AN6000 Series

Optical Line Terminal Equipment

CLI Configuration Guide

Version: B

Code: MN000004293

FiberHome Telecommunication Technologies Co., Ltd.

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Contents

1 Documentation Guide

Document Orientation

CLI Configuration Guide introduces how to start and configure services for the AN6000 Series in CLI mode.

In this manual, configuration examples are given for the AN6000-17 only. Other AN6000 Series equipment has different slot distribution, and hence should be configured according to actual situations.

Intended Readers

- Commissioning engineers
- Operation and maintenance engineers

Version Information

Version	Description
A	Initial version.
B	Adds how to configure DHCPv6 Relay, VPN, IS-IS, BGP, OSPF, MPLS, and Agile-PON using command lines. Adds how to configure Ethernet P2P services using command lines.

Related Documentation

Document	Applied to
AN6000 Series Optical Line Terminal Equipment Product Description	Network planning
AN6000 Series Optical Line Terminal Equipment Hardware Description	Network planning
AN6000-2 Optical Line Terminal Equipment Product Description	Network planning
AN6000-2 Optical Line Terminal Equipment Hardware Description	Network planning
AN6000-2 Optical Line Terminal Equipment Quick Installation Guide	Network deployment / network maintenance

Document	Applied to
AN6000-7 Optical Line Terminal Equipment Quick Installation Guide	Network deployment / network maintenance
AN6000-15 Optical Line Terminal Equipment Quick Installation Guide	Network deployment / network maintenance
AN6000-17 Optical Line Terminal Equipment Quick Installation Guide	Network deployment / network maintenance
AN6000 Series Optical Line Terminal Equipment UNM2000 Configuration Guide	Network deployment / network maintenance
AN6000 Series Optical Line Terminal Equipment CLI Reference	Network deployment / network maintenance
AN6000-17 Optical Line Terminal Equipment Alarm and Event Reference	Network deployment / network maintenance

2 Logging into the Device

This chapter introduces how to log into the AN6000 Series.

☑ Login Through SecureCRT

☑ Login Through Telnet

2.1 Login Through SecureCRT

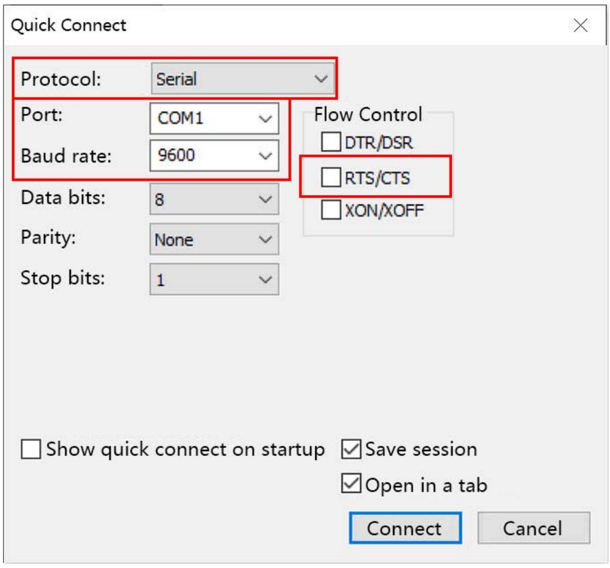
This section introduces how to log into the CLI system for the AN6000 Series through the SecureCRT tool on a PC.

Prerequisites

- The SecureCRT tool is installed on the PC.
- If the out-of-band and in-band management IP addresses of the device need to be configured, connect the PC to the **CONSOLE** port on the device using a serial port line.

Procedure

1. Double-click the icon of SecureCRT and select **File**→**Quick Connect** from the main menu. The **Quick Connect** dialog box appears.
2. Create a connection according to how the PC is connected to the device.
   - If the PC connects to the device through a serial port, do as follows:
     a) In the **Quick Connect** dialog box, set **Protocol** to **Serial** and configure the following parameters.
        - **Port**: Select a port on the PC to which the serial port line will be connected. Here the **COM1** port is used as an example.
        - **Baud rate**: 9600
        - **Flow Control**: Deselect the **RTS/CTS** checkbox.
        - Retain the default values for other parameters.



Protocol: Serial

Port: COM1

Baud rate: 9600

Data bits: 8

Parity: None

Stop bits: 1

□ DTR/DSR

□ RTS/CTS

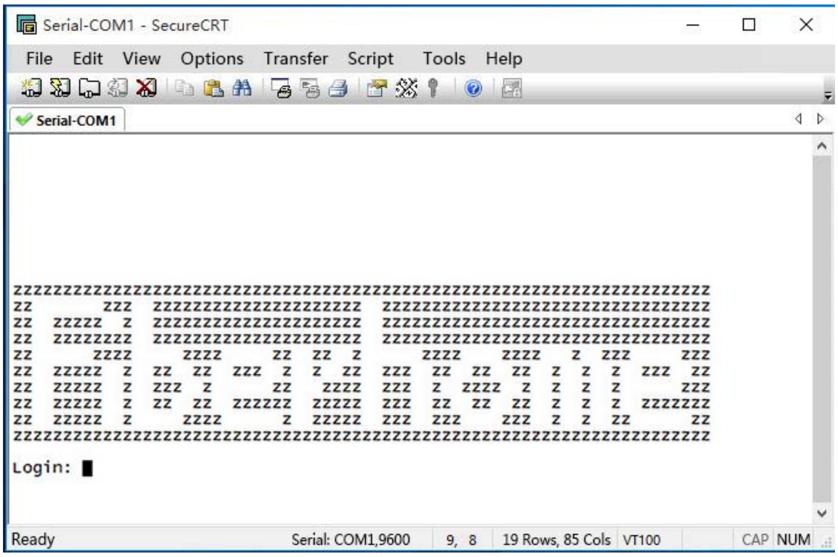
□ XON/XOFF

□ Show quick connect on startup

☑ Save session

☑ Open in a tab

b) Click the **Connect** button to access the login GUI of the CLI system.

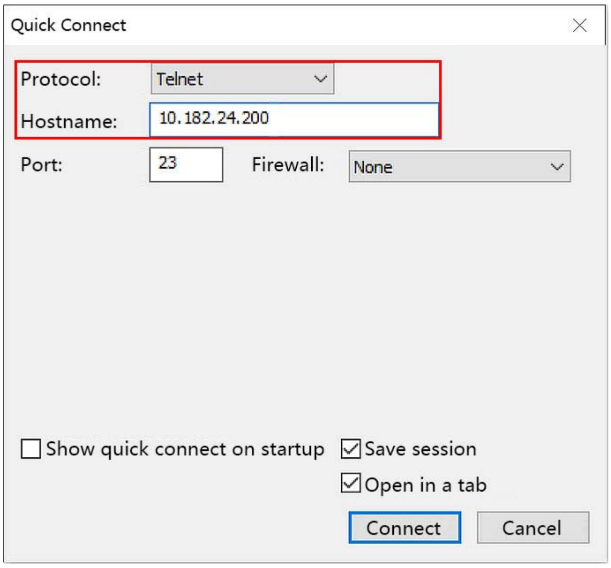


```
zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz       zzz  zzzzzzzzzzzzzzzzzzzzz  zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz  zzzzz  z  zzzzzzzzzzzzzzzzzzzzz  zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz  zzzzzzzz  zzzzzzzzzzzzzzzzzzzzz  zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz      zzzz     zzzz     zz  zz  z      zzzz    zzzz   z  zzz     zzz
zz  zzzzz  z  zz  zz  zzz  z  z  zz  zzz  zz  zz  zz  z  z  z  zzz  zz
zz  zzzzz  z  zzz  z      zz   zzzz  zzz  z  zzzz  z  z  z  z      zzz
zz  zzzzz  z  zz  zz  zzzzzz  zzzzz  zzz  zz  zz  zz  z  z  z  zzzzzzz
zz  zzzzz  z     zzzz      z  zzzzz  zzz  zzz    zzz  z  z zz       zz
zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz

Login: █
```

- If the PC connects to the device through Telnet, do as follows:

a) In the **Quick Connect** dialog box, set **Protocol** to **Telnet** and configure the following parameters.

- **Host Name**: Set it to the IP address of the NE to be connected.
- Retain the default values for other parameters.



Quick Connect

Protocol: Telnet

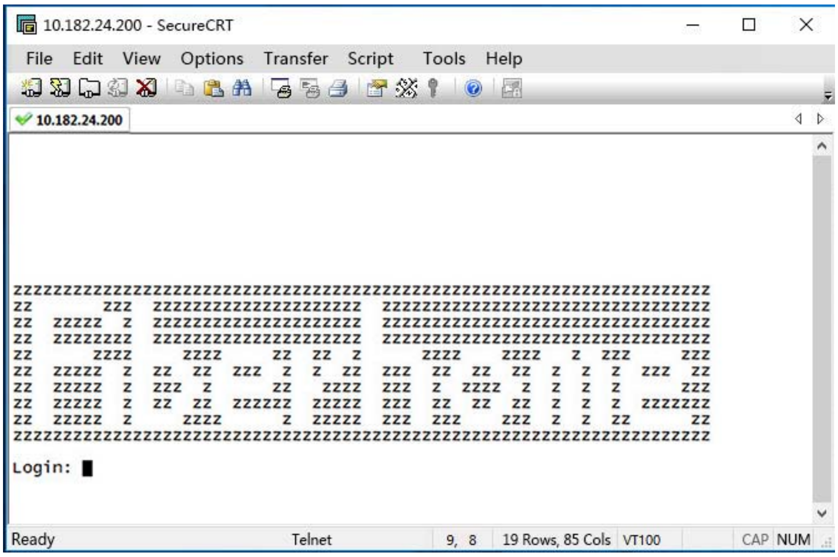
Hostname: 10.182.24.200

Port: 23 Firewall: None

□ Show quick connect on startup ☑ Save session

☑ Open in a tab

b) Click the **Connect** button to access the login GUI of the CLI system.



10.182.24.200 - SecureCRT
File Edit View Options Transfer Script Tools Help
10.182.24.200

```
zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz       zzz  zzzzzzzzzzzzzzzzzzzzz  zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz  zzzzz  z  zzzzzzzzzzzzzzzzzzzzz  zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz  zzzzzzzz  zzzzzzzzzzzzzzzzzzzzz  zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz
zz      zzzz     zzzz     zz  zz  z      zzzz    zzzz   z  zzz     zzz
zz  zzzzz  z  zz  zz  zzz  z  z  zz  zzz  zz  zz  zz  z  z  z  zzz  zz
zz  zzzzz  z  zzz  z      zz   zzzz  zzz  z  zzzz  z  z  z  z      zzz
zz  zzzzz  z  zz  zz  zzzzzz  zzzzz  zzz  zz  zz  zz  z  z  z  zzzzzzz
zz  zzzzz  z     zzzz      z  zzzzz  zzz  zzz    zzz  z  z  zz      zz
zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz

Login: █
```

Ready Telnet 9, 8 19 Rows, 85 Cols VT100 CAP NUM

3. Press <Enter> and enter the username and password to log into the CLI system.

```
Login:GEPON
Password:*****
// The initial password is "GEPON".
User>enable
// In the read-only mode, run the "enable" command to enter the management mode.
Password:*****
// The initial password is "GEPON".
Admin#
// After the prompt "Admin#" appears, you can type command lines to operate the AN6000 Series.
```

Note:

◆ If the command prompt is **User**, you log into the system as a common user. If the command prompt is **Admin#**, you log into the system as an administrator.

◆ The user name is case insensitive, while the password is case sensitive.

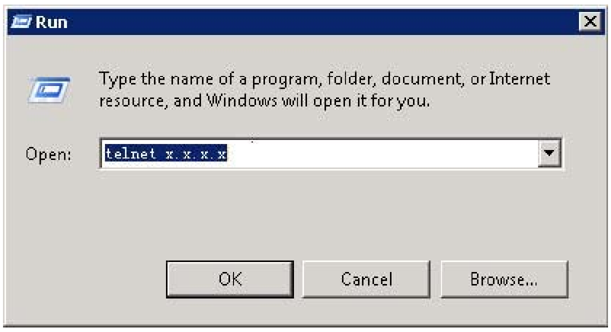
Caution:

Users should memorize their passwords and keep them secret. Regularly changing passwords is recommended.

2.2 Login Through Telnet

To log into the device through SecureCRT, you need to configure the out-of-band and in-band management IP addresses for the device. After the aforesaid configuration, you can log into the device though Telnet. The procedures are as follows:

1. Click the **Start** button on the desktop, and select **Run** to bring up the **Run** dialog box.
2. Enter **telnet x.x.x.x** in the **Run** dialog box.



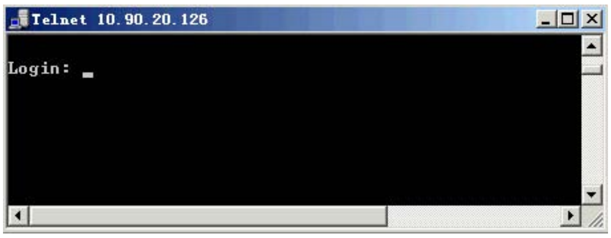
Run
Type the name of a program, folder, document, or Internet resource, and Windows will open it for you.
Open:
OK
Cancel
Browse...

```
telnet x.x.x.x
```

Note:

The value **x.x.x.x** is the out-of-band management IP address of the device, that is, the out-of-band management IP address configured under the Admin(config-if-meth-1) directory, or the in-band management IP address of the device, that is, the management VLAN IP address configured under the Admin(config) directory.

3. Click **OK** to bring up the **Telnet x.x.x.x** window.



```
Login: _
```

4. Enter the username and password to log into the CLI network management system.

`Login:`**GEPON**

// The default user is administrator, and the user name is "GEPON".

`Password:`*****

// The initial password is always "GEPON".

`User>`**enable**

// In the read-only mode, users can enter the management mode via the command "enable".

`Password:`*****

// The initial password of the administrator account is "GEPON".

`Admin#`

// After the prompt "Admin # " appears, users can type command lines to operate the AN6000 Series.

Note:

- If the command prompt is **User**, you log into the system as a common user. If the command prompt is **Admin#**, you log into the system as as administrator.
- The user name is case insensitive, while the password is case sensitive.

Caution:

Users should memorize their passwords and keep them secret. Regularly changing passwords is recommended.

3 Overview of Command Lines

This chapter introduces command modes, the command syntax and some interaction characteristics of the AN6000 Series.

☑ Command View

☑ Command Syntax

☑ Interaction Feature

3.1 Command View

Command View (Directory)	Directory Name	Prompt Example	Entry Example
Common user view	user	user>	Common user login
Slice user view	vs**vs_id**	vs1>	Slice 1 user login
Privileged user view	admin	Admin#	user>enable
			Admin-vs1#switch vs 0 (The system will check whether the current user is an administrator. Not available for slice users.)
Privileged slice user view	admin-vs**vs_id**	Admin-vs1#	vs1>enable
			Admin#switch vs 1
Global configuration view	config	Admin(config)#	Admin#config
		Admin-vs1(config)#	Admin-vs1#config
AAA view	config-aaa	Admin(config-aaa)#	Admin(config)#aaa
BGP view	config-bgp-**as_number**	Admin(config-bgp-100)#	Admin(config)#router bgp 100
DHCP view	config-dhcp	Admin(config-dhcp)#	Admin(config)#dhcp
IGMP view	config-igmp	Admin(config-igmp)#	Admin(config)#igmp
IS-IS view	config-isis-**isis_tag**	Admin(config-isis-10)#	Admin(config)#router isis 10
LDP view	config-router	Admin(config-router)#	Admin(config)#router ldp
OSPFv2 view	config-ospf	Admin(config-ospf)#	Admin(config)#ospf
	config-ospf-**ospf_id**	Admin(config-ospf-1)#	Admin(config)#router ospf 1
OSPFv3 view	config-ospfv3-**ospfv3_tag**	Admin(config-ospfv3-1)#	Admin(config)#router ipv6 ospf 1
RSVP view	config-rsvp	Admin(config-rsvp)#	Admin(config)#router rsvp
VPLS view	config-vpls-**vpls_name**	Admin(config-vpls-abc)#	Admin(config)#mpls vpls abc 1
Multicast VLAN and multicast configuration view	config-mvlan**vlan_id**	Admin(config-mvlan100)#	Admin(config)#multicast-vlan 100
VLANIF view	config-vlanif-**vlan_id**	Admin(config-vlanif-200)#	Admin(config)#interface vlanif 200
PON view (subrack/slot/port)	config-if-pon-**frame/slot/pon**	Admin(config-if-pon-1/1/2)#	Admin(config)#interface pon 1/1/2

Command View (Directory)	Directory Name	Prompt Example	Entry Example
Ethernet view (subrack/slot/port)	config-if-eth-**frame/slot/eth**	`Admin(config-if-eth-1/18/1)#`	`Admin(config)#interface eth 1/18/1`
Fan view (subrack/slot)	config-if-fan-**frame/slot**	`Admin(config-if-fan-1/23)#`	`Admin(config)#interface fan 1/23`
Maintenance network port view	config-if-meth-**port**	`Admin(config-if-meth-1)#`	`Admin(config)#interface meth 1` (Port 1 is dedicated for the out-of-band management network port)
Network slice view	config-vs-**vs_id**	`Admin(config-vs-1)#`	`Admin(config)#vs 1`
Debugging diagnosis view	diagnose	`Admin(diagnose)#`	`Admin#diagnose`

3.2 Command Syntax

Command Format

The command format is command name(s) + command parameter(s).

A complete command consists of command name(s) and command parameter(s). A valid command may contain one or more command names and their parameters. A parameter may have a name as well as a value. For a parameter with a name, enter the name first and then the value. For a parameter without a name, enter the value only.

Format	Meaning
< >	The content in **< >** is the parameter value.
<a/b/...>	All the parameters in **< >** should be configured.
[ ]	The parameter in **[ ]** is mandatory.
[a|b|...]	One of the mandatory parameters in **[ ]** should be selected.
{ }	The parameter in **{ }** is optional.
{ }* （ 1 ~ n ）	The optional parameter in **{ }** can be configured for one to n times.

3.3 Interaction Feature

Intelligent Match

Intelligent match allows you to type only the first one or several letters of a command keyword plus the Tab key. If a unique keyword starting with the letters entered is found, the CLI network management system will replace the letters you have entered with the complete keyword and display it in the next line, with a space between the cursor and the keyword. This helps simplify the work for typing long keywords. For example, to use the **enable** command, you only need to type **en** or **ena**.

Edition Function

Key	**Function**
Common key	If the edition buffer area is not filled, pressing the key will insert the key content to the current cursor position, and the cursor will moves rightward accordingly.
Backspace	Presses this key to delete the character before the cursor and move the cursor backwards. When reaching the beginning of the command, the cursor stops.
Tab	Typeaheads the keyword of the command.
Left arrow key ← or Ctrl + B	Moves the cursor to the left of one character.
Right arrow key → or Ctrl + F	Moves the cursor to the right of one character.
Up/Down arrow key ↑ / ↓	Displays historical commands. For some display terminals that do not support the upward / downward arrow key, you can press Ctrl + P to select the previous historical command or press Ctrl + O to select the next historical command.
Ctrl + U	Deletes the characters before the current cursor and moves the cursor to the beginning of the line.
Ctrl + K	Deletes the characters that follow the current cursor and moves the cursor to the end of the line.
Ctrl + D	Deletes a character after the cursor.
Ctrl + A	Moves the cursor to the beginning of the line.
Ctrl + W	Deletes a word before the cursor.
Ctrl + C	Stops executing the current command.
Q	Goes back to the upper layer directory.
Any keys except Q	Displays the command output.
?	Displays the help information.

4 Configuring Management Information

This chapter introduces how to configure management information for the AN6000 Series.

☑ Configuring the IP Address for In-Band Management

☑ Configuring the IP Address for Out-of-Band Management

☑ Configuring a Static Route

☑ Configuring the SNMP Trap Receiver Address

☑ Configuring the SNMP Time System

☑ Synchronizing Time

☑ Saving Current Configuration to the Flash

4.1 Configuring the IP Address for In-Band Management

Command Format

Configure the management VLAN.

```
manage-vlan <name> svlan <svlan> {cvlan <cvlan>}*1
```

Configure the management IP address.

```
manage-vlan ipv4 <name> <A.B.C.D/M>
```

Add the management VLAN to the uplink port.

```
port vlan <vlanid> {to <end-vlanid>}*1 [tag|untag] <frameid/slotid> <port-list>
```

View the management VLAN.

```
show manage-vlan [<1-4085>|all]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the management VLAN	manage-vlan <name>	The name of the management VLAN	Mandatory	test
	svlan <svlan>	The outer management VLAN, ranging from 1 to 4085	Mandatory	1001
	{cvlan <cvlan>}*1	The inner management VLAN, ranging from 1 to 4085	Optional	2001
Configuring the management IP address	ipv4 <name>	The management IP address name	Mandatory	test
	<A.B.C.D/M>	The management IP address and the number of mask digits	Mandatory	10.90.40.123/24
Adding the management VLAN to the uplink port	vlan <vlanid>	The starting VLAN ID, ranging from 1 to 4085	Mandatory	1001
	{to <end-vlanid>}*1	The ending VLAN ID, ranging from 1 to 4085	Optional	-
	[tag|untag]	The mode of adding VLAN ◆ tag: retaining the tags ◆ untag: stripping the tags	Mandatory	tag

Procedure	Parameter	Description	Attribute	Example
	`<frameid/slotid>`	The subrack No. / slot No.	Mandatory	1/19
	`<port-list>`	Port number	Mandatory	3
Viewing the management VLAN	`manage-vlan [<1-4085>|all]`	The management VLAN ID, with **all** indicating all the management VLANs	Mandatory	all

Example

1. Configure the management VLAN.

```
Admin(config)#manage-vlan test svlan 1001 cvlan 2001
```

2. Configure the management IP address.

```
Admin(config)#manage-vlan ipv4 test 10.90.40.123/24
```

3. Add the management VLAN to the uplink port.

```
Admin(config)#port vlan 1001 tag 1/19 3
```

4. View the management VLAN.

```
Admin(config)#show manage-vlan all
---------------------------------
Manage name      : test
---------------------------------
Svlan            : 1001
Cvlan            : 2001
Port             : 19:3[T]
Device           : sub
Unit             : 1001
Ethernet address: 34:bf:90:56:bc:e7
Total protocols : 0
Inet             : 10.90.40.123
mask             : 255.255.255.0
RX packets       : 0
TX packets       : 6
RX bytes         : 0
TX bytes         : 506
MTU              : 1492
Admin(config)#
```

4.2 Configuring the IP Address for Out-of-Band Management

Command Format

Configure the IP address for out-of-band management.

```
ip address <A.B.C.D> mask <A.B.C.D>
```

View the IP address for out-of-band management.

```
show ip address
```

Planning Data

Parameter	Description	Attribute	Example
`ip address <A.B.C.D>`	The IP address for out-of-band management	Mandatory	10.182.24.120
`mask <A.B.C.D>`	Mask	Mandatory	255.255.248.0

Example

1. Set the IP address for out-of-band management to 10.182.24.120 and the mask to 255.255.248.0.

```
Admin(config-if-meth-1)#ip address 10.182.24.120 mask 255.255.248.0
```

2. View the IP address for out-of-band management.

```
Admin(config-if-meth-1)#show ip address
debugip 10.182.24.120 mask 255.255.248.0
Admin(config-if-meth-1)#
```

4.3 Configuring a Static Route

Command Format

```
static-route destination-ip <ipaddr> mask [<mask>|<mask-length>] nexthop
<ipaddr> {metric <metric>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`destination-ip <ipaddr>`	Destination IP address, used to identify the destination IP address or destination network of the IP packets	Mandatory	3.3.3.0
`mask [<mask>|<mask-length>]`	◆ <mask>: subnet mask ◆ <mask-length>: subnet mask length	Mandatory	255.255.255.0
`nexthop <ipaddr>`	Next-hop IP address of the designated route	Mandatory	1.1.1.10
`{metric <metric>}*1`	Priority of the route. The system selects the route with the highest priority (the smallest value) to forward IP packets. Value range: 0 to 255.	Optional	-

Configuration Example

Configure a static route. Set its destination IP address to 3.3.3.0, mask to 255.255.255.0, and next-hop IP address of the designated route to 1.1.1.10.

```
Admin(config)#static-route destination-ip 3.3.3.0 mask 255.255.255.0 nexthop 1.1.1.10
Admin(config)#
```

4.4 Configuring the SNMP Trap Receiver Address

Command Format

Configure the SNMP Trap receiver address.

```
snmp-agent trap-reciever add ip <ip-address> {security-name <securityname>}
*1 {[v1|v2c|v3]}*1
```

View the SNMP Trap receiver address.

```
show snmp-agent trap-receiver
```

Data Planning

Parameter	Description	Attribute	Example
`ip <ip-address>`	The IP address of the SNMP Trap receiver.	Mandatory	10.32.154.11
`{security-name <securityname>}*1`	The security name.	Optional	public
`{[v1|v2c|v3]}*1`	The SNMP version, including v1, v2c, and v3.	Optional	v2c

Example

1. Set the IP address of the SNMP Trap receiver to **10.32.154.11**, the security name to **public**, and the SNMP version to **v2c**.

```
Admin(config)#snmp-agent trap-receiver add ip 10.32.154.11 security-name public v2c
```

2. View the SNMP Trap receiver address.

```
Admin(config)#show snmp-agent trap-receiver
IPAddress        Port  Version SecurityName   SecurityLevel  SourceIP
10.190.40.140    162   v2c     public
10.32.103.18     162   v2c     public
10.32.154.11     162   v2c     public
Total 3 trap-receiver in system.
Admin(config)#
```

4.5 Configuring the SNMP Time System

Command Format

Configure the SNMP time management.

```
snmp-time interval <0-86400> servip [ipv4|ipv6|ipv4z|ipv6z|dns] <servip>
```

View the configuration of the SNMP time management.

```
show snmp-time
```

Planning Data

Parameter	Description	Attribute	Example
`interval <0-86400>`	The automatic time calibration interval (unit: s), ranging from 0 to 86 400. The default value is 600s.	Mandatory	3260
`servip [ipv4|ipv6|ipv4z|ipv6z|dns]`	The IP address type for time calibration	Mandatory	ipv4
`<servip>`	The IP address of the calibration server	Mandatory	10.32.135.102

Example

1. Configure the SNMP time management.

```
Admin(config)#snmp-time interval 3260 servip ipv4 10.32.135.102
Set ok!
Admin(config)#
```

2. View the configuration of the SNMP time management.

```
Admin(config)#show snmp-time
SNMP TIME CONFIG INTERVAL=3260 Server IP : 10.32.135.102
Admin(config)#
```

4.6 Synchronizing Time

Command Format

```
time <2012-2100> <1-12> <1-31> <HH:MM:SS>
show time
```

Planning Data

Parameter	Description	Attribute	Example
`<2012-2100>`	Year	Mandatory	2018
`<1-12>`	Month	Mandatory	08
`<1-31>`	Day	Mandatory	17
`<HH:MM:SS>`	Hour, minute and second	Mandatory	04:12:30

Example

1. Calibrate the time.

```
Admin(config)#time 2018 08 17 04:12:30
```

2. View the time.

```
Admin(config)#show time
Current Date is 2018-08-17
Current Time is 04:12:31
System running time is 0 day 04:11:53
Admin(config)#
```

4.7 Saving Current Configuration to the Flash

Command Format

```
save
```

Example

Save current configuration to the Flash.

```
Admin(config)#save
Trying save configuration to flash, please wait ......
Admin(config)#
```

5 Authorizing Cards and ONUs

This chapter introduces how to authorize a card and how to authenticate and authorize an ONU.

