view	**interface vlan-interface** *vlan-id*	—
Associate a specified key with the corresponding NTP server	Broadcast server mode: **ntp-service broadcast-server authentication-keyid** *key-id* Multicast server mode: **ntp-service multicast-server authentication-keyid** *key-id*	■ In NTP broadcast server mode and NTP multicast server mode, you need to associate the specified key with the corresponding NTP server on the server. ■ You can associate an NTP server with an authentication key while configuring a switch to operate in a specific NTP mode. You can also associate them using this command after configuring the NTP mode where a switch is to operate.

The procedures for configuring NTP authentication on the server are the same as that on the client. Besides, the client and the server must be configured with the same authentication key.

Configuration of Optional NTP Parameters

Optional NTP parameters are:

- The local VLAN interface that sends NTP packets
- The number of the dynamic sessions that can be established locally
- Disabling the VLAN interface configured on a switch from receiving NTP packets

Table 261 Configure optional NTP parameters

Operation	Command	Description
Enter system view	system-view	—
Configure the local interface that sends NTP packets	**ntp-service source-interface** *vlan-interface*	Optional
Configure the number of the sessions that can be established locally	**ntp-service max-dynamic-sessions** *number*	Optional By default, up to 100 dynamic sessions can be established locally.
Enter VLAN interface view	**interface vlan-interface** *vlan-id*	—

Table 261 Configure optional NTP parameters (Continued)

Operation	Command	Description
Disable the interface from receiving NTP packets	ntp-service in-interface disable	Optional By default, a VLAN interface receives NTP packets.
Display the session information maintained by the NTP services	**display ntp-service sessions** [**verbose]**	This command can be executed in any view.

CAUTION:

- The source IP address in an NTP packet is the address of the sending interface specified by the **ntp-service unicast-server** command or the **ntp-service unicast-peer** command if you provide the address of the sending interface in these two commands.
- Dynamic connections can only be established when a switch operates in passive peer mode, NTP broadcast client mode, or NTP multicast client mode. In other modes, the connections established are static.

Displaying and Debugging NTP

After the above configuration, you can execute the **display** command in any view to display the running status of the NTP configuration, and verify the effect of the configuration.

Table 262 Display and debug NTP

Operation	Command
Display the status of NTP service	display ntp-service status
Display the information about the sessions maintained by NTP	**display ntp-service sessions** [**verbose]**
Display the brief information about the NTP time servers of the reference clock sources that the local device traces to	display ntp-service trace

Configuration Example

NTP Server Mode Configuration

Network requirements

Configure the local clock of S4200G 1 to be NTP master clock, with the stratum being 2.

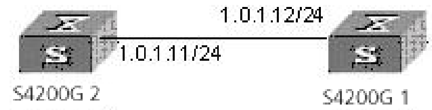
S4200G1 is a switch that allows the local clock to be the master clock.

A S4200G 1 series switch operates in client mode, with S4200G2 as the time server. S4200G 2 operates in server mode automatically.

The 1, 2, 3, etc. destinations in the switch names are for explanation purposes only and are not part of the command structure.

Network diagram

Figure 94 Network diagram for the NTP server mode configuration



Configuration procedures

The following configurations are for the S4200G 1 switch.

1 Display the NTP status of the S4200G 1 switch before synchronization.

```
<S4200G> display ntp-service status
clock status: unsynchronized
clock stratum: 16
reference clock ID: none
nominal frequence: 99.8562 Hz
actual frequence: 99.8562 Hz
clock precision: 2^7
clock offset: 0.0000 ms
root delay: 0.00 ms
root dispersion: 0.00 ms
peer dispersion: 0.00 ms
reference time: 00:00:00.000 UTC Jan 1 1900 (00000000.00000000)
```

2 Configure S4200G 2 to be the time server.

```
S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G] ntp-service unicast-server 1.0.1.11
```

3 After the above configuration, the S4200G 1 switch is synchronized to S4200G 2. Display the NTP status of the S4200G 1 series switch.

```
[S4200G] display ntp-service status
clock status: synchronized
clock stratum: 3
reference clock ID: 1.0.1.11
nominal frequence: 250.0000 Hz
actual frequence: 249.9992 Hz
clock precision: 2^19
clock offset: 0.66 ms
root delay: 27.47 ms
root dispersion: 208.39 ms
peer dispersion: 9.63 ms
reference time: 17:03:32.022 UTC Thu Sep 6 2001 (BF422AE4.05AEA86C)
```

The above output information indicates that the S4200G 1 series switch is synchronized to S4200G 2, and the stratum of its clock is 3, one stratum higher than S4200G 2.

4 Display the information about the NTP sessions of the S4200G 2 series switch. You can see that the S4200G 1 series switch establishes a connection with S4200G 2.

```
[S4200G]dis ntp-service sessions
     source        reference       stra reach poll  now offset  delay disper
****************************************************
    [ 5]1.0.1.11     0.0.0.0         2    1   64    1   350.1   15.1
0.0
```

```
note: 1 source(master),2 source(peer),3 selected,4 candidate,5
configured
```

NTP Peer Mode Configuration

Network requirements

S4200G 2 sets the local clock to be the NTP master clock, with the clock stratum being 2.

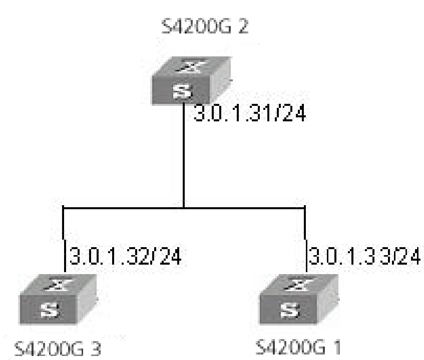
Configure an S4200G 1 series switch to operate as a client, with S4200G 2 as the time server. S4200G 2 will then operate in the server mode automatically. Meanwhile, S4200G 3 sets the S4200G 1 series switch to be its peer.

This example assumes that:

- S4200G 2 is a switch that allows its local clock to be the master clock.
- S4200G 3 is a switch that allows its local clock to be the master clock and the stratum of its clock is 1.

Network diagram

Figure 95 Network diagram for NTP peer mode configuration



Configuration procedures

1 Configure the S4200G 1 series switch.

a Set S4200G 2 to be the time server.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G] ntp-service unicast-server 3.0.1.31
```

2 Configure S4200G 3 (after the S4200G 1 series switch is synchronized to S4200G 2).

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b After the local synchronization, set the S4200G 1 series switch to be its peer.

```
[S4200G3] ntp-service unicast-peer 3.0.1.32
```

The S4200G 1 series switch and S4200G 3 are configured to be peers with regard to each other. S4200G 3 operates in active peer mode, while the S4200G 1 series switch operates in passive peer mode. Because the stratum of the local clock of S4200G 3 is 1, and that of the S4200G 1 switch is 3, the S4200G 1 series switch is synchronized to S4200G 3.

Display the status of the S4200G switch after the synchronization.

```
[S4200G] display ntp-service status
Clock status: synchronized
 Clock stratum: 2
 Reference clock ID: 3.0.1.32
 Nominal frequency: 250.0000 Hz
 Actual frequency: 249.9992 Hz
 Clock precision: 2^19
clock offset: 0.66 ms
 Root delay: 27.47 ms
 Root dispersion: 208.39 ms
 Peer dispersion: 9.63 ms
 Reference time: 17:03:32.022 UTC Thu Sep 6 2001 (BF422AE4.05AEA86C)
```

The output information indicates that the S4200G 1 series switch is synchronized to S4200G 3 and the stratum of its local clock is 2, one stratum higher than S4200G 3.

c Display the information about the NTP sessions of the S4200G 1 series switch and you can see that a connection is established between the S4200G 1 series switch and S4200G 3.

```
[S4200G] display ntp-service sessions
     source        reference       stra reach poll  now offset  delay
disper
****************************************************
[ 2]3.0.1.32        0.0.0.0       1    1   64    1  350.1   15.1    0.0
note: 1 source(master),2 source(peer),3 selected,4 candidate,5
configured
```

NTP Broadcast Mode Configuration

Network requirements

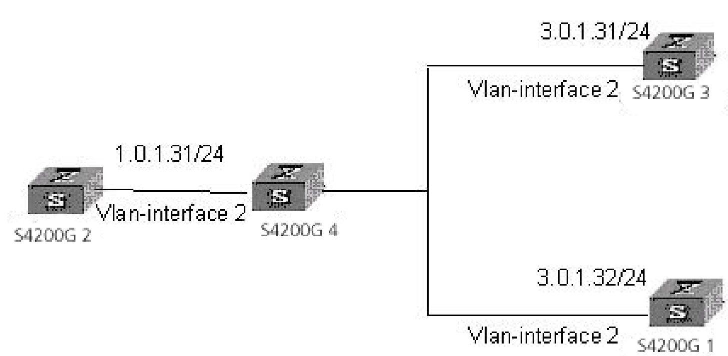
S4200G3 sets its local clock to be an NTP master clock, with the stratum being 2. NTP packets are broadcast through VLAN interface 2.

Configure S4200 to listen broadcast packets through their VLAN interface 2.

This example assumes that S4200G3 is a switch that supports the local clock being the master clock.

Network diagram

Figure 96 Network diagram for the NTP broadcast mode configuration



Configuration procedures

1 Configure S4200G 3.

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Enter VLAN interface 2 view.

```
[S4200G] interface vlan-interface 2
[S4200G-Vlan-interface2]
```

c Configure S4200G 3 to be the broadcast server and send broadcast packets through VLAN interface 2.

```
[S4200G-Vlan-interface2] ntp-service broadcast-server
```

2 Configure S4200G 1.

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Enter VLAN interface 2 view.

```
[S4200G] interface vlan-interface 2
[S4200G-Vlan-interface2]
```

c Configure S4200G 1 to be a broadcast client.

```
[S3100S4200G-Vlan-interface2] ntp-service broadcast-client
```

3 Configure S4200G 2

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Enter VLAN interface 2 view.

```
[S4200G] interface vlan-interface 2
[S4200G-Vlan-Interface2]
```

c Configure S4200G 2 to be a broadcast client.

```
[S4200G-Vlan-interface2] ntp-service broadcast-client
```

The above configuration configures S4200G 1 to listen to broadcast packets through their VLAN interface 2, and S4200G 3 to send broadcast packets through VLAN interface 2. Because S4200G 2 does reside in the same network segment as S4200G 3 resides, the former cannot receive broadcast packets sent by S4200G 3, while S4200G 1 is synchronized to S4200G 3 after receiving broadcast packets sent by S4200G 3.

Display the status of S4200G 1 after the synchronization.

```
[S4200G] display ntp-service status
Clock status: synchronized
 Clock stratum: 3
 Reference clock ID: 3.0.1.31
 Nominal frequency: 250.0000 Hz
 Actual frequency: 249.9992 Hz
 Clock precision: 2^19
 Clock offset: 198.7425 ms
```

```
Root delay: 27.47 ms
Root dispersion: 208.39 ms
Peer dispersion: 9.63 ms
Reference time: 17:03:32.022 UTC Thu Sep 6 2001 (BF422AE4.05AEA86C)
```

The output information indicates that S4200G 1 is synchronized to S4200G 3, with the clock stratum of 3, one stratum higher than S4200G 3.

d Display the information about the NTP sessions of S4200G and you can see that a connection is established between S4200G and S4200G3.

```
[S4200G] display ntp-service sessions
    source          refid       st  now  poll reach  delay offset   dis
********************************************************************
[1]3.0.1.31       0.0.0.0      2    1    64   377    26.1   199.53   9.7
note: 1 source(master),2 source(peer),3 selected,4 candidate,5
configured
```

NTP Multicast Mode Configuration

Network requirements

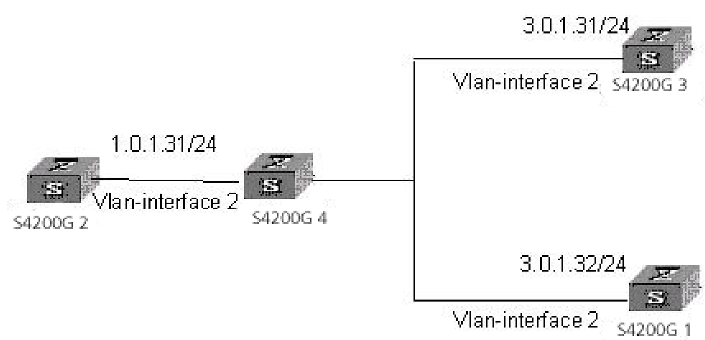
S4200G3 sets the local clock to be NTP master clock, with the clock stratum of 2. It advertises multicast packets through VLAN interface 2.

Configure S4200G 1 to listen multicast packets through their VLAN interface 2.

This example assumes that S4200G 3 is a switch that supports the local clock being the master clock.

Network diagram

Figure 97 Network diagram for NTP multicast mode configuration



Configuration procedures

1 Configure S4200G 3.

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Enter VLAN interface 2 view.

```
[S4200G] interface vlan-interface 2
```

c Configure S4200G 3 to be a multicast server.

```
[S4200G-Vlan-Interface2] ntp-service multicast-server
```

2 Configure S4200G 1.

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Enter VLAN interface 2 view.

```
[[S4200G] interface vlan-interface 2
```

c Configure S4200G 4 to be a multicast client.

```
[S4200G-Vlan-interface2] ntp-service multicast-client
```

3 Configure S4200G.2

a Enter system view.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Enter VLAN interface 2 view.

```
[[S4200G] interface vlan-interface 2
```

c Configure S4200G 1 to be a multicast client.

```
[S4200G-Vlan-interface2] ntp-service multicast-client
```

The above configuration configures S4200G 1 to listen multicast packets through their VLAN interface 2, and S4200G 3 to advertise multicast packets through VLAN interface 2. Because S4200G 2 does not resides in the same network segment as S4200G 3 does, the former cannot receive multicast packets sent by S4200G 3, while S4200G 1 is synchronized to S4200G 3 after receiving multicast packets sent by S4200G 3.

Display the status of S4200G 1 after the synchronization.

```
[S4200G] display ntp-service status
Clock status: synchronized
 Clock stratum: 3
 Reference clock ID: 3.0.1.31
 Nominal frequency: 250.0000 Hz
 Actual frequency: 249.9992 Hz
 Clock precision: 2^19
 Clock offset: 198.7425 ms
 Root delay: 27.47 ms
 Root dispersion: 208.39 ms
 Peer dispersion: 9.63 ms
 Reference time: 17:03:32.022 UTC Thu Sep 6 2001 (BF422AE4.05AEA86C)
```

The output information indicates that S4200G 1 is synchronized to S4200G 3, with the clock stratum being 3, one stratum higher than S4200G 3.

d Display the information about the NTP sessions S4200G 1 and you can see that a connection is established between S4200G 1 and S4200G 3.

```
[S4200G] display ntp-service sessions
    source          refid       st  now  poll reach  delay offset   dis
********************************************************************
[1]3.0.1.31       0.0.0.0      2    1    64   377    26.1   199.53   9.7
note: 1 source(master),2 source(peer),3 selected,4 candidate,5 
configured
```

NTP Server Mode with Authentication Configuration

Network requirements

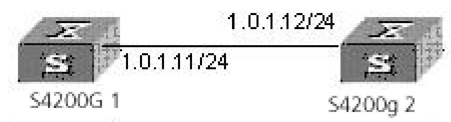
The local clock of S4200G1 operates as the master NTP clock, with the clock stratum set to 2.

A S4200G 2 series switch operates in client mode with S4200G 1 as the time server. S4200G 1 operates in the server mode automatically. Meanwhile, NTP authentication is enabled on both sides.

This example assumes that S4200G 1 is a switch that supports the local clock being the master NTP clock.

Network diagram

Figure 98 Network diagram for NTP server mode with authentication configuration



Configuration procedures

1 Configure the S4200G 2 series switch.

a Enter system view.

```
<S4200G > system-view
System View: return to User View with Ctrl+Z.
[S4200G]
```

b Configure S4200G 1 to be the time server.

```
[S4200G] ntp-service unicast-server 1.0.1.11
```

c Enable NTP authentication.

```
[S4200G] ntp-service authentication enable
```

d Set the authentication key.

```
[S4200G] ntp-service authentication-keyid 42 authentication-mode md5
aNiceKey
```

e Specify the key to be a trusted key.

```
[S4200G] ntp-service reliable authentication-keyid 42
[[S4200G] ntp-service unicast-server 1.0.1.11 authentication-keyid 42
```

The above configuration synchronizes S4200G 2 to S4200G 1. As NTP authentication is not enabled on S4200G 1, S4200G 2 will fail to be synchronized to S4200G 1.

To synchronize the S4200G 2 series switch, the following configuration is needed for S4200G 1.

f Enable authentication on S4200G 1.

```
[S4200G] ntp-service authentication enable
```

g Set the authentication key.

```
[S4200G] ntp-service authentication-keyid 42 authentication-model md5
aNiceKey
```

h Specify the key to be a trusted key.

```
[S4200G] ntp-service reliable authentication-keyid 42
```

After the above configuration, the S4200G 2 series switch can be synchronized to S4200G 1. You can display the status of S4200G 2 after the synchronization.