☑ Authorizing a Card

☑ Authenticating and Authorizing an ONU

☑ Modifying the Authentication Mode and Re-authorizing an ONU

☑ Deauthorizing an ONU

5.1 Authorizing a Card

Command Format

Automatically authorize all the cards detected in the hardware test.

```
card auto-auth
```

Authorize a specified card.

```
card auth <frameid/slotid> <cardtype>
```

Deauthorize a card.

```
card unauth <frameid/slotid>
```

View the card authorization information.

```
show card info
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid>`	The subrack No. / slot No.	Mandatory	1/1
`<cardtype>`	Card name	Mandatory	EX8A

Example

1. Authorize all the cards automatically.

```
Admin(config)#card auto-auth
Success to set all detected card authed.
Admin(config)#
```

2. Authorize the EX8A card in Slot 1 of Subrack 1.

```
Admin(config)#card auth 1/1 EX8A
Success to set 1 slot as type EX8A.
Admin(config)#
```

3. Deauthorize the card in Slot 1 of Subrack 1.

```
Admin(config)#card unauth 1/1
Unauthorize card will delete all config on this slot.
Are you sure to unauthorize slot 1/1 ? [Y/N].
y
Success to unauthorize the slot 1/1!
```

```
Admin(config)#
```

4. View the card authorization information.

```
Admin(config)#show card info
---------------------AN6000-17---------------------
CARD   EXIST   CONFIG   DETECT    DETAIL
  1     ---     EX8A      ---    NO_MATCH
  2     YES     GM8A     GM8A       MATCH
  3     ---      ---      ---         ---
  4     ---     GM8A      ---    NO_MATCH
  5     ---      ---      ---         ---
  6     YES     EX8A     EX8A       MATCH
  7     ---      ---      ---         ---
  8     ---      ---      ---         ---
  9     YES     HSCA     HSCA     MATCH/M
 10     ---     HSCA      ---         ---
 11     ---      ---      ---         ---
 12     ---      ---      ---         ---
 13     YES     GPOA     GPOA       MATCH
 14     ---      ---      ---         ---
 15     YES     GM8A     GM8A       MATCH
 16     ---      ---      ---         ---
 17     YES     GPOA     GPOA       MATCH
 18     YES     HU8A     HU8A       MATCH
 19     YES     HU8A     HU8A       MATCH
 23     YES      FAN      FAN       MATCH
 24     YES     PIBA     PIBA       MATCH
 25     ---      ---      ---         ---
 26     ---      ---      ---         ---
Current temperature is 66 C.
 Power 1 is ON.
 FAN 1 speed is 1.
 Subframe type is 17.
Admin(config)#
```

5.2 Authenticating and Authorizing an ONU

This section introduces how to authenticate and authorize an ONU.

5.2.1 Configuring the PON Port Authentication Mode

Command Format

```
port authentication-mode <frameid/slotid/portid> mode [phyid|phy-id+psw|
password|log-id|log-id+psw|no-auth|phy-id/psw|phy-id/log-id/psw|phy-id/
log-id+psw/psw]
```

Planning Data

Parameter	Description	Attribute	Example	
`<frameid/slotid/portid>`	Subrack No. / slot No. / PON port No.	Mandatory	1/1/1	1/1/2
`mode [phyid|phy-id+psw|password|log-id|log-id+psw|no-auth|phy-id/psw|phy-id/log-id/psw|phy-id/log-id+psw/psw]`	Authentication mode ◆ phyid: physical identifier authentication ◆ phy-id+psw: physical identifier plus password authentication ◆ password: password authentication ◆ log-id: logical identifier authentication (without password) ◆ log-id+psw: logical identifier plus password authentication ◆ no-auth: no authentication ◆ phy-id/psw: physical identifier / password hybrid authentication ◆ phy-id/log-id/psw: physical identifier / logical identifier (without password) / password hybrid authentication ◆ phy-id/log-id+psw/psw: physical identifier / logical identifier (with password) / password hybrid authentication	Mandatory	phyid	no-auth

Example

1. Set physical identifier authentication for PON Port 1 of the PON interface card in Slot 1 of Subrack 1.

```
Admin(config)#port authentication-mode 1/1/1 mode phyid
Command executes success.
Admin(config)#
```

2. Set no authentication for PON Port 2 of the PON interface card in Slot 1 of Subrack 1.

```
Admin(config)#port authentication-mode 1/1/2 mode no-auth
Command executes success.
Admin(config)#
```

5.2.2 Configuring a White List

Command Format

Configure a white list.

```
whitelist add [phy-id|logic-id|password] <sn> {[checkcode] <checkcode>}*1
{[type] <onutype>}*1 {[slot] <slotno> [pon] <ponno> [onuid] <onuid>}*1
```

View the white list.

```
show whitelist [phy-id|logic-id|password] {<frameid/slotid/portid>}*1
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring a white list	[phy-id|logic-id|password]	White list type ◆ phy-id: physical identifier authentication ◆ logic-id: logical identifier authentication ◆ password: password authentication	Mandatory	phy-id
	<sn>	◆ phy-id: physical identifier ◆ logic-id: logical identifier: ONU identifier ◆ password: physical password	Mandatory	8888888-88888
	{[checkcode] <checkcode>}*1	◆ phy-id: physical password ◆ logic-id: logical identifier; logical password	Optional	-
	{[type] <onutype>}*1	ONU type	Optional	5006-04
	{[slot] <slotno> [pon] <ponno> [onuid] <onuid>}*1	Slot No., PON port No., and ONU authorization No.	Optional	1, 1, 1

Procedure	Parameter	Description	Attribute	Example
Viewing the white list	`[phy-id|logic-id|password]`	White list type ◆ phy-id: physical identifier authentication ◆ logic-id: logical identifier authentication ◆ password: password authentication	Mandatory	phy-id
	`{<frameid/slotid/portid>}*1`	Subrack No. / slot No. / PON port No.	Optional	1/1/1

Example

1. Configure the white list for ONU No. 1 connected to PON Port 1 in Slot 1, setting the physical identifier of the ONU to 888888888888, keeping the physical password empty, and setting the ONU type to 5006-04.

```
Admin(config)#whitelist add phy-id 888888888888 type 5006-04 slot 1 pon 1 onuid 1
Admin(config)#
```

2. View the physical white list for PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config)#show whitelist phy-id 1/1/1
----- Physical Address Whitelist -----
Slot  Pon   Onu   Onu-Type       Phy-ID       Phy-Pwd    Used
----- ----- ----- -------------- ------------ ---------- ----
1     1     1     5006-04        888888888888            Y
--------------------------
slot 1  pon 1 item 1
Admin(config)#
```

5.3 Modifying the Authentication Mode and Re-authorizing an ONU

This section introduces how to modify the authentication mode and re-authorize an ONU.

5.3.1 Switching the PON Port Authentication Mode

Command Format

```
port authentication-mode <frameid/slotid/portid> mode [phyid|phy-id+psw|
password|log-id|log-id+psw|no-auth|phy-id/psw|phy-id/log-id/psw|phy-id/
log-id+psw/psw]
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/portid>`	Subrack No. / slot No. / PON port No.	Mandatory	1/1/1
`mode [phyid|phy-id+psw|password|log-id|log-id+psw|no-auth|phy-id/psw|phy-id/log-id/psw|phy-id/log-id+psw/psw]`	Authentication mode ◆ phyid: physical identifier authentication ◆ phy-id+psw: physical identifier plus password authentication ◆ password: password authentication ◆ log-id: logical identifier authentication (without password) ◆ log-id+psw: logical identifier plus password authentication ◆ no-auth: no authentication ◆ phy-id/psw: physical identifier / password hybrid authentication ◆ phy-id/log-id/psw: physical identifier / logical identifier (without password) / password hybrid authentication ◆ phy-id/log-id+psw/psw: physical identifier / logical identifier (with password) / password hybrid authentication	Mandatory	phy-id/log-id+psw/psw

Example

Switch PON Port 1 of the PON interface card in Slot 1 of Subrack 1 from the physical authentication mode to the physical identifier / logical identifier (with password) / password hybrid authentication mode.

```
Admin(config)#port authentication-mode 1/1/1 mode phy-id/log-id+psw/psw
Command executes success.
Admin(config)#
```

5.3.2 Re-configuring the White List

Command Format

Configure the white list.

```
whitelist add [phy-id|logic-id|password] <sn> {[checkcode] <checkcode>}*1
{[type] <onutype>}*1 {[slot] <slotno> [pon] <ponno> [onuid] <onuid>}*1
```

View the white list.

```
show whitelist [phy-id|logic-id|password] {<frameid/slotid/portid>}*1
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the white list	[phy-id|logic-id|password]	White list type ◆ phy-id: physical identifier authentication ◆ logic-id: logical identifier authentication ◆ password: password authentication	Mandatory	logic-id
	<sn>	◆ phy-id: physical identifier ◆ logic-id: logical identifier: ONU identifier ◆ password: physical password	Mandatory	88888888-88
	[checkcode] <checkcode>	◆ phy-id: physical password ◆ logic-id: logical identifier; logical password	Optional	666666
	[type] <onutype>	ONU type	Optional	5006-04
	[slot] <slotno> [pon] <ponno> [onuid] <onuid>	Slot No., PON port No., and ONU authorization No.	Optional	1, 1, 1
Viewing the white list	[phy-id|logic-id|password]	White list type ◆ phy-id: physical identifier authentication ◆ logic-id: logical identifier authentication ◆ password: password authentication	Mandatory	logic-id
	{<frameid/slotid/portid>}*1	Subrack No. / slot No. / PON port No.	Optional	1/1/1

Example

1. Configure the white list for ONU No. 1 connected to PON Port 1 in Slot 1, setting the logical identify of the ONU to 888888888888, the logical password to 666666, and the ONU type to 5006-04.

```
Admin(config)#whitelist add logic-id 8888888888 checkcode 666666 type 5006-04 slot 1
pon 1 onuid 1
Admin(config)#
```

2. View the logical white list for PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config)#show whitelist logic-id 1/1/1
----- Logic SN Whitelist-----
Slot  Pon   Onu   Onu-Type       Logic-Id        Logic-Pwd    En Used
----- ----- ----- -------------- --------------- ------------ -- ----
1     1     1     5006-04        8888888888      666666       Y  Y
--------------------------
slot 1  pon 1 item 1
Admin(config)#
```

5.4 Deauthorizing an ONU

◆ When the no-authentication mode is configured for a PON port, deauthorize the ONU connected to the PON port using the command described in **Deauthorizing an ONU in the No-authentication Mode**.

◆ In other authentication modes, deauthorize the ONU using the command described in **Deleting the White List**.

5.4.1 Deauthorizing an ONU in the No-authentication Mode

Command Format

```
no authorize <frameid/slotid/portid> <onulist>
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/portid>`	Subrack No. / slot No. / PON port No.	Mandatory	1/1/1
`<onulist>`	ONU authorization No.	Mandatory	1

Example

De-authorize ONU 1 under PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config)#no authorize 1/1/1 1
Command executes success.
Admin(config)#
```

5.4.2 Deleting an ONU from the Physical Identifier White List

Command Format

```
no whitelist [phy-id|logic-id|password] <slotno> <ponno> <sn> {<checkcode>}
*1
```

Planning Data

Parameter	Description	Attribute	Example
[phy-id|logic-id|password]	White list type ◆ phy-id: physical identifier authentication ◆ logic-id: logical identifier authentication ◆ password: password authentication	Mandatory	phy-id
<slotno>	Slot No.	Mandatory	1
<ponno>	PON port No.	Mandatory	1
<sn>	◆ phy-id: physical identifier ◆ logic-id: logical identifier: ONU identifier ◆ password: physical password	Mandatory	888888888888
{<checkcode>}*1	◆ phy-id: physical password ◆ logic-id: logical identifier; logical password	Optional	-

Example

Delete the physical white list for PON Port 1 in Slot 1 with the physical identifier 888888888888.

```
Admin(config)#no whitelist phy-id 1 1 888888888888
Admin(config)#
```

6 Configuring OLT Slices

This chapter introduces how to configure OLT slices for the AN6000 Series.

☑ Background Information

☑ Configuration Rules

☑ Uplink Port Shared Mode for OLT Slices

☑ Creating OLT Slices

☑ Configuring Slice Resources

☑ Operations on Slice Objects

☑ Slice User Management

6.1 Background Information

A physical OLT is divided into multiple logical slices, or virtual systems (VSs) via the virtualization technology. Each VS can serve as an independent OLT logically and can be separately deployed with services and managed. A physical OLT can be divided into eight VSs at most, including the management VS and the service VSs. The physical OLT itself serves as the management VS, and the other seven slices created serve as the service VSs.

- The management VS manages all physical resources, and creates and manages service VSs.
- A service VS can manage its own physical resources and can be deployed with services independently.

Advantages of OLT slicing application:

- A physical device is virtualized into several logical devices to enhance the device utilization and reduce the deployment cost.
- Unified service carrying and on-demand network partitioning. An entity access network is partitioned into multiple virtual access networks to carry different services respectively.
- Resource independence and service isolation. The forwarding and control resources are virtualized to enable independence and isolation, which ensures secure forwarding and highly reliable private line services.
- Role-based and domain-based independent operation. Virtual access networks are divided into different domains and managed by users in different roles with different privileges. They are independently planned, operated and managed, featuring easier network maintenance.

6.2 Configuration Rules

The following describes the rules for configuring OLT slices:

- At most seven virtual OLTs can be created for the AN6000 Series, in addition to the entity OLT. That is, there are altogether eight OLT slices.
- For each OLT slice, at least one service card (or service port) and one uplink card (or uplink port) should be selected.

- Slicing based on cards, PON ports, ONUs or combination of them is supported. The smallest granularity for slicing is ONU.
- When OLT slices are created, the ONUs involved will be migrated to the OLT slices, and the services concerned may be interrupted for a short period of time. Be cautious when creating OLT slices.

The following describes the rules for configuring the uplink port shared mode for OLT slices:

- You can configure the shared mode for each uplink port. Optional parameters include "not-share" (not shared), "svlan-id" (shared based on VLAN ID) and "vnid" (shared based on VXLAN ID). The parameters affect the logic for setting the uplink local VLAN and allocating the slice objects. After a parameter is set, the system should determine its validity.

Mode in Column One Switching to Mode in Row One	**not-share**	**svlan-id**	**vnid**
not-share	-	If no VLAN has been set, the shared mode can be switched; otherwise it cannot be switched.	If no VXLAN has been set, the shared mode can be switched; otherwise it cannot be switched.
svlan-id	Switching of the shared mode is allowed only when the uplink port is not shared by multiple slices. If the uplink port is shared by multiple slices, you need to delete the port from the slice and then perform the switching.	-	If no VXLAN has been set, the shared mode can be switched; otherwise it cannot be switched.
vnid	Switching of the shared mode is allowed only when the uplink port is not shared by multiple slices. If the uplink port is shared by multiple slices, you need to delete the port from the slice and then perform the switching.	If no VLAN has been set, the shared mode can be switched; otherwise it cannot be switched.	-

- An uplink port that is not shared can be allocated only to a certain slice during allocation of the OLT slice objects.

- An uplink port shared based VLAN ID can be allocated to multiple slices during allocation of the OLT slice objects. In the configuration for **Add vlan to port**, make sure that the VLAN IDs of multiple slices added to the port are not repeated.
- An uplink port shared based VXLAN ID can be allocated to multiple slices during allocation of the OLT slice objects. Since VXLAN is globally configured, a VNID maps one-to-one to a FID. When VXLAN tunnels are mapped, you need to check and make sure that objects in different slices are not mapped to the same VNI (the objects belonging to the same slice in different mapping rules can be mapped to the same VNI.)

6.3 Uplink Port Shared Mode for OLT Slices

Background Information

An uplink port shared among OLT slices means an uplink port belonging to various slices and forwarding sliced services according to specified VLAN IDs and VXLAN IDs. This helps settle the issue of insufficient uplink resources in actual project applications by saving the uplink resources.

Command Format

Configure the uplink port shared mode for OLT slices.

```
vs-sharing-mode [not-share|svlan-id|vnid]
```

View the uplink port shared mode for OLT slices (in the Ethernet mode).

```
show vs-sharing-mode
```

View the uplink port shared mode for OLT slices (in the global mode).

```
show vs-sharing-mode <frameid/slotid>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the uplink port shared mode for OLT slices	`vs-sharing-mode [not-share|svlan-id|vnid]`	Uplink port shared mode for OLT slices ◆ not-share: not shared ◆ svlan-id: shared based on SVLAN ID ◆ vnid: shared based on VXLAN ID	Mandatory	svlan-id
Viewing the uplink port shared mode for OLT slices	`<frameid/slotid>`	Subrack No. / slot No.	Mandatory	1/9

Example

1. Configure the shared mode of uplink port 1/9/2 to svlan-id for OLT slices.

```
Admin(config-if-eth-1/9/2)#vs-sharing-mode svlan-id
set 1/9/2 vs sharing mode svlan-id success.
Admin(config-if-eth-1/9/2)#
```

2. View the shared mode of uplink port 2 in slot 9 of subrack 1.

```
Admin(config-if-eth-1/9/2)#show vs-sharing-mode
vs-sharing-mode: SVLAN-ID
Admin(config-if-eth-1/9/2)#
```

3. View the shared modes of the uplink ports in slot 9 of subrack 1.

```
Admin(config)#show vs-sharing-mode 1/9
 1/9/1 vs-sharing-mode: NOT-SHARE
 1/9/2 vs-sharing-mode: SVLAN-ID
 1/9/3 vs-sharing-mode: NOT-SHARE
 1/9/4 vs-sharing-mode: NOT-SHARE
Admin(config)#
```

6.4 Creating OLT Slices

Command Format

Create an OLT slice and enter the slice directory.

```
vs <vs_id>
```

Note:

Enter the vs directory. If no slice exists, create one.

View the slice information.

```
show vs info [<vs-id>|all]
```

Delete an OLT slice.

```
no vs <vs-id>
```

Configure the alarm report mode of an OLT slice.

```
alarm-report-mode <0-1>
```

View the alarm report mode of an OLT slice.

```
show alarm-report-mode
```

Planning Data

Procedure	Parameter	Description	Attribute	Example	
Creating an OLT slice and entering the slice directory	`vs <vs_id>`	The OLT slice ID, ranging from 1 to 7	Mandatory	1	
Viewing the slice information	`[<vs-id>|all]`	The OLT slice ID, with "all" referring to all slices	Mandatory	1	all
Deleting an OLT slice	`vs <vs-id>`	The OLT slice ID, ranging from 1 to 7	Mandatory	1	
Configuring the alarm report mode of an OLT slice	`alarm-report-mode <0-1>`	The alarm report mode of an OLT slice ◆ 0: Alarms are reported to the entity OLT. ◆ 1: Alarms are not reported to the entity OLT.	Mandatory	1	

Example

1. Create OLT Slice 1 and enter the slice directory.

```
Admin(config)#vs 1
create vs 1 success!
```

```
Admin(config-vs-1)#
```

2. Create OLT Slice 2 and enter the slice directory.

```
Admin(config-vs-1)#vs 2
create vs 2 success!
Admin(config-vs-2)#
```

3. View the information about Slice 1.

```
Admin(config)#show vs info 1
-------------------------    Vs Information    ---------------------
id   cur/max(user) cur/max(ser-vlan)  cur/max(mac) cur/max(mc-group)
1    0/10          0/4000             --/32000     --/3000
Admin(config)#
```

4. View the information about all slices.

```
Admin(config)#show vs info all
-------------------------    Vs Information    ---------------------
id   cur/max(user) cur/max(ser-vlan)  cur/max(mac) cur/max(mc-group)
1    0/10          0/4000             --/32000     --/3000
Admin(config)#
```

5. Delete Slice 1.

```
Admin(config)#no vs 1
Del vs will lost all of vs info.
Are you sure to del vs 1 ? [Y/N].
y
Del volt 1 success!
Admin(config)#
```

6. Configure the alarm report mode of Slice 1 such that alarms are not reported to the entity OLT.

```
Admin(config-vs-1)#alarm-report-mode 1
Set vs 1 alarm report mode success!
Admin(config-vs-1)#
```

7. View the alarm report mode of Slice 1.

```
Admin(config-vs-1)#show alarm-report-mode
vs id[1] report mode : not report to vs 0
Admin(config-vs-1)#
```

6.5 Configuring Slice Resources

Command Format

Configure the slice resources.

```
resource [mac|mc-group|vlan|terminal-user] max-count <count>
```

View the slice resources.

```
show resource info
```

Planning Data

Parameter	Description	Attribute	Example			
`resource [mac|mc-group|vlan|terminal-user]`	◆ mac: learning the MAC address dynamically ◆ mc-group: multicast address ◆ vlan: service VLAN ◆ terminal-user: quantity of accounts	Mandatory	mac	mc-group	vlan	terminal-user
`max-count <count>`	Maximum quantity ◆ mac: The value ranges from 0 to 288 000. ◆ mc-group: The value ranges from 0 to 24 000. ◆ vlan: The value ranges from 0 to 4095. ◆ terminal-user: The value ranges from 0 to 10; the default value is 10.	Mandatory	2000	1000	3000	5

Example

1. Set the quantity of MAC addresses to be learned dynamically to 2000.

```
Admin(config-vs-1)#resource mac max-count 2000
Set vs 1 resource success!
Admin(config-vs-1)#
```

2. Set the quantity of multicast addresses to 1000.

```
Admin(config-vs-1)#resource mc-group max-count 1000
Set vs 1 resource success!
Admin(config-vs-1)#
```

3. Set the quantity of service VLANs to 3000.

```
Admin(config-vs-1)#resource vlan max-count 3000
Set vs 1 resource success!
Admin(config-vs-1)#
```

4. Set the quantity of accounts to 5.

```
Admin(config-vs-1)#resource terminal-user max-count 5
Set vs 1 resource success!
Admin(config-vs-1)#
```

5. View the slice resources.

```
Admin(config-vs-1)#show resource info
--------------------------    Vs Information    ------------------------
id   cur/max(user)  cur/max(ser-vlan)  cur/max(mac)   cur/max(mc-group)
1    0/5            0/3000             --/2000        --/1000
Admin(config-vs-1)#
```

6.6 Operations on Slice Objects

Command Format

Assign the slice object.

```
assign object [<frameid/slotid>|<frameid/slotid/portid>] {<list>}*1
```

Delete the slice object.

```
no assign object [<frameid/slotid>|<frameid/slotid/portid>] {<list>}*1
```

View the slice object (only available for authorized ONUs).

```
show object
```

View the list of ONUs assigned to the slice (When a slice has only one PON port, the ONU list will not be displayed.)

```
show onu-list
```

View the information about which slice an object is assigned to in the directory Admin(config)#.

```
show vs object [<frameid/slotid>|<frameid/slotid/portid>|<frameid/slotid/
portid/onuid>]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example		
Assigning the slice object	[<frameid/slotid>|<frameid/slotid/portid>]	◆ frameid/slotid: subrack No. / slot No. ◆ frameid/slotid/portid: subrack No. / slot No. / port No.	Mandatory	1/4/3	1/2/1	1/18/1
	{<list>}*1	PON port No. or ONU authorization No.	Optional	-	1	-
Viewing the information about the slice ownership	[<frameid/slotid>|<frameid/slotid/portid>|<frameid/slotid/portid/onuid>]	◆ frameid/slotid: subrack No. / slot No. ◆ frameid/slotid/portid: subrack No. / slot No. / port No. ◆ frameid/slotid/portid/onuid: subrack No. / slot No. / port No. / ONU No.	Mandatory	1/2/1/1		

Example

1. Assign Port 3 in Slot 4 of Subrack 1 to Slice 1.

```
Admin(config-vs-1)#assign object 1/4/3
Admin(config-vs-1)#
```

2. Assign ONU 1 under PON Port 1 in Slot 2 of Subrack 1 to Slice 1.

```
Admin(config-vs-1)#assign object 1/2/1 1
Admin(config-vs-1)#
```

3. Assign Port 1 in Slot 18 of Subrack 1 to Slice 1.

```
Admin(config-vs-1)#assign object 1/18/1
Admin(config-vs-1)#
```

4. Delete Port 3 in Slot 4 of Subrack 1 from Slice 1.

```
Admin(config-vs-1)#no assign object 1/4/3
Admin(config-vs-1)#
```

5. View the objects of Slice 1.

```
Admin(config-vs-1)#show object
  SLOT      PORT      ONU     VSID
-------  -------  -------  -------
    2         1         1         1
   18         1       ---         1
----------------------------------
Admin(config-vs-1)#
```

6. View the list of ONUs assigned to Slice 1.

```
Admin(config-vs-1)#show onu-list
SLOT      PON      ONU    VSID
-------  -------  -------  -------
      2        1    1-  1        1
----------------------------------
Admin(config-vs-1)#
```

7. View the information about the slice to which ONU 1 under PON Port 1 in Slot 2 of Subrack 1 is assigned.

```
Admin(config)#show vs object 1/2/1/1
SLOT      PON      ONU    VSID
-------  -------  -------  -------
      2        1        1  1,
----------------------------------
Admin(config)#
```

6.7 Slice User Management

Command Format

Switch the slice area.

```
switch vs <id>
```

Add a user.

```
terminal user name <username> <password>
```

Modify the password.

```
terminal user password <username>
```

Modify the user level.

```
terminal user level <username> <level>
```

Delete a user.

```
no terminal user name <username>
```

View the currently logged-in slice users.

```
who
```

Disable a user.

```
terminal user enable <username> [enable|disable]
```

Planning Data

Parameter	Description	Attribute	Example
vs <id>	Slice ID	Mandatory	1
<username>	Slice user name	Mandatory	user1_vs1
<password>	Slice password	Mandatory	user1_vs1
<level>	User level, ranging from 0 to 15.	Mandatory	10
[enable|disable]	◆ enable ◆ disable	Mandatory	disable

Example

1. Switch to the area vs1.

```
Admin#switch vs 1
Switch the volt user success.
Admin-vs1#
```

2. Add a user, setting the user name to "user1_vs1" and the password to "user1_vs1".

```
Admin-vs1(config)#terminal user name user1_vs1 user1_vs1
Successfully add user user1_vs1.
Admin-vs1(config)#
```

3. Modify the password for user1_vs1.

```
Admin-vs1(config)#terminal user password user1_vs1
Input new login password for user user1_vs1 please.
New Password:********
Confirm Password:********
Successfully changed password!.
Admin-vs1(config)#
```

4. Modify the user level of user1_vs1 to 10.

```
Admin-vs1(config)#terminal user level user1_vs1 10
Admin-vs1(config)#
```

5. Delete user1_vs1.

```
Admin-vs1(config)#no terminal user name user_vs1
Successfully delete user user_vs1.
Admin-vs1(config)#
```

6. View the currently logged-in slice users.

```
Admin-vs1(config)#who
SessionID.- UserName -LOCATION ----UserLevel-VSId-MODE --
5673        user1_vs1 10.32.155.11 15        1    CONFIG(That's me.)
5997        user_vs1  10.32.155.11 15        1    CONFIG
Total 2 sessions in current system.
Admin-vs1(config)#
```

7. Disable user1_vs1.

```
Admin-vs1(config)#terminal user enable user1_vs1 disable
Admin-vs1(config)#
```

7 Configuring the VXLAN Service

This chapter introduces how to configure the VXLAN service for the AN6000 Series.