```
[S4200G] display ntp-service status
clock status: synchronized
clock stratum: 3
reference clock ID: 1.0.1.11
nominal frequence: 250.0000 Hz
actual frequence: 249.9992 Hz
clock precision: 2^19
clock offset: 0.66 ms
root delay: 27.47 ms
root dispersion: 208.39 ms
peer dispersion: 9.63 ms
reference time: 17:03:32.022 UTC Thu Sep 6 2001 (BF422AE4.05AEA86C)
```

The output information indicates that S4200G 2 is synchronized to S4200G 1, with the clock stratum being 3, one stratum higher than S4200G 1.

36 SSH Terminal Services

SSH Terminal Services

Introduction to SSH

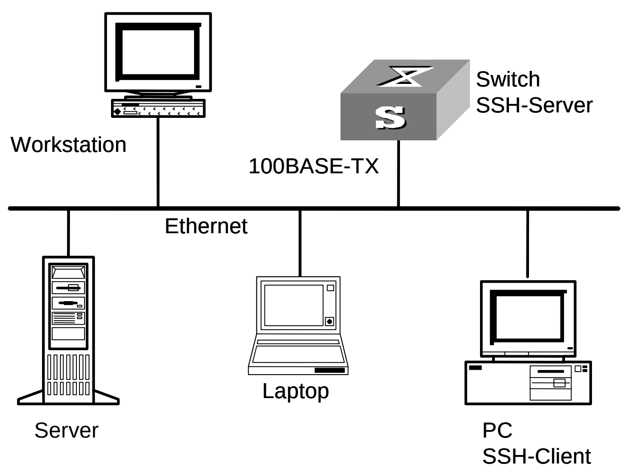
Secure Shell (SSH) can provide information security and powerful authentication to prevent such assaults as IP address spoofing, plain-text password interception when users log on to the Switch remotely using an insecure network environment.

A Switch can connect to multiple SSH clients. SSH2.0 and SSH1.x are currently available. SSH client functions to enable SSH connections between users and the Switch or UNIX host that support SSH server.

Figure 99and Figure 100 shows respectively SSH connection establishment for client and server.

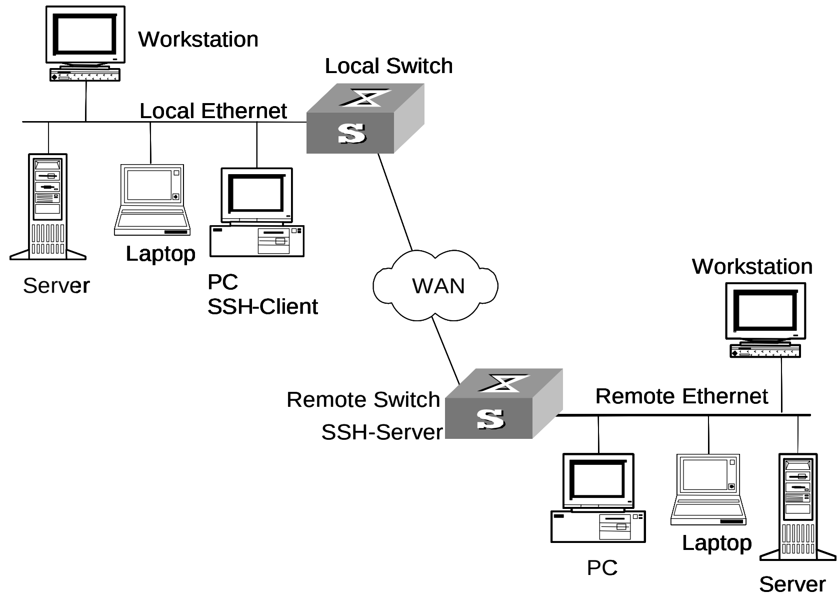
- SSH connections through LAN

Figure 99 Establish SSH channels through LAN



- SSH connections through WAN

Figure 100 Establish SSH channels through WAN



The communication process between the server and client includes these five stages:

1 Version negotiation stage. These operations are completed at this stage:

- The client sends TCP connection requirement to the server.
- When TCP connection is established, both ends begin to negotiate the SSH version.
- If they can work together in harmony, they enter the key algorithm negotiation stage. Otherwise the server clears the TCP connection.

2 Key algorithm negotiation stage. These operations are completed at this stage:

- The server sends the public key in a randomly generated RSA key pair to the client.
- The client figures out session key based on the public key from the server and the random number generated locally.
- The client encrypts the random number with the public key from the server and sends the result back to the server.
- The server then decrypts the received data with the server private key to get the client random number.
- The server then uses the same algorithm to work out the session key based on server public key and the returned random number.

Then both ends get the same session key without data transfer over the network, while the key is used at both ends for encryption and decryption.

3 Authentication method negotiation stage. These operations are completed at this stage:

- The client sends its username information to the server.
- The server authenticates the username information from the client. If the user is configured as no authentication on the server, authentication stage is skipped and session request stage starts directly.
- The client authenticates information from the user at the server till the authentication succeeds or the connection is turned off due to authentication timeout.

SSH supports two authentication types: password authentication and RSA authentication.

(1) Password authentication works as follows:

- The client sends its username and password to the server.
- The server compares the username and password received with those configured locally. The user is allowed to log on to the Switch if the usernames and passwords match exactly.

(2) RSA authentication works as follows:

- Configure the RSA public key of the client user at the server.
- The client sends the member modules of its RSA public key to the server.
- The server checks the validity of the member module. If it is valid, the server generates a random number, which is sent to the client after being encrypted with RSA public key of the client.
- Both ends calculate authentication data based on the random number and session ID.
- The client sends the authentication data calculated back to the server.
- The server compares it with its authentication data obtained locally. If they match exactly, the user is allowed to access the switch.

4 Session request stage. The client sends session request messages to the server which processes the request messages.

5 Interactive session stage. Both ends exchange data till the session ends.

SSH Server Configuration

Table 263 describes SSH server configuration tasks.

Table 263 Configure SSH2.0 server

Serial No	Operation	Command	Remarks
1	Configure supported protocols	protocol inbound	Refer to "Configuring supported protocols"
2	Generate a local RSA key pair	rsa local-key-pair create	Refer to "Generating or destroying RSA key pairs"
	Destroy the local RSA key pair	rsa local-key-pair destroy	
3	Configure authentication mode for SSH users	**ssh user** *username* **authentication-type**	Refer to "Configuring authentication type "
4	Set SSH authentication timeout time	ssh server timeout	Refer to "Configuring server SSH attributes "
	Set SSH authentication retry times	ssh server authentication-retries	
5	Allocate public keys for SSH users	**ssh user** *username* **assign rsa-key** *keyname*	Refer to "Configuring client public keys "

Configuring supported protocols

Table 264 Configure supported protocols

Operation	Command	Remarks
Enter system view	system-view	-
Enter one or multiple user interface views	**user-interface** [*type-keyword*] *number* [*ending-number]*	Required
Configure the protocols supported in the user interface view(s)	**protocol inbound** { **all** |**ssh** | **telnet }**	Optional By default, the system supports both Telnet and SSH.

CAUTION: *When SSH protocol is specified, to ensure a successful login, you must configure the AAA authentication using the* ***authentication-mode scheme*** *command.*

The ***protocol inbound ssh*** *configuration fails if you configured* ***authentication-mode password*** *or* ***authentication-mode none****. When you configure SSH protocol successfully for the user interface, then you cannot configure* ***authentication-mode password*** *or* ***authentication-mode none*** *any more.*

Generating or destroying RSA key pairs

The name of the server RSA key pair is in the format of switch name plus _host, S4200G_host for example.

After you use the command, the system prompts you to define the key length.

- In SSH1.x, the key length is in the range of 512 to 2,048 (bits).
- In SSH2.0, the key length is in the range of 1024 to 2048 (bits). To make SSH 1.x compatible, 512- to 2,048-bit keys are allowed on clients, but the length of server keys must be more than 1,024 bits. Otherwise, clients cannot be authenticated.

Table 265 Generate or destroy RSA key pairs

Operation	Command	Remarks
Enter system view	system-view	-
Generate a local RSA key pair	rsa local-key-pair create	Required
Destroy a local RSA key pair	rsa local-key-pair destroy	Optional

CAUTION:

- For a successful SSH login, you must generate a local RSA key pair first.
- You just need to execute the command once, with no further action required even after the system is rebooted.
- If you use this command to generate an RSA key provided an old one exits, the system will prompt you to replace the previous one or not.

Configuring authentication type

New users must specify authentication type. Otherwise, they cannot access the switch.

Table 266 Configure authentication type

Operation	Command	Remarks
Enter system view	system-view	-
Configure authentication type for SSH users	**ssh user** *username* **authentication-type** { **password** | **password-publickey** | **rsa**| **all** }	Required

CAUTION:

- If RSA authentication type is defined, then the RSA public key of the client user must be configured on the switch.
- By default, no authentication type is specified for a new user, so they cannot access the switch.
- For the **password-publickey** authentication type: SSHv1 client users can access the switch as long as they pass one of the two authentications. SSHv2 client users can access the switch only when they pass both the authentications.

Configuring server SSH attributes

Configuring server SSH authentication timeout time and retry times can effectively assure security of SSH connections and avoid illegal actions.

Table 267 Configure server SSH attributes

Operation	Command	Remarks
Enter system view	system-view	-
Set SSH authentication timeout time	**ssh server timeout** *seconds*	Optional The timeout time defaults to 60 seconds.
Set SSH authentication retry times	**ssh server authentication-retries** *times*	Optional The retry times defaults to 3.

Configuring client public keys

You can configure RSA public keys for client users on the switch and specify RSA private keys, which correspond to the public keys, on the client. Then client keys are generated randomly by the SSH2.0 client software. This operation is not required for password authentication type.

Table 268 Configure client public keys

Operation	Command	Remarks
Enter system view	system-view	-
Enter public key view	**rsa peer-public-key** *key-name*	Required
Enter public key edit view	public-key-code begin	You can key in a blank space between characters, since the system can remove the blank space automatically. But the public key should be composed of hexadecimal characters.
Return to public key view from public key edit view	public-key-code end	The system saves public key data when exiting from public key edit view

Table 268 Configure client public keys (Continued)

Operation	Command	Remarks
Return to system view from public key view	**peer-public-key end**	
Allocate public keys to SSH users	**ssh user** *username* **assign rsa-key** *keyname*	Required *Keyname* is the name of an existing public key. If the user already has a public key, the new public key overrides the old one.

SSH Client Configuration

Table 269 describes SSH configuration tasks.

Table 269 Configure SSH client

Operation	Command	Remarks
Enter system view	system-view	
Enable the connection between SSH client and server	**ssh2** *host-ipaddr* [**port**] [**prefer_kex** { **dh_group1** | **dh_exchange_group** }] [**prefer_ctos_cipher** { **des** | **aes128 }**] [**prefer_stoc_cipher** { **des** | **aes128** }] [**prefer_ctos_hmac** { **sha1** | **sha1_96** | **md5** | **md5_96** }] [**prefer_stoc_hmac** { **sha1** | **sha1_96** | **md5** | **md5_96** }]	Required You can use this command to enable the connection between SSH client and server, define key exchange algorithm preference, encryption algorithm preference and HMAC algorithm preference between the server and client.
Allocate a public key to the server	**ssh client** *server-ip* **assign rsa-key** *keyname*	Required You can specify on the client the public key for the server to be connected to guarantee the client can be connected to a reliable server.
Configure the client to run the initial authentication	ssh client first-time enable	Optional By default, the client runs the initial authentication.

In the initial authentication, if the SSH client does not have the public key for the server which it accesses for the first time, the client continues to access the server and save locally the public key of the server. Then at the next access, the client can authenticate the server using the public key saved locally.

Displaying SSH Configuration

Use the **display** commands in any view to view the running of SSH and further to check the configuration result.

Table 270 Display SSH configuration

Operation	Command
Display host and server public keys	display rsa local-key-pair public
Display client RSA public key	**display rsa peer-public-key** [**brief** | **name** *keyname*]
Display SSH status and session information	**display ssh server** { **status** | **session }**
Display SSH user information	**display ssh user-information** [*username*]

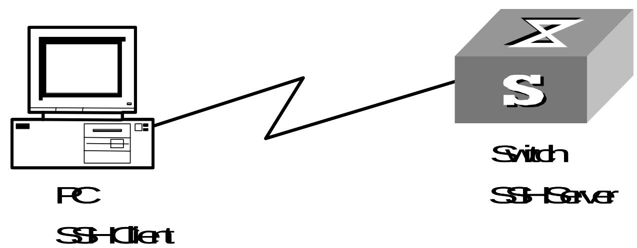
SSH Server Configuration Example

Network requirements

As shown in Figure 101, configure a local connection from the SSH client to the switch. The PC runs the SSH2.0-supported client software.

Network diagram

Figure 101 Network diagram for SSH server configuration



Configuration procedure

1 Generate a local RSA key pair.

```
<S4200G>system-view
[4200G] rsa local-key-pair create
```

If the local RSA key pair has been generated in previous operations, skip this step.

2 Set authentication type.

Settings for the two authentication types are described respectively in the following:

- Password authentication
- Set AAA authentication on the user interfaces.

```
[4200G] user-interface vty 0 4
[4200G-ui-vty0-4] authentication-mode scheme
```

Set the user interfaces to support SSH.

```
[4200G-ui-vty0-4] protocol inbound ssh
```

Configure the login protocol for the clinet001 user as SSH and authentication type as password.

```
[4200G] local-user client001
[4200G-luser-client001] password simple abc
[4200G-luser-client001] service-type ssh
[4200G-luser-client001] quit
[4200G] ssh user client001 authentication-type password
```

Select the default SSH authentication timeout time and authentication retry times. After these settings, run the SSH2.0-supported client software on other hosts connected to the switch. Log in to the switch using user name client001 and password abc.

- RSA public key authentication
- Set AAA authentication on the user interfaces.

```
[4200G] user-interface vty 0 4
[4200G-ui-vty0-4] authentication-mode scheme
```

Set the user interfaces to support SSH.

```
[4200G-ui-vty0-4] protocol inbound ssh
```

Configure the login protocol for the client002 user as SSH and authentication type as RSA public key.

```
[4200G] ssh user client002 authentication-type rsa
```

Generate randomly RSA key pairs on the SSH2.0 client and send the corresponding public keys to the server.

Configure client public keys on the server, with their name as S4200G002.

```
[4200G] rsa peer-public-key S4200G002
[4200G-rsa-public-key] public-key-code begin
[4200G-rsa-key-code] 308186028180739A291ABDA704F5D93DC8FDF84C427463
[4200G-rsa-key-code] 1991C164B0DF178C55FA833591C7D47D5381D09CE82913
[4200G-rsa-key-code] D7EDF9C08511D83CA4ED2B30B809808EB0D1F52D045DE4
[4200G-rsa-key-code] 0861B74A0E135523CCD74CAC61F8E58C452B2F3F2DA0DC
[4200G-rsa-key-code] C48E3306367FE187BDD944018B3B69F3CBB0A573202C16
[4200G-rsa-key-code] BB2FC1ACF3EC8F828D55A36F1CDDC4BB45504F020125
[4200G-rsa-key-code] public-key-code end
[4200G-rsa-public-key] peer-public-key end
[4200G] ssh user client002 assign rsa-key S4200G002
```

Start the SSH client software on the host which stores the RSA private keys and make corresponding configuration to establish an SSH connection.

SSH Client Configuration Example

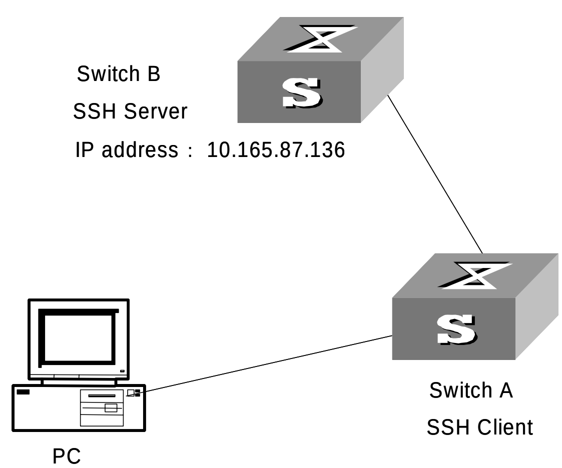
Network Requirements

As shown in Figure 102,

- Switch A serves as an SSH client with user name as client003.
- Switch B serves as an SSH server, with its IP address 10.165.87.136.

Network diagram

Figure 102 Network diagram for SSH client configuration



Configuration procedure

1 Configure the client to run the initial authentication.

```
[4200G] ssh client first-time enable
```

2 Configure server public keys on the client.

```
[4200G] rsa peer-public-key public
[4200G-rsa-public-key] public-key-code begin
[4200G-rsa-key-code] 308186028180739A291ABDA704F5D93DC8FDF84C427463
```

```
[4200G-rsa-key-code] 1991C164B0DF178C55FA833591C7D47D5381D09CE82913
[4200G-rsa-key-code] D7EDF9C08511D83CA4ED2B30B809808EB0D1F52D045DE4
[4200G-rsa-key-code] 0861B74A0E135523CCD74CAC61F8E58C452B2F3F2DA0DC
[4200G-rsa-key-code] C48E3306367FE187BDD944018B3B69F3CBB0A573202C16
[4200G-rsa-key-code] BB2FC1ACF3EC8F828D55A36F1CDDC4BB45504F020125
[4200G-rsa-key-code] public-key-code end
[4200G-rsa-public-key] peer-public-key end
[4200G] ssh client 10.165.87.136 assign rsa-key public
```

3 Start SSH client.

Settings for the two authentication types are described respectively in the following:

- Use the password authentication and start the client using the default encryption algorithm.

```
[4200G] ssh2 10.165.87.136
username: client003
Trying 10.165.87.136
Press CTRL+K to abort
Connected to 10.165.87.136…
The Server is not autherncated.Do you continue access it?(Y/N):y
Do you want to save the server's public key?(Y/N):y
Enter password:
*********************************************************
*          All rights reserved (1997-2005)              *
*      Without the owner's prior written consent,       *
*no decompiling or reverse-engineering shall be allowed.*
*********************************************************

<S4200G>
```

- Start the client and use the RSA public key authentication according to the encryption algorithm defined.

```
[4200G] ssh2 10.165.87.136 22 perfer_kex dh_group1 perfer_ctos_cipher
des perfer_ctos_hmac md5 perfer_stoc_hmac md5
username: client003
Trying 10.165.87.136…
Press CTRL+K to abort
Connected to 10.165.87.136…
The Server is not autherncated.Do you continue access it?(Y/N):y
Do you want to save the server's public key?(Y/N):y
*********************************************************
*          All rights reserved (1997-2005)              *
*      Without the owner's prior written consent,       *
*no decompiling or reverse-engineering shall be allowed.*
*********************************************************

<S4200G>
```

SFTP Service

SFTP Overview

Secure FTP (SFTP) is a new feature introduced in SSH 2.0.

SFTP is established on SSH connections to secure remote users’ login to the switch, perform file management and file transfer (such as upgrade the system), and provide secured data transfer. As an SFTP client, it allows you to securely log onto another device to transfer files.

SFTP Server Configuration

The following sections describe SFTP server configuration tasks:

- Configuring service type for an SSH user
- Enabling the SFTP server
- Setting connection timeout time

Configuring service type for an SSH user

Table 271 Configure service type for an SSH user

Operation	Command	Remarks
Enter system view	system-view	-
Configure service type for an SSH user	**ssh user** *username* **service-type** { **stelnet** | **sftp** | **all }**	Optional By default, the SSH service type is **stelnet**.

Enabling the SFTP server

Table 272 Enable the SFTP server

Operation	Command	Remarks
Enter system view	system-view	-
Enable the SFTP server	sftp server enable	Required By default, the SFTP server is not enabled.

Setting connection timeout time

After you set the timeout time for the SFTP user connection, the system will automatically release the connection when the time is up.

Table 273 Set connection timeout time

Operation	Command	Remarks
Enter system view	system-view	
Set timeout time for the SFTP user connection	**sftp timeout** *timeout-value*	Required By default, the connection timeout time is 10 minutes.

SFTP Client Configuration

The following sections describe SFTP client configuration tasks:

Table 274 Configuring SFTP client

Serial No	Operation		Command Key word	View	Remarks
1	Enable the SFTP client		sftp	System view	Required
2	Disable the SFTP client		bye	SFTP client view	Optional
			exit		
			quit		
3	SFTP directory -related operations	Change the current directory	cd	SFTP client view	Optional
		Return to the upper directory	cdup		
		Display the current directory	pwd		
		Display the list of the files in a directory	dir		
			ls		
		Create a new directory	mkdir		
		Delete a directory	rmdir		
4	SFTP file-related operations	Rename a file on the SFTP server	rename	SFTP client view	Optional
		Download a file from the remote SFTP server	get		
		Upload a local file to the remote SFTP server	put		
		Display the list of the files in a directory	dir		
			ls		
		Delete a file from the SFTP server	delete		
			remove		
5	Get help information about SFTP client commands		help	SFTP client view	Optional

Enabling the SFTP client

You can enable the SFTP client, establish a connection to the remote SFTP server and enter STP client view.

Table 275 Enable the SFTP client

Operation	Command	Remarks
Enter system view	system-view	-
Enable the SFTP client	**sftp** *ipaddr* [**prefer_kex** { **dh_group1** | **dh_exchange_group** }] [**prefer_ctos_cipher** { **des** | **aes128** }] [**prefer_stoc_cipher** { **des** | **aes128** }] [**prefer_ctos_hmac** { **sha1** | **sha1_96** | **md5** | **md5_96** }] [**prefer_stoc_hmac** { **sha1** | **sha1_96** | **md5** | **md5_96** }]	Required

Disabling the SFTP client

Table 276 Disable the SFTP client

Operation	Command	Remarks
Enter system view	system-view	-
Enter SFTP client view	**sftp** { *host-ip* | *host-name* }	-
Disable the SFTP client	bye	The three commands have the same function.
	exit	
	quit	

Operating with SFTP directories

SFTP directory-related operations include: changing or displaying the current directory, creating or deleting a directory, displaying files or information of a specific directory.

Table 277 Operate with SFTP directories

Operation	Command	Remarks
Enter system view	system-view	Optional
Enter SFTP client view	**sftp** { *host-ip* | *host-name* }	
Change the current directory	**cd** *remote-path*	
Return to the upper directory	cdup	
Display the current directory	pwd	
Display the list of the files in a directory	**dir** [*remote-path]*	Optional The **dir** and **ls** commands have the same function.
	ls [*remote-path]*	
Create a directory on the SFTP server	**mkdir** *remote-path*	Optional
Delete a directory from the SFTP server	**rmdir** *remote-path*	

Operating with SFTP files

SFTP file-related operations include: changing file name, downloading files, uploading files, displaying the list of the files, deleting files.

Table 278 Operate with SFTP files

Operation	Command	Remarks
Enter system view	system-view	Optional
Enter SFTP client view	**sftp** { *host-ip* | *host-name* }	
Change the name of a file on the remote SFTP server	**rename** *old-name new-name*	
Download a file from the remote SFTP server	**get** *remote-file* [*local-file]*	
Upload a file to the remote SFTP server	**put** *local-file* [*remote-file*]	
Display the list of the files in a directory	**dir** [*remote-path]*	Optional The **dir** and **ls** commands have the same function.
	ls [*remote-path]*	
Delete a file from the SFTP server	**delete** *remote-file*	Optional The **delete** and **remove** commands have the same function.
	remove *remote-file*	

Displaying help information

You can display help information about a command, such as syntax and parameters.

Table 279 Display help information about SFTP client commands

Operation	Command	Remarks
Enter system view	system-view	-
Enter SFTP client view	**sftp** { *host-ip* | *host-name* }	-
Display help information about SFTP client commands	**help** [*command-name*]	Optional

SFTP Configuration Example

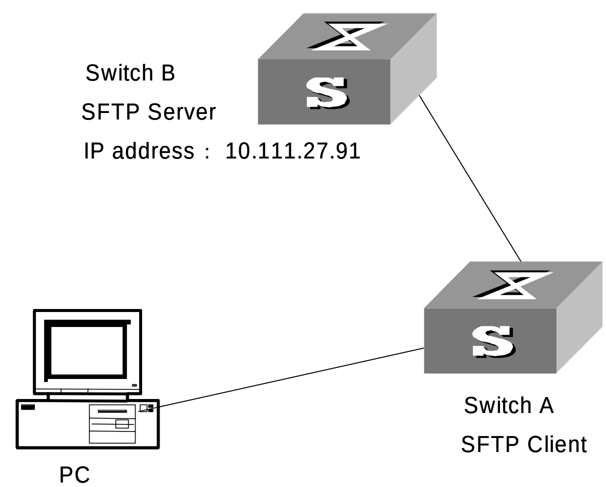
Network requirements

As shown in Figure 103,

- An SSH connection is present between Switch A and Switch B.
- Switch B serves as an SFTP server, with IP address 10.111.27.91.
- Switch A serves as an SFTP client.
- An SSH user name abc with password hello is created.

Network diagram

Figure 103 Network diagram for SFTP configuration



Configuration procedure

1 Configure Switch B (SFTP server)

a Enable the SFTP server.

```
[4200G] sftp server enable
```

b Specify SFTP service for SSH user abc.

```
[4200G] ssh user abc service-type sftp
```

2 Configure Switch A (SFTP client)

a Establish a connection to the remote SFTP server and enter SFTP client view.

```
[4200G] sftp 10.111.27.91
```

b Display the current directory on the SFTP server, delete file z and verify the operation.

```
sftp-client> dir
-rwxrwxrwx   1 noone    nogroup      1759 Aug 23 06:52 vrpcfg.cfg
-rwxrwxrwx   1 noone    nogroup       225 Aug 24 08:01 pubkey2
-rwxrwxrwx   1 noone    nogroup       283 Aug 24 07:39 pubkey1
drwxrwxrwx   1 noone    nogroup         0 Sep 01 06:22 new
-rwxrwxrwx   1 noone    nogroup       225 Sep 01 06:55 pub
-rwxrwxrwx   1 noone    nogroup         0 Sep 01 08:00 z
sftp-client> delete z
The following File will be deleted:
flash:/z
Are you sure to delete it?(Y/N):y
This operation may take a long time.Please wait…

File successfully Removed
sftp-client> dir
-rwxrwxrwx   1 noone    nogroup      1759 Aug 23 06:52 vrpcfg.cfg
-rwxrwxrwx   1 noone    nogroup       225 Aug 24 08:01 pubkey2
-rwxrwxrwx   1 noone    nogroup       283 Aug 24 07:39 pubkey1
drwxrwxrwx   1 noone    nogroup         0 Sep 01 06:22 new
-rwxrwxrwx   1 noone    nogroup       225 Sep 01 06:55 pub
```

c Create directory new1 and verify the operation.

```
sftp-client> mkdir new1
New directory created
sftp-client> dir
-rwxrwxrwx   1 noone    nogroup      1759 Aug 23 06:52 vrpcfg.cfg
-rwxrwxrwx   1 noone    nogroup       225 Aug 24 08:01 pubkey2
-rwxrwxrwx   1 noone    nogroup       283 Aug 24 07:39 pubkey1
drwxrwxrwx   1 noone    nogroup         0 Sep 01 06:22 new
-rwxrwxrwx   1 noone    nogroup       225 Sep 01 06:55 pub
drwxrwxrwx   1 noone    nogroup         0 Sep 02 06:30 new1
```

d Change the name of directory new1 to new2 and verify the operation.

```
sftp-client> rename new1 new2
File successfully renamed
sftp-client> dir
-rwxrwxrwx   1 noone    nogroup      1759 Aug 23 06:52 vrpcfg.cfg
-rwxrwxrwx   1 noone    nogroup       225 Aug 24 08:01 pubkey2
-rwxrwxrwx   1 noone    nogroup       283 Aug 24 07:39 pubkey1
drwxrwxrwx   1 noone    nogroup         0 Sep 01 06:22 new
-rwxrwxrwx   1 noone    nogroup       225 Sep 01 06:55 pub
drwxrwxrwx   1 noone    nogroup         0 Sep 02 06:33 new2
```

e Download file pubkey2 and rename it to public.

```
sftp-client> get pubkey2 public
Remote file:flash:/pubkey2 --->  Local file: public..
Downloading file successfully ended
```

f Upload file pu to the SFTP server and rename it to puk. Verify the operations.

```
sftp-client> put pu puk
Local file: pu --->  Remote file: flash:/puk
Uploading file successfully ended
sftp-client> dir
-rwxrwxrwx   1 noone    nogroup      1759 Aug 23 06:52 vrpcfg.cfg
-rwxrwxrwx   1 noone    nogroup       225 Aug 24 08:01 pubkey2
-rwxrwxrwx   1 noone    nogroup       283 Aug 24 07:39 pubkey1
drwxrwxrwx   1 noone    nogroup         0 Sep 01 06:22 new
drwxrwxrwx   1 noone    nogroup         0 Sep 02 06:33 new2
```

```
-rwxrwxrwx   1 noone    nogroup       283 Sep 02 06:35 pub
-rwxrwxrwx   1 noone    nogroup       283 Sep 02 06:36 puk
sftp-client>
```

g Exit from SFTP.