☑ Background Information

☑ Configuration Rules

☑ Configuring VXLAN VTEP Globally

☑ Configuring the VXLAN VNI Tunnel

☑ VXLAN Mapping Rules

☑ Configuring the Head-End Replication Table for the VXLAN Tunnel

☑ Configuring QoS Remapping for the VXLAN Tunnel

☑ Configuring Static MAC Address Table Entries for the VXLAN

7.1 Background Information

VXLAN is a tunnel technology using the MAC-in-UDP encapsulation. Data packets are encapsulated in the UPD via the VXLAN tunnel endpoints (VTEP); while the IP and MAC addresses used on the physical network are encapsulated in the outer header. After that, the packets are transmitted over the IP network. At the destination, the tunnel endpoints decapsulate the packets and send them to the expected receivers.

Advantages of VXLAN application:

- Supports up to 16M VXLAN segments for network isolation, which is far more than the 4K virtual network identifiers supported by VLAN. There is no restriction on user isolation and identifiers, and a large number of tenants can be supported.
- When VXLAN encapsulation is used, only edge devices in the VXLAN need to identify MAC addresses on the user side. This relieves the MAC address learning pressure on other devices and improves their performance.
- Extends Layer 2 networks by using the MAC-in-UDP encapsulation, and decouples the physical and virtual networks. This facilitates the configuration and migration of virtual machines on the user side.
- In the scenario with centralized data center in the access equipment room, VXLAN technology is used to distribute the user services to their VXLAN tunnels respectively and connect them to the cloud computing center. In this way, the services can be imported to the network function modules (such as vBRAS and vBNG) for processing, isolated from each other with their quality assured.

7.2 Configuration Rules

The following describes the rules for configuring the VXLAN service.

The VXLAN tunnel head-end replication table needs to be configured only when the point-to-multipoint tunnel is used and head-end replication is applied to broadcast, unknown unicast and multicast (BUM).

7.3 Configuring VXLAN VTEP Globally

Command Format

Configure the VXLAN VTEP globally.

```
vxlan-vtep <vtep-name> vtep-ip <vtep-ip> mask <mask-len> flood-learning
[enable]
```

View the global configuration of VXLAN VTEP.

```
show vxlan-vtep <vtep-name>
```

Delete the global configuration of VXLAN VTEP.

```
no vxlan-vtep <vtep-name>
```

Planning Data

Parameter	Description	Attribute	Example
vxlan-vtep <vtep-name>	The VTEP name, containing no more than 16 characters	Mandatory	aaa
vtep-ip <vtep-ip>	The IP address of the local VTEP	Mandatory	10.10.10.10
mask <mask-len>	The mask length	Mandatory	16
flood-learning [enable]	Enables the address learning for the peer end.	Mandatory	enable

Example

1. Configure the VXLAN VTEP globally, setting the VTEP name to aaa, the VTEP IP address to 10.10.10.10, and the mask length to 16, and enabling the address learning for the peer end.

```
Admin(config)#vxlan-vtep aaa vtep-ip 10.10.10.10 mask 16 flood-learning enable
Admin(config)#
```

2. View the global configuration of the VXLAN VTEP named aaa.

```
Admin(config)#show vxlan-vtep aaa
vtep-id:1 ,vtep-name:aaa ,vtep-ip:10.10.10.10, flood-learn:enable
Admin(config)#
```

3. Delete the global configuration of the VXLAN VTEP named aaa.

```
Admin(config)#no vxlan-vtep aaa
Admin(config)#
```

7.4 Configuring the VXLAN VNI Tunnel

Command Format

Configure the VXLAN tunnel.

```
vxlan-tunnel vni <vnid> type [e-lan|e-line] peer-ip <peer-ip> bum-mode <bum-mode> multicast-address <mc-addr> tunnel-vlan <outer-vlan> user-vlan-policy [untagged|tagged]
```

View the VXLAN tunnel.

```
show vxlan-tunnel vni {<vnid>}*1
```

Delete the VXLAN tunnel.

```
no vxlan-tunnel <vnid>
```

Planning Data

Parameter	Description	Attribute	Example
vni <vnid>	VXLAN ID	Mandatory	1
type [e-lan|e-line]	The tunnel types available (selected according to the service demand) ◆ e-lan: point-to-multipoint. Select this item if there are several devices at the opposite end. ◆ e-line: point-to-point. Select this item if there is only one device at the opposite end.	Mandatory	e-lan
peer-ip <peer-ip>	Peer VTEP IP address	Mandatory	0.0.0.0
bum-mode <bum-mode>	BUM mode ◆ 0: multicast ◆ 1: head-end replication	Mandatory	1
multicast-address <mc-addr>	Multicast IP address	Mandatory	0.0.0.0
tunnel-vlan <outer-vlan>	The outer VLAN ID of the tunnel	Mandatory	4050
user-vlan-policy [untagged|tagged]	The inner VLAN policy, including untagged and tagged	Mandatory	untagged

Example

1. Configure a VXLAN tunnel.

```
Admin(config)#vxlan-tunnel vni 1 type e-lan peer-ip 0.0.0.0 bum-mode 1 multicast-address 0.0.0.0 tunnel-vlan 4050 user-vlan-policy untagged
Admin(config)#
```

2. View a VXLAN tunnel.

```
Admin(config)#show vxlan-tunnel vni
vxlan-id:1,tunnel-type:0,peer-ip:0.0.0.0,bum-mode:1,mc-addr:0.0.0.0,
outer-vlan:4050,inner-vlan:0
Admin(config)#
```

3. Delete a VXLAN 1 tunnel.

```
Admin(config)#no vxlan-tunnel 1
Admin(config)#
```

7.5 VXLAN Mapping Rules

Background Information

The AN6000 Series equipment supports flexible mapping of tunnels, specifically objects (including PON service cards, PON ports and ONUs) mapped into VNIs and slices mapped into VNIs.

Command Format

Configure the VXLAN mapping rules.

```
vxlan-mapping <vnid> map-type [obj-mode|vs-mode] {<slot-no> <pon-no> <onu-no> <vlan-id>}*1
```

View the VXLAN mapping rules.

```
show vxlan-mapping {<vnid>}*1
```

Delete the VXLAN mapping rules.

```
no vxlan-mapping <vnid>
```

Planning Data

Parameter	Description	Attribute	Example	
<vnid>	The mapped tunnel VXLAN ID	Mandatory	1	2
map-type [obj-mode|vs-mode]	VNI mapping mode ◆ obj-mode: objects mapped into VNIs ◆ vs-mode: slices mapped into VNIs	Mandatory	vs-mode	obj-mode

Parameter	Description	Attribute	Example	
`<slot-no>`	Slot No.	Optional	-	1
`<pon-no>`	PON No.	Optional	-	1
`<onu-no>`	ONU	Optional	-	1
`<vlan-id>`	The VLAN ID, ranging from 0 to 4095	Optional	-	4050

Example

1. Configure the VNI mapping type as slices mapped into VNIs, setting the mapped tunnel VXLAN ID to 1.

```
Admin(config)#vxlan-mapping 1 map-type vs-mode
Admin(config)#
```

2. Configure the VNI mapping type as objects mapped into VNIs, setting the mapped tunnel VXLAN ID to 2, the slot No. to 1, the PON port No. to 1, the ONU No. to 1, and the VLAN ID to 4050.

```
Admin(config)#vxlan-mapping 2 map-type obj-mode 1 1 1 4050
Admin(config)#
```

3. View the VXLAN mapping rules.

```
Admin(config)#show vxlan-mapping
vxlan-id:1,map-type:vsid-mode
vxlan-id:2,map-type:obj-mode,slot-no:1,pon-no:1,onu-no:1,vlan-id:4050
Admin(config)#
```

4. Delete the mapping rules for VXLAN 1.

```
Admin(config)#no vxlan-mapping 1
Admin(config)#
```

7.6 Configuring the Head-End Replication Table for the VXLAN Tunnel

Command Format

Configure the head-end replication table for the VXLAN tunnel.

```
vxlan-headend <vnid> peer-ip <peer-ip>
```

View the head-end replication table for the VXLAN tunnel.

```
show vxlan-headend {<vnid>}*1
```

Delete the head-end replication table for the VXLAN tunnel.

```
no vxlan-headend <vnid>
```

Planning Data

Parameter	Description	Attribute	Example
`<vnid>`	The VXLAN ID of the local end tunnel	Mandatory	1
`peer-ip <peer-ip>`	Peer VTEP IP address	Mandatory	10.10.10.10

Example

1. Configure the head-end replication table for the VXLAN tunnel.

```
Admin(config)#vxlan-headend 1 peer-ip 10.10.10.10
Admin(config)#
```

2. View the head-end replication table for the VXLAN tunnel.

```
Admin(config)#show vxlan-headend
vxlanid:1,peer-ip:10.10.10.10
Admin(config)#
```

3. Delete the head-end replication table for the VXLAN 1 tunnel.

```
Admin(config)#no vxlan-headend 1
Admin(config)#
```

7.7 Configuring QoS Remapping for the VXLAN Tunnel

Command Format

Configure QoS remapping for the VXLAN tunnel.

```
vxlan-qos-remark <vnid> direction <qos-direc> type <qos-type> from <qos-old> to <qos-new>
```

View the QoS remapping for the VXLAN tunnel.

```
show vxlan-qos-remark {<vnid>}*1
```

Delete the QoS remapping for the VXLAN tunnel.

```
no vxlan-qos-remark <vnid>
```

Planning Data

Parameter	Description	Attribute	Example
`<vnid>`	The VXLAN ID of the local end tunnel	Mandatory	1
`direction <qos-direc>`	The service flow direction for remapping ◆ 0: uplink ◆ 1: downlink	Mandatory	0
`type <qos-type>`	Remapping type ◆ 0: from 8021P to 8021P ◆ 1: from 8021P to DSCP ◆ 2: from DSCP to 8021P ◆ 3: from DSCP to DSCP	Mandatory	0
`<qos-old>`	The QoS value before remapping ◆ 0 to 7: 8021P ◆ 0 to 63: DSCP	Mandatory	3
`<qos-new>`	The QoS value after remapping ◆ 0 to 7: 8021P ◆ 0 to 63: DSCP	Mandatory	1

Example

1. Configure QoS remapping for the VXLAN tunnel.

```
Admin(config)#vxlan-qos-remark 1 direction 0 type 0 from 3 to 1
Admin(config)#
```

2. View the QoS remapping for the VXLAN tunnel.

```
Admin(config)#show vxlan-qos-remark
vxlan-id:1,qos-direc:0,qos-type:0,qos-old:3,qos-new:1
Admin(config)#
```

3. Delete the QoS remapping for the VXLAN 1 tunnel.

```
Admin(config)#no vxlan-qos-remark 1
Admin(config)#
```

7.8 Configuring Static MAC Address Table Entries for the VXLAN

Command Format

Configure static MAC address table entries for the VXLAN.

```
vxlan-mac <mac-addr> vlan-id <vlan-id> vni <vn-id> peer-ip <peer-ip>
```

View static MAC address table entries for the VXLAN.

```
show vxlan-mac
```

Delete static MAC address table entries for the VXLAN.

```
no vxlan-mac <mac-addr> vlan-id <vlan-id> vni <vn-id> peer-ip <peer-ip>
```

Planning Data

Parameter	Description	Attribute	Example
`<mac-addr>`	The MAC address of the opposite end equipment	Mandatory	12-21-12-aa-a1-21
`vlan-id <vlan-id>`	The service VLAN ID	Mandatory	4050
`vni <vn-id>`	The VXLAN ID	Mandatory	1
`peer-ip <peer-ip>`	The opposite end VTEP IP address	Mandatory	10.10.10.10

Example

1. Configure static MAC address table entries for the VXLAN.

```
Admin(config)#vxlan-mac 12-21-12-aa-a1-21 vlan-id 4050 vni 1 peer-ip 10.10.10.10
Admin(config)#
```

2. View static MAC address table entries for the VXLAN.

```
Admin(config)#show vxlan-mac
mac-addr:12-21-12-aa-a1-21,vlan-id:4050,vxlan-id:1,peer-ip:10.10.10.10
Admin(config)#
```

3. Delete static MAC address table entries for the VXLAN.

```
Admin(config)#no vxlan-mac 12-21-12-aa-a1-21 vlan-id 4050 vni 1 peer-ip 10.10.10.10
Admin(config)#
```

8 Basic Configurations

This chapter introduces how to configure basic parameters such as the VLAN service channel for the AN6000 Series.

- ☑ Configuring Local End Outer VLAN Data
- ☑ Adding Ports to the VLAN
- ☑ Disabling Suppression of Multicast Packets at the Uplink Port

8.1 Configuring Local End Outer VLAN Data

Command Format

Configure local end outer VLAN data.

```
service-vlan <name> <vlanbegin> {[to]<vlanend>}*1 {[type]<value>}*1
```

View the configuration data of local end outer VLAN.

```
show service-vlan {<name>}
```

Planning Data

Parameter	Description	Attribute	Example	
`service-vlan <name>`	The service VLAN name. You can enter numbers, letters and underlines not exceeding 32 characters for the subscriber service name.	Mandatory	data1	ngn1
`<vlanbegin>`	The starting VLAN ID, ranging from 1 to 4085. The starting VLAN ID should not be larger than the ending VLAN ID.	Mandatory	500	300
`{[to]<vlanend>}*1`	The ending VLAN ID, ranging from 1 to 4085. The starting VLAN ID should not be larger than the ending VLAN ID.	Optional	-	-
`{[type]<value>}*1`	The service VLAN type. Select it according to the type of service to be configured. ◆ data: data service. ◆ iptv: IPTV service. ◆ ngn: voice service in the carrier network. ◆ voip: voice service based on Internet. ◆ vod: video-on-demand service. ◆ cnc: CNC service. ◆ system: system service.	Optional	data	ngn

Example

1. Set the service VLAN name to **data1**, service VLAN ID to **500**, and VLAN type to **data**.

```
Admin(config)#service-vlan data1 500 type data
```

2. Set the service VLAN name to **ngn1**, service VLAN ID to **300**, and VLAN type to **ngn**.

```
Admin(config)#service-vlan ngn1 300 type ngn
Admin(config)#
```

3. View the configuration data of local end outer VLAN.

```
Admin(config)#show service-vlan
servicevlan 101 :
name : data1,   type : data
vlan range: 500 #####end.
servicevlan 102 :
name : ngn1,   type : ngn
vlan range: 300 #####end.
Admin(config)#
```

8.2 Adding Ports to the VLAN

Command Format

Add the uplink port to the VLAN.

```
port vlan <vlanid> {to <end-vlanid>}*1 [tag|untag] <frameid/slotid> <port-list>
```

Add all the slots to the VLAN.

```
port vlan <vlanid> {to <end-vlanid>}*1 allslot
```

Planning Data

Parameter	Description	Attribute	Example
<vlanid>	VLAN ID	Mandatory	300
{to <end-vlanid>}*1	Ending VLAN ID	Optional	-

Parameter	Description	Attribute	Example
`[tag|untag]`	Configure the tag processing mode for the uplink service VLAN. Two options are available: **untag** and **tag**. ◆ In the **untag** mode, the tags of the uplink packets will be stripped automatically when they pass the port and the packets will be further transmitted in the untagged mode, while the downlink untagged packets will be added with corresponding tags when they pass the port. ◆ In the **tag** mode, the tags of the uplink / downlink data packets will not be processed when they pass the port.	Mandatory	tag
`<frameid/slotid>`	The subrack No. / slot No.	Mandatory	1/19
`<port-list>`	Port number	Mandatory	4

Example

1. Add the uplink port to VLAN 300 in the tag mode.

```
Admin(config)#port vlan 300 tag 1/19 4
```

2. Add all the slots to VLAN 300.

```
Admin(config)#port vlan 300 allslot
Admin(config)#
```

8.3 Disabling Suppression of Multicast Packets at the Uplink Port

Command Format

```
no traffic-suppress <frameid/slotid/portid> [broadcast|multicast|unknown|
all]
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/-portid>`	Subrack No. / slot No. / port No.	Mandatory	1/19/3
`[broadcast|multicast|unknown|all]`	◆ broadcast: broadcast packets ◆ multicast: multicast service ◆ unknown: unknown unicast packets ◆ all: all types of packets	Mandatory	multicast

Example

Disable multicast packet suppression for Port 3 in Slot 19 of Subrack 1.

```
Admin(config)#no traffic-suppress 1/19/3 multicast
Admin(config)#
```

9 Configuring Voice Services

This chapter introduces how to configure voice services for the AN6000 Series.

9.1 Configuration Example of Voice Services

This section introduces how to configure H.248 and SIP voice services using examples.

9.1.1 Configuring the H.248 Voice Service

Command Format

Configure parameters of the H.248 uplink interface.

```
ngn-uplink-interface name <name> protocol-type [mgcp|h.248|sip] {[mgc] <1-3> <addr> <0-65535>}*3 {[keepalive] [enable|disable|passive]}*1 {[m-dns] [ipv4|ipv6] <ipaddr>}*1 {[s-dns] [ipv4|ipv6] <ipaddr>}*1 {[dhcp] [enable|disable]}*1 {[sip-reg-addr] <addr>}*1 {[sip-reg-port] <0-65535>}*1 {[sip-proxy-addr] <addr>}*1 {[sip-proxy-port] <0-65535>}*1 {[sip-expires] <0-4294967294>}*1
```

Configure parameters of the NGN uplink user.

```
ngn-uplink-user service <name> {[vid] <vid>}*1 {[potsqinqstate] [enable|disable] svlanid <0-4085>}*1 {[service-cos] <value>}*1 {[customer-cos] <value>}*1 {[ip-mode] [static|pppoe|dhcp|pppoev6|dhcpv6]}*1 {[public-ip] [ipv4|ipv6] <ipaddress/prefix>}*1 {[public-gate] [ipv4|ipv6] <ipaddress>}*1 {[pppoeuser] <name> }*1 {[password] <pwd>}*1 {[dhcp-option60] [enable|disable]}*1 {[dhcp-value] <value>}*1 {[domainname] <name>}*1 {[protocol-port] <0-65535>}*1 {[user-index] <value>}*1
```

Configure the user telephone number.

```
ngn-uplink-user-port phone <value> {[username] <name>}*1 {[sip-user-name] <name>}*1 {[sip-user-password] <password>}*1 {[user-index] <value>}*1
```

Configure the NGN softswitch platform interconnection profile. (optional)

```
ngn-softswitch-profile <profilename> fixed <value> varb <value> vare <value> step <value> fixedlen [unfixed|fixed] begint <value> shortt <value> longt <value> matchem [exclusive|immediately] switch [disable|enable] txi <value> rxi <value> voicec [g711u|g711a|nochange] offhkwt [unregiste|registe] flashthd <value> 2833n [disable|enable] 2833d <value> 2198d <value> t38edm [default|v21|all] calleridm [fsk|dtmf] onhkdt <value> dailtonett <value> noanstt <value> busytonett <value> rohtt <value> retrantt <value> ecm [disable|enable] l [chinese|english] {[id] <id>}*1 {[timethd] <value>
userthd <value>}*1 {[heart] [notify|change]}*1 {[tripartmode] <value>}*1
{[signaldscp] <value> rtpdscp <value> minport <value> maxport <value>
portstep <value>}*1 {[portreg] [disable|enable]}*1
```

Bind the softswitch platform interconnection profile. (optional)

```
onu ngn-iad-softswitch-profile <onulist> profile <profile-name>
```

Configure voice service parameters of the ONU.

```
onu ngn-voice-service <onuno> pots <portno> phonenum <num> {[vid] <vid>}*1
{[code-mode] [g.711m|g.711a|g.723|g.729]}*1 {[fax-mode] [transparent|
t.38]}*1 {[slience] [enable|disable]}*1 {[echo-cancel] [enable|disable]}*1
{[input-gain] <num>}*1 {[voice-value] <value>}*1 {[dtmf] [transparent|
rfc2833|sip]}*1 {[heartbeat] [enable|disable]}*1 {[potsqinqstate] [enable|
disable] svlanid <0-4085>}*1 {[service-cos] <value>}*1 {[customer-cos]
<value>}*1 {[fax-control] [passthrough|softswitch|autovbd]}*1 {[bill-
type] [16kc|12kc|revpol|free]}*1
```

Data Planning

Procedure	Parameter	Description	Attribute	Example
Configuring parameters of the H. 248 uplink interface	`ngn-uplink-interface name <name>`	The name of the uplink interface for the NGN voice service, consisting of the service name and the interface identifier.	Mandatory	ngn1@h. 248
	`protocol-type [mgcp|h.248|sip]`	The MGC protocol type. ◆ mgcp: the MGCP protocol ◆ h248: the H248 protocol ◆ sip: the SIP protocol	Mandatory	h.248
	`{[mgc] <1-3> <addr> <0-65535>}*3`	<1-3>: the MGC sequence number. <addr>: the MGC address. <0-65535>: the MGC port number.	Optional	1 192.168.1. 101 2944
	`{[keepalive] [enable|disable|passive]}*1`	The heartbeat switch. ◆ enable: Enable active heartbeat. ◆ disable: Disable the function. ◆ passive: Enable passive heartbeat.	Optional	enable
	`{[m-dns] [ipv4|ipv6] <ipaddr>}*1`	The master DNS server.	Optional	-
	`{[s-dns] [ipv4|ipv6] <ipaddr>}*1`	The slave DNS server.	Optional	-

Procedure	Parameter	Description	Attribute	Example
	{[dhcp] [enable|disable]}*1	The DHCP function switch.	Optional	-
	{[sip-reg-addr] <addr>}*1	The SIP registrar server address.	Optional	-
	{[sip-reg-port] <0-65535>}*1	The port number of the SIP registrar, that is, the protocol port number of the MG registered to the SIP registrar. The value ranges from 0 to 65535, and the default value is 5060.	Optional	-
	{[sip-proxy-addr] <addr>}*1	The address of the SIP proxy server.	Optional	-
	{[sip-proxy-port] <0-65535>}*1	The port number of the SIP proxy server. The value ranges from 0 to 65535, and the default value is 5060.	Optional	-
	{[sip-expires] <0-4294967294>}*1	The SIP timeout time (second). If the MG does not receive the corresponding information from the SIP server before this time expires, the registration fails. The value ranges from 0 to 4294967294.	Optional	-
Configuring parameters of the NGN uplink user	service <name>	The name of the voice service, same as the name of the uplink interface for the NGN voice service.	Mandatory	ngn1@h.248
	{[vid] <vid>}*1	The signaling VLAN ID.	Optional	300
	[potsqinqstate] [enable|disable]	The SVLAN state (enabled or disabled).	Optional	-
	svlanid <0-4085>	The SVLAN ID.	Optional	-
	{[service-cos] <value>}*1	The outer CoS.	Optional	-
	{[customer-cos] <value>}*1	The inner CoS.	Optional	-
	{[ip-mode] [static|pppoe|dhcp|pppoev6|dhcpv6]}*1	The IP configuration mode.	Optional	-
	{[public-ip] [ipv4|ipv6] <ipaddress/prefix>}*1	The public network IP address / mask of the ONU. Configure this item according to the operator’s network planning.	Optional	ipv4 10.90.60.2/16

Procedure	Parameter	Description	Attribute	Example
	`{[public-gate] [ipv4|ipv6] <ipaddress>}*1`	The public network gateway IP address of the ONU. Configure this item according to the operator's network planning.	Optional	ipv4 10.90.1.154
	`{[pppoeuser] <name> }*1`	The PPPoE user name.	Optional	-
	`{[password] <pwd>}*1`	The PPPoE user password.	Optional	-
	`{[dhcp-option60] [enable| disable]}*1`	The DHCP Option60 state (enabled or disabled).	Optional	-
	`{[dhcp-value] <value>}*1`	The DHCP Option60 suffix.	Optional	-
	`{[domainname] <name>}*1`	The end point domain name / SIP user name suffix. Configure this item according to the operator's network planning.	Optional	10.90.60.2
	`{[protocol-port] <0-65535>}*1`	The ONU protocol port. Configure this item according to the operator's network planning. The value ranges from 0 to 65535 and the default value is 2944.	Optional	2944
	`{[user-index] <value>}*1`	The index ID, ranging from 0 to 40000.	Optional	1
Configuring the user phone number	`phone <value>`	The user index and logical number within the system. It is advised to set this item to the phone number defined by the softswitch platform. The value ranges from 1 to 4294967294.	Mandatory	88880003
	`{[username] <name>}*1`	The endpoint user name / SIP phone number. ◆ When the MGCP or H.248 protocol is used, the endpoint username should be configured. ◆ When the SIP protocol is used, the SIP telephone number should be configured.	Mandatory	a1
	`{[sip-user-name] <name>}*1`	The user name authenticated by SIP.	Optional	-
	`{[sip-user-password] <password>}*1`	The user password authenticated by SIP.	Optional	-

Procedure	Parameter	Description	Attribute	Example
	`{[user-index] <value>}*1`	The index ID, ranging from 0 to 40000.	Optional	1
Configuring the NGN softswitch platform interconnection profile (optional)	`ngn-softswitch-profile <profilename>`	The name of the NGN softswitch platform interconnection profile.	Mandatory	ngn1
	`fixed <value>`	The fixed part of the RTP resource name.	Mandatory	RTP/000
	`varb <value>`	The starting value of the variable part of the RTP resource name.	Mandatory	0
	`vare <value>`	The ending value of the variable part of the RTP resource name.	Mandatory	15
	`step <value>`	The step of the variable part of the RTP resource name.	Mandatory	1
	`fixedlen [unfixed|fixed]`	The fixed length of the RTP name. ◆ unfixed ◆ fixed	Mandatory	unfixed
	`begint <value>`	The DigitMap start timer (second). The value ranges from 1 to 255.	Mandatory	16
	`shortt <value>`	The DigitMap short timer (second). The value ranges from 1 to 255.	Mandatory	4
	`longt <value>`	The DigitMap long timer (second). The value ranges from 1 to 255.	Mandatory	16
	`matchem [exclusive|immediately]`	Reporting the matching result immediately when match with any rule is found. ◆ exclusive: reporting when exclusive matching is found ◆ immediately: reporting immediately	Mandatory	immediate-ly
	`switch [disable|enable]`	The VBD state.	Mandatory	disable
	`txi <value>`	The VBD packet transmitting interval (ms).	Mandatory	20
	`rxi <value>`	The VBD packet receiving interval (ms).	Mandatory	10
	`voicec [g711u|g711a|nochange]`	The VBD encoding type. ◆ g711u: G.711U ◆ g711a: G.711A ◆ nochange: not changed	Mandatory	nochange
	`offhkwt [unregiste|registe]`	Howler tone timeout processing	Mandatory	unregiste

Procedure	Parameter	Description	Attribute	Example
	flashthd <value>	The flash duration (ms).	Mandatory	90
	2833n [disable|enable]	The RFC2833 negotiation state. ◆ disable: no auto-negotiation ◆ enable: auto-negotiation	Mandatory	disable
	2833d <value>	The default RFC2833 PT.	Mandatory	97
	2198d <value>	The default RFC2198 PT.	Mandatory	96
	t38edm [default|v21|all]	The T.38 event detection mode. ◆ default: reporting normally ◆ v21: reporting V21 only ◆ all: all reporting V21	Mandatory	default
	calleridm [fsk|dtmf]	The caller ID mode.	Mandatory	fsk
	onhkdt <value>	The minimum onhook detection time (ms).	Mandatory	600
	dailtonett <value>	The dial tone time (s).	Mandatory	60
	noanstt <value>	The no-answer tone time (s).	Mandatory	60
	busytonett <value>	The busy tone time (s).	Mandatory	60
	rohtt <value>	The howler tone time (s).	Mandatory	60
	retrantt <value>	The retransmission timer (s).	Mandatory	25
	ecm [disable|enable]	The error correction switch. ◆ enable: Enable the function. ◆ disable: Disable the function.	Mandatory	disable
	l [chinese|english]	The CLI language. ◆ chinese ◆ english	Mandatory	english
	{[id] <id>}*1	The profile ID.	Optional	1
	[timethd] <value>	The NGN register timer threshold (s).	Optional	-
	userthd <value>	The threshold for quantity of NGN registered users.	Optional	-
	{[heart] [notify|change]}*1	The heatbeat mode.	Optional	-
	{[tripartmode] <value>}*1	The three-party service establishing mode.	Optional	-
	[signaldscp] <value>	The signaling DSCP value.	Optional	-
	rtpdscp <value>	The media stream DSCP value.	Optional	-

Procedure	Parameter	Description	Attribute	Example
	`minport <value>`	The minimum port number for RTP flow.	Optional	-
	`maxport <value>`	The maximum port number for RTP flow.	Optional	-
	`portstep <value>`	The step of the RTP flow port number.	Optional	-
	`{[portreg] [disable|enable]}*1`	The port registration.	Optional	-
Binding the softswitch platform interconnection profile (optional)	`<onulist>`	The ONU authorization number.	Mandatory	1
	`profile <profile-name>`	The name of the softswitch platform interconnection profile.	Mandatory	ngn1
Configuring voice service parameters of the ONU	`<onuno>`	The ONU authorization number.	Mandatory	1
	`pots <portno>`	The POTS port number.	Mandatory	1
	`phonenum <num>`	The telephone number.	Optional	88880003
	`{[vid] <vid>}*1`	The VLAN ID.	Optional	-
	`{[code-mode] [g.711m|g.711a|g.723|g.729]}*1`	The voice encoding mode, i.e., the compression encoding mode for the NGN service voice stream. Select the encoding mode as required. The default setting is G.711A.	Optional	g.711a
	`{[fax-mode] [transparent|t.38]}*1`	The fax mode. **transparent** refers to the transparent mode, i.e., T.30 fax. Select the fax mode as needed. The default setting is **transparent**.	Mandatory	transparent
	`{[slience] [enable|disable]}*1`	The silence switch. When this function is enabled and no voice is detected during the conversion, mute compression packets are transmitted. ◆ enable: Enable the function. ◆ disable: Disable the function.	Mandatory	enable
	`{[echo-cancel] [enable|disable]}*1`	The echo suppression. The echo is suppressed when this function is enabled. ◆ enable: Enable the function. ◆ disable: Disable the function.	Optional	-
	`{[input-gain] <num>}*1`	The input gain. The value range is -32 to 32.	Optional	-
	`{[voice-value] <value>}*1`	The output gain. The value range is -32 to 32.	Optional	-

Procedure	Parameter	Description	Attribute	Example
	`{[dtmf] [transparent|rfc2833|sip]}*1`	The DTMF mode.	Optional	-
	`{[heartbeat] [enable|disable]}*1`	The heartbeat function. ◆ enable: Enable the function. ◆ disable: Disable the function.	Optional	-
	`[potsqinqstate] [enable|disable]`	The SVLAN state (enabled or disabled).	Optional	-
	`svlanid <0-4085>`	The SVLAN ID.	Optional	-
	`{[service-cos] <value>}*1`	The outer CoS.	Optional	-
	`{[customer-cos] <value>}*1`	The inner CoS.	Optional	-
	`{[fax-control] [passthrough|softswitch|autovbd]}*1`	The fax control mode. ◆ passthrough: voice path ◆ softswitch: softswitch full control ◆ autovbd: auto negotiation	Optional	-
	`{[bill-type] [16kc|12kc|revpol|free]}*1`	The bill type. ◆ 16kc: 16KC ◆ 16kc: 12KC ◆ revpol: reversal polarity ◆ free: no charging	Optional	-

Example

1. Configure parameters of the H.248 uplink interface.

```
Admin(config)#ngn-uplink-interface name ngn1@h.248 protocol-type h.248 mgc 1 192.168.1.101 2944 keepalive enable
```

2. Configure parameters of the NGN uplink user.

```
Admin(config)#ngn-uplink-user service ngn1@h.248 vid 300 public-ip ipv4 10.90.60.2/16 public-gate ipv4 10.90.1.154 domainname 10.90.60.2 protocol-port 2944 user-index 1
Admin(config)#
```

3. Configure the user telephone number.

```
Admin(config)#ngn-uplink-user-port phone 88880003 username a1 user-index 1
Admin(config)#
```

4. Configure the NGN softswitch platform interconnection profile.

```
Admin(config)#ngn-softswitch-profile ngn1 fixed RTP/000 varb 15 vare 15 step 1 fixedlen unfixed begint 16 shortt 4 longt 16 matchem immediately switch disable txi 20 rxi 10 voicec nochange offhkwt unregiste flashthd 90 2833n disable 2833d 97 2198d 96 t38edm default
```

```
calleridm fsk onhkdt 600 dailtonett 60 noanstt 60 busytonett 60 rohtt 60 retrantt 25 ecm disable l chinese id 1
Admin(config)#
```

5. Bind the softswitch platform interconnection profile.

```
Admin(config-if-pon-1/2/1)#onu ngn-iad-softswitch-profile 1 profile ngn1
Admin(config-if-pon-1/2/1)#
```

6. Configure voice service parameters of the ONU.

```
Admin(config-if-pon-1/2/1)#onu ngn-voice-service 1 pots 1 phonenum 88880003 code-mode g.711a fax-mode transparent slience enable
Admin(config-if-pon-1/2/1)#
```

7. Save the configuration data.

```
Admin(config)#save
Trying save configuration to flash, please wait ......
save config success
Admin(config)#
```

9.1.2 Configuring the SIP Voice Service

Command Format

Configure parameters of the SIP uplink interface.

```
ngn-uplink-interface name <name> protocol-type [mgcp|h.248|sip] {[mgc] <1-3> <addr> <0-65535>}*3 {[keepalive] [enable|disable|passive]}*1 {[m-dns] [ipv4|ipv6] <ipaddr>}*1 {[s-dns] [ipv4|ipv6] <ipaddr>}*1 {[dhcp] [enable|disable]}*1 {[sip-reg-addr] <addr>}*1 {[sip-reg-port] <0-65535>}*1 {[sip-proxy-addr] <addr>}*1 {[sip-proxy-port] <0-65535>}*1 {[sip-expires] <0-4294967294>}*1
```

Configure parameters of the NGN uplink user.

```
ngn-uplink-user service <name> {[vid] <vid>}*1 {[potsqinqstate] [enable|disable] svlanid <0-4085>}*1 {[service-cos] <value>}*1 {[customer-cos] <value>}*1 {[ip-mode] [static|pppoe|dhcp|pppoev6|dhcpv6]}*1 {[public-ip] [ipv4|ipv6] <ipaddress/prefix>}*1 {[public-gate] [ipv4|ipv6] <ipaddress>}*1 {[pppoeuser] <name> }*1 {[password] <pwd>}*1 {[dhcp-option60] [enable|disable]}*1 {[dhcp-value] <value>}*1 {[domainname] <name>}*1 {[protocol-port] <0-65535>}*1 {[user-index] <value>}*1
```

Configure the user telephone number.

```
ngn-uplink-user-port phone <value> {[username] <name>}*1 {[sip-user-name]
<name>}*1 {[sip-user-password] <password>}*1 {[user-index] <value>}*1
```

Configure voice service parameters of the ONU.

```
onu ngn-voice-service <onuno> pots <portno> phonenum <num> {[vid] <vid>}*1
{[code-mode] [g.711m|g.711a|g.723|g.729]}*1 {[fax-mode] [transparent|
t.38]}*1 {[slience] [enable|disable]}*1 {[echo-cancel] [enable|disable]}*1
{[input-gain] <num>}*1 {[voice-value] <value>}*1 {[dtmf] [transparent|
rfc2833|sip]}*1 {[heartbeat] [enable|disable]}*1 {[potsqinqstate] [enable|
disable] svlanid <0-4085>}*1 {[service-cos] <value>}*1 {[customer-cos]
<value>}*1 {[fax-control] [passthrough|softswitch|autovbd]}*1 {[bill-
type] [16kc|12kc|revpol|free]}*1
```

Data Planning

Procedure	Parameter	Description	Attribute	Example
Configuring parameters of the SIP uplink interface	`ngn-uplink-interface name <name>`	The name of the uplink interface for the NGN voice service, consisting of the service name and the interface identifier.	Mandatory	ngn1@sip
	`protocol-type [mgcp|h.248|sip]`	The MGC protocol type. ◆ mgcp: the MGCP protocol ◆ h248: the H248 protocol ◆ sip: the SIP protocol	Mandatory	sip
	`{[mgc] <1-3> <addr> <0-65535>}*3`	<1-3>: the MGC sequence number. <addr>: the MGC address. <0-65535>: the MGC port number.	Optional	-
	`{[keepalive] [enable|disable|passive]}*1`	The heartbeat switch. ◆ enable: Enable active heartbeat. ◆ disable: Disable the function. ◆ passive: Enable passive heartbeat.	Optional	-
	`{[m-dns] [ipv4|ipv6] <ipaddr>}*1`	The master DNS server.	Optional	-
	`{[s-dns] [ipv4|ipv6] <ipaddr>}*1`	The slave DNS server.	Optional	-
	`{[dhcp] [enable|disable]}*1`	The DHCP function switch.	Optional	-
	`{[sip-reg-addr] <addr>}*1`	The SIP registrar server address.	Optional	10.80.20.3

Procedure	Parameter	Description	Attribute	Example
	`{[sip-reg-port] <0-65535>}*1`	The port number of the SIP registrar, that is, the protocol port number of the MG registered to the SIP registrar. The value ranges from 0 to 65535, and the default value is 5060.	Optional	5060
	`{[sip-proxy-addr] <addr>}*1`	The address of the SIP proxy server.	Optional	10.80.20.3
	`{[sip-proxy-port] <0-65535>}*1`	The port number of the SIP proxy server. The value ranges from 0 to 65535, and the default value is 5060.	Optional	5060
	`{[sip-expires] <0-4294967294>}*1`	The SIP timeout time (second). If the MG does not receive the corresponding information from the SIP server before this time expires, the registration fails. The value ranges from 0 to 4294967294.	Optional	3600
Configuring parameters of the NGN uplink user	`service <name>`	The name of the voice service, same as the name of the uplink interface for the NGN voice service.	Mandatory	ngn1@sip
	`{[vid] <vid>}*1`	The signaling VLAN ID.	Optional	300
	`[potsqinqstate] [enable|disable]`	The SVLAN state (enabled or disabled).	Optional	-
	`svlanid <0-4085>`	The SVLAN ID.	Optional	-
	`{[service-cos] <value>}*1`	The outer CoS.	Optional	-
	`{[customer-cos] <value>}*1`	The inner CoS.	Optional	-
	`{[ip-mode] [static|pppoe|dhcp|pppoev6|dhcpv6]}*1`	The IP configuration mode.	Optional	static
	`{[public-ip] [ipv4|ipv6] <ipaddress/pre-fix>}*1`	The public network IP address / mask of the ONU. Configure this item according to the operator’s network planning.	Optional	ipv4 10.80.20.3/16
	`{[public-gate] [ipv4|ipv6] <ipaddress>}*1`	The public network gateway IP address of the ONU. Configure this item according to the operator’s network planning.	Optional	ipv4 10.80.1.254

Procedure	Parameter	Description	Attribute	Example
	`{[pppoeuser] <name> }*1`	The PPPoE user name.	Optional	-
	`{[password] <pwd>}*1`	The PPPoE user password.	Optional	-
	`{[dhcp-option60] [enable| disable]}*1`	The DHCP Option60 state (enabled or disabled).	Optional	-
	`{[dhcp-value] <value>}*1`	The DHCP Option60 suffix.	Optional	-
	`{[domainname] <name>}*1`	The end point domain name / SIP user name suffix, that is, the domain name of the gateway. Configure this item according to the operator's network planning.	Optional	10.80.20.3
	`{[protocol-port] <0-65535>}*1`	The ONU protocol port. Configure this item according to the operator's network planning. The value ranges from 0 to 65535 and the default value is 5060.	Optional	5060
	`{[user-index] <value>}*1`	The index ID, ranging from 0 to 40000.	Optional	1
Configuring the user phone number	`phone <value>`	The user index and logical number within the system. It is advised to set this item to the phone number defined by the softswitch platform. The value ranges from 1 to 4294967294.	Mandatory	88880003
	`{[username] <name>}*1`	The endpoint user name / SIP phone number. ◆ When the MGCP or H.248 protocol is used, the endpoint username should be configured. ◆ When the SIP protocol is used, the SIP telephone number should be configured.	Mandatory	88882211
	`{[sip-user-name] <name>}*1`	The user name authenticated by SIP.	Optional	test3
	`{[sip-user-password] <password>}*1`	The user password authenticated by SIP.	Optional	test3
	`{[user-index] <value>}*1`	The index ID, ranging from 0 to 40000.	Optional	1

Procedure	Parameter	Description	Attribute	Example
Configuring voice service parameters of the ONU	<onuno>	The ONU authorization number.	Mandatory	1
	pots <portno>	The POTS port number.	Mandatory	1
	phonenum <num>	The telephone number.	Optional	88880003
	{[vid] <vid>}*1	The VLAN ID.	Optional	-
	{[code-mode] [g.711m|g.711a|g.723|g.729]}*1	The voice encoding mode, i.e., the compression encoding mode for the NGN service voice stream. Select the encoding mode as required. The default setting is G.711A.	Optional	g.711a
	{[fax-mode] [transparent|t.38]}*1	The fax mode. **transparent** refers to the transparent mode, i.e., T.30 fax. Select the fax mode as needed. The default setting is **transparent**.	Mandatory	transparent
	{[slience] [enable|disable]}*1	The silence switch. When this function is enabled and no voice is detected during the conversion, mute compression packets are transmitted. ◆ enable: Enable the function. ◆ disable: Disable the function.	Mandatory	enable
	{[echo-cancel] [enable|disable]}*1	The echo suppression. The echo is suppressed when this function is enabled. ◆ enable: Enable the function. ◆ disable: Disable the function.	Optional	-
	{[input-gain] <num>}*1	The input gain. The value range is -32 to 32.	Optional	-
	{[voice-value] <value>}*1	The output gain. The value range is -32 to 32.	Optional	-
	{[dtmf] [transparent|rfc2833|sip]}*1	The DTMF mode.	Optional	-
	{[heartbeat] [enable|disable]}*1	The heartbeat function. ◆ enable: Enable the function. ◆ disable: Disable the function.	Optional	-
	[potsqinqstate] [enable|disable]	The SVLAN state (enabled or disabled).	Optional	-
	svlanid <0-4085>	The SVLAN ID.	Optional	-

Procedure	Parameter	Description	Attribute	Example
	`{[service-cos] <value>}*1`	The outer CoS.	Optional	-
	`{[customer-cos] <value>}*1`	The inner CoS.	Optional	-
	`{[fax-control] [passthrough|softswitch|autovbd]}*1`	The fax control mode. ◆ passthrough: voice path ◆ softswitch: softswitch full control ◆ autovbd: auto negotiation	Optional	-
	`{[bill-type] [16kc|12kc|revpol|free]}*1`	The bill type. ◆ 16kc: 16KC ◆ 16kc: 12KC ◆ revpol: reversal polarity ◆ free: no charging	Optional	-

Example

1. Configure parameters of the SIP uplink interface.

```
Admin(config)#ngn-uplink-interface name ngn1@sip protocol-type sip sip-reg-addr 10.80.20.3 sip-reg-port 5060 sip-proxy-addr 10.80.20.3 sip-proxy-port 5060 sip-expires 3600
```

2. Configure parameters of the NGN uplink user.

```
Admin(config)#ngn-uplink-user service ngn1@sip vid 300 ip-mode static public-ip ipv4 10.80.20.3/16 public-gate ipv4 10.80.1.254 domainname 10.80.20.3 protocol-port 5060 user-index 1
```

3. Configure the user telephone number.

```
Admin(config)#ngn-uplink-user-port phone 88880003 username 88882211 sip-user-name test3 sip-user-password test3 user-index 1
```

4. Configure voice service parameters of the ONU.

```
Admin(config-if-pon-1/2/1)#onu ngn-voice-service 1 pots 1 phonenum 88880003 code-mode g.711a fax-mode transparent slience enable
Admin(config-if-pon-1/2/1)#
```

5. Save the configuration data.

```
Admin(config)#save
Trying save configuration to flash, please wait ......
save config success
Admin(config)#
```

9.2 Optional Functions

This section introduces how to configure optional functions for voice services on the AN6000 Series.

9.2.1 Configuring NGN Heartbeat Parameters

Command Format

```
ngn-keepalive service <name> aliveinterval <1-65535> alivetimes <1-65535>
```

Planning Data

Parameter	Description	Attribute	Example
service <name>	The NGN service name	Mandatory	ngn1
aliveinterval <1-65535>	The heartbeat interval (s), i.e., the interval for sending keep-alive messages.	Mandatory	60
alivetimes <1-65535>	The heartbeat timeout times. If the MGC fails to receive the keep-alive messages from the ONU in time for the set times, it is considered that the MGC loses its communication with the ONU.	Mandatory	60

Example

```
Admin(config)#ngn-keepalive service ngn1 aliveinterval 60 alivetimes 60
Admin(config)#
```

9.2.2 Configuring IAD MD5 Authentication

Command Format

```
ngn-iad-md5 domain <name> md5-state [enable|disable] {[mgid] <value>}*1
{[key] <value>}*1 {[dhg-value] <value>}*1 {[dhp-value] <value>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`domain <name>`	The end point domain name. It should be consistent with the endpoint domain name configured in the **NGN uplink user parameter**.	Mandatory	10.90.60.2
`md5-state [enable|disable]`	The MD5 state. Configure this item according to the network planning of the operator.	Mandatory	enable
`{[mgid] <value>}*1`	The MG ID. Configure this item according to the network planning of the operator.	Optional	60
`{[key] <value>}*1`	The key. Configure this item according to the network planning of the operator.	Optional	60
`{[dhg-value] <value>}*1`	The base g. Configure this item according to the network planning of the operator.	Optional	60
`{[dhp-value] <value>}*1`	The prime p. Configure this item according to the network planning of the operator.	Optional	60

Example

```
Admin(config)#ngn-iad-md5 domain 10.90.60.2 md5-state enable mgid 60 key 60 dhg-value 60 dhp-value 60
Admin(config)#
```

9.2.3 Configuring the Digitmap

Command Format

Configure the digitmap.

```
ngn-bitmap bitmap1 <bitmap> {id <index> <name>}*1
ngn-bitmap bitmap2 <bitmap> {id <index>}*1
ngn-bitmap bitmap3 <bitmap> {id <index>}*1
ngn-bitmap bitmap4 <bitmap> {id <index>}*1
ngn-bitmap bitmap5 <bitmap> {id <index>}*1
ngn-bitmap bitmap6 <bitmap> {id <index>}*1
ngn-bitmap bitmap7 <bitmap> {id <index>}*1
ngn-bitmap bitmap8 <bitmap> {id <index>}*1
```

Bind the digitmap profile to the ONU.

```
onu bitmap-profile <onulist> profile-id <index>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the digitmap	`<bitmap>`	The digitmap, no longer than 128 bytes	Mandatory	12345677777
	`{id <index> <name>}*1`	The ID and name of the digitmap profile	Optional	3, wang
Binding the digitmap profile to the ONU	`<onulist>`	ONU authorization No.	Mandatory	1
	`profile-id <index>`	The digitmap profile ID	Mandatory	3

Example

1. Configure the digitmap.

```
Admin(config)#ngn-bitmap bitmap1 12345677777 id 3 wang
```

2. Bind the digitmap profile to ONU 1 under PON Port 1 in Slot 2 of Subrack 1.

```
Admin(config-if-pon-1/2/1)#onu bitmap-profile 1 profile-id 3
Admin(config-if-pon-1/2/1)#
```

10 Configuring Data Services

This chapter introduces how to configure data services for the AN6000 Series.

10.1 Configuration Example of Data Services in the Transparent Transmission Mode

This section uses an example to introduce how to configure data services in the transparent transmission mode.

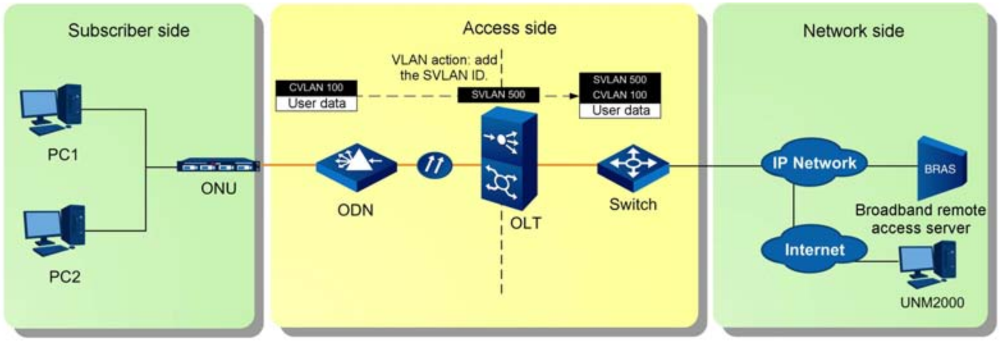
10.1.1 Network Scenario

Service Planning

- The subscribers are accessed via the ONUs.
- The subscriber services include IPTV, broadband Internet services and so on, which have high requirement on bandwidth.
- QinQ transparent transmission is applied to the subscriber packets, with the outer VLAN identifying services and the inner VLAN identifying subscribers.

Network Diagram

The network diagram for the data service in the transparent transmission mode is shown in the figure below.



10.1.2 Configuring Parameters of Data Services at the ONU Ports

Command Format

Configure the quantity of services at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service count <service-count>
```

Configure the type of service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> type [multicast|
unicast]
```

Note:

The default service type is unicast. If multicast service is used, you need to configure it.

Configure the VLAN mode for the service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> [tag|transparent]
priority <priority> tpid <tpid> vid <vlanlist>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring quantity of services at the ONU port	`<onulist>`	ONU authorization No.	Mandatory	1
	`eth <onu-port>`	The ONU port number	Mandatory	1
	`service count <service-count>`	Quantity of services	Mandatory	1
Configuring VLAN mode for the service at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1
	`[tag|transparent]`	The service VLAN mode ◆ tag: the TAG identifier ◆ transparent: transparent transmission	Mandatory	transparent
	`priority <priority>`	The CVLAN priority, ranging from 0 to 7. 7 stands for the highest priority level, and 0 the lowest one.	Mandatory	7
	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 0 to 65534, and the default value is 33024.	Mandatory	33024
	`vid <vlanlist>`	The CVLAN ID, ranging from 1 to 4085	Mandatory	100

Example

1. Configure the ONU with the authorization number 1 under PON Port 1 in Slot 1 of Subrack 1, adding a service to Port 1 of the ONU.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service count 1
Admin(config-if-pon-1/1/1)#
```

2. Configure the VLAN mode for Port 1 of ONU 1, setting the service ID to 1, service VLAN mode to transparent transmission, priority level to 7, tag protocol identifier to 33024, and VLAN ID to 100.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 transparent priority 7 tpid 33024 vid 100
Admin(config-if-pon-1/1/1)#
```

10.1.3 Configuring the ONU QinQ Profile

Command Format

```
onuqinq-classification-profile [add|modify] <profile-name> {<field-type>
<field-val> <operator>}*8
```

Planning Data

Parameter	Description	Attribute	Example
[add|modify]	◆ add ◆ modify	Mandatory	add
<profile-name>	The profile name	Mandatory	qinq

Parameter	Description	Attribute	Example
`<field-type>`	The rule domain type. The value ranges from 0 to 18. ◆ 0 (Src Mac): source MAC address ◆ 1 (Dst Mac): destination MAC address ◆ 2 (Src IPv4): source IP address ◆ 3 (Dst IPv4): destination IP address ◆ 4 (VID): VLAN ID ◆ 5 (Ethernet Type): Ethernet type ◆ 6 (Protocol Type): IP protocol type ◆ 7 (COS): Ethernet priority ◆ 8 (TOS): IP TOS/DSCP (IP v4) ◆ 9 (L4 Src Port): L4 source port ◆ 10 (L4 Dst Port): L4 destination port ◆ 11 (Dst IPv6 Prefix): destination IPv6 address ◆ 12 (Src IPv6 Prefix): source IPv6 address ◆ 13 (IP Version): IP version ◆ 14 (IPv6 Traffic Class): IPv6 traffic class ◆ 15 (IPv6 Flow Label): IPv6 flow label ◆ 16 (IPv6 Next Header): IPv6 next header ◆ 17 (Src IPv6): source IPv6 address ◆ 18 (Dst IPv6): destination IPv6 address	Optional	0
`<field-val>`	The rule domain value, which depends on the type of the rule domain. The rule domain type is	Optional	000000000000

Parameter	Description	Attribute	Example
	displayed before the brackets, while the rule domain value is inside the brackets. ◆ 0: the source MAC address (6 bytes) ◆ 1: the destination MAC address (6 bytes) ◆ 2: based on the source IP address classification (4 bytes) ◆ 3: based on the destination IP address classification (4 bytes) ◆ 4: based on the VLAN ID classification (2 bytes; 0 to 4085; 0 to 4095 is available for temporary requirement) ◆ 5: based on the Ethernet type (2 bytes, 0 to 0xffff) ◆ 6: based on the IP protocol type (1 byte, 0 to 0xff) ◆ 7: based on the Ethernet priority classification (1 byte, 1 to 7) ◆ 8: based on the IP TOS/DSCP (IPv4) classification (1 byte, 0 to 0xff) ◆ 9: based on the L4 source PORT classification (2 bytes, 0 to 0xffff) ◆ 10: based on the L4 destination PORT classification (2 bytes, 0 to 0xffff) ◆ 11: based on the destination IPv6 address prefix classification ◆ 12: based on the source IPv6 address prefix classification ◆ 13: based on the IP version (v4 or v6) classification (2 bytes, v4 or v6) ◆ 14: based on the IPv6 traffic class (1 byte, 0 to 255) ◆ 15: based on the IPv6 flow label (4 bytes, 0 to 0xFFFFF) ◆ 16: based on the IPv6 next header (1 byte, 0 to 255) ◆ 17: based on the source IPv6 address (16 bytes) ◆ 18: based on the destination IPv6 address (16 bytes)		

Parameter	Description	Attribute	Example
`<operator>`	The operator, which is an integer ranging from 0 to 6 ◆ 0 indicates **equal to** (=). ◆ 1 indicates **not equal to** (! =). ◆ 2 indicates **equal to or smaller than** (< =). ◆ 3 indicates **equal to or larger than** (> =). ◆ 4 indicates **exist then match**. ◆ 5 indicates **not exist then match**. ◆ 6 indicates **always match**.	Optional	4

Example

Configure a QinQ profile named **qinq**. The profile rule is that it is valid when the source MAC address 000000000000 exists (exist then match).