```
sftp-client> quit
Bye
[4200G]
```

37 FILE SYSTEM MANAGEMENT

File Attribute Configuration

Introduction to File Attributes

An app file, a configuration file, or a Web file can be of one of these three attributes: main, backup and none, as described in Table 280.

Table 280 Descriptions on file attributes

Attribute name	Description	Feature	Identifier
main	The main attribute identifies main startup files. The main startup file is used first for a switch to startup.	In the Flash, there can be only one app file, one configuration file and one Web file with main attribute.	(*)
backup	The backup attribute identifies backup startup files. The backup startup file is used after a switch fails to startup using the main startup file.	In the Flash, there can be only one app file, one configuration file and one Web file with the backup attribute.	(b)
none	Files that are neither of main attribute nor backup attribute are of none attribute.		None

An app file is an executable file, with .app as the extension. A configuration file is used to store and restore configuration, with cfg as the extension. A Web file is used for Web-based network management, with web as the extension. If clustering is configured, there will also be a file called topology.top.

*A file can have both the main and backup attributes. Files of this kind are labeled as *b.*

If a newly created file is configured to be of the main attribute, the existing file in the Flash that is of the same attribute and the same type loses its attribute. This ensures that there can be only one app file, one configuration file and one Web file with the main attribute in the Flash. It is the same with the files in the Flash that are of the backup attribute.

File operations and file attribute operations are independent of each other. For example, if you delete a file with the main attribute from the Flash, the main attribute is not deleted. It becomes the attribute of a valid file that is later downloaded to the Flash and has same name as the previously deleted one.

The file attributes are compatible with that of the previous versions. After the BootROM of a switch is upgraded, the previous default app startup file will have the main attribute.

Configuring File Attributes

You can configure and view the main attribute and backup attribute of the files used for the next startup of a switch, and switch the main and backup attribute of the files.

Perform the following configuration in user view.

Table 281 Configure file attributes

Operation	Command	Description
Configure the app file with the main attribute for the next startup	**boot boot-loader** *file-url*	Optional
Configure the app file with the backup attribute for the next startup	**boot boot-loader backup-attribute** *file-url*	Optional
Configure the attribute (main or backup) of the Web file for the next startup	**boot web-package** *webfile* { **backup** | **main**}	Optional
Switch the file attributes between main and backup for files that are of specific attribute	**boot attribute-switch** { **all** | **app** | **configuration** | **web** }	Optional
Specify to prompt for the customized password before entering the BOOT menu	startup bootrom-access enable	Optional By default, a user cannot access the BOOT menu with a customized password.
Display the information about the app file used as the startup file	**display boot-loader** [**unit** *unit-id*]	Optional Can be executed in any view.
Display the information about the startup configuration file	**display startup** [**unit** *unit-id* **]**	

CAUTION: *Before configuring the main or backup attribute for a file, make sure the file already exists. For example, to configure the main or backup attribute for a Web file, you need to make sure the file exists on the switch.*

The configuration of the main or backup attribute of a Web file takes effect immediately without restarting the switch.

Currently, a configuration file has the extension of cfg and resides in the root directory of a switch.

File System Configuration

Introduction to File System

To facilitate management on storage devices such as the Flash of a switch, Ethernet switches provide the file system module. The file system allows users to access and manage files and directories, such as the operations of creating/deleting/modifying/renaming a file or a directory and displaying the contents of a file.

By default, a switch prompts for confirmation before executing the commands which have potential risks (for example, deleting and overwriting files).

According to the operation objects, the operations on the file system fall into the following categories:

- Directory operation
- File operation
- Storage device operation
- Prompt mode configuration

File path and file name can be represented in one of the following ways:

In URL (universal resource locator) format and starting with unit[No.]>flash:/ ([No.] represents the unit ID of a switch). This method is used to specify a file on a specified unit. For example, if the unit ID of a switch is 1, unit1>flash:/text.txt specifies the file named text.txt and residing in the root directory.

Starting with flash:/. This method can be used to specify a file in the Flash of the current unit.

Inputting the path name or file name directly. This method can be used to specify the path to go to or a file in the current work directory.

Directory Operations

The file system provides directory-related functions, such as:

- Creating/deleting a directory
- Displaying the information about the files or the directories in the current work directory or a specified directory

Table 282 describes the directory-related operations.

Perform the following configuration in user view.

Table 282 Directory operations

Operation	Command	Description
Create a directory	**mkdir** *directory*	Optional
Delete a directory	**rmdir** *directory*	Optional Only empty directories can be deleted.
Display the current work directory	Pwd	Optional
Display the information about specific directories and files	**dir** [**/all**] [*file-url*]	Optional
Enter a specified directory	**cd** *directory*	Optional The default directory is the root directory of Flash.

*In the output information of the **dir /all** command, deleted files (that is, those in the recycle bin) are embraced in brackets.*

File Operations

The file system also provides file-related functions, such as:

- Deleting a file
- Restoring a deleted file
- Deleting a file completely

- Managing a configuration file
- Renaming a file
- Copying a file
- Moving a file
- Displaying the content of a file
- Displaying the information about a file
- Checking file system

Table 283 describes the file-related operations.

Perform the following configuration in user view.

Table 283 File operations

Operation	Command	Description
Delete a file	**delete** [**/unreserved**] *file-url* **delete** { **running-files | standby-files** } [**/unreserved**]	Optional A deleted file can be restored if you delete it by executing the **delete** command with the **/unreserved** keyword not specified. You can use the **undelete** command to restore a deleted file of this kind.
Restore a deleted file	**undelete** *file-url*	Optional
Delete a file in the recycle bin	**reset recycle-bin** [*file-url]* [**/force**]	Optional
Rename a file	**rename** *fileurl-source fileurl-dest*	Optional
Copy a file	**copy** *fileurl-source fileurl-dest*	Optional
Move a file	**move** *fileurl-source fileurl-dest*	Optional
Display the content of a file	**more** *file-url*	Optional Currently, the file system only supports displaying the contents of a file in texts.
Display the information about a directory or a file	**dir** [**/all**] [*file-url*]	Optional

CAUTION: *For deleted files whose names are the same, only the latest deleted file can be restored.*

*The files which are deleted using the **delete** command with the **/unreserved** keyword not specified are actually moved to the recycle bin and thus still take storage space. You can clear the recycle bin to make room for other files by using the **reset recycle-bin** command.*

If the configuration files are deleted, the switch adopts the default configuration parameters when it starts the next time.

You can consider clearing the configuration files in the Flash when:

- The configuration files in the Flash are not compatible with the system software. (This may occur after you upgrade the system software of the switch.)
- The configuration files are corrupted. (This is usually because a wrong configuration file is loaded.)

As for the **save** command listed in Table 283 the **safely** keyword determines the ways to save the current configuration, as described in the following.

- If you execute this command with the **safely** keyword not specified, the system saves the current configuration in the fast mode. In this mode, the configuration gets lost if the switch restarts or is powered off when the saving operation is being processed.
- If you execute this command with the **safely** keyword specified, the system saves the current configuration in the safe mode. Although this mode takes more time than the fast mode, the configuration can be saved to the Flash even if the switch restarts or is powered off when the saving operation is being processed.

The fast mode is recommended under the circumstances where the power systems are reliable, while the safe mode is recommended when power system is unreliable or you are performing a remote maintenance operation.

*If you execute the **save** command with the cfgfile argument not specified, the current configuration is saved in the configuration file with which the switch latest starts. If the switch starts using the default configuration, the current configuration is saved in the default configuration file.*

*To make a switch to adopt the current configuration when it starts the next time, save the current configuration using the **save** command before restarting the switch.*

Storage Device Operations

With the file system, you can format a storage device. Note that the format operation leads to the loss of all files on the storage device and is irretrievable.

Perform the following operation in user view.

Table 284 Operations on storage device

Operation	Command	Description
Format the storage device	**format** *device*	Required

Prompt Mode Configuration

Table 285 lists the operations to configure the prompt mode of the current file system.

Table 285 Configuration on prompt mode of file system

Operation	Command	Description
Enter system view	system-view	
Configure the prompt mode of the file system	**file prompt** { **alert** | **quiet** }	Required By default, the prompt mode of the file system is **alert**.

File System Configuration Example

Display all the files in the root directory of the file system on the local unit.

```
<4200G>dir /all
Directory of unit1>flash:/

   1 (b)   -rw-   4560196  Apr 16 2000 23:18:23   s3t03_01_00s168c03.app
   2        -rwh         4  Apr 01 2000 23:55:50   snmpboots
   3        -rw-      5074  Apr 01 2000 23:57:27   updtcfg.old
   4 (*)   -rw-   4560582  Apr 02 2000 00:33:41   s3t03_01_00s168c04.app
   5        -rwh       151  Apr 02 2000 00:42:45   private-data.txt
   6        -rw-   4559103  Apr 02 2000 00:34:10   s3t03_01_00s56c04.app
```

```
   7       -rw-    296368  Apr 02 2000 00:34:16   s3u01_00.btm
   8       -rw-    951305  Apr 02 2000 00:34:25   s3v01_00.web
   9       -rw-      8451  Apr 01 2000 23:56:53   3comoscfgdef.old
   10      -rw-      3114  Apr 02 2000 23:21:44   l3config.old
   11(*)   -rw-      3628  Apr 09 2000 00:11:00   updt.cfg
   12      -rwh       716  Apr 05 2000 21:33:33   hostkey
   13      -rwh       572  Apr 05 2000 21:33:42   serverkey
   14      -rw-      1735  Apr 02 2000 00:43:04   [l3.cfg]

15367 KB total (628 KB free)

(*) -with main attribute   (b) -with backup attribute
(*b) -with both main and backup attribute
```

Copy the file flash:/vrpcfg.cfg to flash:/test/, with 1.cfg as the name of the new file.

```
<4200G>mkdir test
.
%Created dir unit1>flash:/test.

<4200G>copy flash:/updt.cfg flash:/test/updt_backup.cfg
Copy unit1>flash:/updt.cfg to unit1>flash:/test/updt_backup.cfg?[Y/N]:y
..
%Copy file unit1>flash:/updt.cfg to
unit1>flash:/test/updt_backup.cfg...Done.
<4200G>dir
Directory of unit1>flash:/

   1 (b)   -rw-   4560196  Apr 16 2000 23:18:23   s3t03_01_00s168c03.app
   2       -rwh         4  Apr 01 2000 23:55:50   snmpboots
   3       -rw-      5074  Apr 01 2000 23:57:27   updtcfg.old
   4 (*)   -rw-   4560582  Apr 02 2000 00:33:41   s3t03_01_00s168c04.app
   5       -rwh       151  Apr 02 2000 00:42:45   private-data.txt
   6       -rw-   4559103  Apr 02 2000 00:34:10   s3t03_01_00s56c04.app
   7       -rw-    296368  Apr 02 2000 00:34:16   s3u01_00c04.btm
   8       -rw-    951305  Apr 02 2000 00:34:25   s3v01_00c04.web
   9       -rw-      8451  Apr 01 2000 23:56:53   3comoscfgdef.old
   10      -rw-      3114  Apr 02 2000 23:21:44   l3config.old
   11(*)   -rw-      3628  Apr 09 2000 00:11:00   updt.cfg
   12      -rwh       716  Apr 05 2000 21:33:33   hostkey
   13      -rwh       572  Apr 05 2000 21:33:42   serverkey
   14      drw-         -  Apr 16 2000 01:22:48   test
   15      -rw-      1735  Apr 02 2000 00:43:04   [l3.cfg]

15367 KB total (623 KB free)

(*) -with main attribute   (b) -with backup attribute
(*b) -with both main and backup attribute
```

Display the file information after the copy operation.

```
<4200G>dir flash:/test
Directory of unit1>flash:/

   1       drw-         -  Apr 16 2000 01:22:48   test

15367 KB total (623 KB free)

(*) -with main attribute   (b) -with backup attribute
(*b) -with both main and backup attribute

<4200G>
```

Testing Tools for Network Connection

This section contains the tools necessary to test network connections.

ping

The **ping** command can be used to check the network connection and if the host is reachable.

Perform the following operation in all views.

Table 286 The ping Command

Operation	Command
Support IP ping	**ping [-a** *ip-address* **] [-c** *count* **] [-d] [-h** *ttl* **] [-i {** *interface-type interface-num* | *interface-name* **}] [ip] [-n] [- p** *pattern* **] [-q] [-r] [-s** *packetsize* **] [-t** *timeout* **] [-tos** *tos* **] [-v]** *host*

The output of the command includes:

- The response to each ping message. If no response packet is received when time is out, "Request time out" information appears. Otherwise, the data bytes, the packet sequence number, TTL, and the round-trip time of the response packet will be displayed.
- The final statistics, including the number of the packets the Switch sent out and received, the packet loss ratio, the round-trip time in its minimum value, mean value and maximum value.

Test Periodically if the IP Address is Reachable

You can use the **end-station polling ip-address** command in System View to configure the IP address requiring periodical testing.

Perform the following configuration in System View.

Table 287 Test Periodically if the IP address is Reachable

Operation	Command
Configure the IP address requiring periodical testing	**end-station polling ip-address** *ip-address*
Delete the IP address requiring periodical testing	**undo end-station polling ip-address** *ip-address*

The Switch can ping an IP address every one minute to test if it is reachable. Three PING packets can be sent at most for every IP address in every testing with a time interval of five seconds. If the Switch cannot successfully ping the IP address after the three PING packets, it assumes that the IP address is unreachable.

You can configure up to 50 IP addresses by using the command repeatedly.

tracert

The **tracert** is used for testing the gateways passed by the packets from the source host to the destination one. It is mainly used for checking if the network is connected and analyzing where the fault occurs in the network.

The execution process of **tracert** is described as follows: Send a packet with TTL value as 1 and the first hop sends back an ICMP error message indicating that the packet cannot be sent, for the TTL is timeout. Re-send the packet with TTL value as 2 and the second hop returns the TTL timeout message. The process is carried over and over until the packet reaches the destination. The purpose to carry out the process is to record the source address of each ICMP TTL timeout message, so as to provide the route of an IP packet to the destination.

Perform the following operation in all views.

Figure 104 The tracert Command

Operation	Command
Trace route	**tracert [-a** *source-IP* **] [-f** *first-TTL* **] [-m** *max-TTL* **] [-p** *port* **] [-q** *nqueries* **] [-w** *timeout* **]** *string*

38 FTP AND TFTP CONFIGURATION

FTP Configuration

Introduction to FTP

FTP (File Transfer Protocol) is commonly used in IP-based networks to transmit files. Before World Wide Web comes into being, files are transferred through command lines, and the most popular application is FTP. At present, although E-mail and Web are the usual methods for file transmission, FTP still has its strongholds.

As an application layer protocol, FTP is used for file transfer between remote server and local host.

An Ethernet switch provides the following FTP services:

- FTP Client

  A switch can operate as an FTP client, through which you can access files on FTP servers. In this case, you need to establish a connection between the switch and your PC through a terminal emulation program or Telnet and then execute the **ftp X.X.X.X** command on your PC. (X.X.X.X is the IP address of an FTP server.)

- FTP Server

  A switch can also operate as an FTP server to provide file transmission services for FTP clients. You can log into a switch operating as an FTP server by running an FTP client program on your PC to access files on the FTP server. In this case, the FTP server must be configured with an IP address.

Figure 105 Network diagram for FTP configurations

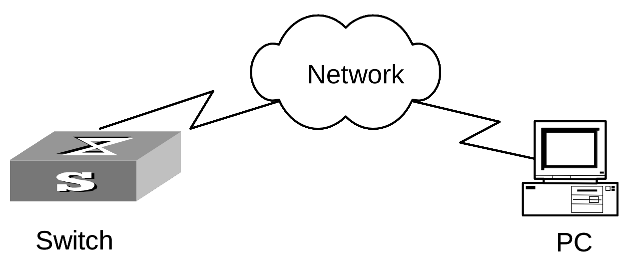


Table 288 describes the operations needed when a switch operates as an FTP client.

Table 288 Configurations needed when a switch operates as an FTP client

Device	Configuration	Default	Description
Switch	Run the ftp command directly to log into a remote FTP server	—	To log into a remote FTP server, you need to provide the user name and password.
FTP server	Have an FTP server application run and the corresponding operations performed, such as usernames, passwords, and permissions to assess files/directories.	—	—

Table 289 describes the operations needed when a switch operates as an FTP server.

Table 289 Configurations needed when a switch operates as an FTP server

Device	Configuration	Default	Description
Switch	Enable the FTP server function	The FTP function is disabled by default	You can run the **display ftp-server** command to view the FTP server configuration on the switch.
	Perform the authentication and authorization configurations	—	Configure user names, passwords and authorized work directories.
	Configure the connection idle time	The default idle time is 30 minutes.	—
PC	Use an FTP client application to log into the switch.	—	—

CAUTION: *The FTP-related functions require that the route between a FTP client and the FTP server is reachable.*

FTP Configuration: A Switch Operating as an FTP Server

Prerequisites

A switch operates as an FTP server. A remote PC operates as an FTP client. The network operates properly, as shown in Figure 105

Following configurations are performed on the FTP server:

- Creating local users
- Setting local user passwords
- Setting the password display mode for the local user
- Configuring service types for the local users

(For the information about these configurations, refer to these commands in "AAA and RADIUS Configuration" module: **local-user**, **local-user password-display-mode**, **password**, and **service-type**.)

Configuration procedure

Table 290 Configure an FTP server

Operation	Command	Description
Enter system view	system-view	—
Enable the FTP server function	ftp server enable	Required By default, the FTP server function is disabled.
Set the connection idle time	**ftp timeout** *minute*	Optional The default connection idle time is 30 minutes.
Display the information about a switch operating as an FTP server	display ftp-server	You can execute these two commands in any view.
Display the information about the FTP clients	display ftp-user	

Only one user can access an S4200G switch at a given time when the latter operates as an FTP server.

FTP services are implemented in this way: An FTP client sends FTP requests to the FTP server. The FTP server receives the requests, perform operations accordingly, and return the results to the FTP client.

To prevent unauthorized accesses, an FTP server disconnects a FTP connection when it does not receive requests from the FTP client for a specific period of time known as the connection idle time.

To log into an FTP server, a user needs to provide a user name and a password for being authenticated, and the FTP server authorizes the FTP client by providing the information about work directory. FTP services are available to users only when they pass the authentication and authorization.

Displaying and debugging an FTP server

After the above configurations, you can run the **display** command in any view to view the running information of the FTP server and verify your configurations.

Table 291 Display and debug an FTP server

Operation	Command
Display the information about an FTP server	display ftp-server
Display the information about FTP clients	display ftp-user

FTP Configuration: A Switch Operating as an FTP Client

The function for a switch to operate as an FTP client is implemented by an application module built in the switch. A switch can operate as an FTP client without any configuration. You can perform FTP-related operations (such as creating/removing a directory) by executing FTP client commands on a switch operating as an FTP client. Table 292 lists the operations that can be performed on an FTP client.

Table 292 FTP client operations

Operation	Command	Description
Enter FTP Client view	**ftp** [*ip-address* [*port-number]*]	
Specify to transfer files in ASCII characters	ascii	Optional By default, files are transferred in ASCII characters.
Specify to transfer files in binary streams	binary	Optional
Set the data transfer mode to passive	passive	Optional By default, the passive mode is adopted.
Change the work directory on the remote FTP server	**cd** *pathname*	Optional
Change the work directory to be the parent directory	**cdup**	Optional
Get the local work path on the FTP client	lcd	Optional
Display the work directory on the FTP server	pwd	Optional
Create a directory on the remote FTP server	**mkdir** *pathname*	Optional
Remove a directory on the remote FTP server	**rmdir** *pathname*	Optional
Delete a specified file	**delete** *remotefile*	Optional

Table 292 FTP client operations (Continued)

Operation	Command	Description
Query the specified files	**dir** [*filename*] [*localfile*]	Optional
Query a specified remote file	**ls** [*remotefile*] [*localfile*]	Optional
Download a remote file	**get** *remotefile* [*localfile*]	Optional
Upload a local file to the remote FTP server	**put** *localfile* [*remotefile*]	Optional
Rename a file on a remote host.	**rename** *remote-source remote-dest*	Optional
Switch to another FTP user	**user** *username* [*password*]	Optional
Connect to a remote FTP server	**open** { *ip-address* | *server-name* } [*port*]	Optional
Terminate the current FTP connection without exiting FTP client view	disconnect	Optional
Terminate the current FTP connection without exiting FTP client view	close	Optional
Terminate the current FTP connection and quit to user view	quit	Optional
Terminate the current FTP control connection and data connection	bye	Optional
Display the on-line help on a specified command concerning FTP	**remotehelp** [*protocol-command*]	Optional
Enable verbose function	verbose	Optional The verbose function is enabled by default.

Configuration Example: A Switch Operating as an FTP Client

Network requirements

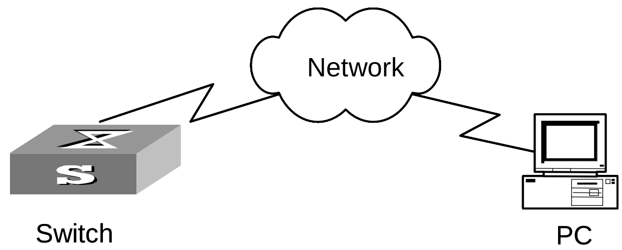
A switch and a remote PC operate as an FTP client and an FTP server.

- Create a user account on the FTP server, with the user name being switch, password being hello, and the permission to access the directory named Switch assigned to the user account.
- The IP address of a VLAN interface on the switch is 1.1.1.1. The IP address of the PC is 2.2.2.2. And the route between the two is reachable.

Download the application named switch.bin from the PC to the switch and upload the configuration file named vrpcfg.txt to the directory named Switch on the PC to backup the configuration file.

Network diagram

Figure 106 Network diagram for FTP configuration (A)



Configuration procedure

1. Perform FTP server-related configurations on the PC, that is, create a user account on the FTP server, with the user name being switch, password being hello, and the permission to access the directory named Switch assigned to the user account. (These operations are omitted here.)
2. Configure the switch.

   Log into the switch. (You can log into a switch through the Console port or by Telneting to the switch. See Chapter 2 for detailed information.)

```
<S4200G>
```

CAUTION: *If the free space of the Flash of the switch is insufficient to hold the file to be downloaded, you need to delete useless files in the flash to make room for the file.*

1. Connect to the FTP server using the **ftp** command. You need to provide the IP address of the FTP server, the user name and the password as well.

```
<S4200G> ftp 2.2.2.2
Trying …
Press CTRL+K to abort
Connected.
220 WFTPD 2.0 service (by Texas Imperial Software) ready for new user
User(none):switch
331 Give me your password, please
Password:*****
230 Logged in successfully
[ ftp]
```

2. Enter the authorized directory on the FTP server.

```
[ ftp] cd switch
```

3. Upload the configuration file named vrpcfg.txt to the FTP server.

```
[ ftp] put vrpcfg.txt
```

4. Download the file named switch.bin.