```
Admin(config)#onuqinq-classification-profile add qinq 0 000000000000 4
Admin(config)#
```

10.1.4 Binding the QinQ Profile to an ONU

Command Format

```
onu port vlan <onulist> eth <onu-port> service <serviceid> qinq [enable|
disable] {priority <priority> tpid <tpid> vid <s-vlanlist> <qinq-
classification-profile> <service-profile>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`<onulist>`	ONU authorization No.	Mandatory	1
`<onu-port>`	ONU port	Mandatory	1
`service <serviceid>`	Service ID	Mandatory	1
`qinq [enable|disable]`	QinQ state ◆ enable: enabled ◆ disable: disabled	Mandatory	enable
`priority <priority>`	The SVLAN priority, ranging from 0 to 7. 7 stands for the highest priority level, and 0 the lowest one.	Optional	7
`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 1 to 65535, and the default value is 33024.	Optional	33024
`vid <s-vlanlist>`	The SVLAN ID, ranging from 1 to 4085	Optional	500

Parameter	Description	Attribute	Example
`<qinq-classification-profile>`	QinQ profile name	Optional	qinq
`<service-profile>`	Service VLAN name	Optional	data1

Example

Enable the QinQ function for Service 1 at Port 1 of ONU 1, setting the priority of the service to **7**, the TPID to **33024**, the SVLAN to **500**, the QinQ profile name to **qinq** and the service VLAN name to **data1**. The ONU is under PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 qinq enable priority 7 tpid
33024 vid 500 qinq data1
Admin(config-if-pon-1/1/1)#
```

10.2 Configuration Example of Data Services in the VLAN Translation Mode

This section uses an example to introduce how to configure data services in the VLAN translation mode.

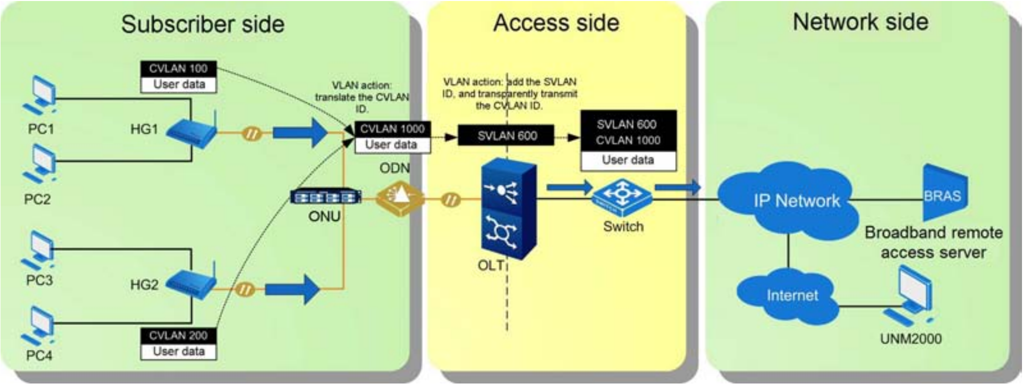
10.2.1 Network Scenario

Service Planning

The subscribers' PCs are connected to the ONU via home gateways. The home gateways add different VLAN tags to the subscribers' packets, and then transmit the packets to the ONU. The ONU translates the varied VLAN IDs into 1000 and sends the packets to the OLT. The OLT then adds the SVLAN to the subscribers' packets and sends them to the upper layer network.

Network Diagram

The network diagram for the data service in the VLAN N:1 translation mode is shown in the figure below.



- In the uplink direction, the data services uploaded by the two subscribers' PCs are added with different CVLAN IDs by the home gateways and uplinked to the ONU. The ONU translates the CLVAN IDs and transmits the data services to the OLT via the splitters. The OLT adds SVLAN IDs to the data services and transmits the data services to the providers network via the uplink interface.
- In the downlink direction, the data services carrying stacked VLAN tags pass by the OLT. The OLT strips the SVLAN tags off the data, and transmits the data services to the ONU via the splitter. The ONU translates the CVLAN tags and sends the data services to the corresponding HGs. The HGs strip the CVLAN tags off the data and transmit the data to the subscribers' PCs.

10.2.2 Configuring the OLT QinQ Domain

Command Format

Create a QinQ domain.

```
oltqinq-domain add <name>
```

Configure the quantity of services in the QinQ domain.

```
oltqinq-domain modify <name> service-count <service-count>
```

Configure uplink rules for the OLT QinQ domain.

```
oltqinq-domain <name> service <1-8> classification upstream {field-id <1-
27> value <value> condition <condition>}*4 {serv-id <1-8>}*1
```

Configure downlink rules for the OLT QinQ domain.

```
oltqinq-domain <name> service <1-8> classification downstream {field-id <1-27> value <value> condition <condition>}*4
```

Configure the service VLAN for the QinQ domain.

```
oltqinq-domain <name> service <1-8> {vlan <1-4> user-vlanid [<0-4085>|null] user-cos [<0-7>|null] [add|translation|transparent] tpid <tpid> cos [<cos>|null] vlanid [<vlanid>|null]}*4
```

Planning Data

Procedure	Parameter	Description	Attribute	Example	
Creating a QinQ domain	`<name>`	Name of QinQ domain	Mandatory	qinqdomain	
Configuring the quantity of services in the QinQ domain	`service-count <service-count>`	The service quantity. The value ranges from 1 to 8. You should configure one service at least, and eight services at most.	Mandatory	2	
Configuring uplink rules for the OLT QinQ domain	`service <1-8>`	The service index. The quantity of services should be same to that of uplink rule clauses. The value ranges from 1 to 8.	Mandatory	1	2

Procedure	Parameter	Description	Attribute	Example	
	classification upstream field-id <1-27>	The uplink rule type. Altogether 27 types are provided and the default one is 1. ◆ 1: DA (destination MAC address) ◆ 2: SA (source MAC address) ◆ 3: ethtype (Ethernet type) ◆ 4: vlan4 (Layer 4 VLAN) ◆ 5: vlan3 (Layer 3 VLAN) ◆ 6: vlan2 (Layer 2 VLAN) ◆ 7: vlan1 (Layer 1 VLAN) ◆ 8: TOS (service type) ◆ 10: TTL (Time-to-Live) ◆ 11: protocol type ◆ 12: sip (source IP address) ◆ 14: dip (destination IP address) ◆ 16: L4srcport (Layer 4 source port number) ◆ 17: L4dstport (Layer 4 destination port number) ◆ 18: cos4 (Priority level 4) ◆ 19: cos3 (Priority level 3) ◆ 20: cos2 (Priority level 2) ◆ 21: cos2 (Priority level 1) ◆ 22: based on the destination IPv6 address prefix classification (DA IPv6 Prefix) ◆ 23: based on the source IPv6 address prefix classification (SA IPv6 Prefix) ◆ 24: based on the IP version (v4 or v6) classification (IP version) ◆ 25: based on the IP priority field (IPv6) classification (IPv6 Traffic Class) ◆ 26: based on the IP flow label field (IPv6 Flow Label) ◆ 27: based on next packet header (IPv6 Next Header)	Mandatory	1	1

Procedure	Parameter	Description	Attribute	Example	
	value <value>	The domain value corresponding to the uplink rule. Enter the value according to the domain type.	Mandatory	000000-000000	000000-000000
	condition <condition>	The uplink operator. The value ranges from 0 to 7, and the default value is 5. ◆ 0: Never (never match) ◆ 1: = (equal to) ◆ 2: != (not equal to) ◆ 3: <= (smaller than or equal to) ◆ 4: >= (larger than or equal to) ◆ 5: Exist (exist means match). ◆ 6: No exist (not exist means match). ◆ 7: Always (always match).	Mandatory	5	5
	{serv-id <1-8>}*1	The service ID. If no ID is entered, the service index will be used as the service ID.	Optional	1	2
Configuring downlink rules for the OLT QinQ domain	service <1-8>	The service index. The quantity of services should be same to that of downlink rule clauses. The value ranges from 1 to 8.	Mandatory	1	2

Procedure	Parameter	Description	Attribute	Example	
	classification downstream field-id <1-27>	The downlink rule type. Altogether 27 types are provided and the default one is 1. ◆ 1: DA (destination MAC address) ◆ 2: SA (source MAC address) ◆ 3: ethtype (Ethernet type) ◆ 4: vlan4 (Layer 4 VLAN) ◆ 5: vlan3 (Layer 3 VLAN) ◆ 6: vlan2 (Layer 2 VLAN) ◆ 7: vlan1 (Layer 1 VLAN) ◆ 8: TOS (service type) ◆ 10: TTL (Time-to-Live) ◆ 11: protocol type ◆ 12: sip (source IP address) ◆ 14: dip (destination IP address) ◆ 16: L4srcport (Layer 4 source port number) ◆ 17: L4dstport (Layer 4 destination port number) ◆ 18: cos4 (Priority level 4) ◆ 19: cos3 (Priority level 3) ◆ 20: cos2 (Priority level 2) ◆ 21: cos2 (Priority level 1) ◆ 22: based on the destination IPv6 address prefix classification (DA IPv6 Prefix) ◆ 23: based on the source IPv6 address prefix classification (SA IPv6 Prefix) ◆ 24: based on the IP version (v4 or v6) classification (IP version) ◆ 25: based on the IP priority field (IPv6) classification (IPv6 Traffic Class) ◆ 26: based on the IP flow label field (IPv6 Flow Label) ◆ 27: based on next packet header (IPv6 Next Header)	Mandatory	1	1

Procedure	Parameter	Description	Attribute	Example	
	`value <value>`	The value of the selected downlink domain. Enter the value according to the domain type.	Mandatory	000000-000000	000000-000000
	`condition <condition>`	The downlink operator. The value ranges from 0 to 7, and the default value is 5. ◆ 0: Never (never match) ◆ 1: = (equal to) ◆ 2: != (not equal to) ◆ 3: <= (smaller than or equal to) ◆ 4: >= (larger than or equal to) ◆ 5: exist (exist means match) ◆ 6: no exist (not exist means match) ◆ 7: always (always match)	Mandatory	5	5
Configuring the service VLAN for the QinQ domain	`vlan <1-4>`	The VLAN layer No., i.e., the number of the current VLAN layer. Services can be configured on up to four VLAN layers. The value ranges from 1 to 4.	Mandatory	1	2
	`user-vlanid [<0-4085>|null]`	The original VLAN ID	Mandatory	100 200	null
	`user-cos [<0-7>|null]`	The CoS value. null: no configuration. The value ranges from 0 to 7, and the default value is 0.	Mandatory	0	null
	`[add|translation|transparent]`	Action of the VLAN at the selected layer ◆ add: adding ◆ translation: translation ◆ transparent: transparent transmission	Mandatory	translation	add
	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 1 to 0xfffe.	Mandatory	33024	33024
	`cos [<cos>|null]`	The CoS value. null: no configuration. The value ranges from 0 to 7, and the default value is 0.	Mandatory	null	null

Procedure	Parameter	Description	Attribute	Example	
	vlanid [<vlanid>| null]	The new VLAN ID. null: no configuration. The value ranges from 1 to 4085.	Mandatory	1000	600

Example

1. Create a QinQ domain named **qinqdomain**.

```
Admin(config)#oltqinq-domain add qinqdomain
```

2. Set the service quantity to 2 for the QinQ domain named **qinqdomain**.

```
Admin(config)#oltqinq-domain modify qinqdomain service-count 2
```

3. Configure the uplink rule for the OLT QinQ domain **qinqdomain**. Configure the first service, setting the uplink rule type to 1, the selected uplink domain value to the MAC address 000000000000, the uplink operator to 5, and the service ID to 1.

```
Admin(config)#oltqinq-domain qinqdomain service 1 classification upstream field-id 1
value 000000000000 condition 5 serv-id 1
```

4. Configure the downlink rule for the OLT QinQ domain **qinqdomain**. Configure the first service, setting the downink rule type to 1, the selected downlink domain value to the MAC address 000000000000, and the uplink operator to 5.

```
Admin(config)#oltqinq-domain qinqdomain service 1 classification downstream field-id 1
value 000000000000 condition 5
```

5. Configure the service VLAN for the QinQ domain. Configure the first service as follows. Set the original VLAN ID of the first layer VLAN to **100**, CoS value to **0**, VLAN mode to **translation**, TPID to **33024**, and CoS to **null**. Set the new VLAN ID to **1000**, the second layer VLAN action to **add**, the VLAN ID value to **600**, the TPID to **33024**, and the CoS value to **null**.

```
Admin(config)#oltqinq-domain qinqdomain service 1 vlan 1 user-vlanid 100 user-cos 0
translation tpid 33024 cos null vlanid 1000 vlan 2 user-vlanid null user-cos null add tpid
33024 cos null vlanid 600
Admin(config)#
```

6. Configure the uplink rule for the OLT QinQ domain **qinqdomain**. Configure the second service, setting the uplink rule type to 1, the selected uplink domain value to the MAC address 000000000000, the uplink operator to 5, and the service ID to 2.

```
Admin(config)#oltqinq-domain qinqdomain service 2 classification upstream field-id 1
value 000000000000 condition 5 serv-id 2
```

7. Configure the downlink rule for the OLT QinQ domain **qinqdomain**. Configure the second service, setting the downink rule type to 1, the selected downlink domain value to the MAC address 000000000000, and the uplink operator to 5.

```
Admin(config)#oltqinq-domain qinqdomain service 2 classification downstream field-id 1 value 000000000000 condition 5
```

8. Configure the service VLAN for the QinQ domain. Configure the second service as follows. Set the original VLAN ID of the first layer VLAN to **200**, CoS value to **0**, VLAN mode to **translation**, TPID to **33024**, and CoS to **null**. Set the new VLAN ID to **1000**, the second layer VLAN action to **add**, the VLAN ID value to **600**, the TPID to **33024**, and the CoS value to **null**.

```
Admin(config)#oltqinq-domain qinqdomain service 2 vlan 1 user-vlanid 200 user-cos 0 translation tpid 33024 cos null vlanid 1000 vlan 2 user-vlanid null user-cos null add tpid 33024 cos null vlanid 600
Admin(config)#
```

10.2.3 Binding the QinQ Domain to a PON Port

Command Format

```
oltqinq-domain <name>
```

Planning Data

Parameter	Description	Attribute	Example
<name>	Name of QinQ domain	Mandatory	qinqdomain

Example

Bind the domain **qinqdomain** to PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config-if-pon-1/1/1)#oltqinq-domain qinqdomain
Admin(config-if-pon-1/1/1)#
```

10.2.4 Configuring Parameters of Data Services at the ONU Ports

Command Format

Configure the quantity of services at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service count <service-count>
```

Configure the type of service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> type [multicast|
unicast]
```

Note:

The default service type is unicast. If multicast service is used, you need to configure it.

Configure the VLAN mode for the service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> [tag|transparent]
priority <priority> tpid <tpid> vid <vlanlist>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example	
Configuring quantity of services at the ONU port	`<onulist>`	ONU authorization No.	Mandatory	1	1
	`eth <onu-port>`	The ONU port number	Mandatory	1	2
	`service count <service-count>`	Quantity of services	Mandatory	1	1
Configuring VLAN mode for the service at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1	1
	`[tag|transparent]`	The service VLAN mode ◆ tag: the TAG identifier ◆ transparent: transparent transmission	Mandatory	transparent	transparent
	`priority <priority>`	The CVLAN priority, ranging from 0 to 7. 7 stands for the highest priority level, and 0 the lowest one.	Mandatory	7	7
	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 0 to 65534, and the default value is 33024.	Mandatory	33024	33024
	`vid <vlanlist>`	The CVLAN ID, ranging from 1 to 4085	Mandatory	100	200

Example

1. Configure the ONU with the authorization number 1 under PON Port 1 in Slot 1 of Subrack 1, adding a service to Port 1 of the ONU.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service count 1
Admin(config-if-pon-1/1/1)#
```

2. Configure the ONU with the authorization number 1 under PON Port 1 in Slot 1 of Subrack 1, adding a service to Port 2 of the ONU.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 2 service count 1
Admin(config-if-pon-1/1/1)#
```

3. Configure the VLAN mode for Port 1 of ONU 1, setting the service ID to 1, service VLAN mode to transparent transmission, priority level to 7, tag protocol identifier to 33024, and VLAN ID to 100.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 transparent priority 7 tpid
33024 vid 100
Admin(config-if-pon-1/1/1)#
```

4. Configure the VLAN mode for Port 1 of ONU 2, setting the service ID to 1, service VLAN mode to transparent transmission, priority level to 7, tag protocol identifier to 33024, and VLAN ID to 200.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 2 service 1 transparent priority 7 tpid
33024 vid 200
Admin(config-if-pon-1/1/1)#
```

10.3 Configuration Example of Data Services in the TAG Mode

This section uses an example to introduce how to configure data services in the TAG mode.

10.3.1 Network Scenario

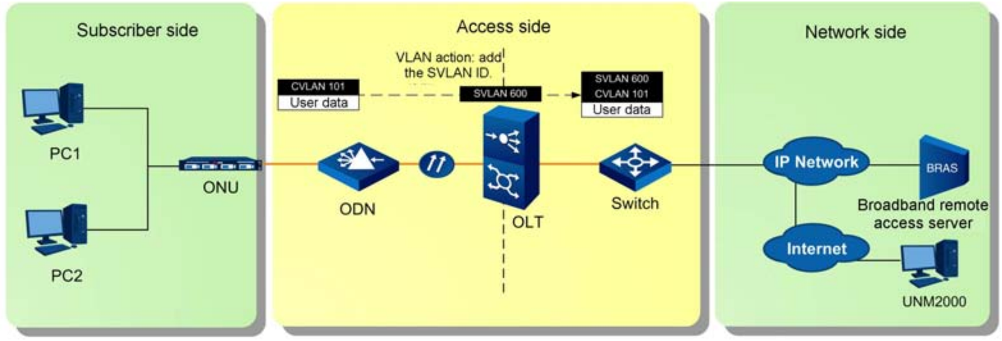
Service Planning

- The subscribers are accessed via the ONUs.
- The subscriber services include IPTV, broadband Internet services and so on, which have high requirement on bandwidth.

- The TAG mode is applied to the subscriber packets, with the outer VLAN identifying services and the inner VLAN identifying subscribers.

Network Diagram

The network diagram for the data service in the TAG mode is shown in the figure below.



10.3.2 Configuring the OLT QinQ Domain

Command Format

Create a QinQ domain.

```
oltqinq-domain add <name>
```

Configure the quantity of services in the QinQ domain.

```
oltqinq-domain modify <name> service-count <service-count>
```

Configure uplink rules for the OLT QinQ domain.

```
oltqinq-domain <name> service <1-8> classification upstream {field-id <1-
27> value <value> condition <condition>}*4 {serv-id <1-8>}*1
```

Configure downlink rules for the OLT QinQ domain.

```
oltqinq-domain <name> service <1-8> classification downstream {field-id <1-
27> value <value> condition <condition>}*4
```

Configure the service VLAN for the QinQ domain.

```
oltqinq-domain <name> service <1-8> {vlan <1-4> user-vlanid [<0-4085>|null]
user-cos [<0-7>|null] [add|translation|transparent] tpid <tpid> cos [<cos>|
null] vlanid [<vlanid>|null]}*4
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Creating a QinQ domain	`<name>`	Name of QinQ domain	Mandatory	qinqdomain
Configuring the quantity of services in the QinQ domain	`service-count <service-count>`	The service quantity. The value ranges from 1 to 8. You should configure one service at least, and eight services at most.	Mandatory	1
Configuring uplink rules for the OLT QinQ domain	`service <1-8>`	The service index. The quantity of services should be same to that of uplink rule clauses. The value ranges from 1 to 8.	Mandatory	1

Procedure	Parameter	Description	Attribute	Example
	`classification upstream field-id <1-27>`	The uplink rule type. Altogether 27 types are provided and the default one is 1. ◆ 1: DA (destination MAC address) ◆ 2: SA (source MAC address) ◆ 3: ethtype (Ethernet type) ◆ 4: vlan4 (Layer 4 VLAN) ◆ 5: vlan3 (Layer 3 VLAN) ◆ 6: vlan2 (Layer 2 VLAN) ◆ 7: vlan1 (Layer 1 VLAN) ◆ 8: TOS (service type) ◆ 10: TTL (Time-to-Live) ◆ 11: protocol type ◆ 12: sip (source IP address) ◆ 14: dip (destination IP address) ◆ 16: L4srcport (Layer 4 source port number) ◆ 17: L4dstport (Layer 4 destination port number) ◆ 18: cos4 (Priority level 4) ◆ 19: cos3 (Priority level 3) ◆ 20: cos2 (Priority level 2) ◆ 21: cos2 (Priority level 1) ◆ 22: based on the destination IPv6 address prefix classification (DA IPv6 Prefix) ◆ 23: based on the source IPv6 address prefix classification (SA IPv6 Prefix) ◆ 24: based on the IP version (v4 or v6) classification (IP version) ◆ 25: based on the IP priority field (IPv6) classification (IPv6 Traffic Class) ◆ 26: based on the IP flow label field (IPv6 Flow Label) ◆ 27: based on next packet header (IPv6 Next Header)	Mandatory	1
	`value <value>`	The domain value corresponding to the uplink rule. Enter the value according to the domain type.	Mandatory	000000000000

Procedure	Parameter	Description	Attribute	Example
	`condition <condition>`	The uplink operator. The value ranges from 0 to 7, and the default value is 5. ◆ 0: Never (never match) ◆ 1: = (equal to) ◆ 2: != (not equal to) ◆ 3: <= (smaller than or equal to) ◆ 4: >= (larger than or equal to) ◆ 5: Exist (exist means match). ◆ 6: No exist (not exist means match). ◆ 7: Always (always match).	Mandatory	5
	`{serv-id <1-8>}*1`	The service ID. If no ID is entered, the service index will be used as the service ID.	Optional	1
Configuring downlink rules for the OLT QinQ domain	`service <1-8>`	The service index. The quantity of services should be same to that of downlink rule clauses. The value ranges from 1 to 8.	Mandatory	1

Procedure	Parameter	Description	Attribute	Example
	`classification downstream field-id <1-27>`	The downlink rule type. Altogether 27 types are provided and the default one is 1. ◆ 1: DA (destination MAC address) ◆ 2: SA (source MAC address) ◆ 3: ethtype (Ethernet type) ◆ 4: vlan4 (Layer 4 VLAN) ◆ 5: vlan3 (Layer 3 VLAN) ◆ 6: vlan2 (Layer 2 VLAN) ◆ 7: vlan1 (Layer 1 VLAN) ◆ 8: TOS (service type) ◆ 10: TTL (Time-to-Live) ◆ 11: protocol type ◆ 12: sip (source IP address) ◆ 14: dip (destination IP address) ◆ 16: L4srcport (Layer 4 source port number) ◆ 17: L4dstport (Layer 4 destination port number) ◆ 18: cos4 (Priority level 4) ◆ 19: cos3 (Priority level 3) ◆ 20: cos2 (Priority level 2) ◆ 21: cos2 (Priority level 1) ◆ 22: based on the destination IPv6 address prefix classification (DA IPv6 Prefix) ◆ 23: based on the source IPv6 address prefix classification (SA IPv6 Prefix) ◆ 24: based on the IP version (v4 or v6) classification (IP version) ◆ 25: based on the IP priority field (IPv6) classification (IPv6 Traffic Class) ◆ 26: based on the IP flow label field (IPv6 Flow Label) ◆ 27: based on next packet header (IPv6 Next Header)	Mandatory	1
	`value <value>`	The value of the selected downlink domain. Enter the value according to the domain type.	Mandatory	000000000000

Procedure	Parameter	Description	Attribute	Example	
	`condition <condition>`	The downlink operator. The value ranges from 0 to 7, and the default value is 5. ◆ 0: Never (never match) ◆ 1: = (equal to) ◆ 2: != (not equal to) ◆ 3: <= (smaller than or equal to) ◆ 4: >= (larger than or equal to) ◆ 5: exist (exist means match) ◆ 6: no exist (not exist means match) ◆ 7: always (always match)	Mandatory	5	
Configuring the service VLAN for the QinQ domain	`vlan <1-4>`	The VLAN layer No., i.e., the number of the current VLAN layer. Services can be configured on up to four VLAN layers. The value ranges from 1 to 4.	Mandatory	1	2
	`user-vlanid [<0-4085>|null]`	The original VLAN ID	Mandatory	101	null
	`user-cos [<0-7>|null]`	The CoS value. null: no configuration. The value ranges from 0 to 7, and the default value is 0.	Mandatory	0	null
	`[add|translation|transparent]`	Action of the VLAN at the selected layer ◆ add: adding ◆ translation: translation ◆ transparent: transparent transmission	Mandatory	trans-parent	add
	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 1 to 0xfffe.	Mandatory	33024	33024
	`cos [<cos>|null]`	The CoS value. null: no configuration. The value ranges from 0 to 7, and the default value is 0.	Mandatory	null	null
	`vlanid [<vlanid>|null]`	The new VLAN ID. null: no configuration. The value ranges from 1 to 4085.	Mandatory	null	600

Example

1. Create a QinQ domain named **qinqdomain**.

```
Admin(config)#oltqinq-domain add qinqdomain
```

2. Set the service quantity to 1 for the QinQ domain named "qinqdomain".

```
Admin(config)#oltqinq-domain modify qinqdomain service-count 1
```

3. Configure the uplink rule for the OLT QinQ domain "qinqdomain". Configure the first service, setting the uplink rule type to 1, the selected uplink domain value to the MAC address 000000000000, the uplink operator to 5, and the service ID to 1.

```
Admin(config)#oltqinq-domain qinqdomain service 1 classification upstream field-id 1
value 000000000000 condition 5 serv-id 1
```

4. Configure the downlink rule for the OLT QinQ domain "qinqdomain". Configure the first service, setting the downink rule type to 1, the selected downlink domain value to the MAC address 000000000000, and the uplink operator to 5.

```
Admin(config)#oltqinq-domain qinqdomain service 1 classification downstream field-id 1
value 000000000000 condition 5
```

5. Configure the service VLAN for the QinQ domain. Configure the first service as follows. Set the original VLAN ID of the first layer VLAN to 101, the CoS value to 0, the VLAN mode to "transparent", the TPID to 33024, and the CoS to "null". Set the new VLAN ID to "null", the second layer VLAN action to "add", the VLAN ID to "600", the TPID to "33024", and the CoS value to "null".

```
Admin(config)#oltqinq-domain qinqdomain service 1 vlan 1 user-vlanid 101 user-cos 0
transparent tpid 33024 cos null vlanid null vlan 2 user-vlanid null user-cos null add tpid
33024 cos null vlanid 600
Admin(config)#
```

10.3.3 Binding the QinQ Domain to the ONU

Command Format

```
onu oltqinq-domain <onuid> <name>
```

Planning Data

Parameter	Description	Attribute	Example
<onuid>	ONU authorization No.	Mandatory	1
<name>	Name of QinQ domain	Mandatory	qinqdomain

Example

Bind the domain "qinqdomain" to ONU 1 under PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config-if-pon-1/1/1)#onu oltqinq-domain 1 qinqdomain
Admin(config-if-pon-1/1/1)#
```

10.3.4 Configuring Parameters of Data Services at the ONU Ports

Command Format

Configure the quantity of services at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service count <service-count>
```

Configure the type of service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> type [multicast|
unicast]
```

Note:

The default service type is unicast. If multicast service is used, you need to configure it.