```
[ ftp] get switch.bin
```

5. Terminate the FTP connection and quit to user view.

```
[ ftp] quit
<S4200G>
```

6 Specify the downloaded file (the file named switch.bin) to be the startup file used when the switch starts the next time and restart the switch. Thus the switch application is upgraded.

```
<S4200G> boot boot-loader switch.bin
<S4200G> reboot
```

Configuration Example: A Switch Operating as an FTP Server

Network requirements

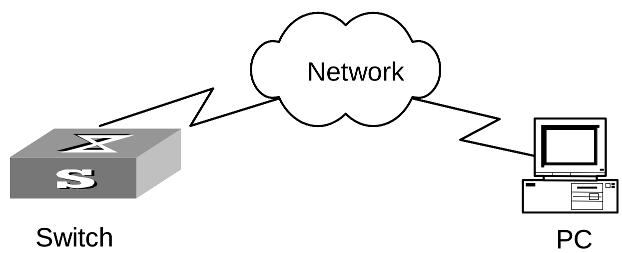
A switch and a PC operate as an FTP server and an FTP client.

- Create a user account on the FTP server, with the user name being switch, password being hello, and the permission to access the root directory of the Flash assigned to the user account.
- The IP address of a VLAN interface on the switch is 1.1.1.1. The IP address of the PC is 2.2.2.2. And the route between the two is reachable.

The PC uploads the application named switch.bin to the FTP server through FTP and downloads the configuration file named vrpcfg.txt from the switch to backup the configuration file.

Network diagram

Figure 107 Network diagram for FTP configuration (B)



Configuration procedure

1 Configure the switch.

a Log into the switch. (You can log into a switch through the Console port or by Telneting to the switch. See Chapter 2 for detailed information.)

```
<S4200G>
```

b Start the FTP service on the switch and create a user account and a password.

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G] ftp server enable
[4200G] local-user switch
[4200G-luser-switch] password simple hello
```

2 Run an FTP client application on the PC to connect to the FTP server. Upload the application named switch.bin to the root directory of the Flash and download the configuration file named vrpcfg.txt from the FTP server.

CAUTION: *If the free space of the Flash of the switch is insufficient to hold the file to be uploaded, you need to delete useless files in the flash to make room for the file.*

S4200G series switch is not shipped with FTP client applications. You need to purchase and install it separately.

3 After uploading the application, you can update the application on the switch.

Specify the downloaded file (the file named switch.bin) to be the startup file used when the switch starts the next time and restart the switch. Thus the switch application is upgraded.

```
<S4200G> boot boot-loader switch.bin
<S4200G> reboot
```

TFTP Configuration

Introduction to TFTP

Compared with FTP, TFTP (trivial file transfer protocol) features simple interactive access interface and authentication control. It simplifies the interaction between servers and clients remarkably. TFTP is usually implemented based on UDP.

TFTP transmission is initiated by clients, as described in the following:

- To download a file, a client sends read request packets to the TFTP server, receives data from the TFTP server, and then sends acknowledgement packets to the TFTP server.
- To upload a file, a client sends writing request packets to the TFTP server, sends data to the TFTP server, and then receives acknowledgement packets from the TFTP server.

TFTP-based file transmission can be performed in the following modes:

- Binary mode, where executable files are transmitted.
- ASCII mode, where text files are transmitted.

Before performing TFTP-related configurations, you need to configure IP addresses for the TFPT client and the TFTP server, and make sure the route between the two is reachable.

A switch can only operate as a TFTP client.

Figure 108 Network diagram for TFTP configuration

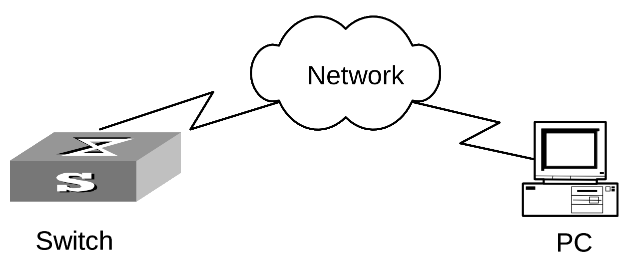


Table 293 describes the operations needed when a switch operates as an TFTP client.

Table 293 Configurations needed when a switch operates as a TFTP client

Device	Configuration	Default	Description
Switch	Configure an IP address for the VLAN interface of the switch so that it is reachable for TFTP server.	—	TFTP applies to networks where client-server interactions are comparatively simple. It requires the routes between TFTP clients TFTP servers are reachable.
	You can log into a TFTP server directly for file accessing through TFTP commands.	—	—
PC	The TFTP server is started and the TFTP work directory is configured.	—	—

TFTP Configuration

Prerequisites

A switch operates as a TFTP client. A PC operates as the TFTP server. The network operates properly, as shown in Figure 108 4.

Configuration procedure

Table 294 Configure TFTP

Operation	Command	Description
Set the TFTP file transmission mode	**tftp** { **ascii** | **binary }**	Optional By default, the **binary** file transmission mode is adopted.
Download a file	**tftp** *tftp-server* **get** *source-file* [*dest-file]*	Optional
Upload a file	**tftp** *tftp-server* **put** *source-file* [*dest-file]*	Optional
Enter system view	system-view	—
Specify the ACL adopted when a switch attempts to connect a TFTP server	**tftp-server acl** *acl-number*	Optional

TFTP Configuration Example

Network requirements

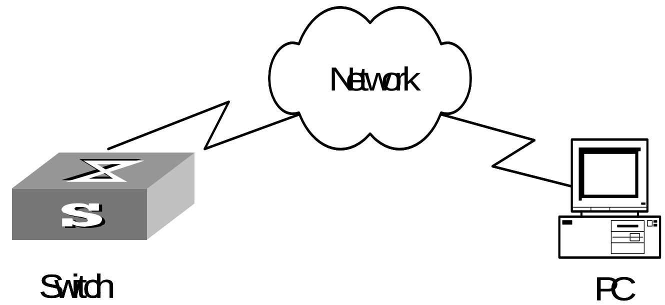
A switch and a PC operate as a TFTP client and the TFTP server.

- The TFTP work directory is configured on the TFTP server.
- The IP address of a VLAN interface on the switch is 1.1.1.1. The port through which the switch connects with the PC belongs to the VLAN. The IP address of the PC is 1.1.1.2.

Download the application named switch.bin from the PC to the switch and upload the configuration file named vrpcfg.txt to the directory named Switch on the PC to backup the configuration file.

Network diagram

Figure 109 Network diagram for TFTP configuration



Configuration procedure

1 Start the TFTP server and configure the work directory on the PC.

2 Configure the switch.

a Log into the switch. (You can log into a switch through the Console port or by Telneting to the switch. See Chapter 2 for detailed information.)

```
<S4200G>
```

CAUTION: *If the free space of the Flash of the switch is insufficient to hold the file to be downloaded, you need to delete useless files in the flash to make room for the file.*

b Enter system view

```
<S4200G> system-view
System View: return to User View with Ctrl+Z.
[4200G]
```

c Configure the IP address of a VLAN interface on the switch to be 1.1.1.1, and ensure that the port through which the switch connects with the PC belongs to this VLAN. (This example assumes that the port belongs to VLAN 1.)

```
[4200G] interface vlan 1
[4200G-vlan-interface1] ip address 1.1.1.1 255.255.255.0
[4200G-vlan-interface1] quit
```

d Download the application named switch.bin from the TFTP server to the switch.

```
<S4200G> tftp 1.1.1.2 get switch.bin switch.bin
```

e Upload the configuration file named vrpcfg.txt to the TFTP server.

```
<S4200G> tftp 1.1.1.2 put vrpcfg.txt vrpcfg.txt
```

f Specify the downloaded file (the file named switch.bin) to be the startup file used when the switch starts the next time and restart the switch. Thus the switch application is upgraded.

```
<S4200G> boot boot-loader switch.bin
<S4200G> reboot
```

39 INFORMATION CENTER

Information Center Overview

Information center is an indispensable part of Ethernet switches and exists as an information hub of system software modules. The information center manages most information outputs; it sorts information carefully, and hence can screen information in an efficient way. Combined with the debug program, it provides powerful support for network administrators and developers in network operation monitoring and fault diagnosis.

Information items are presented in the following format:

<priority>**timestamp sysname module/level/digest:content**

Here, angle brackets "<>", spaces, slashes "/" and colon are valid and required.

Below is an example of log output to a log host:

```
<188>Apr  9 17:28:50 2004 3Com 4200G IFNET/5/UPDOWN:Line protocol on
the interface M-Ethernet0/0/0 is UP    (SIP=10.5.1.5 ,SP=1080)
```

The following describes the fields contained in an information item:

1 Priority

The calculation formula for priority is priority = facility × 8 + severity – 1. For VRP, the default facility value is 23 and severity ranges from one to eight. See Table 296 for description of severity levels.

Note that no character is permitted between the priority and time stamp. The priority takes effect only when the information is sent to the log host.

2 Time stamp

The data type of the time stamp field contained in log information sent to the log host is date, whose format is Mmm dd hh:mm:ss yyyy, where:

"Mmm" represents the month, and the available values are: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov and Dec.

"dd" is the date, which shall follow a space if less than 10, for example, " 7".

"hh:mm:ss yyyy" is the local time, where "hh" is in the 24-hour format, ranging from 00 to 23, both "mm" and "ss" range from 00 to 59, and "yyyy" is the year.

Note that a space separates the time stamp and host name.

3 Host name

It refers to the system name of the host, which is "S4200G" by default.

You can modify the host name with the **sysname** command.

Note that a space separates the host name and module name.

4 Module name

It indicates the modules that generate the information. Table 295 gives some examples of the modules.

Table 295 Examples of some module names

Module name	Module and description
8021X	802.1x
ACL	Access control list
ARP	Address resolution protocol
CFAX	Configuration agent
CFG	Configuration management plane
CFM	Configuration file management
CLST	Cluster management
CMD	Command line

Note that a slash (/) separates the module name and severity level.

5 Level

Switch information falls into three categories: log information, debug information and trap information. Information of each category can be one of eight severities. Information filtering prevents information whose severity is lower than the specified threshold from being output. The higher the information severity is, the lower the corresponding level is. For example, the "debugging" severity corresponds to level 8, and the "emergencies" severity corresponds to level 1. When the severity threshold is set to "debugging", all information will be output. See Table 296 for description of severities and corresponding levels.

Table 296 Severity definitions on the information center

Severity	Value	Description
emergencies	1	The system is unavailable.
alerts	2	Errors that need to be corrected immediately
critical	3	Critical errors
errors	4	Common errors
warnings	5	Warnings
notifications	6	Normal information that needs to be noticed
informational	7	Normal prompt information
debugging	8	Debug information

Note that a slash (/) separates the level and digest.

6 Digest

It is a phrase within 32 characters, abstracting the information contents.

A colon (:) separates the digest and information contents.

Information Center Configuration

The switch supports information output to six directions.

By far, each output direction is assigned with an information channel, as shown in Table 297.

Table 297 Information channel names and numbers

Output direction	Channel number	Default channel name
Console	0	console
Monitor terminal	1	monitor
Log host	2	loghost
Trap buffer	3	trapbuffer
Log buffer	4	logbuffer
SNMP	5	snmpagent

Settings for the six output directions are independent. However, for any output direction, you must first enable the information center to make all other settings effective.

Information center of the Ethernet switch features:

- Supporting six information output directions, namely, console (console), monitor terminal (monitor), log host (loghost), trap buffer (trapbuffer), log buffer (logbuffer) and SNMP (snmpagent),
- Filtering information by information severities (information is divided into eight severity levels),
- Filtering information by modules where information is generated,
- Language options (Chinese or English) for information output.

Enabling Synchronous Terminal Output

To avoid user's input from being interrupted by system information output, you can enable the synchronous terminal output function, which echoes user's input after each system output. This makes users work with ease, for they no longer worry about losing uncompleted inputs.

Table 298 Enable synchronous terminal output

Operation	Command	Description
Enter system view	system-view	—
Enable synchronous terminal output	info-center synchronous	Optional By default, synchronous terminal output is disabled.

*Running the **info-center synchronous** command during debug information collection may result in a command prompt echoed after each item of debug information. To avoid unnecessary output, it is recommended that you disable synchronous terminal output in such cases.*

Enabling Information Output to a Log Host

Table 299 lists the related configurations on the switch.

Table 299 Enable information output to a log host

Operation	Command	Description
Enter system view	system-view	—
Enable the information center	info-center enable	Optional By default, the information center is enabled.
Define an information source	**info-center source** { *modu-name* | **default } channel** { *channel-number* | *channel-name }* [{ **log** | **trap** | **debug** } * { **level** *severity* | **state** *state }* *]	Required

*To view the debug information of specific modules, you need to set the information type as debug in the **info-center source** command, and enable the debugging function on corresponding modules by using the **debugging** command.*

Enabling Information Output to the Console

Table 300 lists the related configurations on the switch.

Table 300 Enable information output to the console

Operation	Command	Description
Enter system view	system-view	—
Enable the information center	info-center enable	Optional By default, the information center is enabled.
Enable information output to the console	**info-center console channel** { *channel-number* | *channel-name* }	Required By default, the switch does not output information to the console.
Define an information source	**info-center source** { *modu-name* | **default } channel** { *channel-number* | *channel-name }* [{ **log** | **trap** | **debug** } * { **level** *severity* | **state** *state }* *]	Required
Set the format of time stamp	**info-center timestamp** { **log | trap** | **debugging }** { **boot** | **date** | **none** }	Optional

To view debug/log/trap output information on the console, you should also enable the corresponding debug/log/trap terminal display on the switch.

For example, to view log information of the switch on the console, you should not only enable log information output to the console, but also enable logging terminal display with the **terminal logging** command.

Enter the following commands in user view.

Table 301 Enable debug/log/trap terminal display

Operation	Command	Description
Enable the debug/log/trap terminal display function	terminal monitor	Optional By default, this function is enabled for console user.

Table 301 Enable debug/log/trap terminal display

Operation	Command	Description
Enable debug terminal display	terminal debugging	Optional By default, debug terminal display is disabled for terminal users.
Enable log terminal display	terminal logging	Optional By default, log terminal display is enabled for console users.
Enable trap terminal display	terminal trapping	Optional By default, trap terminal display is enabled for terminal users.

Enabling Information Output to a Monitor Terminal

Table 302 lists the related configurations on the switch.

Table 302 Enable information output to a monitor terminal

Operation	Command	Description
Enter system view	system-view	—
Enable the information center	info-center enable	Optional By default, the information center is enabled.
Enable information output to Telnet terminal or dumb terminal	**info-center monitor channel** { *channel-number* | *channel-name }*	Required By default, a switch outputs log information to user terminal.
Define an information source	**info-center source** { *modu-name* | **default } channel** { *channel-number* | *channel-name }* [{ **log** | **trap** | **debug** } * { **level** *severity* | **state** *state }* *]	Required
Set the format of time stamp	**info-center timestamp** { **log | trap** | **debugging }** { **boot** | **date** | **none** }	Optional This is to set the time stamp format for log/debug/trap information output. This determines how the time stamp is presented to users.

When there are multiple Telnet users or dumb terminal users, some configuration parameters (including module filter, language and severity level threshold settings) are shared between them. In this case, change to any such parameter made by one user will also be reflected on all other user terminals.

To view debug information of specific modules, you need to set the information type as debug in the ***info-center source*** *command, and enable debugging on corresponding modules with the* ***debugging*** *command as well.*

To view output debug/log/trap information on the monitor terminal, you should also enable the corresponding debug/log/trap display on the switch.

For example, to view log information of the switch on a monitor terminal, you need to not only enable log information output to the monitor terminal, but also enable log terminal display with the **terminal logging** command.

Perform the following configuration in user view.

Table 303 Enable debug/log/trap terminal display

Operation	Command	Description
Enable the debug/log/trap terminal display function	terminal monitor	Optional By default, this function is enabled for console user.
Enable debugging terminal display	terminal debugging	Optional By default, debugging terminal display is disabled for terminal users.
Enable logging terminal display	terminal logging	Optional By default, logging terminal display is enabled for console users.
Enable trapping terminal display	terminal trapping	Optional By default, trapping terminal display is enabled for terminal users.

Enabling Information Output to the Log Buffer

Table 304 lists the related configurations on the switch.

Table 304 Enable information output to the log buffer

Operation	Command	Description
Enter system view	**system-view**	—
Enable the information center	info-center enable	Optional By default, the information center is enabled.
Enable information output to the log buffer	**info-center logbuffer** [**channel** { *channel-number* | *channel-name* } | **size** *buffersize]*	Optional By default, the switch outputs information to the log buffer, which can holds up to 512 items by default.
Define an information source	**info**-**center source** { *modu-name* | **default } channel** { *channel-number* | *channel-name }* [{ **log** | **trap** | **debug** } * { **level** *severity* | **state** *state }* *]	Required
Set the format of time stamp	**info-center timestamp** { **log** | **trap** | **debugging }** { **boot** | **date** | **none** }	Optional This is to set the time stamp format for log/debug/trap information output. This determines how the time stamp is presented to users.

*To view debug information of specific modules, you need to set the information type as debug in the **info-center source** command, and enable debugging on corresponding modules with the **debugging** command as well.*

Enabling Information Output to the Trap Buffer

Table 305 lists the related configurations on the switch.

Table 305 Enable information output to the trap buffer

Operation	Command	Description
Enter system view	system-view	—
Enable the information center	info-center enable	Optional By default, the information center is enabled.

Table 305 Enable information output to the trap buffer

Operation	Command	Description
Enable information output to the trap buffer	**info-center trapbuffer** [**channel** { *channel-number* | *channel-name* }] [**size** *buffersize*]	Optional By default, the switch outputs information to the trap buffer, which can holds up to 256 items by default.
Define an information source	**info-center source** { *modu-name* | **default }** **channel** { *channel-number* | *channel-name }* [{ **log** | **trap** | **debug** } * { **level** *severity* | **state** *state }* *]	Required
Set the format of time stamp	**info-center timestamp** { **log | trap** | **debugging }** { **boot** | **date** | **none** }	Optional This is to set the time stamp format for log/debug/trap information output. This determines how the time stamp is presented to users.

To view debug information of specific modules, you need to set the information type as debug in the ***info-center source*** *command, and enable debugging on corresponding modules with the* ***debugging*** *command as well.*

Enabling Information Output to the SNMP

Table 306 lists the related configurations on the switch.

Table 306 Enable information output to the SNMP

Operation	Command	Description
Enter system view	system-view	—
Enable the information center	info-center enable	Optional By default, the information center is enabled.
Enable information output to the SNMP	**info-center snmp channel** { *channel-number* | *channel-name }*	Required By default, SNMP information goes through channel 5.
Define an information source	**info-center source** { *modu-name* | **default }** **channel** { *channel-number* | *channel-name }* [{ **log** | **trap** | **debug** } * { **level** *severity* | **state** *state }* *]	Required
Set the format of time stamp	**info-center timestamp** { **log** | **trap** | **debugging }** { **boot** | **date** | **none** }	Optional This is to set the time stamp format for log/debug/trap information output. This determines how the time stamp is presented to users.

To view debug information of specific modules, you need to set the information type as ***debug*** *in the* ***info-center source*** *command, and enable debugging on corresponding modules with the* ***debugging*** *command as well.*

To send information to remote SNMP workstation properly, related configurations are required on both the switch and the SNMP workstation.

Displaying and Debugging Information Center

After the performing the above configurations, you can execute the **display** command in any view to display the running status of the information center, and thus validate your configurations. You can also execute the **reset** command to clear statistics on the information center. Make sure to execute the **reset** commands in the User View.

Table 307 Display and debug information center

Operation	Command
Display the settings of one or all information channels	**display channel** [*channel-number* | *channel-name* **]**
Display system log settings and memory buffer record statistics	display info-center
display the status of the log buffer and the records in the log buffer	**display logbuffer** [**unit** *unit-id]* [**level** *severity* | **size** *buffersize*]* [| { **begin** | **exclude** | **include }** *regular-expression]*
Display summary of the log buffer	**display logbuffer summary** [**level** *severity]*
Display the status of the trap buffer and the records in the trap buffer	**display trapbuffer** [**unit** *unit-id]* [**size** *buffersize*]
Clear information in the log buffer	**reset logbuffer** [**unit** *unit-id]*
Clear information in the trap buffer.	**reset trapbuffer** [**unit** *unit-id]*

Information Center Configuration Example

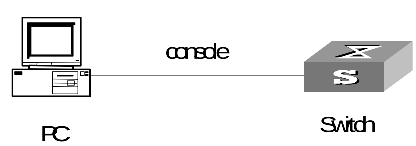
Log Output to the Console

Network requirements

The switch sends the following information to the console: the log information of the two modules ARP and IP, with severity higher than "informational".

Network diagram

Figure 110 Networking for log output to the console



Configuration procedure

1 Enable the information center.

```
<S4200G> system-view
[4200G] info-center enable
```

2 Enable log information output to the console. Set the severity level threshold to informational. Permit information output from the ARP and IP modules.

```
[4200G] info-center console channel console
[4200G] info-center source arp channel console log level informational
[4200G] info-center source ip channel console log level informational
```

3 Enable terminal display.

```
<S4200G> terminal monitor
```

```
<S4200G> terminal logging
```

40 BOOTROM AND HOST SOFTWARE LOADING

Traditionally, the loading of switch software is accomplished through a serial port. This approach is slow, inconvenient, and cannot be used for remote loading. To resolve these problems, the TFTP and FTP modules are introduced into the switch. With these modules, you can load/download software/files conveniently to the switch through an Ethernet port.

This chapter introduces how to load BootROM and host software to a switch locally and how to do this remotely.

Introduction to Loading Approaches

You can load software locally by using:

- XMODEM through Console port
- TFTP through Ethernet port
- FTP through Ethernet port

You can load software remotely by using:

- FTP
- TFTP

The BootROM software version should be compatible with the host software version when you load the BootROM and host software.

Local Software Loading

If your terminal is directly connected to the switch, you can load the BootROM and host software locally.

Before loading the software, make sure that your terminal is correctly connected to the switch to insure successful loading.

The loading process of the BootROM software is the same as that of the host software, except that during the former process, you should press <Ctrl+U> and <Enter> after entering the Boot Menu and the system gives different prompts. The following text mainly describes the BootROM loading process.

Boot Menu

```
Starting......

 **********************************************************
 *                                                        *
*        Switch 4200G 24-Port BOOTROM, Version 108        *
 *                                                        *
 **********************************************************

 Copyright (C) 2003-2005, 3Com
 All rights reserved.
 Creation date   : Nov 30 2005, 16:54:35
```

```
CPU type        : BCM4704
CPU Clock Speed : 200MHz
BUS Clock Speed : 33MHz
Memory Size     : 64MB
Mac Address     : 00e0fc005104
```

```
Press Ctrl-B to enter Boot Menu… 5
```

Press <Ctrl+B>. The system displays:

```
Password :
```

To enter the Boot Menu, you should press <Ctrl+B> within five seconds after the information "Press Ctrl-B to enter Boot Menu…" appears. Otherwise, the system starts to decompress the program; and if you want to enter the Boot Menu at this time, you will have to restart the switch.

Input the correct BootROM password (no password is need by default). The system enters the Boot Menu:

```
         BOOT  MENU

1. Download application file to flash
2. Select application file to boot
3. Display all files in flash
4. Delete file from flash
5. Modify bootrom password
6. Enter bootrom upgrade menu
7. Skip current configuration file
8. Set bootrom password recovery
9. Set switch startup mode
0. Reboot

Enter your choice(0-9):
```

Loading Software Using XMODEM Through Console Port

Introduction to XMODEM

XMODEM is a file transfer protocol that is widely used due to its simplicity and good performance. XMODEM transfers files using Console port. It supports two types of data packets (128 bytes and 1 KB), two check methods (checksum and CRC), and multiple attempts of error packet retransmission (generally the maximum number of retransmission attempts is ten).

The XMODEM transmission procedure is completed by a receiving program and a sending program: The receiving program sends negotiation characters to negotiate a packet checking method. After the negotiation, the sending program starts to transmit data packets. When receiving a complete packet, the receiving program checks the packet using the agreed method. If the check succeeds, the receiving program sends an acknowledgement character and the sending program proceeds to send another packet; otherwise, the receiving program sends a negative acknowledgement character and the sending program retransmits the packet.

Loading BootROM software

Follow these steps to load the BootROM software:

1 At the prompt "Enter your choice(0-9):" in the Boot Menu, press <6> or <Ctrl+U>, and then press <Enter> to enter the BootROM update menu shown below:

```
Bootrom update menu:
1. Set TFTP protocol parameter
2. Set FTP protocol parameter
3. Set XMODEM protocol parameter
0. Return to boot menu
Enter your choice(0-3):
```

2 Enter 3 in the above menu to download the BootROM software using XMODEM. The system displays the following download baud rate setting menu:

```
Please select your download baudrate:
1.* 9600
2. 19200
3. 38400
4. 57600
5. 115200
0. Return
Enter your choice (0-5):
```

3 Choose an appropriate download baud rate. For example, if you enter 5, the baud rate 115200 bps is chosen and the system displays the following information:

```
Download baudrate is 115200 bps
Please change the terminal's baudrate to 115200 bps and select XMODEM
protocol
Press enter key when ready
```

Now, press <Enter>.

If you have chosen 9600 bps as the download baud rate, you need not modify the HyperTerminal's baud rate, and therefore you can skip step 4 and step 5 and proceed to step 6 directly. In this case, the system will not display the above information.

4 Choose [File/Properties] in HyperTerminal, click <Configure> in the pop-up dialog box, and then select the baud rate of 115200 bps in the Console port configuration dialog box that appears.

Figure 111 Properties dialog box

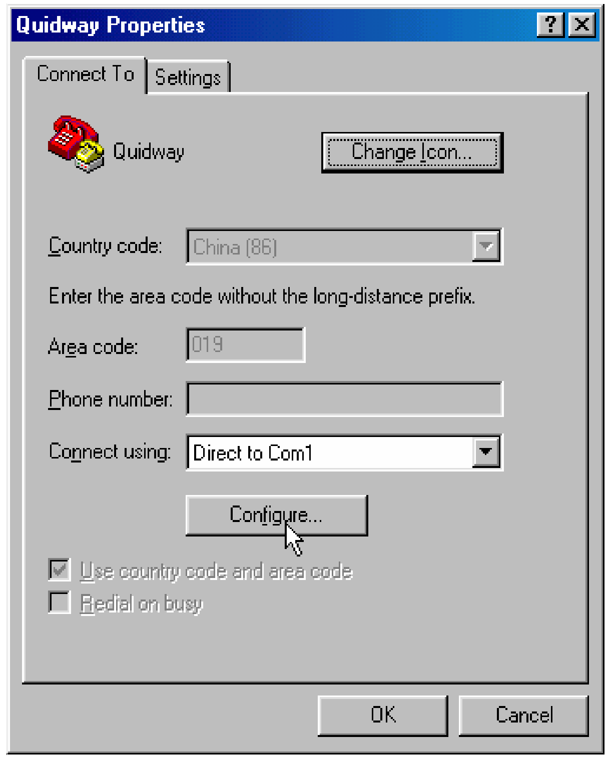
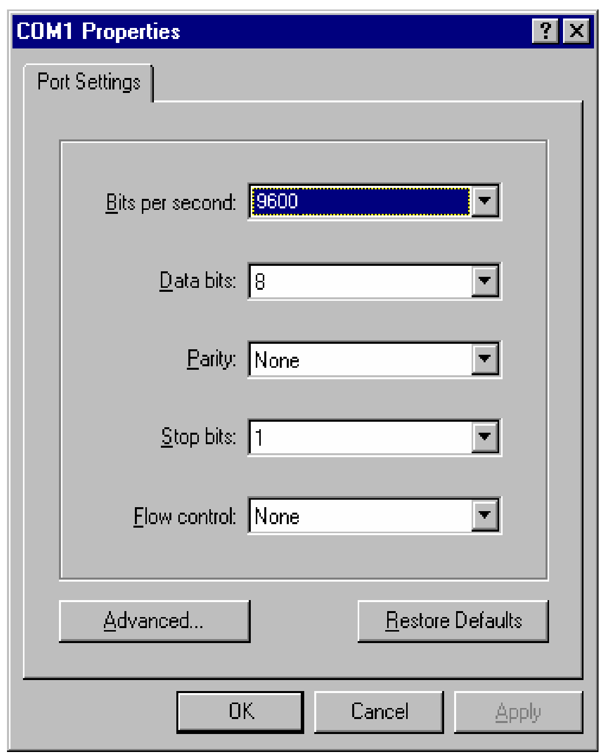
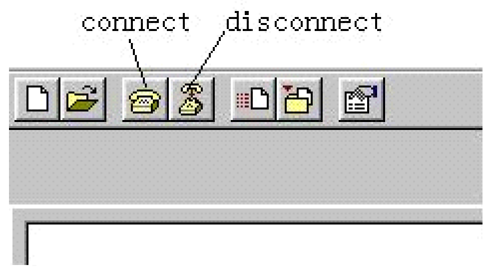


Figure 112 Console port configuration dialog box



5 Click the <Disconnect> button to disconnect the HyperTerminal from the switch and then click the <Connect> button to reconnect the HyperTerminal to the switch.

Figure 113 Connect and disconnect buttons



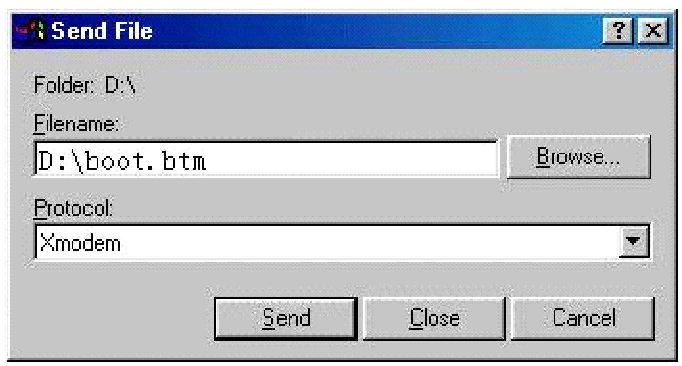
The new baud rate takes effect only after you disconnect and reconnect the terminal emulation program.

6 Press <Enter> to start downloading the program. The system displays the following information:

```
Now please start transfer file with XMODEM protocol.
If you want to exit, Press <Ctrl+X>.
Loading …CCCCCCCCCC
```

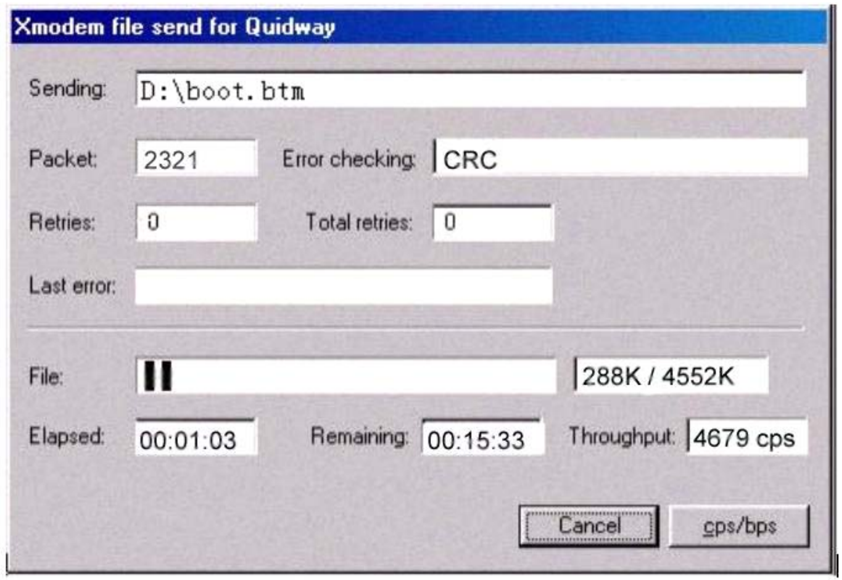
7 Choose [Transfer/Send File] in the HyperTerminal's window, and in the following pop-up dialog box click <Browse>, select the software you need to download, and set the protocol to XMODEM.

Figure 114 Send file dialog box



8 Click <Send>. The system displays the following page.

Figure 115 Sending file page



After the download completes, the system displays the following information:

```
Loading …CCCCCCCCCC done!
```

You need not reset the HyperTerminal's baud rate and can skip the last step if you have chosen 9600 bps. In this case, the system display the prompt "BootROM is updating now.................................done!" instead of the prompt "Your baudrate should be set to 9600 bps again! Press enter key when ready".

9 Reset HyperTerminal's baud rate to 9600 bps (refer to step 4 and step 5). Then, press any key as prompted. The system will display the following information when it completes the loading.

```
Bootrom updating..................................done!
```

Loading host software

Follow these steps to load the host software:

1 Select <1> in Boot Menu. The system displays the following information:

```
1. Set TFTP protocol parameter
2. Set FTP protocol parameter
3. Set XMODEM protocol parameter
0. Return to boot menu
Enter your choice(0-3):3
```

2 Enter 3 in the above menu to download the host software using XMODEM.

The subsequent steps are the same as those for loading the BootROM software, except that the system gives the prompt for host software loading instead of BootROM loading.

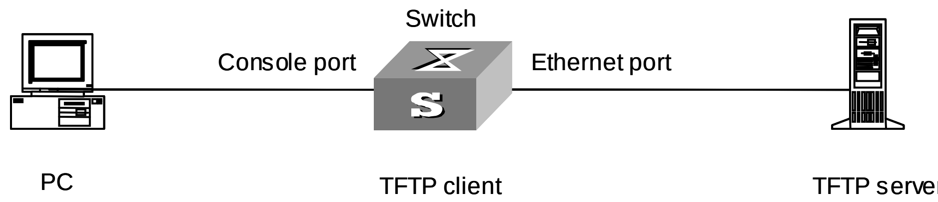
Loading Software Using TFTP Through Ethernet Port

Introduction to TFTP

TFTP, one protocol in TCP/IP protocol suite, is used for trivial file transfer between client and server. It uses UDP to provide unreliable data stream transfer service.

Loading BootROM software

Figure 116 Local loading using TFTP



1 As shown in Figure 116, connect the switch through an Ethernet port to the TFTP server, and connect the switch through the Console port to the configuration PC.

You can use one PC as both the configuration device and the TFTP server.

2 Run the TFTP server program on the TFTP server, and specify the path of the program to be downloaded.

CAUTION: *TFTP server program is not provided with the S4200G Series Ethernet Switches.*

3 Run the terminal emulation program on the configuration PC. Start the switch. Then enter the Boot Menu.

At the prompt "Enter your choice(0-9):" in the Boot Menu, press <6> or <Ctrl+U>, and then press <Enter> to enter the BootROM update menu shown below:

```
Bootrom update menu:
1. Set TFTP protocol parameter
2. Set FTP protocol parameter
3. Set XMODEM protocol parameter
0. Return to boot menu
Enter your choice(0-3):
```

4 Enter 1 to in the above menu to download the BootROM software using TFTP. Then set the following TFTP-related parameters as required:

```
Load File name          :S4200G.btm
Switch IP address       :1.1.1.2
Server IP address       :1.1.1.1
```

5 Press <Enter>. The system displays the following information:

```
Are you sure to update your bootrom?Yes or No(Y/N)
```

6 Enter Y to start file downloading or N to return to the Bootrom update menu. If you enter Y, the system begins to download and update the BootROM software. Upon completion, the system displays the following information:

```
Loading…………………………….done
Bootrom updating……….done!
```

Loading host software

Follow these steps to load the host software.

1 Select <1> in Boot Menu. The system displays the following information:

```
1. Set TFTP protocol parameter
2. Set FTP protocol parameter
3. Set XMODEM protocol parameter
0. Return to boot menu
Enter your choice(0-3):3
```

2 Enter 1 in the above menu to download the host software using TFTP.

The subsequent steps are the same as those for loading the BootROM program, except that the system gives the prompt for host software loading instead of BootROM loading.

Loading Software Using FTP Through Ethernet Port

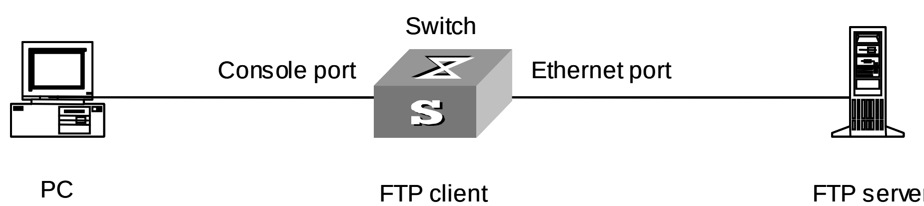
Introduction to FTP

FTP is an application-layer protocol in the TCP/IP protocol suite. It is used for file transfer between server and client, and is widely used in IP networks.

You can use the switch as an FTP client and download software to the switch through an Ethernet port. The following is an example.

Loading BootROM software

Figure 117 Local loading using FTP



1 As shown in Figure 117, connect the switch through an Ethernet port to the FTP server, and connect the switch through the Console port to the configuration PC.

You can use one computer as both configuration device and FTP server.

2 Run the FTP server program on the FTP server, configure an FTP user name and password, and specify the path of the program to be downloaded.

3 Run the terminal emulation program on the configuration PC. Start the switch. Then enter the Boot Menu.

At the prompt "Enter your choice(0-9):" in the Boot Menu, press <6> or <Ctrl+U>, and then press <Enter> to enter the BootROM update menu shown below:

```
Bootrom update menu:

1. Set TFTP protocol parameter
2. Set FTP protocol parameter
3. Set XMODEM protocol parameter
0. Return to boot menu
Enter your choice(0-3):
```

4 Enter 2 in the above menu to download the BootROM software using FTP. Then set the following FTP-related parameters as required:

```
Load File name          :S4200G.btm
Switch IP address       :10.1.1.2
Server IP address       :10.1.1.1
FTP User Name           :4200G
FTP User Password       :abc
```

5 Press <Enter>. The system displays the following information:

```
Are you sure to update your bootrom?Yes or No(Y/N)
```

6 Enter Y to start file downloading or N to return to the Bootrom update menu. If you enter Y, the system begins to download and update the program. Upon completion, the system displays the following information:

```
Loading…………………………………….done
Bootrom updating……….done!
```

Loading host software

Follow these steps to load the host software:

1 Select <1> in Boot Menu. The system displays the following information:

```
1. Set TFTP protocol parameter
2. Set FTP protocol parameter
3. Set XMODEM protocol parameter
0. Return to boot menu
Enter your choice(0-3):
```

2 Enter 2 in the above menu to download the host software using FTP.

The subsequent steps are the same as those for loading the BootROM program, except for that the system gives the prompt for host software loading instead of BootROM loading.

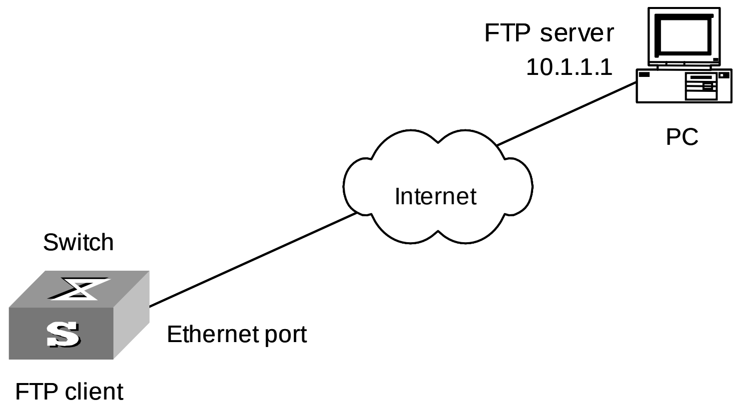
Remote Software Loading

If your terminal is not directly connected to the switch, you can telnet to the switch, and use FTP or TFTP to load BootROM and host software remotely.

Remote Loading Using FTP

As shown in Figure 118, a PC is used as both the configuration device and the FTP server. You can telnet to the switch, and then execute the FTP commands to download the host program S4200G.bin and the BootROM program S4200G.btm from the remote FTP server (with an IP address 10.1.1.1) to the switch.

Figure 118 Remote loading using FTP



1 Download the software to the switch using FTP commands.

```
<S4200G> ftp 10.1.1.1
Trying …
Press CTRL+K to abort
Connected.
220 WFTPD 2.0 service (by Texas Imperial Software) ready for new user
User(none):abc
331 Give me your password, please
Password:
230 Logged in successfully
[ ftp] get S4200G.bin
[ ftp] get S4200G.btm
[ ftp] bye
```

2 Update the BootROM program on the switch.

```
<S4200G>boot bootrom S4200G.btm
 This will update BootRom file on unit 1. Continue? [ Y/N] y
 Upgrading BOOTROM, please wait…
 Upgrade BOOTROM succeeded!
```

3 Update the host program on the switch.

```
<S4200G>boot boot-loader S4200G.bin
 The specified file will be booted next time on unit 1!
<S4200G>display boot-loader
 Unit 1:
   The current boot app is: S4200G.bin
   The main boot app is:    S4200G.bin
   The backup boot app is:
```

Restart the switch.

```
<S4200G> reboot
```

Before restarting the switch, make sure you have saved all other configurations that you want, so as to avoid losing configuration information.

After the above operations, the BootROM and host software loading is completed.

Pay attention to the following:

- The loading of host software takes effect only after you restart the switch with the **reboot** command.
- If the space of the Flash memory is not enough, you can delete the useless files in the Flash memory before software downloading.
- No power-down is permitted during software loading.

Remote Loading Using TFTP

The remote loading using TFTP is similar to that using FTP. The only difference is that TFTP is used instead off FTP to load software to the switch, and the switch can only act as a TFTP client.

41 Basic System Configuration and Debugging

Basic System Configuration

The following sections describe the basic system configuration and management tasks:

- Setting the System Name of the Switch
- Setting the Date and Time of the System
- Setting the Local Time Zone
- Setting the Summer Time
- Setting the CLI Language Mode
- Returning from Current View to Lower Level View
- Returning from Current View to User View
- Entering System View from User View
- Enabling/Disabling System Debugging
- Displaying Debugging Status
- Displaying Operating Information about Modules in System

Setting the System Name of the Switch

Table 308 Set the system name of the switch

Operation	Command	Description
Enter system view	system-view	—
Set the system name of the switch	**sysname** *sysname*	Optional By default, the name is S4200G.

There is no built-in clock on the 4200G. The date and time will revert to 23:55:00 2000/04/01 when the system is booted or power is cycled. In environments that require exact absolute time, NTP (network time protocol) must be used to obtain and set the current date and time of the Switch.

Setting the Date and Time of the System

Perform the following configuration in user view.

Table 309 Set the date and time of the system

Operation	Command	Description
Set the current date and time of the system	**clock datetime** *HH:MM:SS YYYY/MM/DD*	Optional By default, it is 23:55:00 04/01/2000 when the system starts up.

Setting the Local Time Zone

This configuration task is to set the name of the local time zone and the difference between the local time zone and the standard UTC (universal time coordinated) time.

Perform the following configuration in user view.

Table 310 Set the local time zone

Operation	Command	Description
Set the local time zone	**clock timezone** *zone-name* { **add** | **minus** } *HH:MM:SS*	Optional By default, it is the UTC time zone.

Setting the Summer Time

This configuration task is to set the name, time range (start time and end time), and time offset of the summer timer. The operation here saves you from manually adjust the system time.

- When the system reaches the specified start time, it automatically adds the specified offset to the current time, so as to toggle the system time to the summer time.
- When the system reaches the specified end time, it automatically subtracts the specified offset from the current time, so as to toggle the summer time to normal system time.

Perform the following configuration in user view.

Table 311 Set the summer time

Operation	Command	Description
Set the name and time range of the summer time	**clock summer-time** *zone_name* { **one-off** | **repeating** } *start-time start-date end-time end-date offset-time*	Optional

Setting the CLI Language Mode

Perform the following configuration in user view.**T**

Table 312 Set the CLI language mode

Operation	Command	Description
Set the CLI language mode	**language-mode** { **chinese** | **english }**	Optional By default, the command line interface (CLI) language mode is English.

Returning from Current View to Lower Level View

Perform the following operation in system view or a view higher than system view.

Table 313 Return from current view to lower level view

Operation	Command	Description
Return from current view to lower level view	quit	This operation will result in exiting the system if current view is user view.

Returning from Current View to User View

Perform the following operation in any view.

Table 314 Return from current view to user view

Operation	Command	Description
Return from current view to user view	return	The composite key <Ctrl+Z> has the same effect with the **return** command.

Entering System View from User View

Perform the following configuration in user view.

Table 315 Enter system view from user view

Operation	Command	Description
Enter system view from user view	system-view	—

Displaying the System Status

You can use the following **display** commands to check the status and configuration information about the system. For information about protocols and ports, and the associated **display** commands, refer to relevant sections.

Perform the following operations in any view.

Table 316 System display commands

Operation	Command	Description
Display the current date and time of the system	display clock	—
Display the version of the system	display version	—
Display the information about user terminal interfaces	**display users** [**all]**	—
Display the debugging status	**display debugging** [**interface** { *interface-name* | *interface-type interface-number* **}]** [*modu name* **]**	Optional By default, all debugging is disabled in the system.