Configure the VLAN mode for the service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> [tag|transparent]
priority <priority> tpid <tpid> vid <vlanlist>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring quantity of services at the ONU port	`<onulist>`	ONU authorization No.	Mandatory	1
	`eth <onu-port>`	The ONU port number	Mandatory	1
	`service count <service-count>`	Quantity of services	Mandatory	1
Configuring VLAN mode for the service at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1

Procedure	Parameter	Description	Attribute	Example

	`[tag|`
	`transparent]`
		The service VLAN mode
		◆ tag: the TAG identifier
		◆ transparent: transparent transmission
			Mandatory	tag

	`priority`
	`<priority>`
		The CVLAN priority, ranging from 0 to 7. 7 stands for the highest priority level, and 0 the lowest one.	Mandatory	7

	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 0 to 65534, and the default value is 33024.	Mandatory	33024
	`vid <vlanlist>`	The CVLAN ID, ranging from 1 to 4085	Mandatory	101

Example

1. Configure the ONU with the authorization number 1 under PON Port 1 in Slot 1 of Subrack 1, adding a service to Port 1 of the ONU.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service count 1
Admin(config-if-pon-1/1/1)#
```

2. Configure the VLAN mode for Port 1 of ONU 1, setting the service ID to 1, the service VLAN mode to "tag", the priority level to 7, the tag protocol identifier to 33024, and the VLAN ID to 101.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 tag priority 7 tpid 33024
vid 101
Admin(config-if-pon-1/1/1)#
```

11 Configuring Multicast Services

This chapter introduces how to configure multicast services for the AN6000 Series.

- ☑ Background Information
- ☑ Configuration Rules
- ☑ Configuration Example of Multicast Services
- ☑ Configuration Example of SSM Multicast Services
- ☑ Optional Functions

11.1 Background Information

Multicast is a communication mode in which one copy of data packet is sent to multiple subscribers. Each multicast address stands for a multicast group, and all hosts in the multicast group can receive the same data from the multicast source.

Advantages of multicast service application:

- Saving bandwidth: There is only one copy of the same multicast data stream on each link. This can save the network bandwidth.
- Lessening the load: In the multicast mode, increase of subscribers does not visibly increase the burden on the network. This helps avoid heavy load on the video server and the CPU.
- Long-haul transmission: The multicast packets can be transmitted across network segments to allow long-haul transmission of massive data.
- Security: The multicast packets are transmitted only to the expected receivers, so as to guarantee the security of information.

11.2 Configuration Rules

The following describes the rules for global configuration of the multicast service for the AN6000 Series:

- When the multicast mode is disabled, the multicast subscribers cannot watch the programs in the multicast VLAN.
- The AN6000 Series support processing multicast protocol packets (including those requesting joining / leaving a multicast group and those for querying).
- The AN6000 Series support VLAN adding or translation for the subscriber protocol packets.
- The multicast mode is based on the VLAN. Different multicast modes can be set for different VLANs on the same equipment.
- Generally, default values can be used for the parameters in common or special multicast queries.
- The multicast SSM IP address is the multicast address, while the source IP address of SSM-Mapping is the unicast address.

11.3 Configuration Example of Multicast Services

This section uses an example to introduce how to configure multicast services in the proxy-snooping mode.

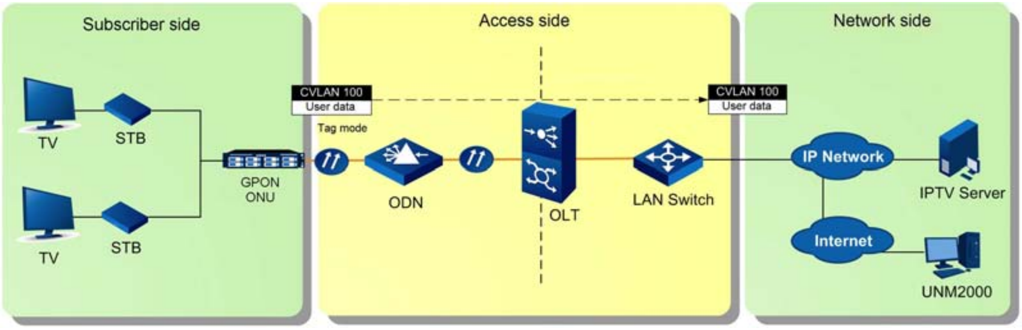
11.3.1 Network Scenario

Service Planning

Two subscribers are connected to the GPON ONU, and they can use the set top boxes (STB) to watch IPTV programs. The service in this case is the multicast service in the proxy-snooping mode. Accordingly, the OLT should work in the proxy-snooping mode.

Network Diagram

The figure below shows the network diagram for the multicast services implemented by the OLT in the proxy-snooping mode.



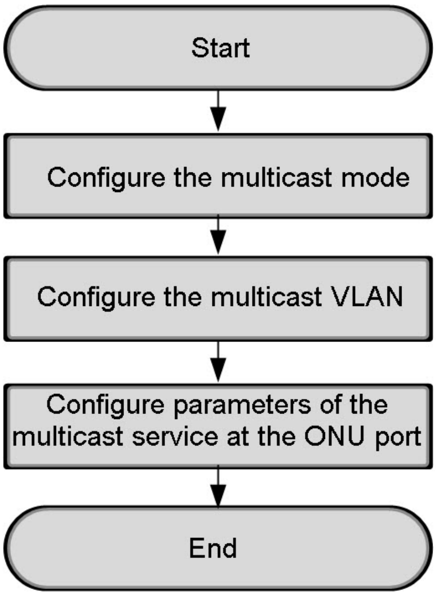
- In the downlink direction, the ONU strips the tag from the multicast stream (VLAN ID=100) on the OLT side, and transmits the stream to the set top box. The set top box then forwards the stream to video subscribers.
- In the uplink direction, the ONU attaches the tag (VLAN ID=100) to the multicast protocol packets requesting joining / leaving a multicast group received from the set top box, and transmits the packets to the OLT. The OLT then forwards the protocol packets to the IPTV server.

11.3.2 Configuration Flow

Prerequisites

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Configuration Flow


Start
Configure the multicast mode
Configure the multicast VLAN
Configure parameters of the multicast service at the ONU port
End

11.3.3 Configuring the Multicast Mode

Command Format

```
igmp mode [control|proxy-proxy|snooping|proxy-snooping|disable]
```

Data Planning

Parameter	Description	Attribute	Example
igmp mode [control|proxy-proxy|snooping|proxy-snooping|disable]	The multicast mode. ◆ control: controlled mode ◆ proxy-proxy: proxy-proxy mode ◆ snooping: snooping mode ◆ proxy-snooping: proxy-snooping mode ◆ disable: disabled mode	Mandatory	proxy-snooping

Example

Set the multicast mode to proxy-snooping mode.

```
Admin(config-igmp)#igmp mode proxy-snooping
Admin(config-igmp)#
```

11.3.4 Configuring the Multicast VLAN

Command Format

```
igmp vlan {[default]}*1 {<value>}*1
```

Planning Data

Parameter	Description	Attribute	Example
igmp vlan {[default]}*1	The default multicast VLAN	Optional	-
{<value>}*1	The multicast VLAN, ranging from 1 to 4085	Optional	100

Example

Set the multicast VLAN to 100.

```
Admin(config-igmp)#igmp vlan 100
Admin(config-igmp)#
```

11.3.5 Configuring Parameters of Multicast Service at the ONU Port

Command Format

Configure the quantity of services at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service count <service-count>
```

Configure the type of service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> type [multicast|
unicast]
```

Note:

The default service type is unicast. If multicast service is used, you need to configure it.

Configure the VLAN mode for the service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> [tag|transparent]
priority <priority> tpid <tpid> vid <vlanlist>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring quantity of services at the ONU port	`<onulist>`	ONU authorization No.	Mandatory	1
	`eth <onu-port>`	The ONU port number	Mandatory	1
	`service count <service-count>`	Quantity of services	Mandatory	1
Configuring services at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1
	`type [multicast|unicast]`	Type of service at the ONU port ◆ multicast: multicast service ◆ unicast: unicast service	Mandatory	multicast
Configuring VLAN mode for the service at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1
	`[tag|transparent]`	The service VLAN mode ◆ tag: the TAG identifier ◆ transparent: transparent transmission	Mandatory	tag
	`priority <priority>`	The CVLAN priority, ranging from 0 to 7. 7 stands for the highest priority level, and 0 the lowest one.	Mandatory	0
	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 0 to 65534, and the default value is 33024.	Mandatory	33024
	`vid <vlanlist>`	The CVLAN ID, ranging from 1 to 4085	Mandatory	100

Example

1. Configure the ONU with the authorization number 1 under PON Port 1 in Slot 1 of Subrack 1, adding a service to Port 1 of the ONU.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service count 1
Admin(config-if-pon-1/1/1)#
```

2. Set the type of Service 1 at Port 1 of ONU 1 to "multicast". The ONU is connected to PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 type multicast
```

3. Configure the VLAN mode for Port 1 of ONU 1, setting the service ID to 1, the service VLAN mode to "tag", the priority level to 0, the tag protocol identifier to 33024, and the VLAN ID to 100.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 tag priority 0 tpid 33024
vid 100
Admin(config-if-pon-1/1/1)#
```

11.4 Configuration Example of SSM Multicast Services

This section uses an example to introduce how to configure a source-specific multicast (SSM) service.

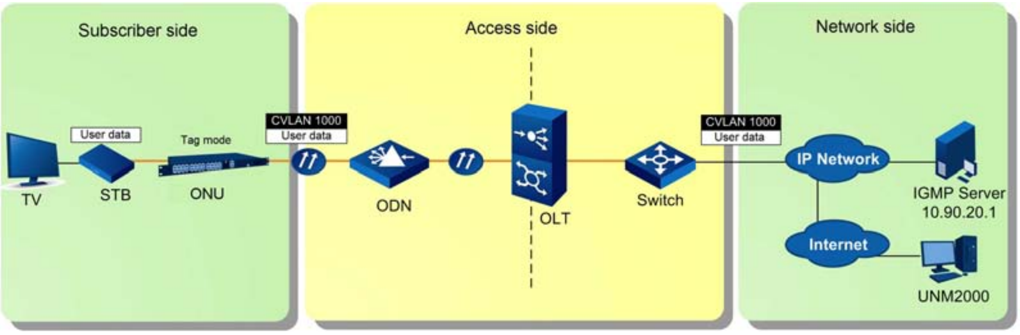
11.4.1 Network Scenario

Service Planning

A subscriber needs to watch the IPTV programs in the SSM multicast mode using the set top box. The subscriber is connected to the OLT equipment via an ONU.

Network Diagram

The network diagram for the SSM multicast service is shown in the figure below.



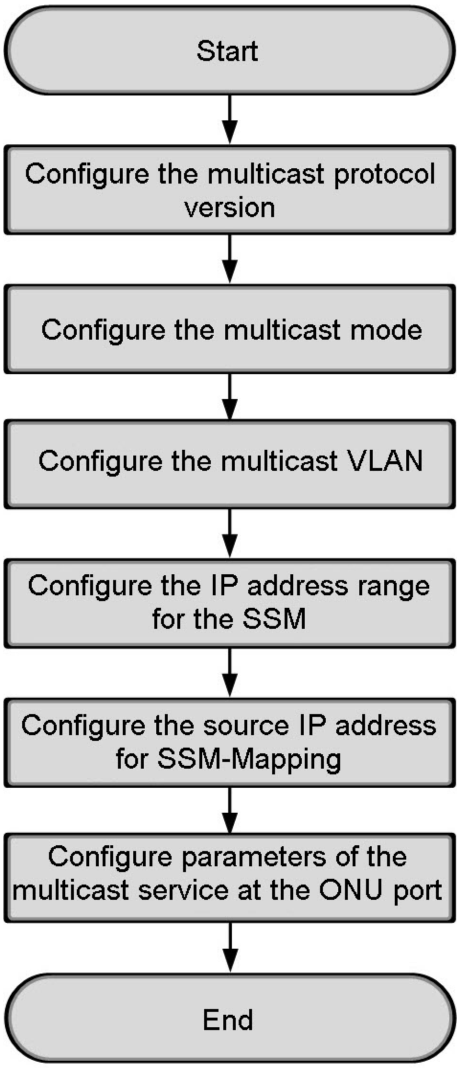
- In the downlink direction, the multicast SPT (Shortest Path Tree) is set up between the multicast source and the OLT equipment. The multicast source 10.90.20.1 provides the SSM service for the subscriber connected to the OLT. The ONU strips the VLAN tag from the multicast packets and then forwards the packets to the set top box on the subscriber side.
- In the uplink direction, the ONU adds the tag to the multicast protocol packets requesting joining / leaving a multicast group received from the set top box, and sends the packets to the OLT equipment. The OLT then forwards the protocol packets to the IPTV server.

11.4.2 Configuration Flow

Prerequisites

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Configuration Flow


Start
Configure the multicast protocol version
Configure the multicast mode
Configure the multicast VLAN
Configure the IP address range for the SSM
Configure the source IP address for SSM-Mapping
Configure parameters of the multicast service at the ONU port
End

11.4.3 Configuring the Multicast Protocol Version

Command Format

```
igmp version [v1|v2|v3]
```

Planning Data

Parameter	Description	Attribute	Example
`igmp version [v1|v2|v3]`	The multicast protocol version ◆ v1: IGMP Version 1 ◆ v2: IGMP Version 2 ◆ v3: IGMP Version 3	Mandatory	v3

Example

Set the multicast protocol version to IGMP Version 3.

```
Admin(config-igmp)#igmp version v3
Admin(config-igmp)#
```

11.4.4 Configuring the Multicast Mode

Command Format

```
igmp mode [control|proxy-proxy|snooping|proxy-snooping|disable]
```

Data Planning

Parameter	Description	Attribute	Example
igmp mode [control|proxy-proxy|snooping|proxy-snooping|disable]	The multicast mode. ◆ control: controlled mode ◆ proxy-proxy: proxy-proxy mode ◆ snooping: snooping mode ◆ proxy-snooping: proxy-snooping mode ◆ disable: disabled mode	Mandatory	proxy-proxy

Example

Set the multicast mode to the proxy mode.

```
Admin(config-igmp)#igmp mode proxy-proxy
Admin(config-igmp)#
```

11.4.5 Configuring the Multicast VLAN

Command Format

```
igmp vlan {[default]}*1 {<value>}*1
```

Planning Data

Parameter	Description	Attribute	Example
igmp vlan {[default]}*1	The default multicast VLAN	Optional	-
{<value>}*1	The multicast VLAN, ranging from 1 to 4085	Optional	1000

Example

Set the multicast VLAN to 1000.

```
Admin(config-igmp)#igmp vlan 1000
Admin(config-igmp)#
```

11.4.6 Configuring the Multicast SSM IP Address Range

Command Format

```
igmp-ssm ip-range <ipaddr/m>
```

Planning Data

Parameter	Description	Attribute	Example
igmp-ssm ip-range <ipaddr/m>	The SSM IP address range, i.e., the multicast addresses.	Mandatory	239.0.0.0/16

Example

Set the multicast SSM IP address range to 239.0.0.0/16.

```
Admin(config-igmp)#igmp-ssm ip-range 239.0.0.0/16
Admin(config-igmp)#
```

11.4.7 Configuring the Source IP Address of Multicast SSM-Mapping

Command Format

```
igmp ssm-map <ipaddr>
```

Planning Data

Parameter	Description	Attribute	Example
ssm-map <ipaddr>	The SSM-Mapping source IP address, i.e., the unicast address	Mandatory	10.90.20.1

Example

Set the source IP address of multicast SSM-Mapping to 10.90.20.1.

```
Admin(config-igmp)#igmp ssm-map 10.90.20.1
Admin(config-igmp)#
```

11.4.8 Configuring Parameters of Multicast Service at the ONU Port

Command Format

Configure the quantity of services at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service count <service-count>
```

Configure the type of service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> type [multicast|
unicast]
```

Note:

The default service type is unicast. If multicast service is used, you need to configure it.

Configure the VLAN mode for the service at the ONU port.

```
onu port vlan <onulist> eth <onu-port> service <serviceid> [tag|transparent]
priority <priority> tpid <tpid> vid <vlanlist>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring quantity of services at the ONU port	`<onulist>`	ONU authorization No.	Mandatory	1
	`eth <onu-port>`	ONU port No.	Mandatory	1
	`service count <service-count>`	Quantity of services	Mandatory	1
Configuring services at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1

Procedure	Parameter	Description	Attribute	Example
	`type [multicast| unicast]`	Type of service at the ONU port ◆ multicast: multicast service ◆ unicast: unicast service	Mandatory	multicast
Configuring VLAN mode for the service at the ONU port	`service <serviceid>`	The service ID, ranging from 1 to 10	Mandatory	1
	`[tag| transparent]`	The service VLAN mode ◆ tag: the TAG identifier ◆ transparent: transparent transmission	Mandatory	tag
	`priority <priority>`	The CVLAN priority, ranging from 0 to 7. The value 7 stands for the highest priority level, and 0 the lowest one.	Mandatory	5
	`tpid <tpid>`	The TPID, i.e, the tag protocol identifier. The value ranges from 0 to 65534, and the default value is 33024.	Mandatory	33024
	`vid <vlanlist>`	The CVLAN ID, ranging from 1 to 4085	Mandatory	1000

Example

1. Configure the ONU with the authorization number 1 under PON Port 1 in Slot 1 of Subrack 1, adding a service to Port 1 of the ONU.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service count 1
Admin(config-if-pon-1/1/1)#
```

2. Set the type of Service 1 at Port 1 of ONU 1 to "multicast". The ONU is connected to PON Port 1 in Slot 1 of Subrack 1.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 type multicast
```

3. Configure the VLAN mode for Port 1 of ONU 1, setting the service ID to 1, the service VLAN mode to "tag", the priority level to 5, the tag protocol identifier to 33024, and the VLAN ID to 1000.

```
Admin(config-if-pon-1/1/1)#onu port vlan 1 eth 1 service 1 tag priority 5 tpid 33024
vid 1000
Admin(config-if-pon-1/1/1)#
```

11.5 Optional Functions

This section introduces how to configure optional functions for the multicast service on the AN6000 Series.

11.5.1 Configuring the Multicast Cascade Port

Command Format

```
igmp cascade slot <slotno> port <portno>
```

Planning Data

Parameter	Description	Attribute	Example
slot <slotno>	Slot number	Mandatory	19
port <portno>	The number of the uplink port	Mandatory	1

Example

Set the multicast cascade port to Port 1 in Slot 19.

```
Admin(config-igmp)#igmp cascade slot 19 port 1
Admin(config-igmp)#
```

11.5.2 Configuring OLT Multicast Protocol Parameters

Command Format

```
igmp parameters [robustness|old|last-query-interval|last-query-count|
query-interval|query-response-interval] <value>
```

Planning Data

Parameter	Description	Attribute	Example
igmp parameters [robustness|old|last-query-interval|last-query-count|query-interval|query-response-interval]	Configuring multicast protocol parameters ◆ robustness: the robustness parameter ◆ old: the aging time for the group member ◆ last-query-interval: the last query interval ◆ last-query-count: the count of last queries ◆ query-interval: the common query interval ◆ query-response-interval: the common query response time	Mandatory	robustness
<value>	The protocol parameter value ◆ robustness: 2 to 16 ◆ old: 0 / 1 ◆ last-query-interval: 1 to 255 (unit: s) ◆ last-query-count: 1 to 16 ◆ query-interval: 11 to 255 (unit: s) ◆ query-response-interval: 1 to 255 (unit: s)	Mandatory	2

Example

Set the OLT multicast protocol robustness parameter to 2.

```
Admin(config-igmp)#igmp parameters robustness 2
Admin(config-igmp)#
```

11.5.3 Configuring ONU Multicast Parameters

Command Format

```
igmp port <frameid/slotid/portid> <onu> <port> {[control] [enable|disable]}
*1 {[bandwidth] <0-100000>}*1 {[leave] [fast|non-fast]}*1 {[max-group]
<groupno>}*1 {[signal-vlan] <vlanno>}*1
```

Data Planning

Parameter	Description	Attribute	Example
<frameid/slotid/-portid>	The subrack number / slot number / port number.	Mandatory	1/1/1
<onu>	The ONU authorization number.	Optional	1
<port>	The ONU port number.	Mandatory	1

Parameter	Description	Attribute	Example
{[control] [enable|disable]}*1	The controlled mode. Enable or disable the mode.	Optional	-
{[bandwidth] <0-100000>}*1	The maximum bandwidth. The value ranges from 0 to 100000.	Optional	-
{[leave] [fast|non-fast]}*1	The leaving mode. ◆ fast: leaving fast ◆ non-fast: leaving normally	Optional	non-fast
{[max-group] <groupno>}*1	The maximum number of the groups. The value ranges from 0 to 254.	Optional	31
{[signal-vlan] <vlanno>}*1	The signaling VLAN, ranging from 0 to 4085.	Optional	-

Example

Set the leaving mode to "non-fast" for Port 1 of ONU 1 under PON Port 1 in Slot 1 of Subrack 1, and set the maximum number of online groups to 31.

```
Admin(config-igmp)#igmp port 1/1/1 1 1 leave non-fast max-group 31
Admin(config-igmp)#
```

11.5.4 Configuring the Prejoin Group

Command Format

```
igmp prejoin <groupaddress>
```

Planning Data

Parameter	Description	Attribute	Example
prejoin <groupaddress>	The address of the prejoin group	Mandatory	224.1.1.1

Example

Set the address of the prejoin group to 224.1.1.1.

```
Admin(config-igmp)#igmp prejoin 224.1.1.1
Admin(config-igmp)#
```

12 Configuring Wi-Fi Services

This chapter introduces how to configure Wi-Fi services for the AN6000 Series.

☑ Network Scenario

☑ Configuration Flow

☑ Configuring WAN Connection Service at a TL1 Interface

☑ Configuring a Wi-Fi Service

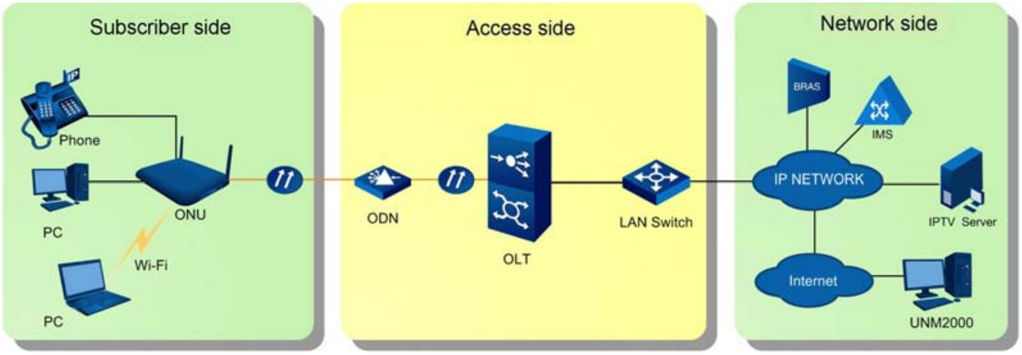
12.1 Network Scenario

Service Planning

Use the ONU supporting the Wi-Fi function to provide the Wi-Fi connection service for fiber broadband family subscribers and access other user terminals.

Network Diagram

The figure below shows the network diagram for the Wi-Fi service on the AN6000 Series.



The wireless terminal equipment accesses the network via the Wi-Fi interface of the ONU.

- Uplink direction:

  The ONU is connected to the OLT equipment via the GPON interface to provide integrated access services.

- Downlink direction:

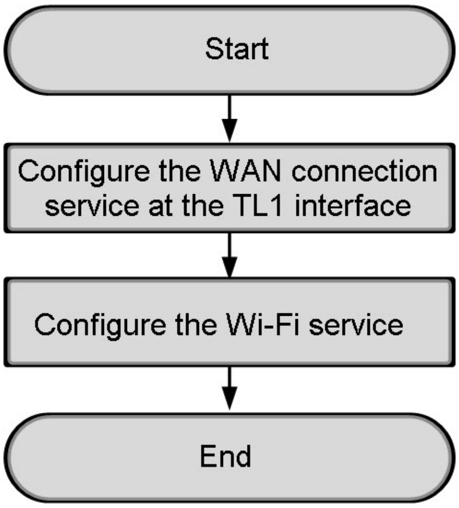
  The ONU is connected to the wireless equipment via the Wi-Fi interface to access the Wi-Fi service.