System Debugging

Enabling/Disabling System Debugging

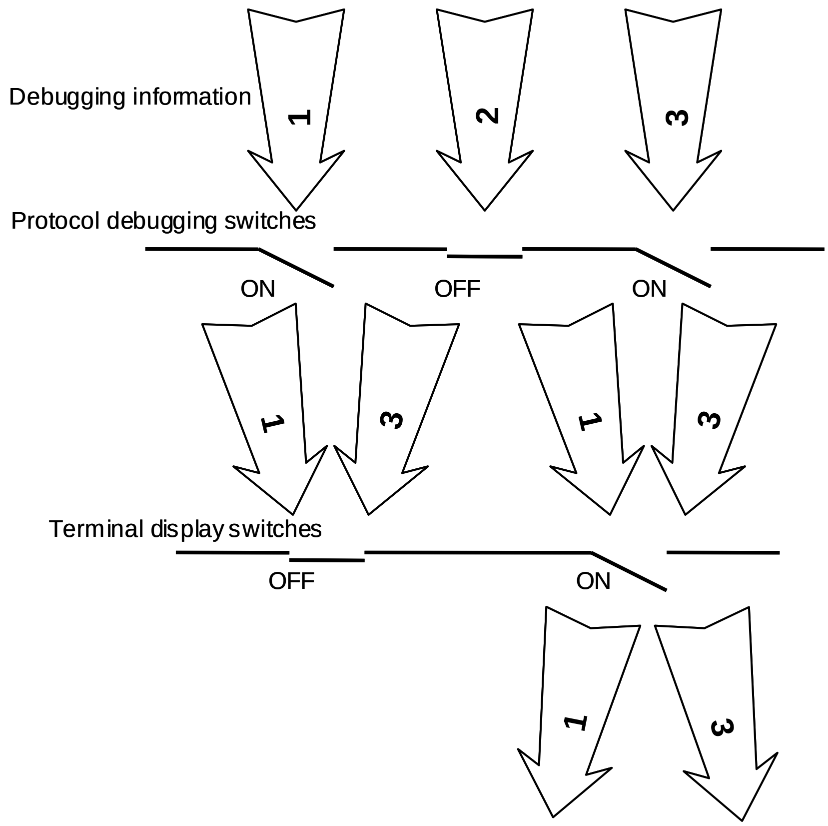
The Ethernet switch provides a variety of debugging functions. Most of the protocols and features supported by the Ethernet switch are provided with corresponding debugging functions. These debugging functions are a great help for you to diagnose and troubleshoot your switch system.

The output of debugging information is controlled by two kinds of switches:

- Protocol debugging, which controls whether the debugging information of a protocol is output.
- Terminal display, which controls whether the debugging information is output to a user screen.

The relation between the two switches is as follows:

Figure 119 Debugging information output



You can use the following commands to operate the two kinds of switches.

Perform the following operations in user view.

Table 317 Enable debugging and terminal display

Operation	Command	Description
Enable system debugging	**debugging** *module-name* [*debugging-option*]	By default, all debugging is disabled in the system. Because the output of debugging information will affect the efficiency of the system, disable your debugging after you finish it.
Enable terminal display for debugging	terminal debugging	By default, terminal display for debugging is disabled.

Displaying Debugging Status

Table 318 Displaying debugging status

Operation	Command	Description
Display all enabled debugging on the specified device	**display debugging** { **unit** *unit-id* } [**interface** *interface-type interface-number* | *module-name*]	You can execute the **display** command in any view.

Displaying Operating Information about Modules in System

When your Ethernet switch is in trouble, you may need to view a lot of operating information to locate the problem. Each functional module has its own operating information display command(s). You can use the command here to display the current operating information about the modules (settled when this command is designed) in the system for troubleshooting your system.

Perform the following operation in any view.

Table 319 Display the current operation information about the modules in the system.

Operation	Command	Description
Display the current operation information about the modules in the system.	display diagnostic-information	You can execute this command twice and find the difference between the two executing results to locate the problem.

42 IP PERFORMANCE CONFIGURATION

IP Performance Configuration

Introduction to TCP Attributes

You can configure the following TCP attributes of the Ethernet switch:

- synwait timer: When a SYN packet is sent, TCP starts the synwait timer. If no response packet is received before the synwait timer times out, the TCP connection is terminated. The timeout time of this timer ranges from 2 seconds to 600 seconds and defaults to 75 seconds.
- finwait timer: When the TCP connection status changes from FIN_WAIT_1 to FIN_WAIT_2, the finwait timer is started. If no FIN packet is received before the finwait timer times out, the TCP connection is terminated. The timeout time of this timer ranges from 76 seconds to 3,600 seconds and defaults to 675 seconds.
- The sizes of receiving and sending buffers of connection-oriented sockets, which range from 1 KB to 32 KB and default to 8 KB.

Configuring TCP Attributes

Table 320 Configure TCP attributes

Operation	Command	Description
Enter system view	system-view	—
Set the timeout time of the TCP synwait timer	**tcp timer syn-timeout** *time-value*	Optional By default, the timeout time of the TCP synwait timer is 75 seconds.
Set the timeout time of the TCP finwait timer	**tcp timer fin-timeout** *time-value*	Optional By default, the timeout time of the TCP finwait timer is 675 seconds.
Set the transceive buffer size of the TCP socket	**tcp window** *window-size*	Optional By default, the transceive buffer size is 8 KB.

Displaying and Debugging IP Performance

After the above IP performance configuration, you can execute the **display** commands in any view to display the system operating status and thus verify the IP performance configuration.

You can execute the **reset** commands in user view to clear the IP, TCP and UDP traffic statistics. You can also execute the **debugging** commands to enable different IP performance debugging.

Table 321 Display and debug the IP performance

Operation	Command	Description
Display the TCP connection status	display tcp status	You can execute the **display** commands in any view.
Display the TCP traffic statistics	display tcp statistics	
Display the UDP traffic statistics	display udp statistics	
Display the IP traffic statistics	display ip statistics	
Display the ICMP traffic statistics	display icmp statistics	
Display the current socket information of the system	**display ip socket** [**socktype** *sock-type]* [*task-id socket-id* **]**	
Display FIB (forward information base) entries	display fib	
Clear the IP traffic statistics	reset ip statistics	—
Clear the TCP traffic statistics	**reset tcp statistics**	—
Clear the UDP traffic statistics	**reset udp statistics**	—
Enable system debugging	**debugging** *module-name* [*debugging-option*]	—

Troubleshooting the IP Performance Configuration

Symptom: IP packets are forwarded normally, but TCP and UDP do not operate normally.

Solution: Enable related debugging and check the debugging information.

- Use the **display** command to check the IP performance of the system, and verify that the PC is operating normally.
- Use the **terminal debugging** command to output the debugging information to the console.
- Use the **debugging udp packet** command to enable UDP debugging to track UDP data packets.

43 NETWORK CONNECTIVITY TEST

Network Connectivity Test

ping

You can use the **ping** command to check the network connectivity and the reachability of a host.

Table 322 The ping command

Operation	Command	Description
Check the IP network connectivity and the reachability of a host	**ping** [**-a** *ip-address*] [**-c** *count*] [**-d**] [**-f**] [**-h** *ttl*] [**-i** { *interface-type interface-number* }] [**ip**] [**-n**] [**- p** *pattern*] [**-q**] [**-r**] [**-s** *packetsize*] [**-t** *timeout*] [**-tos** *tos*] [**-v**] *host*	You can use this command in any view.

This command can output the following results:

- Response status for each ping packet. If no response packet is received within the timeout time, the message "Request time out" is displayed. Otherwise, the number of data bytes, packet serial number, TTL (time to live) and response time of the response packet are displayed.
- Final statistics, including the numbers of sent packets and received response packets, the irresponsive packet percentage, and the minimum, average and maximum values of response time.

tracert

You can use the **tracert** command to trace the gateways a packet passes during its journey from the source to the destination. This command is mainly used to check the network connectivity. It can help you locate the trouble spot of the network.

The executing procedure of the **tracert** command is as follows: First, the source host sends a data packet with the TTL of 1, and the first hop device returns an ICMP error message indicating that it cannot forward this packet because of TTL timeout. Then, the source host resends the packet with the TTL of 2, and the second hop device also returns an ICMP TTL timeout message. This procedure goes on and on until the packet gets to the destination. During the procedure, the system records the source address of each ICMP TTL timeout message in order to offer the path that the packet passed through to the destination.

Table 323 The tracert command

Operation	Command	Description
Trace the gateways a packet passes from the source host to the destination	**tracert** [**-a** *source-IP* | **-f** *first-ttl* | **-m** *max-TTL* | **-p** *port* | **-q** *num-packet* | **-w** *timeout*] *string*	You can execute the **tracert** command in any view.

44 DEVICE MANAGEMENT

Introduction to Device Management

The device management function of the Ethernet switch can report the current status and event-debugging information of the boards to you. Through this function, you can maintain and manage your physical device, and restart the system when some functions of the system are abnormal.

Device Management Configuration

The following sections describe the configuration tasks for device management:

- Restarting the Ethernet Switch
- Schedule a Reboot on the Switch
- Specifying the APP to be Adopted at Reboot
- Updating the BootROM

Restarting the Ethernet Switch

You can perform the following operation when the switch is in trouble or needs to be restarted.

Perform the following configuration in user view:

Table 324 Restart the Ethernet switch

Operation	Command	Description
Restart the Ethernet switch	**reboot** [**unit** *unit-id*]	—

When rebooting, the system checks whether there is any configuration change. If there is, it prompts you to indicate whether or not to proceed. This prevents you from losing your original configuration due to oblivion after system reboot.

Schedule a Reboot on the Switch

After you schedule a reboot on the switch, the switch will reboot at the specified time.

Table 325 Schedule a reboot on the switch

Operation	Command	Description
Schedule a reboot on the switch, and set the reboot date and time	**schedule reboot at** *hh:mm* [*mm/dd/yyyy* | *yyyy/mm/dd*]	—
Schedule a reboot on the switch, and set the reboot waiting delay	**schedule reboot delay** { *hhh:mm* | *mmm* }	—
Display information about scheduled reboot on the switch	display schedule reboot	You can execute the **display** command in any view

There is at most one minute defer for scheduled reboot, that is, the switch will reboot within one minute after reaching the specified reboot date and time.

Specifying the APP to be Adopted at Reboot

APP is the host software of the switch. If multiple APPs exist in the Flash memory, you can use the command here to specify the one that will be adopted when the switch reboots.

Perform the following configuration in user view:

Table 326 Specify the APP to be adopted at reboot

Operation	Command	Description
Specify the APP to be adopted at reboot	**boot boot-loader** [**backup-attribute]** { *file-url* | *device-name* }	—

Updating the BootROM

You can use the BootROM application saved in the Flash memory of the switch to update the running BootROM application without the need to terminate the system. With this command, a remote user can conveniently update the BootRom by uploading the BootROM to the switch through FTP and running this command.

Perform the following configuration in user view:

Table 327 Update the BootROM

Operation	Command	Description
Update the BootROM	**boot bootrom** *file-url*	—

Displaying the Device Management Configuration

After the above configurations, you can execute the **display** command in any view to display the operating status of the device management to verify the configuration effects.

Table 328 Display the operating status of the device management

Operation	Command
Display the APP to be adopted at reboot.	display boot-loader
Display the module type and operating status of each board.	**display device [manuinfo [unit** *unit-id]* **| unit** *unit-id* **]**
Display CPU usage of a switch	**display cpu** [**unit** *unit-id]*
Display memory usage of a switch	**display memory** [**unit** *unit-id]*
Display system diagnostic information or save system diagnostic information to a file suffixed with diag in the Flash memory	display diagnostic-information
Display enabled debugging on a specified switch or all switch in the fabric	**display debugging** { **fabric** | **unit** *unit-id* } [**interface** *interface-type interface-number* | *module-name*]
Display enabled debugging on all switches in the fabric in terms of module names.	**display debugging fabric by-module**

Remote Switch Update Configuration Example

Network requirements

Telnet to the switch from a PC remotely and download applications from the FTP server to the Flash memory of the switch to remotely update the switch software by using the device management commands through CLI.

The switch acts as the FTP client, and the remote PC serves as both the configuration PC and the FTP server.

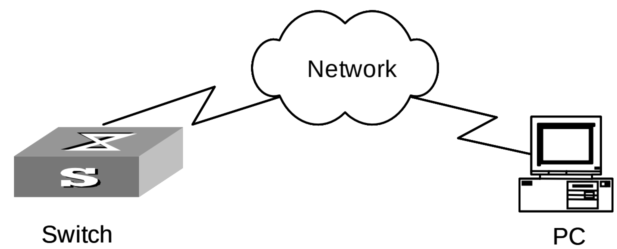
Perform the following configuration on the FTP server.

- Configure an FTP user, whose name and password are switch and hello respectively. Authorize the user with the read-write right of the Switch directory on the PC.
- Make appropriate configuration so that the IP address of a VLAN interface on the switch is 1.1.1.1, the IP address of the PC is 2.2.2.2, and the switch and the PC is reachable to each other.

The PC stores the host software switch.bin and the BootROM file boot.btmof the switch. Use FTP to download the switch.bin and boot.btm files from the FTP server to the switch.

Network diagram

Figure 120 Network diagram of FTP configuration



Configuration procedure

1 Configure the following FTP server-related parameters on the PC: an FTP user with the username and password as switch and hello respectively, being authorized with the read-write right of the Switch directory on the PC. The detailed configuration is omitted here.

2 Configure the switch as follows:

a On the switch, configure a level 3 telnet user with the username and password as user and hello respectively. Authentication by user name and password is required for the user.

b Execute the **telnet** command on the PC to log into the switch. The following prompt appears:

```
<S4200G>
```

CAUTION: *If the Flash memory of the switch is not sufficient, delete the original applications in it before downloading the new ones to the Flash memory.*

c Initiate an FTP connection with the following command in user view. Input the correct user name and password to log into the FTP server.

```
<S4200G> ftp 2.2.2.2
Trying …
Press CTRL+K to abort
Connected.
220 WFTPD 2.0 service (by Texas Imperial Software) ready for new user
User(none):switch
331 Give me your password, please
Password:*****
230 Logged in successfully
[ ftp]
```

d Enter the authorized path on the FTP server.

```
[ ftp] cd switch
```

e Execute the **get** command to download the switch.bin and boot.btm files on the FTP server to the Flash memory of the switch.

```
[ ftp] get switch.bin
[ ftp] get boot.btm
```

f Execute the **quit** command to terminate the FTP connection and return to user view.

```
[ ftp] quit
<S4200G>
```

g Update the BootROM.

```
<S4200G> boot bootrom boot.btm
This will update BootRom file on unit 1. Continue? [ Y/N] y
 Upgrading BOOTROM, please wait…
 Upgrade BOOTROM succeeded!
```

h Specify the downloaded application as the one to be adopted when the switch starts next time. Then restart the switch to update the switch application.

```
<S4200G>boot boot-loader switch.bin
 The specified file will be booted next time on unit 1!
<S4200G>display boot-loader
 Unit 1:
   The current boot app is: switch.bin
   The main boot app is:    switch.bin
   The backup boot app is:
<S4200G> reboot
```

45 CONFIGURATION OF NEWLY ADDED CLUSTER FUNCTIONS

Introduction to the Newly Added Cluster Functions

The newly added cluster functions aim to improve switch performance. They extend switch functionality.

With the cluster function employed, you can manage and maintain all the member switches in a cluster through the master switch. (A cluster can contain up to 16 switches.)

The newly added cluster functions include:

- SNMP configuration synchronization of the member devices passing topological authentication
- lUser name and the corresponding password synchronization of Web users
- Black/white list and topological authentication
- TRACE MAC function
- Upgrading software of the member devices in a cluster through Web
- Member device configuration backup/restoration through Web

These functions enrich the Ethernet switch cluster management technology and significantly relieve network administration workload. They also provide common users with a simple and intuitive way for managing switch clusters.

Notes

- *You need to enable the cluster function before configuring any of the newly added cluster functions.*
- *To employ the newly added cluster functions, you need to enable the cluster function and perform other related configurations on the master device. As for the member devices and the candidate devices, you only need to enable the cluster function for them so that they are under the management of the master device.*
- *For the configurations of the last two functions listed above, see your Web user manual.*

Configuration of the Newly Added Cluster Functions

Configuring the TFTP Server and SNMP Host for a Cluster

You can perform the operations listed in Table 329 on the master device of a cluster to configure the TFTP Server and SNMP host for the cluster. A TFTP server is required if you want to perform upgrade or backup operations to multiple cluster devices simultaneously through Web. An SNMP host is required if you want to access the members of a cluster through an external SNMP host. TFTP server and SNMP host are the prerequisites to implement the newly added cluster functions.

Table 329 Configure a TFTP server and SNMP host for a cluster

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Configure a TFTP Server for cluster	**tftp-server** *ip-address*	Required
Configure an SNMP host for the cluster	**snmp-host** *ip-address*	Required

Synchronizing SNMP Configuration

SNMP configuration synchronization simplifies user configuration. With this function employed, the configuration performed on the master device is synchronized to all the member devices in the cluster. These configurations are mainly used for the SNMP host to access a member switch.

Configuration prerequisites

- NDPand NTDP configurations are performed on the related cluster devices.
- The cluster is created and enabled. That is, you can manage cluster members through the master device.

Configuration procedure

Table 330 Synchronize SNMP community name

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Configure a SNMP community name for the cluster.	**cluster-snmp-agent community** { **read** | **write** } *community-name* [mib-view *view-name*]	Required
Configure a SNMP V3 group for the cluster	**cluster-snmp-agent group v3** *group-name* [**authentication | privacy**] [**read-view** *read-view*] [**write-view** *write-view*] [**notify-view** *notify-view*]	Required
Create or update a MIP view for the cluster	**cluster-snmp-agent mib-view included** *view-name oid-tree*	Required
Configure a SNMP V3 user for the cluster	**cluster-snmp-agent usm-user v3** *username groupname* [**authentication-mode** { **md5** | **sha** } *authpassstring* [**privacy-mode** { **des56** *privpassstring* }]]	Required

Notes

Perform the operations listed in Table 330 in cluster view on the master device. The configuration can only be synchronized to the member devices in the white list only.

The configuration remains valid on a member device even if it quits the cluster or is removed from the white list.

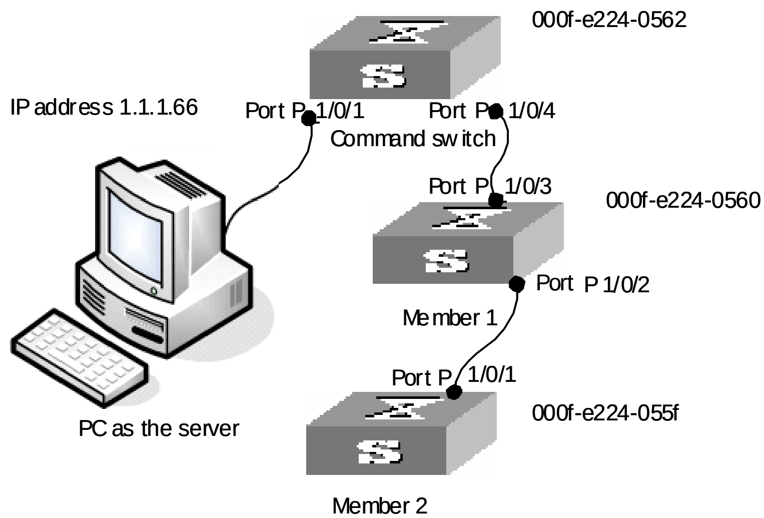
Configuration example

Synchronize the following SNMP configuration to all the member devices in a cluster for logging into the cluster through an SNMP host.

1. Set read-community name to "aaa", write-community name to "bbb", group name to "ggg", and MIP view name to "mmm". The MIP view contains the "org" sub-tree.
2. Set an SNMP V3 user named "uuu". The user belongs to the group named "ggg".

Network requirements

Figure 121 Network diagram for SNMP configuration synchronization



3. Configuration procedure

```
# Enable NDP and NTDP.
<S4200G>system-view
System View: return to User View with Ctrl+Z.
[S4200G]ndp enable
# Create a cluster.
[S4200G]cluster
[S4200G-cluster]ip-pool 168.192.0.1 24
[S4200G-cluster]build chwn
[chwn_0.S4200G-cluster]
# Configure a TFTP server and an SNMP host for the cluster.
[chwn_0.S4200G-cluster]tftp-server 1.1.1.66
[chwn_0.S4200G-cluster]snmp-host 1.1.1.66
# Member devices join the cluster automatically.
[chwn_0.S4200G-cluster]
%Apr  7 03:00:07:981 2000 chwn_0.S4200G CLST/5/LOG:- 1 -
Member 000f-e224-055f is joined in cluster chwn.

%Apr  7 03:00:08:098 2000 chwn_0.S4200G CLST/5/LOG:- 1 -
Member 000f-e224-0560 is joined in cluster chwn.
```

```
# Display the current topology.
[chwn_0.S4200G-cluster]display cluster current-topology
--------------------------------------------------------------------
     (PeerPort) ConnectFlag (NativePort) [SysName:DeviceMac]
--------------------------------------------------------------------
ConnectFlag:
     <--> normal connect      ---> odd connect     **** in blacklist
     ???? lost device         ++++ new device      -¦+- STP discarding
--------------------------------------------------------------------
[chwn_0.S4200G:000f-e224-0562]
    |
    +-(P_1/0/4)<-->(P_1/0/3)[S4200G:000f-e224-0560]
           |
          +-(P_1/0/2)<-->(P_1/0/1)[S4200G:000f-e224-055f]
[chwn_0.S4200G-cluster]
# Display the current configuration.
[chwn_0.S4200G-cluster]display current-configuration
#
 sysname S4200G
#
radius scheme system
#
domain system
#
acl number 3998
 rule 0 deny ip destination 168.192.0.0 0.0.0.255
 rule 1 permit ip source 168.192.0.0 0.0.0.255
acl number 3999
 rule 0 deny ip source 168.192.0.0 0.0.0.255
 rule 1 permit ip destination 168.192.0.0 0.0.0.255
#
vlan 1
#
cluster
 ip-pool 168.192.0.1 255.255.255.0
 build chwn
 tftp-server 1.1.1.66
 snmp-host 1.1.1.66
#
 snmp-agent
 snmp-agent local-engineid 800007DB000FE22405626877
 snmp-agent sys-info version all
 snmp-agent target-host trap address udp-domain 1.1.1.66 params
securityname clu
ster
undo snmp-agent trap enable standard
#
user-interface aux 0
user-interface vty 0 4
#
return
# Configure the read-community name to be aaa.
[chwn_0.S4200G-cluster]cluster-snmp-agent community read aaa
 Member 1 succeeded in the read-community configuration.
 Member 2 succeeded in the read-community configuration.
 Finish to synchronize the command.
# Configure the write-community name to be bbb.
[chwn_0.S4200G-cluster] cluster-snmp-agent community write bbb
          Member 1 succeeded in the write-community configuration.
          Member 2 succeeded in the write-community configuration.
```

```
 Finish to synchronize the command.
# Configure the group name to be ggg.
[chwn_0.S4200G-cluster] cluster-snmp-agent group v3 ggg
 Member 2 succeeded in the group configuration.
 Member 1 succeeded in the group configuration.
 Finish to synchronize the command.
# Configure the MIB view name to be mmm, with org sub-tree contained in
the MIB view.
[chwn_0.S4200G-cluster] cluster-snmp-agent mib-view included mmm org
 Member 1 succeeded in the mib-view configuration.
 Member 2 succeeded in the mib-view configuration.
 Finish to synchronize the command.
# Configure an SNMP v3 user, with the user name being uuu. The user
belongs to the group named ggg.
[chwn_0.io-cluster] cluster-snmp-agent usm-user v3 uuu ggg
 Member 2 succeeded in the usm-user configuration.
 Member 1 succeeded in the usm-user configuration.
 Finish to synchronize the command.
# Display the current configuration on the master switch.
[chwn_0.S4200G-cluster]display current-configuration
#
 sysname S4200G
#
radius scheme system
#
domain system
#
acl number 3998
 rule 0 deny ip destination 168.192.0.0 0.0.0.255
 rule 1 permit ip source 168.192.0.0 0.0.0.255
acl number 3999
 rule 0 deny ip source 168.192.0.0 0.0.0.255
 rule 1 permit ip destination 168.192.0.0 0.0.0.255
#
vlan 1
#
cluster
 ip-pool 168.192.0.1 255.255.255.0
 build chwn
 cluster-snmp-agent community read aaa
 cluster-snmp-agent group v3 ggg
 cluster-snmp-agent mib-view included mmm org
 cluster-snmp-agent usm-user v3 uuu ggg
#
 snmp-agent
 snmp-agent local-engineid 800007DB000FE22405626877
 snmp-agent community read aaa@cm0
 snmp-agent sys-info version all
 snmp-agent group v3 ggg
 snmp-agent mib-view included mmm org
 snmp-agent usm-user v3 uuu ggg
 undo snmp-agent trap enable standard
#
# Display the current configuration on member switch numbered 2.
<chwn_2.S4200G> system-view
System View: return to User View with Ctrl+Z.
[chwn_2.S4200G]cluster
[chwn_2.S4200G-cluster]display current-configuration
#
 sysname S4200G
```

```
#
radius scheme system
#
domain system
#
vlan 1
#
 snmp-agent
 snmp-agent local-engineid 800007DB000FE224055F6877
 snmp-agent community read aaa@cm2
 snmp-agent community write bbb@cm2
 snmp-agent sys-info version all
 snmp-agent group v3 ggg
 snmp-agent target-host trap address udp-domain 168.192.0.1 params
securityname
cluster
 snmp-agent mib-view included mmm org
 snmp-agent usm-user v3 uuu ggg
 snmp-agent usm-user v3 user1 g1
 snmp-agent trap source Vlan-interface1
#
```

Configuring Cluster Management

- Configuring member management

In member management, you can:

- Specify a candidate device that will join the cluster and delete the specific member device in the cluster manually. You are allowed to add or delete a cluster member only on the management device; otherwise the system gives an error prompt.
- Control the member device remotely through the remote control function of the management device if a member device fails due to incorrect configuration. For example, you can delete the boot file and restart the member device to bring the management device and the member device back to normal communication.
- Manage blacklists.
- Locate a device through the MAC address or the IP address.
- Configure the specified member device on the management device after switching to the member device view. After the configuration, you can switch back to the management device.

Table 331 Configure member management

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Add a candidate device to the cluster	**add-member** [*member-number*] **mac-address** *mac-address* [**password** *password*]	Optional Member numbers are assigned based on a certain order. The number that the member with the same MAC address used is recorded by the management device
Delete a member device from the cluster	**delete-member** *member-number* [**to-black-list**]	Optional

Table 331 Configure member management (Continued)

Operation	Command	Description
Reboot the specified member device	**reboot member** { *member-number* | **mac-address** *mac-address* } [**eraseflash**]	Optional
Locate a device with the MAC address or the IP address	**tracemac** { **by-mac** *mac-address* **vlan** *vlan-id* | **by-ip** *ip-address* } [nondp]	Optional You can execute this command according to the MAC table saved by the device. If there is no required VLAN ID, you cannot execute this command
Exit cluster view	**quit**	-
Exit system view	**quit**	-
Switch between the management device and a member device to perform configuration	**cluster switch-to** { *member-number* | **mac-address** *mac-address* | **administrator** }	Optional Currently, before executing this command, you must enable telnet server on the opposite device and ring switching is not allowed

- Configuring topology management

Topology management is performed based on white list and blacklist. The meanings of white list and blacklist are as follows:

- White list: Correct network topology confirmed by the network administrator. You can obtain topology node information and neighboring relationship at this moment from the current network topology. Meanwhile, you can maintain the white list based on the current topology, such as adding a node, deleting a node, and modifying a node.
- Blacklist: Members in the blacklist are not allowed to join the cluster automatically. The network administrator needs to add a member in the black list into the cluster, including the MAC address of the device. After the device is added into the blacklist, if it connects to the network through a non-blacklist device, the information and the access port of the non-blacklist device will be added into related entries of the management device.

White list and blacklist are exclusive. Nodes in the white list are not in the blacklist. Nodes in the black list cannot be added into the white list. Topology nodes are located neither in the white list nor in the blacklist. This kind of nodes is newly-added nodes, which are not confirmed by the network administrator.

White list and black list are saved in the flash of the management device. They still exist after the management device is powered off. You need to resume the white list and the black list manually. When you restart the management device or rebuild the cluster, the white list and the blacklist can be resumed from the flash. t

Table 332 Configure topology management

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Add a device into the blacklist	**black-list add-mac** *mac-address*	Optional

Table 332 Configure topology management (Continued)

Operation	Command	Description
Release a device from the blacklist	**black-list delete-mac** { **all** | *mac-address* }	Optional
Confirm the current topology information of the cluster and save that as a standard topology	**topology accept** { **all** [**save-to** { **administrator** | **local-flash** }] | **mac-address** *mac-address* | **member-id** *member-number* }	Optional
Save the standard topology information into the local flash	**topology save-to local-flash**	Optional
Obtain and restore the standard topology information from the local flash	**topology restore-from local-flash**	Optional If the saved standard topology is incorrect, the management device cannot accept it, so you must ensure that the saved topology is correct

Configuring Cluster Interoperation

After creating a cluster, you can universally configure servers, NMS hosts and logging hosts for the cluster on the management device. Member devices can access the configured servers through the management device.

All the log information of the member devices in the cluster is output to the configuration logging hosts. The member devices send the log information to the management device directly. The management device translates the addresses contained in the logs, and then sends log packets of the member devices to logging hosts of the cluster. Likely, all the trap packets of the member devices are sent to NMS hosts of the cluster.

Table 333 Configure cluster interoperation

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Configure the IP address, username and password of a public FTP server	**ftp-server** *ip-address* [**user-name** *username* **password** { **simple** | **cipher** } *password*]	Optional By default, a cluster has no public FTP server
Configure a public TFTP server	**tftp-server** *ip-address*	Optional By default, a cluster has no public TFTP server
Configure a public logging host	**logging-host** *ip-address*	Optional By default, a cluster has no public logging host
Configure a public SNMP host	**snmp-host** *ip-address* [**community-string read** *string1* **write** *string2*]	Optional By default, a cluster has no public SNMP host
Configuring an NMS interface for the management device	**nm-interface vlan-interface** *vlan-id*	Optional

Synchronizing User Name and Password

User Name and Password Synchronization of Web users simplifies user configuration. With this function employed, the configuration performed on the master device is synchronized to all the member devices in the cluster. These configurations are mainly used for WEB users to log into a cluster.

Configuration prerequisites

- NDP and NTDP configurations are performed on the related cluster devices.
- The cluster is created and enabled. That is, you can manage cluster members through the master device.

Configuration procedure

Table 334 Synchronize SNMP community name

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Configure a Web user	**cluster-local-user** *username* **passward** { **cipher** | **simple** } *passwardstring*	Required

Notes:

Perform the operations listed in Table 334 in cluster view on the master device. The configuration can only be synchronized to the member devices in the white list only.

The configuration remains valid on a member device even if it quits the cluster or is removed from the white list.

Configuration example

```
# Configure a web users.
[chwn_0.S4200G-cluster]cluster-loca www password simple 12345678
 Member 1 succeeded in the web-user configuration.
 Member 2 succeeded in the web-user configuration.
 Finish to synchronize the command.
# Display the current configuration on the master switch (Configuration
resulted from the command is reserved below).
[chwn_0.S4200G-cluster]display current-configuration
#
local-user www
 password simple 12345678
 service-type telnet
 level 2
#
cluster
 ip-pool 168.192.0.1 255.255.255.0
 build chwn
 tftp-server 1.1.1.66
 snmp-host 1.1.1.66
 cluster-local-user www password simple 12345678
#
 snmp-agent
 snmp-agent local-engineid 800007DB000FE22405626877
 snmp-agent sys-info version all
 snmp-agent target-host trap address udp-domain 1.1.1.66 params
securityname clu
ster
 undo snmp-agent trap enable standard
```

```
#
user-interface aux 0
user-interface vty 0 4
#
return
```

Configuring Topology Authentication

You can save a reference topology file that serves as the basis of the current network topology. It can be used to locate problems in subsequent network topologies. After you confirm the structure of the current network through CLI according to the actual cluster deployment, the master device generates a reference topology file named topology.top. The file is saved in the Flash. It contains the information about the link states of all the nodes in the cluster.

A reference topology file contains a white list and a black list.

- The white list contains legal devices. (Legal devices are those confirmed by users.)
- The blacklist contains illegal devices. (Illegal devices are those that fail to pass the topology authentication.)

Thereafter, each time a device attempts to join a cluster, the master device automatically initiates topological authentication based on the reference topology file.

- If the device is in the black list, the master device denies the device.
- If the device is in the white list, the master device adds the device to the cluster and automatically delivers the private configuration of the node to the device.
- If the device is neither in the blacklist nor the white list, the master device adds the device to the cluster but do not deliver private configuration to the device. The app file on the device cannot be automatically upgraded.
- Only the candidates passing topology authentication become member devices of the cluster, and only the devices confirmed by users can be added to the white list.

Configuration prerequisites

- NDP and NTDP configurations are performed on the related cluster devices.
- The cluster is created and enabled. That is, you can manage cluster members through the master device.

Configuration procedure

Table 335 Configure enhanced cluster functions

Operation	Command	Description
Enter system view	**system-view**	-
Enter cluster view	**cluster**	-
Configure an FTP Server for the cluster	**ftp-server ip-address**	Required
Confirm the current topology of the cluster and save it as a reference topology file	**topology accept** { **all** [**save-to local-flash**] | **mac-address** *mac-address* | **member-id** *member-id* }	Optional
Save the reference topology file to the local Flash	**topology save-to local-flash**	Optional
Restore the local topology file to the reference topology file	**topology restore-from local-flash**	Optional
Remove a specified cluster member device from the cluster	**delete-member** *member-id* [**to-black-list**]	Optional
Add the device with the specified MAC address to the black list	**black-list add-mac** *mac-address*	Optional
Remove the device with the specified MAC address from the black list	**black-list delete-mac** { *mac-address* | **all** }	Optional

Displaying and Debugging a Cluster

After the above-mentioned configuration, you can use the display command or the tracemac command in any view to view the cluster operating information, so as to verify configuration result.

Use the reset command in user view to clear the NDP statistics.

Table 336 Display and debug a cluster

Operation	Command
Display cluster members	**display cluster members** [*member-num* | **verbose**]
Display the MAC addresses, names, and the corresponding ports of the devices whose MAC addresses are within that of the current device and the device with specified MAC address	**tracemac by-mac** *mac-address* **vlan** *vlan-id* [**nondp**]
Display the MAC addresses, names, and the corresponding ports of the devices whose IP addresses are within that of the current device and the device with specified IP address	**tracemac by-ip** *ip-address* [**nondp**]
Display the standard topology view of the cluster	**display cluster base-topology** [**mac-address** *mac-address* | **member-id** *member-number*]
Display the current blacklist of the cluster	**display cluster black-list**
Display the current topology view or the topology path between two points	**display cluster current-topology** [**mac-address** *mac-address* [**to-mac-address** *mac-address*] | **member-id** *member-number* [**to-member-id** *member-number*]]

Configuration Example for Newly Added Cluster Functions

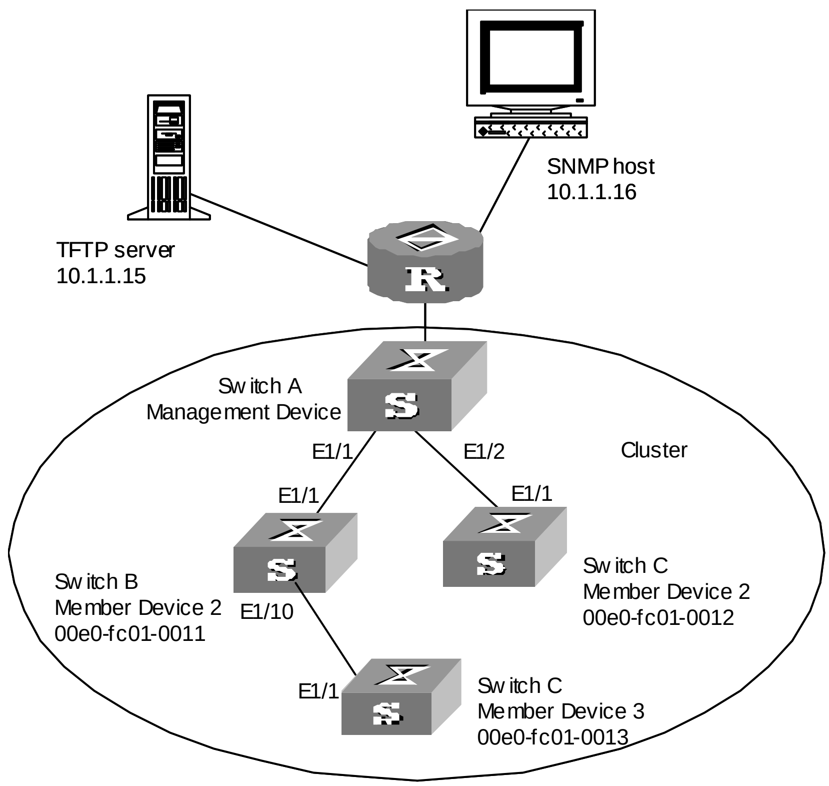
Network requirements

In a cluster formed by Switch A, Switch B, Switch C, and Switch D, Switch A is the master switch. NDP and NTDP configurations are performed on the related devices. The cluster is enabled and you can manage member devices on the master device.

- The IP address of the TFTP Server configured for the cluster is 10.1.1.15.
- The IP address of the SNMP host configured for the cluster is 10.1.1.16.
- Log into the Web page of the master switch and view the file on the Flash of a member device.
- Log into the Web page of the master switch and upgrade software.
- Log in to the Web page of the master switch and restore the configuration.
- Remove the member device numbered 3 from the cluster and add it to the black list.

Network diagram

Figure 122 Network diagram for HGMP cluster management



Configuration procedure

Perform the following configurations on the master device (Switch A).

```
# Configure a TFTP server and SNMP host for the cluster.
[S4200G] cluster
[S4200G-cluster]tftp-server 10.1.1.15
[S4200G-cluster] snmp-host 10.1.1.16
[S4200G-cluster] topology accept all save-to local-flash
# Remove the member device numbered 3 from the cluster and add it to the
black list.
[S4200G-cluster] delete-member 3 to-black-list
```

Log into the Web page of the master switch for querying files, upgrading software, and restoring the configuration.

For details, see Batch Upgrade of COMWARE V300R002 Platform WEB NMS in a

46 DHCP RELAY CONFIGURATION

Introduction to DHCP Relay

Usage of DHCP Relay

Early DHCP implementations assumes that DHCP clients and DHCP servers are on the same network segment, that is, you need to deploy at least one DHCP server for each network segment, which is far from economical.

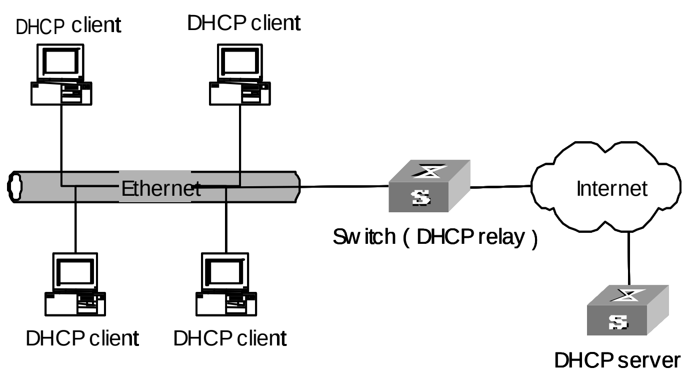
DHCP Relay is designed to address this problem. It enables DHCP clients of multiple networks to share a common DHCP server, through which DHCP clients in a LAN can acquire IP addresses by negotiating with DHCP servers of other networks. It decreases your cost and provides a centralized administration.

A DHCP relay can be a host or a switch that has DHCP relay service enabled.

DHCP Relay Fundamentals

Figure 123 illustrates a typical DHCP relay application.

Figure 123 Typical DHCP relay application



A DHCP relay works as follows:

- A DHCP client broadcasts a configuration request packet in the local network when it starts and initiates.
- If a DHCP server exists in the local network, it processes the configuration request packet directly without the help of a DHCP relay.
- If no DHCP server exists in the local network, the network device serving as a DHCP relay on this network appropriately processes the configuration request packet and forwards it to a specified DHCP server located on another network.
- When the DHCP server receives the packet, it generates configuration information accordingly and sends it to the DHCP client through the DHCP relay to complete the dynamic configuration of the DHCP client.

Note that such an interacting process may be repeated several times for a DHCP client to be successfully configured.

Actually, a DHCP relay enables DHCP clients and DHCP servers on different networks to communicate with each other by forwarding the DHCP broadcasting packets transparently between them.

Option 82 supporting

Introduction to option 82 supporting

Option 82 is a relay agent information option in DHCP packets. When a request packet from a DHCP client travels through a DHCP relay on its way to the DHCP server, the DHCP relay adds option 82 into the request packet. Option 82 includes many sub-options, but the DHCP server supports only sub-option 1 and sub-option 2 at present. Sub-option 1 defines agent circuit ID (that is, Circuit ID) and sub-option 2 defines remote agent ID (that is, Remote ID).

Option 82 enables a DHCP server to track the address information of DHCP clients and DHCP relays, through which and other proper software, you can achieve the DHCP assignment limitation and accounting functions.

Primary terminologies

- Option: A length-variable field in DHCP packets, carrying information such as part of the lease information and packet type. It includes at least one option and at most 255 options.
- Option 82: Also known as relay agent information option. This option is a part of the Option field in DHCP packet. According to RFC3046, option 82 lies before option 255 and after the other options. Option 82 includes at least one sub-option and at most 255 sub-options. Currently, the commonly used sub-options in option 82 are sub-option 1, sub-option 2 and sub-option 5.
- Sub-option 1: A sub-option of option 82. Sub-option 1 represents the agent circuit ID, namely Circuit ID. It holds the VLAN-ID and MAC address of the switch port connected to the DHCP client, and is usually configured on the DHCP relay. Generally, sub-option 1 and sub-option 2 must be used together to identify information about a DHCP source.
- Sub-option 2: A sub-option of option 82. Sub-option 2 represents the remote agent ID, namely Remote ID. It holds the MAC address of the DHCP relay, and is usually configured on the DHCP relay. Generally, sub-option 1 and sub-option 2 must be used together to identify information about a DHCP source.
- Sub-option 5: A sub-option of option 82. Sub-option 5 represents link selection. It holds the IP address added by the DHCP relay, so that the DHCP server can assign an IP address on the same segment to the DHCP client.

Mechanism of option 82 supporting on DHCP relay

The procedure for a DHCP client to obtain an IP address from a DHCP server through a DHCP relay is exactly the same as that for the client to obtain an IP address from a DHCP server directly. The following are the mechanism of option 82 supporting on DHCP relay.

1. A DHCP client broadcasts a request packet when it initiates.
2. If a DHCP server exists in the local network, it assigns an IP address to the DHCP client directly. Otherwise, the DHCP relay on this network receives and processes the request packet. The DHCP relay checks whether the packet contains option 82 and processes the packet accordingly.

3 If the packet contains option 82, the DHCP relay processes the packet depending on the configured policy (that is, discards the packet, replaces the original option 82 in the packet with its own, or leaves the original option 82 unchanged in the packet), and forwards the packet (if not discarded) to the DHCP server.

4 If the packet does not contain option 82, the DHCP relay adds option 82 to the packet and forwards the packet to the DHCP server. The forwarded packet contains the MAC address of the switch port to which the DHCP client is connected, the VLAN to which the DHCP client belongs, and the MAC address of the DHCP relay.

5 Upon receiving the DHCP request packet forwarded by the DHCP relay, the DHCP server stores the information contained in the option field and sends a packet that contains DHCP configuration information and option 82 to the DHCP relay.

6 Upon receiving the packet returned from the DHCP server, the DHCP relay strips option 82 from the packet and forwards the packet with the DHCP configuration information to the DHCP client.

Request packets sent by a DHCP client fall into two categories: DHCP-DISCOVER packets and DHCP-REQUEST packets. As DHCP servers coming from different manufacturers process DHCP request packets in different ways (that is, some DHCP servers process option 82 in DHCP-DISCOVER packets, whereas the rest process option 82 in DHCP-REQUEST packets), a DHCP relay adds option 82 to both types of packets to accommodate to DHCP servers of different manufacturers.

DHCP Relay Configuration

If a switch belongs to a fabric, you need to enable the UDP-helper function on it before configure it to be a DHCP relay.

DHCP Relay Configuration Tasks

Table 337 DHCP relay configuration tasks

Operation	Description	Related section
Enable DHCP	Required	Enabling DHCP
Configure an interface to operate in DHCP relay mode	Required	Configuring an Interface to Operate in DHCP Relay Mode
Configure DHCP relay security	Required	Configuring DHCP Relay Security

Enabling DHCP

Be sure to enable DHCP before you perform other DHCP relay-related configuration, for other DHCP-related configurations cannot take effect with DHCP disabled.

Table 338 Enable DHCP

Operation	Command	Description
Enter system view	system-view	—
Enable DHCP	dhcp enable	Required By default, DHCP is disabled.

Configuring an Interface to Operate in DHCP Relay Mode

There may be multiple DHCP servers deployed in one network. This increases the reliability. Here, you can configure a DHCP server group containing one or multiple DHCP servers.

You can configure an interface to forward DHCP packets received from DHCP clients to a group of external DHCP server(s), so that the DHCP server(s) in this group can assign IP addresses to the DHCP clients under this interface.

Table 339 Configure an interface to operate in DHCP relay mode

Operation	Command	Description
Enter system view	system-view	—
Configure the DHCP server IP address(es) in a specified DHCP server group	**dhcp-server** *groupNo* **ip** *ip-address1* [*ipaddress-list]*	Required By default, no DHCP server IP address is configured in a DHCP server group.
Map an interface to a DHCP server group	**interface** *interface-type interface-number*	Required By default, a VLAN interface is not mapped to any DHCP server group.
	dhcp-server *groupNo*	

You can configure up to eight external DHCP IP addresses in a DHCP server group.

You can map multiple VLAN interfaces to one DHCP server group. But one VLAN interface can be mapped to only one DHCP server group. If you execute the ***dhcp-server*** *groupNo command repeatedly, the new configuration overwrites the previous one.*

The group number referenced in the ***dhcp-server*** *groupNo command must has already been configured by using the* ***dhcp-server*** *groupNo* ***ip*** *ipaddress1 [ipaddress-list] command.*

Configuring DHCP Relay Security

Configuring address checking

When a DHCP client obtain an IP address from a DHCP server with the help of a DHCP relay, the DHCP relay creates an entry (dynamic entry) in the user address table to track the IP-MAC address binding information about the DHCP client. You can also configure user address entries manually (static entries) to bind an IP address and a MAC address statically.