12.2 Configuration Flow

Prerequisites

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Configuration Flow


Start
Configure the WAN connection service at the TL1 interface
Configure the Wi-Fi service
End

12.3 Configuring WAN Connection Service at a TL1 Interface

Format

```
onu wan-cfg <onuid> index <value> mode [tr069|internet|tr069-internet|
other|multi|voip|voip-internet|iptv|radius|radius-internet|unicast-
iptv|multicast-iptv] type [bridge|route] <vid> <cos> nat [enable|disable]
qos [enable|disable] {vlanmode [tag|transparent] tvlan [enable|disable]
<tvid> <tcos>}*1 {qinq [enable|disable] <stpid> <svlan> <scos>}*1 dsp
{[dhcp]}*1 {[dhcp-remoteid] <dhcp-remoteid>}*1 {[static] ip <A.B.C.D> mask
<A.B.C.D> gate <A.B.C.D> master <A.B.C.D> slave <A.B.C.D>}*1 {[pppoe] proxy
[enable|disable] <username> <password> <servname> [auto|payload|manual]}*1
{[null]}*1 {[active] [enable|disable]}*1 {[service-type] <service-type>}*1
{[entries] <bind-num>}*1 {[fe1|fe2|fe3|fe4|ssid1|ssid2|ssid3|ssid4]}*8
{[ssid5|ssid6|ssid7|ssid8]}*4
onu ipv6-wan-cfg <onuid> index <value> ip-stack-mode [ipv4|ipv6|both] ipv6-
src-type [dhcpv6|slaac] prefix-src-type [delegate|static] {[pppoe-
authmode] [pap|chap|mschap|auto]}*1} {[pppoe-idletime] <value>}*1 {[ipv6-
address] <ip/mask> ipv6-gateway <gateway> ipv6-master-dns <masterdns> ipv6-
slave-dns <slavedns> ipv6-static-prefix <ip/mask>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`<onuid>`	ONU authorization number	Mandatory	1
`index <value>`	WAN connection index	Mandatory	1

Parameter	Description	Attribute	Example
`mode [tr069|internet|tr069-internet|other|multi|voip|voip-internet|iptv|radius|radius-internet|unicast-iptv|multicast-iptv]`	WAN connection mode	Mandatory	internet
`type [bridge|route]`	WAN connection type ◆ bridge: Layer 2 bridge connection mode ◆ route: Layer 3 route connection mode	Mandatory	route
`<vid>`	VLAN ID for the WAN connection; value range: 1 to 4085, or 0xffff (null)	Mandatory	1
`<cos>`	802.1p priority for the WAN connection; value range: 0 to 7, or 0xffff (null)	Mandatory	1
`nat [enable|disable]`	NAT switch for the WAN connection ◆ enable ◆ disable	Mandatory	enable
`qos [enable|disable]`	QoS switch for the WAN connection ◆ enable ◆ disable	Mandatory	-
`vlanmode [tag|transparent]`	VLAN mode	Optional	-
`tvlan [enable|disable]`	Translation state (enabled or disabled) ◆ enable ◆ disable	Optional	-
`<tvid>`	Translated VLAN ID; value ranges:1 to 4085, or 0xffff (null)	Optional	-
`<tcos>`	Priority or CoS inside the PON; value range: 0 to 7, or 0xffff (null)	Optional	-
`qinq [enable|disable]`	QinQ state ◆ enable ◆ disable	Optional	-
`<stpid>`	Tag protocol identifier; value range: 0 to 0xfffe	Optional	-
`<svlan>`	SVLAN ID; value range: 1 to 4085, or 0xffff (null)	Optional	-
`<scos>`	Priority or CoS inside the PON; value range: 0 to 7, or 0xffff (null)	Optional	-

Parameter	Description	Attribute	Example
{[dhcp]}*1	DHCP mode switch	Optional	dhcp
{[dhcp-remoteid] <dhcp-remoteid>}*1	DHCP remote identifier, a character string no longer than 10 bytes	Optional	-
[static]	Static mode switch	Optional	-
ip <A.B.C.D>	Static IP address for the WAN connection	Optional	-
mask <A.B.C.D>	Subnet mask for the WAN connection	Optional	-
gate <A.B.C.D>	Default gateway for the WAN connection	Optional	-
master <A.B.C.D>	Preferred DNS for the WAN connection	Optional	-
slave <A.B.C.D>	Standby DNS for the WAN connection	Optional	-
[pppoe]	PPPOE mode switch	Optional	-
proxy [enable| disable]	PPPOE proxy switch for the WAN connection	Optional	-
<username>	User name for the PPPOE connection, with no more than 64 characters	Optional	-
<password>	Password for the PPPoE connection, with no more than 64 characters	Optional	-
<servname>	Name of the PPPoE service, with no more than 32 characters	Optional	-
[auto|payload| manual]	PPPoE dialing mode ◆ auto: automatically connected ◆ payload: connected when payload is detected ◆ manual: manually connected	Optional	-
{[service-type] <service-type>}*1	Service type	Optional	-
{[entries] <bind-num>}*1	Quantity of ports bound; value range: 0 to 8. Enter 0 to delete the port(s), and enter 1 to 8 to set the port quantity.	Optional	1
{[fe1|fe2|fe3|fe4| ssid1|ssid2|ssid3| ssid4]}*8	Bound Ethernet port / SSID port	Optional	fe1
{[ssid5|ssid6|ssid7| ssid8]}*4	Bound SSID port	Optional	-
ip-stack-mode [ipv4| ipv6|both]	Protocol stack type for the WAN connection	Mandatory	ipv6
ipv6-src-type [dhcpv6|slaac]	Source of the IPv6 address	Mandatory	slaac
prefix-src-type [delegate|static]	Source of the IPv6 address prefix	Mandatory	delegate

Parameter	Description	Attribute	Example
`{[pppoe-authmode] [pap|chap|mschap| auto]}*1}`	PPPoE authentication mode	Optional	-
`{[pppoe-idletime] <value>}*1`	PPPoE idle timeout (specifies how long the PPPoE connection remains up without transmitting data before disconnecting); value range: 0 to 2000	Optional	-
`[ipv6-address] <ip/mask>`	IPv6 address for the WAN connection	Optional	-
`ipv6-gateway <gateway>`	Default IPv6 gateway for the WAN connection	Optional	-
`ipv6-master-dns <masterdns>`	Preferred IPv6 DNS for the WAN connection	Optional	-
`ipv6-slave-dns <slavedns>`	Standby IPv6 DNS for the WAN connection	Optional	-
`ipv6-static-prefix <ip/mask>`	IPv6 prefix pool for the WAN connection	Optional	-

Example

- Configure a WAN connection service for ONU 1 under PON port 1 in slot 1 of subrack 1. Set the WAN connection index to 1, WAN connection mode to "internet", WAN connection type to "route", VLAN ID for the WAN connection to 1, and 802.1p priority for the WAN connection to 1. Enable NAT and DHCP, and disable QoS for the WAN connection. Set the quantity of bound ports to 1, and the port bound to "FE1".

```
Admin(config-if-pon-1/1/1)#onu wan-cfg 1 index 1 mode internet type route 1 1 nat enable qos disable dsp dhcp entries 1 fe1
Admin(config-if-pon-1/1/1)#
```

- Configure the WAN connection service for ONU 1 under PON port 1 in slot 1 of subrack 1. Set the WAN connection index to 1, the protocol stack type for WAN connection to "ipv6", the IPv6 address source to "slaac", and the prefix source to "delegate".

```
Admin(config-if-pon-1/1/1)#onu ipv6-wan-cfg 1 index 1 ip-stack-mode ipv6 ipv6-src-type slaac prefix-src-type delegate
Admin(config-if-pon-1/1/1)#
```

12.4 Configuring a Wi-Fi Service

Format

Configure a Wi-Fi service on an ONU.

```
onu wifi attribute <onuid> {[serv-no] <servno>} wifi [enable|disable]
district [etsi|fcc|thailand|philippines|indonesia|brazil|india|armenia|
malaysia|pakistan|russian|china|chile|usa|myanmar|ecuador|colombia|
argentina|stilanka|iran|yemen|saudiarabia|kuwait|iraq] channel <0-165>
{[standard] [802.11b|802.11g|802.11b/g|802.11n|802.11bgn|802.11a|
802.11an|802.11ac]}*1 {[txpower] [<0-40>|<65535>]}*1 {[frequency][2.4ghz|
5.8ghz]}*1 {[freq-bandwidth] [20mhz|40mhz|20mhz/40mhz|80mhz]}*1
```

Configure a WLAN service on an ONU.

```
onu wifi connection <onuid> {[serv-no] <servno>} index <1-4> ssid [enable|
disable] [<ssid>|null] hide [enable|disable] authmode [open|shared|
wepauto|wpa-psk|wpa|wpa2psk|wpa2|wpa/wpa2|wpa-psk/wpa2psk|wpa-psk/
wpapsk2|waipsk|wai] encrypt-type [none|wep|tkip|aes|tkipaes|wpi] wpakey
[<wpakey>|null] interval <0-4194303> {[radius-serv] [unknown|ipv4|ipv6|
ipv4z|ipv6z|dns] <radius-serv> port <0-65535> pswd [<pswd>|null]}*1 {[wep-
length] [40bit|104bit] key-index <1-4> wep-key [<wep-key1>|null] [<wep-
key2>|null] [<wep-key3>|null] [<wep-key4>|null]}*1 {[wapi-serv-addr] <A.B.
C.D> <0-65535>}*1 {[wifi-connect-num] <num>}*1
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring a Wi-Fi service on an ONU	`<onuid>`	ONU authorization number	Mandatory	1
	`{[serv-no] <servno>}`	Sequence number of a service	Optional	1
	`wifi [enable|disable]`	Wi-Fi switch ◆ enable ◆ disable	Mandatory	enable

Procedure	Parameter	Description	Attribute	Example
	district [etsi|fcc|thailand|philippines|indonesia|brazil|india|armenia|malaysia|pakistan|russian|china|chile|usa |myanmar|ecuador|colombia|argentina|stilanka|iran|yemen|saudiarabia|kuwait|iraq]	Wireless area; default setting: etsi ◆ etsi: Europe (ETSI) ◆ fcc: North America (FCC) ◆ thailand: THAILAND ◆ philippines: PHILIPPINES ◆ indonesia: INDONESIA ◆ brazil: BRAZIL ◆ india: INDIA ◆ armenia: ARMENIA ◆ malaysia: MALAYSIA ◆ pakistan: PAKISTAN ◆ russian: RUSSIAN FEDERATION ◆ china: CHINA ◆ chile: CHILE ◆ usa: UNITED STATES ◆ myanmar: MYANMAR ◆ ecuador: ECUADOR ◆ colombia: COLOMBIA ◆ argentina: ARGENTINA ◆ stilanka: SRI LANKA ◆ iran: THE ISLAMIC REPUBLIC OF IRAN ◆ yemen: YEMEN ◆ saudiarabia: SAUDI ARABIA ◆ kuwait: KUWAIT ◆ iraq: IRAQ	Mandatory	etsi
	channel <0-165>	Number of the wireless channel occupied by the service	Mandatory	0
	{[standard] [802.11b|802.11g|802.11b/g|802.11n|802.11bgn|802.11a|802.11an|802.11ac]}*1	Wireless standard; default setting: 802.11bgn	Optional	802.11bgn

Procedure	Parameter	Description	Attribute	Example
	{[txpower] [<0-40>|<65535>]}*1	Tx power (unit: dBm) ◆ 4: 20% ◆ 8: 40% ◆ 12: 60% ◆ 16: 80% ◆ 20: 100% ◆ 24: 120% ◆ 28: 140% ◆ 32: 160% ◆ 36: 180% ◆ 40: 200%	Optional	20
	{[frequency][2.4ghz|5.8ghz]}*1	Working frequency	Optional	2.4ghz
	{[freq-bandwidth] [20mhz|40mhz|20mhz/40mhz|80mhz]}*1	Frequency bandwidth	Optional	20mhz/40mhz
Configuring a WLAN service on an ONU	<onuid>	ONU authorization number	Mandatory	1
	{[serv-no] <servno>}	Sequence number of a service	Optional	1
	index <1-4>	SSID index; value range: 1 to 4	Mandatory	1
	ssid [enable|disable]	SSID switch ◆ enable ◆ disable	Mandatory	enable
	[<ssid>|null]	Service set identifier, i.e., name of a wireless local area network. SSIDs are used to identify networks. Only those who have passed the identity verification can access the corresponding network. This helps prevent the access of unauthorized persons. An SSID contains no more than 32 characters.	Mandatory	2

Procedure	Parameter	Description	Attribute	Example
	`hide [enable|disable]`	Switch for hiding or unhiding an SSID. If the SSID is hidden, the user's PC will not find it. Nevertheless, the user can connect the PC to the wireless network by configuring the SSID manually. ◆ enable: Hide ◆ disable: Unhide	Mandatory	enable
	`authmode [open|shared|wepauto|wpa-psk|wpa|wpa2psk|wpa2|wpa/wpa2|wpa-psk/wpa2psk|wpa-psk/wpapsk2|waipsk|wai]`	WLAN authentication mode	Mandatory	open
	`encrypt-type [none|wep|tkip|aes|tkipaes|wpi]`	WLAN encryption type	Mandatory	none
	`wpakey [<wpakey>|null]`	Pre-shared key for Wi-Fi protected access (WPA). WPA is an upgraded version of WEP with enhanced key protection and 802.1x protocol. Set it to NULL or a character string no longer than 64 bytes. This field is valid only when the authentication mode is WPAPSK or WPA2PSK.	Mandatory	null
	`interval <0-4194303>`	WAP pre-shared key renewal interval (unit: second); value range: 0 to 4194303; default value: 86400	Mandatory	86400
	`[radius-serv] [unknown|ipv4|ipv6|ipv4z|ipv6z|dns]`	RADIUS server, represented by a general INTERNET address	Optional	-
	`<radius-serv> port <0-65535>`	RADIUS server port; value range: 0 to 65535; default value: 0	Optional	-
	`pswd [<pswd>|null]`	RADIUS server password, a character string of no more than 32 bytes	Optional	-

Procedure	Parameter	Description	Attribute	Example
	[wep-length] [40bit|104bit]	WEP key length (unit: bit). This field is valid only when the encryption mode is WEP.	Optional	-
	key-index <1-4>	Key index. This field is valid only when the encryption mode is WEP. Value range: 1 to 4; default value: 1.	Optional	-
	wep-key [<wep-key1>|null] [<wep-key2>|null] [<wep-key3>|null] [<wep-key4>|null]	WEP keys. The values should be NULL or character strings with no more than 32 bytes. ◆ <wep_key1>: the first WEP key ◆ <wep_key2>: the second WEP key ◆ <wep_key3>: the third WEP key ◆ <wep_key4>: the fourth WEP key	Optional	-
	[wapi-serv-addr] <A.B.C.D>	IP address of the WAPI authentication server	Optional	-
	<0-65535>	Port of the WAPI authentication server; value range: 0 to 65535	Optional	-
	{[wifi-connect-num] <num>}*1	Quantity of Wi-Fi connections; value range: 0 to 32	Optional	-

Example

1. Enable Wi-Fi for ONU 1 under PON port 1 in slot 1 of subrack 1. Set the wireless area to "esti", the channel number to 0, the wireless standard to "802.11bgn", the Tx power to 20 dBm, the frequency to "2.4ghz", and the bandwidth to "20mhz/40mhz".

```
Admin(config-if-pon-1/1/1)#onu wifi attribute 1 serv-no 1 wifi enable district etsi channel 0 standard 802.11bgn txpower 20 frequency 2.4ghz freq-bandwidth 20mhz/40mhz
set hg wifi service ok!
Admin(config-if-pon-1/1/1)#
```

2. Configure a WLAN service for ONU 1 under PON port 1 in slot 1 of subrack 1. Set the SSID index to 1 with the SSID enabled, and the SSID to 2, with the SSID hidden. Then set the WLAN authentication mode to "open", the WLAN encryption type to "none", the WPA pre-shared key to "null", and the WPA key renewal interval to "86400" seconds.

```
Admin(config-if-pon-1/1/1)#onu wifi connection 1 serv-no 1 index 1 ssid enable 2 hide enable authmode open encrypt-type none wpakey null interval 86400
set hg wifi config ok!
```

```
Admin(config-if-pon-1/1/1)#
```

13 Configuring CATV Services

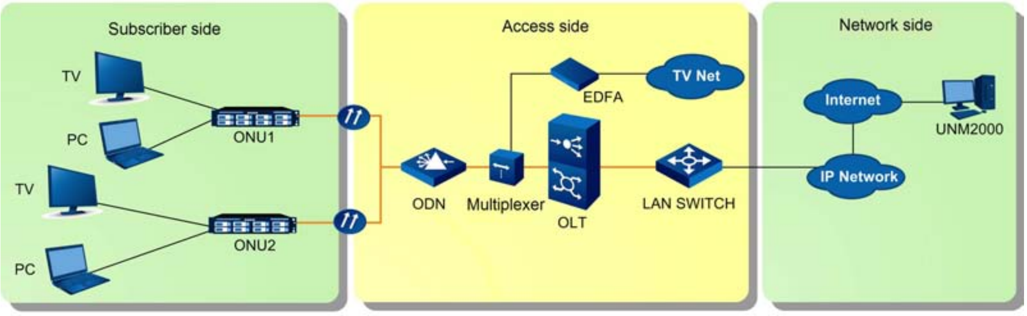
This chapter introduces how to configure CATV services for the AN6000 Series.

☑ Network Scenario

☑ Starting up the CATV Service

13.1 Network Scenario

The CATV service uses the WDM technology. Via a multiplexer, the TV signal is multiplexed with the data signal and voice signal. The downlink data wavelength is 1490 nm, the uplink data wavelength is 1310 nm, and the CATV signal wavelength is 1550 nm. The figure below shows the network diagram.



13.2 Starting up the CATV Service

Command Format

```
onu catv <onuid> [enable|disable] {catv-outp-offset <catv-outp-offset>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`<onuid>`	ONU authorization No.	Mandatory	3
`[enable|disable]`	◆ enable ◆ disable	Mandatory	enable
`{catv-outp-offset <catv-outp-offset>}*1`	The output level adjustment, ranging from -127 to127	Optional	1

Example

```
Admin(config-if-pon-1/2/1)#onu catv 3 enable catv-outp-offset 1
Admin(config-if-pon-1/2/1)#
```

14 Configuring Layer 3 Protocols

This chapter introduces how to configure Layer 3 protocols for the AN6000 Series.

☑ Configuring ARP Proxy

☑ Configuring DHCP

☑ Configuring DHCPv6 Relay

14.1 Configuring ARP Proxy

This section introduces how to configure the ARP proxy for the AN6000 Series.

14.1.1 Background Information

The Address Resolution Protocol (ARP) is an Internet protocol to map IP addresses into MAC addresses. IP address is the network-layer address of a computer. To send the network-layer data packets to the destination computer, the sending device must also know the physical address, i.e. MAC address of the destination computer. Accordingly, ARP is used to resolve a known IP address to a MAC address.

ARP Proxy is implemented as follows: A host sends an ARP request to another host located in the same network segment but not in the same physical network. Then the ARP Proxy-enabled device connected to the two hosts replies to the request. ARP Proxy allows isolated users in a VLAN or different Sub VLANs to communicate with each other. In this way, all the terminal equipment in the same network segment can communicate with each other. Meanwhile, the details of the physical network are unavailable, and the division of networks into subnets is transparent to hosts.

The ARP Proxy is applied in the following aspects:

- ◆ Enabling communication inside PON: ARP Proxy allows user traffics to be forwarded and connected based on Layer-3 routing inside the OLT, so that the isolated PON network users can communicate with each other. ARP Proxy specially applies to service scenarios requiring intercommunication such as voice services.
- ◆ Reducing upper-layer service flow and delay in network transmission: Layer-3 switching of local service flow can be implemented directly at the OLT to reduce the flow in the upper layer network.
- ◆ Simplifying network architecture: The Layer-2 aggregation switch is not needed, and this simplifies network architecture.
- ◆ Enhancing network security: The upper layer network cannot learn the MAC addresses on the user side, so that MAC spoofing and broadcast storm can be avoided.

14.1.2 Configuration Rules

The ARP proxy can be configured flexibly according to network planning. The configuration rules are as follows:

- Supports binding with multiple VLANs.
- Supports binding crossing network segments.
- Supports binding with multiple VLANs crossing network segments.

14.1.3 Network Scenario

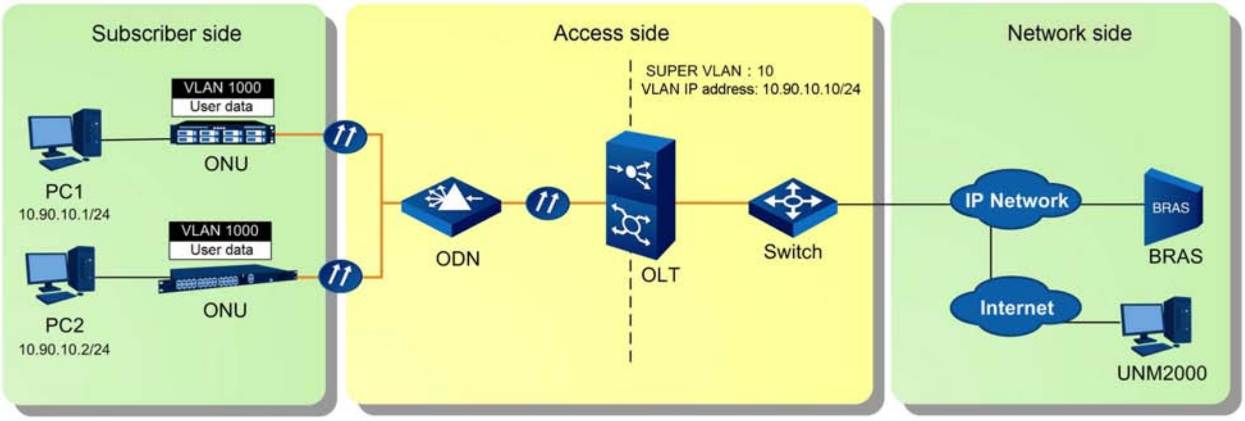
The following introduces how to configure and implement the ARP proxy function between user equipment, taking the most frequently used same-VLAN and same-network segment scenario as an example. The configurations of other scenarios are similar to this.

Service Planning

The OLT equipment serves as ARP proxy to allow internetworking among users in the same network segment (10.90.10.0/24) in the same VLAN. A Super VLAN is provided at the OLT equipment and bound with the Sub VLAN. The ARP proxy service is provided through L3 forwarding.

Network Diagram

The figure below shows the network diagram for ARP proxy in the same-VLAN and same-network segment application.



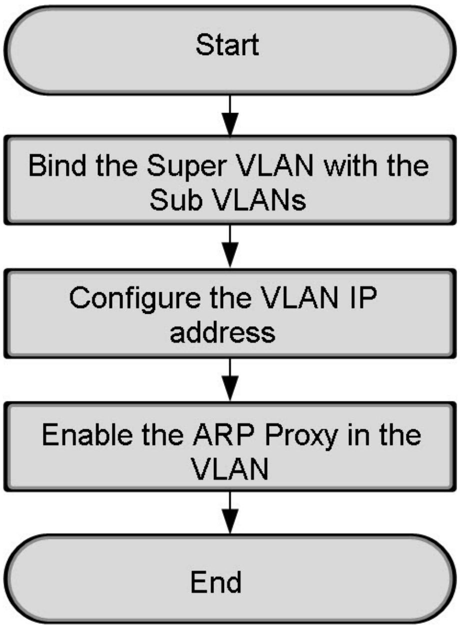
Two subscriber PCs, which belong to the same VLAN with the ID 1000, are connected to the OLT equipment via ONUs.The IP addresses of the two PCs are 10.90.10.1 and 10.90.10.2 respectively. Configure a Super VLAN and a Sub VLAN at the OLT equipment, and bind them together. After the VLAN IP address is set for the Super VLAN, the ARP proxy service can be provided by means of L3 forwarding.

14.1.4 Configuration Flow

Prerequisites

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Configuration Flow


Start
Bind the Super VLAN with the Sub VLANs
Configure the VLAN IP address
Enable the ARP Proxy in the VLAN
End

14.1.5 Binding the Super VLAN with the Sub VLANs

Command Format

Create a Super VLAN.

```
super-vlan <1 - 4095>
```

Bind the Super VLAN with the Sub VLANs.

```
super-vlan <svid> add sub-vlan <vid-begin> {<vid-end>}*1
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Creating a Super VLAN	`super-vlan <1 - 4095>`	The Super VLAN ID, ranging from 1 to 4095	Mandatory	10
Binding the Super VLAN with the Sub VLANs	`super-vlan <svid>`	The Super VLAN ID, ranging from 1 to 4095	Mandatory	10
	`sub-vlan <vid-begin>`	The starting value of the Sub VLAN ID range. The value ranges from 1 to 4085.	Mandatory	1000
	`{<vid-end>}*1`	The ending value of the Sub VLAN ID range. The value ranges from 1 to 4085.	Optional	-

Example

1. Create Super VLAN 10.

```
Admin(config)#super-vlan 10
```

2. Bind Super VLAN 10 with Sub VLAN 1000.

```
Admin(config)#super-vlan 10 add sub-vlan 1000
Admin(config)#
```

14.1.6 Configuring the VLAN IP Address

Command Format

```
super-vlan <1-4095> ip <A.B.C.D> mask <A.B.C.D>
```

Planning Data

Parameter	Description	Attribute	Example
`super-vlan <1 - 4095>`	The Super VLAN ID, ranging from 1 to 4095	Mandatory	10
`ip <A.B.C.D>`	IP address	Mandatory	10.90.10.10
`mask <A.B.C.D>`	Subnet mask	Mandatory	255.255.255.0

Example

Set the IP address of Super VLAN 10 to 10.90.10.10 and its subnet mask to 255.255.255.0.

```
Admin(config)#super-vlan 10 ip 10.90.10.10 mask 255.255.255.0
Admin(config)#
```

14.1.7 Enabling the ARP Proxy Function in the VLAN

Command Format

```
arp-switch <supervlan-id> route [enable|disable] inner-subvlan [enable|
disable] among-subvlan [enable|disable]
```

Data Planning

Parameter	Description	Attribute	Example
arp-switch <supervlan-id>	The ID of the Super VLAN to be configured with the ARP proxy switch.	Mandatory	10
route [enable|disable]	Enable or disable the route ARP proxy function.	Mandatory	enable
inner-subvlan [enable|disable]	Enable or disable the intra-Sub VLAN ARP proxy function.	Mandatory	enable
among-subvlan [enable|disable]	Enable or disable the inter-Sub VLAN ARP proxy function.	Mandatory	disable

Example

Configure the ARP proxy function for Super VLAN 10: Enable route ARP and intra-Sub VLAN ARP, and disable inter-Sub VLAN ARP.

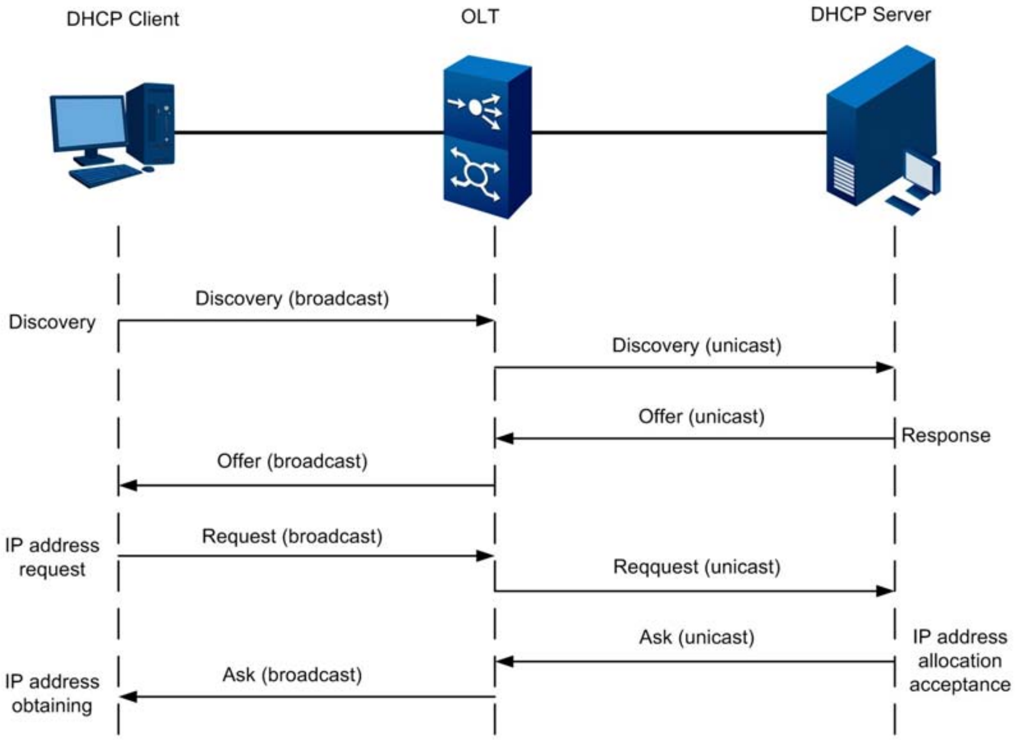
```
Admin(config)#arp-switch 10 route enable inner-subvlan enable among-subvlan disable
Admin(config)#
```

14.2 Configuring DHCP

This section introduces how to configure the DHCP for the AN6000 Series.

14.2.1 Background Information

DHCP Relay allows DHCP packets to be forwarded between the DHCP server and the DHCP clients that are in different network segments. DHCP clients can obtain the IP addresses dynamically allocated by the same DHCP server.



If the DHCP Relay feature is not supported, the DHCP protocol takes effect only when the DHCP clients and the DHCP server are in the same network segment. If they are in different network segments, each network segment requires a DHCP server, which increases deployment costs. The DHCP Relay feature solves this issue. With this feature, one DHCP server can serve multiple DHCP clients in different network segments. This not only reduces deployment costs but also facilitates centralized management of the DHCP clients.

14.2.2 Configuration Rules

The rules for configuring the DHCP service for the AN6000 Series are as follows:

- When serving as the DHCP Relay, the OLT can either be the DHCP proxy only or be both the DHCP proxy and the gateway. Under both conditions, the Super

VLAN interface should be added as the Layer 3 interface to convert the users' DHCP broadcast messages into unicast messages and forward the messages to the designated DHCP server.

  - Super VLAN: a virtual routing interface, also known as VLAN aggregation. A Super VLAN contains multiple Sub VLANs.
  - Sub VLAN: a subsidiary VLAN of the Super VLAN. The relationship between the Super VLAN and the Sub VLAN is master and slave.