The purpose of the address checking function on DHCP relay is to prevent unauthorized users from statically configuring IP addresses to access external networks. With this function enabled, a DHCP relay inhibits a user from accessing external networks if the IP address configured on the user end and the MAC address of the user end do not match any entries (including the entries dynamically tracked by the DHCP relay and the manually configured static entries) in the user address table on the DHCP relay.

Table 340 Configure address checking

Operation	Command	Description
Enter system view	system-view	—
Create a DHCP user address entry manually	**dhcp-security static** *ip-address mac-address*	Optional By default, there is no manually configured DHCP user address entry.
Enter interface view	**interface** *interface-type interface-number*	—
Enable the address checking function	address-check enable	Required By default, the address checking function is disabled.

Configuring the dynamic user address entry updating function

When a DHCP client obtains an IP address from a DHCP server with the help of a DHCP relay, the DHCP relay creates an entry (dynamic entry) in the user address table to track the binding information about the IP address and MAC address of the DHCP client. But as a DHCP relay does not process DHCP-RELEASE packets, which are sent to DHCP servers by DHCP clients through unicast when the DHCP clients release IP addresses, the user address entries maintained by the DHCP cannot be updated in time. The dynamic user address entry updating function is developed to resolve this problem.

The dynamic user address entry updating function works as follows: at regular intervals, the DHCP relay sends a DHCP-REQUEST packet that carries the IP address assigned to a DHCP client and its own MAC address to the corresponding DHCP server. If the DHCP server answers with a DHCP-ACK packet, the IP address is available (it can be assigned again) and the DHCP relay ages out the corresponding entry in the user address table. If the DHCP server answers with a DHCP-NAK packet, the IP address is still in use (the lease is not expired) and the DHCP relay remains the corresponding user address entry unchanged.

Table 341 Configure the dynamic user address entry updating function

Operation	Command	Description
Enter system view	system-view	—
Set the interval to update DHCP user address entries	**dhcp-security tracker** { *interval* | **auto }**	Optional By default, the update interval is automatically determined by the number of DHCP user address entries.

Option 82 Supporting Configuration

Prerequisites

- Before configuring option 82 supporting on a DHCP relay, make sure that the DHCP relay is configured and operates properly.
- The DHCP server operates properly. Address allocation policy-related configurations (such as address pools and the lease time) are performed.
- The routes between the DHCP relay and the DHCP server are reachable.

Enabling Option 82 Supporting on a DHCP Relay

The following operations are expected to be performed on a DHCP relay-enabled network device.

Table 342 Enable option 82 supporting on a DHCP relay

Operation	Command	Description
Enter system view	system-view	—
Enable option 82 supporting on the DHCP relay	dhcp relay information enable	Required By default, this function is disabled.
Configure the strategy for the DHCP relay to process request packets containing option 82	**dhcp relay information strategy** { **drop** | **keep** | **replace }**	Optional By default, the **replace** policy is adopted, that is, the DHCP relay replaces the original option 82 carried in a request packet with its own option 82.

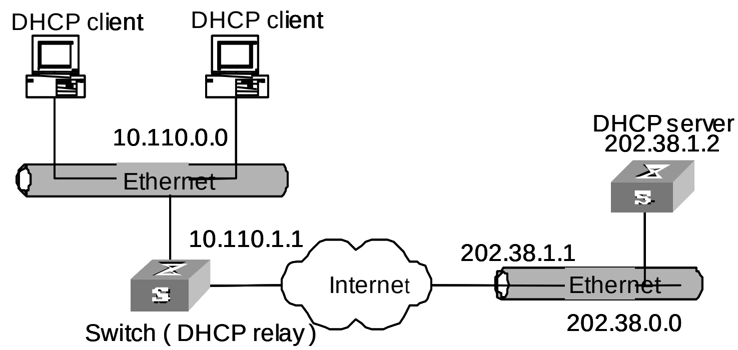
Option 82 Supporting Configuration Example

Network requirements

Two DHCP clients are on the network segment 10.110.0.0 (255.255.0.0). They obtain IP addresses from a DHCP server through a switch acting as DHCP relay. Option 82 supporting is enabled on the DHCP relay.

Network diagram

Figure 124 Network diagram for option 82 supporting



Configuration procedure

This example supposes that the routes between the DHCP relay and the DHCP server are reachable. The following configurations are only for the switch acting as DHCP relay.

1 Enter system view.

```
<S4200G> system-view
```

2 Enable DHCP.

```
[4200G] dhcp enable
```

3 Configure the VLAN interface that is to carry out the DHCP relay function: First enter the corresponding VLAN interface view. Then assign an IP address and a subnet mask to the VLAN interface so that it is on the same network segment with the two DHCP clients.

```
[4200G] interface vlan-interface 100
[4200G-Vlan-interface 100] ip address 10.110.1.1 255.255.0.0
```

4 Specify the IP address of the DHCP server by configuring the IP address of the DHCP server to be used by DHCP server group 1.

```
[4200G] dhcp-server 1 ip address 202.38.1.2
```

5 Map VLAN 100 interface to DHCP server group1.

```
[4200G-Vlan-interface100] dhcp-server 1
[4200G-vlan-interface100] quit
```

6 Return to system view.

```
[4200G-vlan-interface 100] quit
```

7 Enable option 82 supporting on the DHCP relay, with the **keep** keyword specified.

```
[4200G] dhcp relay information enable
[4200G] dhcp relay information strategy keep
```

DHCP Relay Displaying

You can verify your DHCP relay-related configuration by executing the following **display** commands in any view.

Table 343 Display DHCP relay information

Operation	Command
Display information about a specified DHCP server group	**display dhcp-server** *groupNo*
Display information about the DHCP server group to which a specified VLAN interface is mapped	**display dhcp-server interface vlan-interface** *vlan-id*
Display one or all user address entries, or a specified type of entries in the valid user address table of the DHCP server group	**display dhcp-security** [*ip-address* | **dynamic** | **static** | **tracker**]

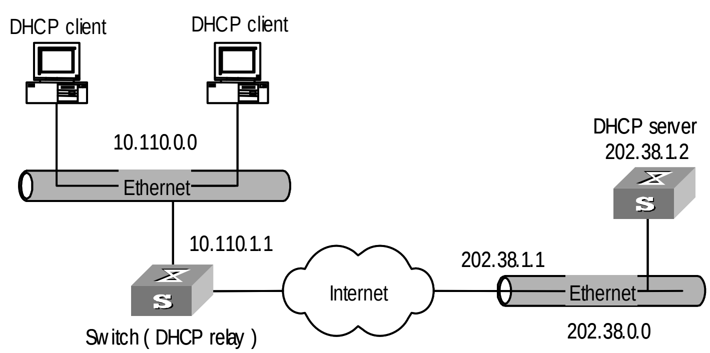
DHCP Relay Configuration Example

Network requirements

The DHCP clients on the network segment 10.110.0.0 (255.255.255.0) are connected to a port of VLAN 2, which has been created on the switch acting as a DHCP relay. The IP address of the DHCP server is 202.38.1.2. DHCP packets between the DHCP clients and the DHCP server are forwarded by the DHCP relay, through which the DHCP clients can obtain IP addresses and related configuration information from the DHCP server.

Network diagram

Figure 125 Network diagram for DHCP relay



Configuration procedure

1 Enter system view.

```
<S4200G> system-view
```

2 Enable DHCP.

```
[4200G] dhcp enable
```

3 Create DHCP server group 1 and configure an IP address of 202.38.1.2 for it.

```
[4200G] dhcp-server 1 ip 202.38.1.2
```

4 Map VLAN 2 interface to DHCP server group 1.

```
[4200G] interface vlan-interface 2
[4200G-Vlan-interface2] dhcp-server 1
```

5 Configure an IP address for VLAN 2 interface, so that this interface is on the same network segment with the DHCP clients.)

```
[4200G-Vlan-interface2] ip address 10.110.1.1 255.255.0.0
```

You need to perform corresponding configurations on the DHCP server to enable the DHCP clients to obtain IP addresses from the DHCP server. The DHCP server configurations differ depending on different DHCP server devices and are thus omitted.

Troubleshooting DHCP Relay

Symptom

A client fails to obtain configuration information through a DHCP relay.

Analyze

This problem may be caused by improper DHCP relay configuration. When a DHCP relay operates improperly, you can locate the problem by enabling debugging and checking the information about debugging and interface state (You can display the information by executing the corresponding **display** command.)

Solution

- Check if an address pool that is on the same network segment with the DHCP clients is configured on the DHCP server.
- Check if a reachable route is configured between the DHCP relay and the DHCP server.
- Check if the DHCP relay has proper relay IP addresses configured on the VLAN interface to which the network segment containing the DHCP clients is connected, and if the configured relay IP addresses conflict.

47 STATIC ROUTE CONFIGURATION

Introduction to Static Route

Attributes and Functions of Static Route

A static route is a special route. You can set up an interconnecting network with the static route configuration. The problem for such configuration is when a fault occurs to the network, the static route cannot change automatically to steer away from the node causing the fault, if without the help of an administrator.

In a relatively simple network, you only need to configure the static routes to make the router work normally. The proper configuration and usage of the static route can improve the network performance and ensure the bandwidth of the important applications.

All the following routes are static routes:

- Reachable route: A normal route is of this type. That is, the IP packet is sent to the next hop using the route marked by the destination. It is a common type of static routes.
- Unreachable route: When a static route to a destination has the “**reject**” attribute, all the IP packets to this destination will be discarded, and the originating host will be informed destination unreachable.
- Blackhole route: If a static route to a destination has the “**blackhole**” attribute, the outgoing interface of this route is the Null 0 interface regardless of the next hop address, and all the IP packet addressed to this destination are dropped without notifying the source host.

The attributes “**reject**” and “**blackhole**” are usually used to control the range of reachable destinations of this router, and help troubleshooting the network.

Default Route

A default route is a static route, too. A default route is a route used only when no suitable routing table entry is matched and when no proper route is found, the default route is used. In a routing table, the default route is in the form of the route to the network 0.0.0.0 (with the mask 0.0.0.0). You can see whether it has been set using the output of the command **display ip routing-table**. If the destination address of a packet fails in matching any entry of the routing table, the router will select the default route to forward this packet. If there is no default route and the destination address of the packet fails in matching any entry in the routing table, this packet will be discarded, and an Internet Control Message Protocol (ICMP) packet will be sent to the originating host to inform that the destination host or network is unreachable.

Default route is very useful in the networks. Suppose that there is a typical network, which consists of hundreds of routers. In that network, far from less bandwidth would be consumed if you put all kinds of dynamic routing protocols into use without configuring a default route. Using the default route could provide an appropriate bandwidth, even not achieving a high bandwidth, for communications between large numbers of users.

Static Route Configuration

Static Route Configuration includes:

- Configuring a static route
- Configuring a default route
- Deleting all the static routes

Configuring a static route

Perform the following configurations in system view.

Table 344 Configuring a static route

Operation	Command
Add a static route	**ip route-static** *ip-address* { *mask* | *mask-length* } { *interface-type interface-number* | *next-hop* } [**preference** *value*] [**reject** | **blackhole**]
Delete a static route	**undo ip route-static** *ip-address* { *mask* | *mask-length* } [*interface-type interface-number* | *next-hop*] [**preference** *value*] [**reject blackhole**]

The parameters are explained as follows:

- IP address and mask

  The IP address and mask are in a dotted decimal format. As "1"s in the 32-bit mask is required to be consecutive, the dotted decimal mask can also be replaced by the *mask-length* (which refers to the digits of the consecutive "1"s in the mask).

- Next hop address and NULL interface

  When configuring a static route, you can specify the *next-hop* to decide the next hop address. In fact, for all the routing items, the next hop address must be specified. When IP layer transmits a packet, it will first search the matching route in the routing table according to the destination address of the packet. Only when the next hop address of the route is specified can the link layer find the corresponding link layer address, and then forward the packet according to this address.

  You cannot specify an interface address of the local switch as the next hop address of an static route.

  The packets sent to NULL interface, a kind of virtual interface, will be discarded at once. This can decrease the system load.

- Preference

  For different configurations of *preference-value*, you can flexibly apply the routing management policy. For configuration of multiple routes to the destination, if you specify the same precedence, load sharing is achieved. If not, the routing backup takes place achieved.

- Other parameters

  The attributes **reject** and **blackhole** respectively indicate the unreachable route and the blackhole route.

Configuring a default route

Perform the following configurations in system view.

Table 345 Configuring a default route

Operation	Command
Configure a default route	**ip route-static** 0.0.0.0 { 0.0.0.0 | 0 } { *interface-type interface-number* | *next-hop* } [**preference** *value*] [**reject** | **blackhole]**
Delete a default route	**undo ip route-static** 0.0.0.0 { 0.0.0.0 | 0 } [*interface-type interface-number* | *next-hop*] [**preference** *value*] [**reject blackhole**]

The meanings of parameters in the command are the same as those of the static route.

Deleting All The Static Routes

You can use the **undo ip route-static** command to delete one static route. S4200G Series ethernet switches also provide a special command for you to delete all static routes at one time, including the default routes.

Perform the following configuration in system view.

Table 346 Deleting all static routes

Operation	Command
Delete all static routes	delete static-routes all

Displaying and Debugging Static Route

After the above configuration, execute **display** command in any view to display the running of the Static Route configuration, and to verify the effect of the configuration.

Table 347 Displaying and debugging the routing table

Operation	Command
View routing table summary	display ip routing-table
View routing table details	display ip routing-table verbose
View the detailed information of a specific route	**display ip routing-table** *ip_address* [*mask]* [**longer-match**] [**verbose**]
View the route information in the specified address range	**display ip routing-table** *ip_address1 mask1 ip_address2 mask2* [**verbose**]
View the route filtered through specified basic access control list (ACL)	**display ip routing-table acl** *acl-number* [**verbose**]
View the route information that through specified ip prefix list	**display ip routing-table ip-prefix** *ip-prefix-name* [**verbose**]
View the routing information found by the specified protocol	**display ip routing-table protocol** *protocol* [**inactive** | **verbose**]
View the tree routing table	**display ip routing-table radix**
View the statistics of the routing table	display ip routing-table statistics

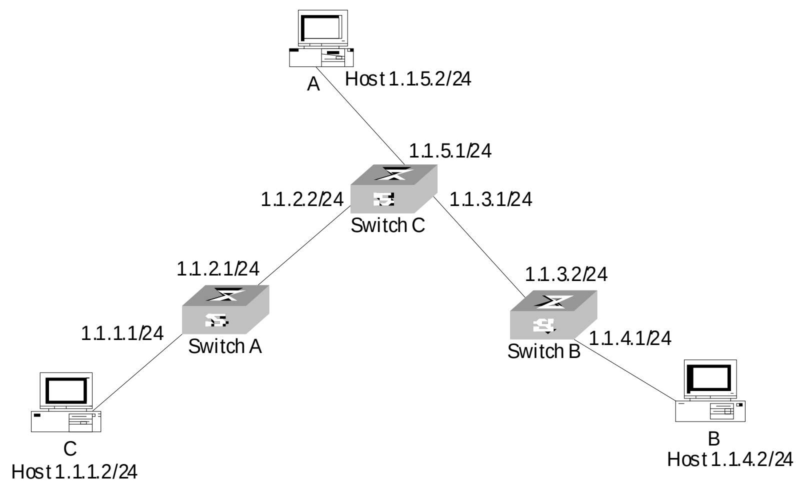
Typical Static Route Configuration Example

Networking requirements

As shown in Figure 126, the masks of all the IP addresses in the figure are 255.255.255.0. It is required that all the hosts or S4200G Series Ethernet Switches can be interconnected in pairs by configuring static routes.

Networking diagram

Figure 126 Networking diagram of the static route configuration example



Configuration procedure

1 Configure the static route for Ethernet Switch A

```
[ Switch A] ip route-static 1.1.3.0 255.255.255.0 1.1.2.2
[ Switch A] ip route-static 1.1.4.0 255.255.255.0 1.1.2.2
[ Switch A] ip route-static 1.1.5.0 255.255.255.0 1.1.2.2
```

2 Configure the static route for Ethernet Switch B

```
[ Switch B] ip route-static 1.1.2.0 255.255.255.0 1.1.3.1
[ Switch B] ip route-static 1.1.5.0 255.255.255.0 1.1.3.1
[ Switch B] ip route-static 1.1.1.0 255.255.255.0 1.1.3.1
```

3 Configure the static route for Ethernet Switch C

```
[ Switch C] ip route-static 1.1.1.0 255.255.255.0 1.1.2.1
[ Switch C] ip route-static 1.1.4.0 255.255.255.0 1.1.3.2
```

4 Configure the default gateway of the Host A to be 1.1.5.1

5 Configure the default gateway of the Host B to be 1.1.4.1

6 Configure the default gateway of the Host C to be 1.1.1.1

By then, all the hosts or Ethernet Switches in the figure can be interconnected in pairs.

Static Route Fault Diagnosis and Troubleshooting

Fault: the S4200G Series Ethernet Switch is not configured with the dynamic routing protocol and both the physical status and the link layer protocol status of the interface is UP, but the IP packets cannot be forwarded normally.

Troubleshooting:

- Use the **display ip routing-table protocol static** command to view whether the corresponding static route is correctly configured.
- Use the **display ip routing-table** command to view whether the corresponding route is valid.

48 UDP HELPER CONFIGURATION

Overview of UDP Helper

The major function of UDP Helper is to relay-forward UDP broadcast packets, that is, it can convert UDP broadcast packets into unicast packets and send to the designated server, as a relay.

When UDP Helper starts, the switch can judge if to forward the UDP broadcast packets received at the port based on UDP port ID. If yes, the switch then modifies the IP address in the IP packet header and sends the packet to the designated destination server. Otherwise, it sends the packet to the upper layer module for further processing.

UDP Helper Configuration

UDP Helper configuration include:

- Enabling/disabling UDP Helper function
- Configuring UDP port with replay function
- Configuring the relay destination server for broadcast packets

Enabling/disabling UDP Helper Function

When UDP Helper function is enabled, you can configure the UDP ports where UDP function is required and the relay function is enabled at UDP ports 69, 53, 37, 137, 138 and 49. When the function is disabled. Relay function configured at all UDP ports, including the default six ports, shall be disabled.

Perform the following configuration in system view.

Table 348 UDP Helper function

Operation	Command
Enable UDP Helper function	udp-helper enable
Disable UDP Helper function	undo udp-helper enable

By default, UDP Helper function is disabled.

Configuring UDP Port with Replay Function

When UDP relay function is enabled, the system by default forwards the broadcast packets on the UDP ports listed in Table 349. You can configure up to 256 UDP ports with relay function.

Table 349 Default UDP ports list

Protocol	UDP port ID
Trivial File Transfer Protocol (TFTP)	69
Domain Name System (DNS)	53
Time service	37
NetBIOS Name Service (NetBIOS-NS)	137
NetBIOS Datagram Service (NetBIOS-DS)	138
Terminal Access Controller Access Control System (TACACS)	49

Perform the following configuration in system view.

Table 350 Configuring a UDP port with replay function

Operation	Command
Configure a UDP port with replay function	**udp-helper port** { *port* | **dns** | **netbios-ds** | **netbios-ns** | **tacacs** | **tftp** | **time** }
Remove the configuration	**undo udp-helper port** { *port* | **dns** | **netbios-ds** | **netbios-ns** | **tacacs** | **tftp** | **time** }

You must first enable UDP Helper function and then configure the UDP port with relay function. Otherwise, error information will appear.

*The parameters **dns** | **netbios-ds** | **netbios-ns** | **tacacs** | **tftp** | **time** respectively refer to the six default ports. You can configure the default UDP port in two ways: specifying port IDs and specifying the right parameters. For example, the **udp-helper port** 53 command is equivalent to the **udp-helper port dns** command in function.*

*The default UDP ports shall not be displayed when using the **display current-configuration** command. But its ID shall be displayed after its relay function is disabled.*

Configuring the Relay Destination Server for Broadcast Packet

You can configure up to 20 replay destination servers for a VLAN interface. If a VLAN interface is configured with relay destination servers and UDP Helper function is enabled at it, then the broadcast packets of a designated UDP port received at the VLAN interface will be unicasted to the destination server.

Perform the following configuration in VLAN interface view.

Table 351 Configuring the relay destination server for broadcast packet

Operation	Command
Configure relay destination server for broadcast packet	**udp-helper server** *ip-address*
Delete relay destination server for broadcast packet	**undo udp-helper server** [*ip-address*]

*The **undo udp-helper server** command without any parameter deletes all destination servers configured on the interface.*

*By **default**, no relay destination server for UDP broadcast packets is configured.*

Displaying and Debugging UDP Helper Configuration

After the above configuration, execute **display** command in any view to display the running of UDP Helper destination server, and to verify the effect of the configuration. Execute debugging command in user view to debug UDP Helper configuration.

Table 352 Displaying and debugging UDP Helper configuration

Operation	Command
Display the destination server corresponding to VLAN interface	**display udp-helper server** [**interface vlan-interface** *vlan-id]*
Enable UDP Helper debugging	**debugging udp-helper** { **event** | **packet** [**receive** | **send**] }
Disable UDP Helper debugging	**undo debugging udp-helper** { **event** | **packet** [**receive** | **send**] }

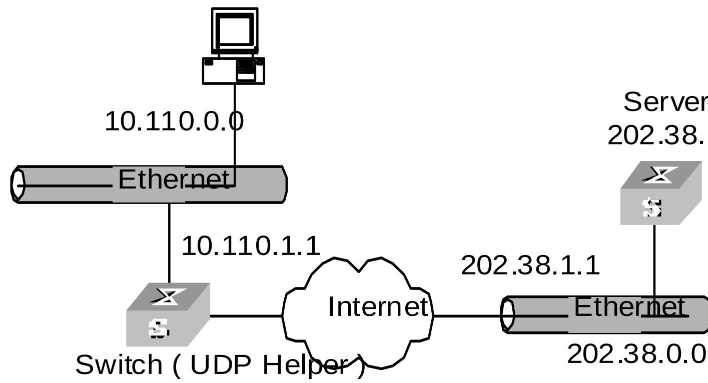
UDP Helper Configuration Example

Networking requirement

The IP address of VLAN interface 2 on the switch is 10.110.1.1, which is connected with network segment 10.110.0.0. Set to relay-forward the broadcast packets with destination IP of all 1s and destination UDP port 55 in the network segment 10.110.0.0 to the destination server 202.38.1.2.

Networking diagram

Figure 127 Networking for UDP Helper configuration



Configuration procedure

1 Enable UDP Helper function.

```
[4200G] udp-helper enable
```

2 Set to relay-forward the broadcast packets with destination UDP port 55.

```
[4200G] udp-helper port 55
```

3 Set the IP address of the destination server corresponding to VLAN interface 2 as 202.38.1.2.

```
[4200G] interface vlan 2
[4200G-Vlan-interface2] udp-helper server 202.38.1.2
```