- The OLT can be configured with up to 16 Super VLANs, and each Super VLAN can be added with four Sub VLANs at most.
- The IP address bound to the downlink Super VLAN should be in the same network segment with the IP address of the DHCP Client which uses the DHCP proxy function of this Super VLAN.
- When the OLT serves as DHCP proxy only, you need to configure static routing so that the DHCP request can be forwarded to the DHCP server via the gateway.
- When the DHCP Snooping function is enabled for the OLT, DHCP broadcast packets need not be processed. However, when trusted ports have been configured for the DHCP Snooping, only the trusted ports can normally receive and forward the DHCP request messages, while the DHCP response messages from the untrusted ports and the untrusted DHCP request messages from users will be filtered. In this way, the client end can only obtain the IP address from a legal DHCP server.
- When serving as the DHCP server, the OLT will search for undistributed IP addresses from the address pool after it receives DHCP broadcast messages from users, and then transmit PING packets to check whether these IP addresses have been occupied. After confirming that the IP addresses are available, the OLT will allocate them to the users.

14.2.3 Network Scenario

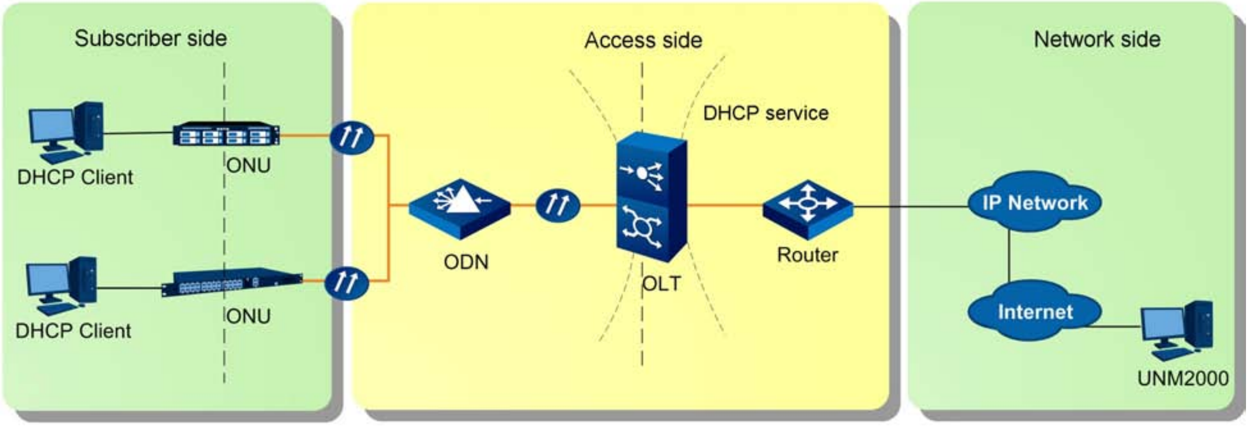
Background Information

The AN6000 Series supports abundant DHCP functions, which can be deployed flexibly to meet varied service demands.

- When serving as the DHCP proxy only, the OLT converts the broadcast DHCP request messages received from the DHCP Client into unicast messages, and modifies the message parameters such as the source MAC address, destination MAC address, source IP address and destination IP address. Then, it forwards the messages to the DHCP server via an external gateway.
- When serving as the DHCP proxy and gateway, the OLT converts the broadcast DHCP request messages received from the DHCP Client into the unicast messages, replaces the gateway IP address of the messages with the IP address of the downlink Super VLAN, and forwards the unicast messages to the DHCP server in a different network segment.
- The OLT provides the DHCP Option 60 authentication function to enable the Option 60 character authentication for PC1 and PC2 users. Two Super VLANs are provided at the OLT and bound with the Sub VLANs. Accordingly, the authentication service is provided based on proxy forwarding and character identification.
- When serving as the DHCP server and having received the broadcast DHCP request messages from the DHCP client, the OLT directly allocates the IP address in the IP address pool to the user.
- With the DHCP Snooping function enabled, the OLT transmits the broadcast DHCP request messages received from the DHCP client to the DHCP server, and prevents the DHCP server spoofing by filtering the response packets received from the DHCP server.

Network Diagram

The network diagram for the DHCP service carried by the AN6000 Series is shown in the figure below.

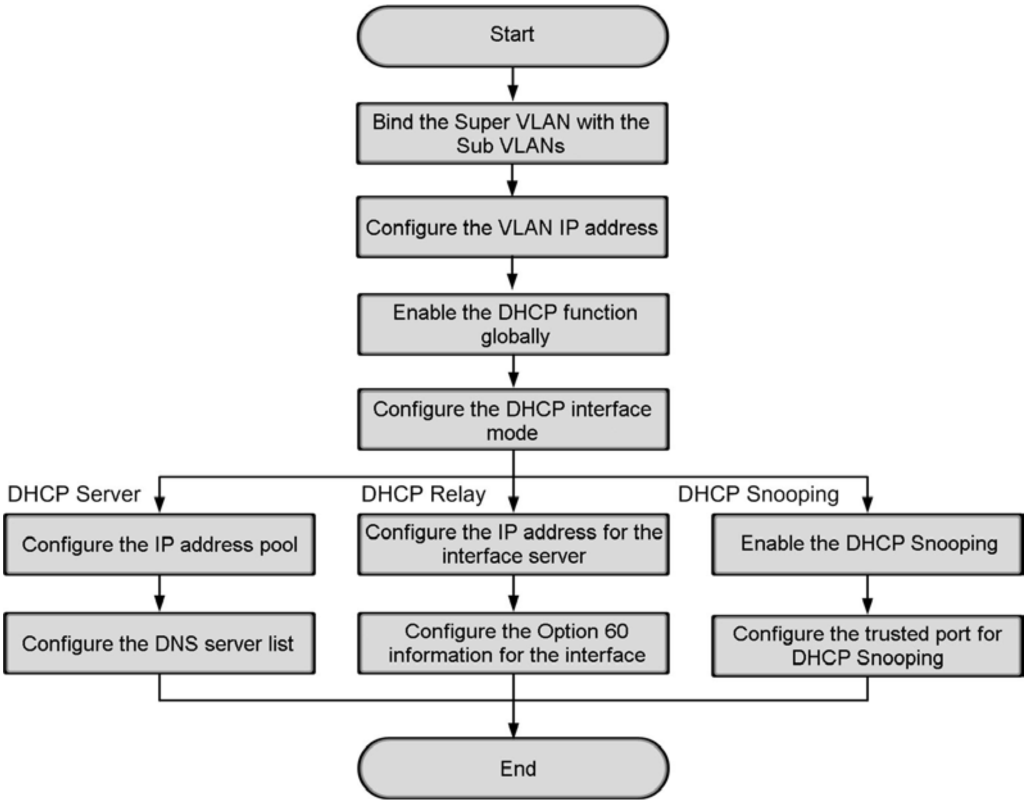


14.2.4 Configuration Flow

Prerequisites

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Configuration Flow


Start
Bind the Super VLAN with the Sub VLANs
Configure the VLAN IP address
Enable the DHCP function globally
Configure the DHCP interface mode
DHCP Server
DHCP Relay
DHCP Snooping
Configure the IP address pool
Configure the IP address for the interface server
Enable the DHCP Snooping
Configure the DNS server list
Configure the Option 60 information for the interface
Configure the trusted port for DHCP Snooping
End

14.2.5 Binding the Super VLAN with the Sub VLANs

Command Format

Create a Super VLAN.

```
super-vlan <1 - 4095>
```

Bind the Super VLAN with the Sub VLANs.

```
super-vlan <svid> add sub-vlan <vid-begin> {<vid-end>}*1
```

Data Planning

Procedure	Parameter	Description	Attribute	Example
Creating a Super VLAN	`super-vlan <1 - 4095>`	The Super VLAN ID, ranging from 1 to 4095.	Mandatory	8
Binding the Super VLAN with the Sub VLANs	`super-vlan <svid>`	The Super VLAN ID, ranging from 1 to 4095.	Mandatory	8

Procedure	Parameter	Description	Attribute	Example
	`sub-vlan <vid-begin>`	The starting value of the Sub VLAN ID range. The value ranges from 1 to 4085.	Mandatory	2000
	`{<vid-end>}*1`	The ending value of the Sub VLAN ID range. The value ranges from 1 to 4085.	Optional	2001

Example

1. Create Super VLAN 8.

```
Admin(config)#super-vlan 8
```

2. Bind Super VLAN 8 with Sub VLANs 2000 and 2001.

```
Admin(config)#super-vlan 8 add sub-vlan 2000 2001
Admin(config)#
```

14.2.6 Configuring the VLAN IP Address

Command Format

```
super-vlan <1-4095> ip <A.B.C.D> mask <A.B.C.D>
```

Planning Data

Parameter	Description	Attribute	Example
`super-vlan <1 - 4095>`	The Super VLAN ID. The value range: 1 to 4095.	Mandatory	8
`ip <A.B.C.D>`	IP address	Mandatory	41.1.1.3
`mask <A.B.C.D>`	Subnet mask	Mandatory	255.255.255.0

Example

Set the IP address of Super VLAN 8 to 41.1.1.3 and its subnet mask to 255.255.255.0.

```
Admin(config)#super-vlan 8 ip 41.1.1.3 mask 255.255.255.0
Admin(config)#
```

14.2.7 Configuring the DHCP Global Switch

Command Format

```
dhcp global [enable|disable]
```

Planning Data

Parameter	Description	Attribute	Example
`dhcp global [enable|disable]`	Enable or disable the DHCP function globally.	Mandatory	enable

Example

Enable the DHCP function.

```
Admin(config-dhcp)#dhcp global enable
Admin(config-dhcp)#
```

14.2.8 Configuring the DHCP Interface Working Mode

Command Format

```
dhcp super-vlan <svlanid> mode [server|relay|disable]
```

Planning Data

Parameter	Description	Attribute	Example
`super-vlan <svlanid>`	Super VLAN ID	Mandatory	8
`mode [server|relay|disable]`	The DHCP mode ◆ server ◆ relay ◆ disable	Mandatory	relay

Example

Set the DHCP interface to the "relay" mode.

```
Admin(config-dhcp)#dhcp super-vlan 8 mode relay
Admin(config-dhcp)#
```

14.2.9 Configuring DHCP Server

This section introduces how to configure the DHCP server.

14.2.9.1 Configuring the IP Address Pool

Command Format

```
dhcp server ip-pool <poolid> begin-ip <ipaddr> end-ip <ipaddr> mask
[<ipaddr>|<mask-length>] gateway <ipaddr>
```

Planning Data

Parameter	Description	Attribute	Example
ip-pool <poolid>	The address pool ID. The value ranges from 1 to 16.	Mandatory	1
begin-ip <ipaddr>	The starting IP address of the address pool	Mandatory	192.168.1.1
end-ip <ipaddr>	The ending IP address of the address pool	Mandatory	192.168.1.20
mask [<ipaddr>|<mask-length>]	The mask of the network segments in the address pool	Mandatory	255.255.255.0
gateway <ipaddr>	The gateway IP address	Mandatory	192.168.1.254

Example

Configure the global address pool of the DHCP server.

```
Admin(config-dhcp)#dhcp server ip-pool 1 begin-ip 192.168.1.1 end-ip 192.168.1.20
mask 255.255.255.0 gateway 192.168.1.254
Admin(config-dhcp)#
```

14.2.9.2 Configuring the DNS Server List

Command Format

```
dhcp server ip-pool <poolid> dns-server <ipaddr>
```

Planning Data

Parameter	Description	Attribute	Example
ip-pool <poolid>	The address pool ID. The value ranges from 1 to 16.	Mandatory	1
dns-server <ipaddr>	Address of the DNS server	Mandatory	10.19.8.10

Example

Set the DNS address of the DHCP server's global address pool 1 to 10.19.8.10.

```
Admin(config-dhcp)#dhcp server ip-pool 1 dns-server 10.19.8.10
Admin(config-dhcp)#
```

14.2.10 Configuring DHCP Relay

This section introduces how to configure the DHCP relay.

14.2.10.1 Configuring the Interface Server Address

Command Format

```
dhcp relay super-vlan <svlanid> server-ip <ipaddr>
```

Planning Data

Parameter	Description	Attribute	Example
super-vlan <svlanid>	Super VLAN ID	Mandatory	8
server-ip <ipaddr>	The IP addresses of the DHCP server	Mandatory	2.2.2.5

Example

Set the IP address of the interface server to 2.2.2.5.

```
Admin(config-dhcp)#dhcp relay super-vlan 8 server-ip 2.2.2.5
Admin(config-dhcp)#
```

14.2.10.2 Configuring Option 60 Information for the Port

Command Format

```
dhcp super-vlan <svlanid> relay-ip <ipaddr> option60 <str>
```

Planning Data

Parameter	Description	Attribute	Example
super-vlan <svlanid>	The configured Super VLAN ID. Configure the Layer 3 interface bound with the VLAN ID.	Mandatory	8
relay-ip <ipaddr>	The IP address of the Relay. The IP address of the Super VLAN interface.	Mandatory	41.1.1.3
option60 <str>	The content of the Option 60 information, which contains no more than 128 characters. Each Super VLAN can be configured with up to 64 Option 60 information entries.	Mandatory	aaaa

Example

Configure the DHCP Relay Option 60 information.

```
Admin(config-dhcp)#dhcp super-vlan 8 relay-ip 41.1.1.3 option60 aaaa
Admin(config-dhcp)#
```

14.2.11 Configuring DHCP Snooping

This section introduces how to configure the DHCP snooping.

14.2.11.1 Enabling the DHCP Snooping Function

Command Format

```
dhcp snooping [enable|disable]
```

Planning Data

Parameter	Description	Attribute	Example
nooping [enable|disable]	Enabling / disabling the DHCP Snooping function	Mandatory	enable

Example

```
Admin(config-dhcp)#dhcp snooping enable
Admin(config-dhcp)#
```

14.2.11.2 Configuring the DHCP Snooping Trusted Port

Command Format

```
dhcp snooping {[port] <portlist> [trust|untrust]}*1 {[serv] <ipaddr>
[trust|untrust]}*1
```

Planning Data

Parameter	Description	Attribute	Example
[port] <portlist>	Uplink port No.	Mandatory	19:5
[trust|untrust]	The state of being trusted / untrusted	Mandatory	trust
[serv] <ipaddr>	IP address of the server	Optional	-
[trust|untrust]	The state of being trusted / untrusted	Optional	-

Example

Set the DHCP Snooping trusted port to 19:5.

```
Admin(config-dhcp)#dhcp snooping port 19:5 trust
Admin(config-dhcp)#
```

14.3 Configuring DHCPv6 Relay

This section introduces the background information, network scenario, configuration flow and configuration example of the DHCPv6 Relay.

14.3.1 Background Information

As a DHCPv6 relay device, the OLT converts a Solicit packet requested by a subscriber to a Relay-forward packet through Layer 3 interfaces and sends it to the DHCPv6 server. The OLT then converts the Advertise packet received from the DHCPv6 server to a Relay-reply packet and sends it back to the subscriber.

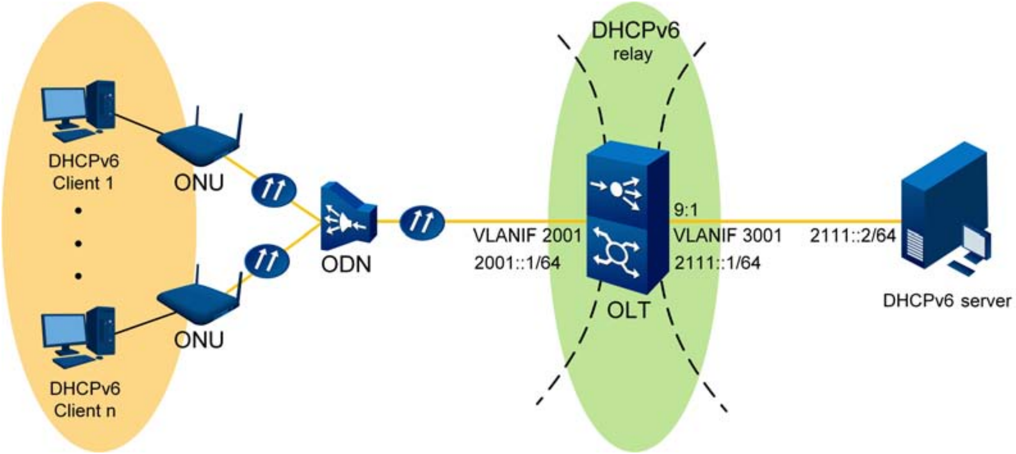
Before configuring DHCPv6 relay on an OLT device, you need to configure a static route or IGP. This ensures that the request packets sent by subscribers are forwarded to the DHCPv6 server.

14.3.2 Network Scenario

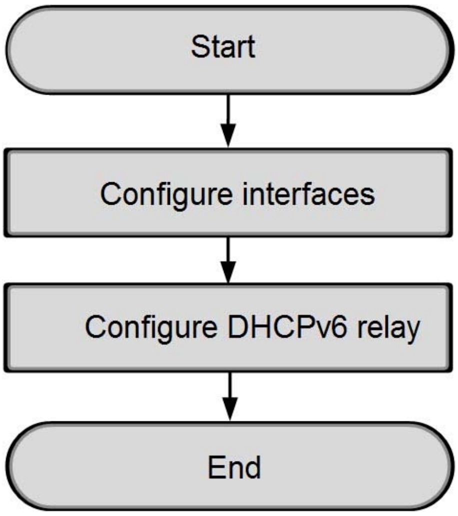
Service Planning

Set the IP address pool of the DHCPv6 server to 2111::/64. Ensure that a route is available for the DHCPv6 server to reach the ONU network segment. Configure the DHCPv6 relay on the OLT. Consequently, the DHCPv6 client obtains the IPv6 address dynamically allocated by the DHCPv6 server after sending a Solicit request.

Network Diagram



14.3.3 Configuration Flow



14.3.4 Configuring Interfaces

Configure Layer 3 interface parameters for the PON ports and uplink ports of the OLTs.

Planning Data

Parameter	Description	Example	
		OLT PON port	**OLT uplink port**
Start VLAN ID	Start VLAN ID of the uplink interface	2001	3001
End VLAN ID	End VLAN ID of the uplink interface	-	-
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	-	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink interface resides	-	1/9
Uplink interface number	Uplink interface number	-	1

Parameter	Description	Example	
		OLT PON port	OLT uplink port
VLAN ID	VLAN ID of the VLANIF interface	2001	3001
Enable / disable	Enable or disable the IPv6 address of the interface.	enable	enable
VLANIF interface address	IPv6 address of the VLANIF interface	2001::1	2111::1
Subnet mask of the VLANIF interface address	Prefix length of the IPv6 address of the VLANIF interface	64	64

Example

- Configure interface parameters for the OLT PON port.

```
Admin(config)#port vlan 2001 allslot
Admin(config)#interface vlanif 2001
Admin(config-vlanif-2001)#ipv6 enable
Admin(config-vlanif-2001)#ipv6 address 2001::1 masklen 64
Admin(config-vlanif-2001)#exit
Admin(config)#
```

- Configure interface parameters for the OLT uplink port.

```
Admin(config)#port vlan 3001 tag 1/9 1
Admin(config)#interface vlanif 3001
Admin(config-vlanif-3001)#ipv6 enable
Admin(config-vlanif-3001)#ipv6 address 2111::1 masklen 64
Admin(config-vlanif-3001)#exit
Admin(config)#
```

14.3.5 Configuring DHCPv6 Relay

Configure the DHCPv6 relay on the OLT. Consequently, the DHCPv6 client obtains the IPv6 address dynamically allocated by the DHCPv6 server after sending a Solicit request.

Planning Data

Parameter	Description	Example		
		OLT PON port	OLT uplink port	DHCPv6 server interface
VLANIF interface ID	VLAN ID of the VLANIF interface	2001	3001	-
Interface mode	◆ server ◆ relay ◆ client-stateless	relay	relay	-
Source IP address	IP address of the interface which sends DHCPv6 request packets, in the format of an IPv6 address	2001::1	-	-
Destination IP address	IPv6 address of the DHCPv6 server or the next-hop relay	-	-	2111::2

Configuration example

Enable DHCPv6 and set the interface to the "relay" mode.

```
Admin(config)#dhcpv6
Admin(config-dhcpv6)#dhcpv6 enable
Admin(config-dhcpv6)#dhcpv6 vlanif 2001 mode relay
Admin(config-dhcpv6)#dhcpv6 vlanif 3001 mode relay
Admin(config-dhcpv6)#dhcpv6 relay vlanif 2001 source 2001::1
Admin(config-dhcpv6)#dhcpv6 relay vlanif 3001 destination 2111::2
```

15 Configuring Routing Protocols

This chapter introduces how to configure routing protocols for the AN6000 Series.

- ☑ Configuring the IS-IS Routing Protocol
- ☑ Configuring the OSPF Routing Protocol
- ☑ Configuring the BGP Routing Protocol

15.1 Configuring the IS-IS Routing Protocol

This section introduces the background information, network scenario, configuration flow and configuration example of the IS-IS routing protocol.

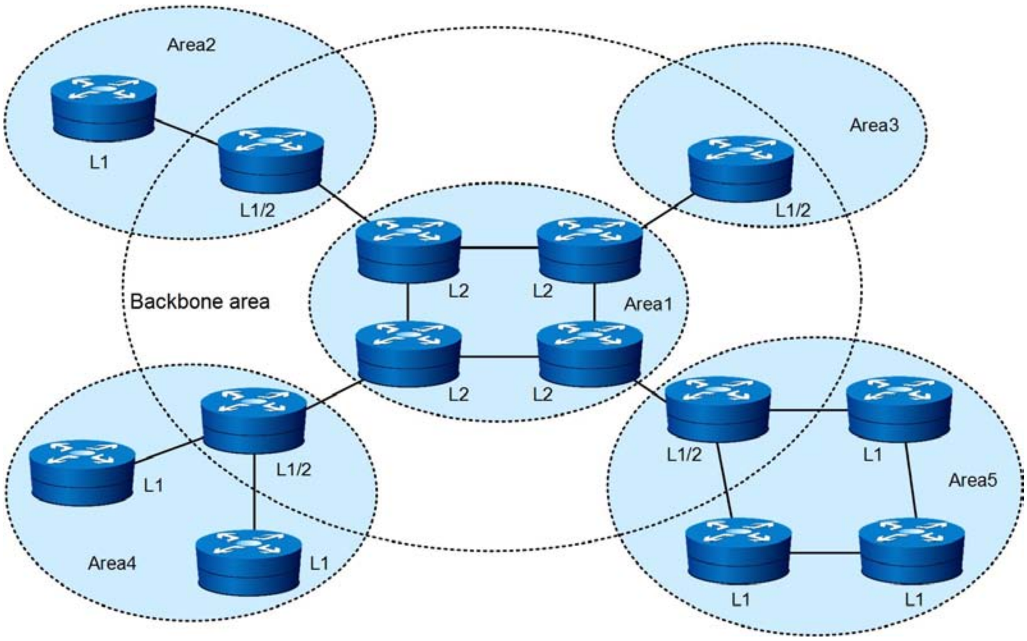
15.1.1 Background Information

The intermediate system-to-intermediate system (IS-IS) protocol is a dynamic routing protocol initially designed by the international organization for standardization (ISO) for its connectionless network protocol (CLNP).

As the TCP/IP protocol is more widely used, the IS-IS is extended and modified to support IP routing. This enables IS-IS to be applied to TCP/IP and OSI environments at the same time. This type of IS-IS is called “integrated IS-IS” or “dual IS-IS”. The IS-IS protocol hereinafter refers to the integrated IS-IS unless otherwise specified.

As an interior gateway protocol (IGP), IS-IS is used in an autonomous system (AS). IS-IS is a link state protocol. It uses the shortest path first (SPF) algorithm to calculate routes.

To support large-scale routing networks, IS-IS uses a two-level hierarchical structure in a routing domain. A routing domain is partitioned into multiple areas. As shown in the figure below, it is a network running the IS-IS protocol. The entire backbone network not only includes all L2 routers in area 1 but also includes L1/2 routers in other areas.



The IS-IS network defines routers of three levels, including Level-1, Level-2 and Level-1-2. The details are as follows:

- Level-1 router: A Level-1 router manages the intra-area routing. It establishes adjacencies only with Level-1 and Level-1-2 routers in the same area. It maintains a Level-1 link state database (LSDB). The LSDB contains the routing information on the local area. If a packet to a destination is outside of this area, Level-1 router will forward it to the nearest Level-1-2 router.
- Level-2 router: A Level-2 router manages the inter-area routing. It can establish adjacencies with Level-2 routers or Level-1-2 routers in the local area and other areas. It maintains a Level-2 LSDB that contains the inter-area routing information.

  All Level-2 routers form the backbone network of a routing domain. They are responsible for communication between areas. Level-2 routers in the routing domain must be in succession to ensure the continuity of the backbone network. Only Level-2 routers can exchange data packets or routing information directly with external routers located outside of the routing domain.

- Level-1-2 router: A router, which is both a Level-1 router and a Level-2 router, is called a Level-1-2 router. It can establish Level-1 adjacencies with Level-1 and Level-1-2 routers in the same area, or establish Level-2 adjacencies with Level-2 and Level-1-2 routers in other areas. A Level-1 router can be connected to other areas only through a Level-1-2 router. A Level-1-2 router maintains two LSDBs. The Level-1 LSDB is used for intra-area routing and the Level-2 LSDB is used for inter-area routing.

15.1.2 Network Scenario

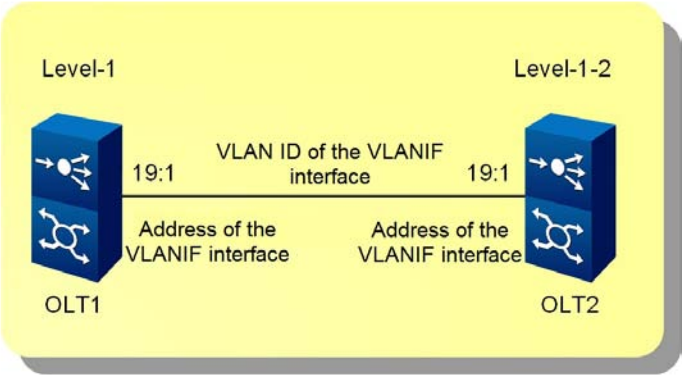
Service Planning

Note:

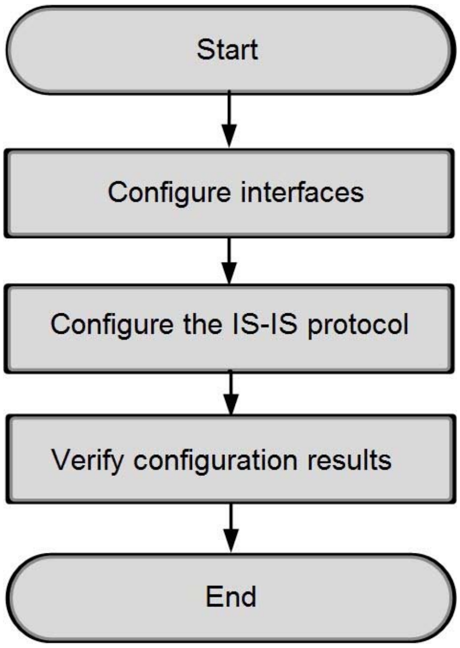
In actual networking, an OLT often serves as a Level-1 router.

Two OLTs are interconnected through the uplink port 19:1. OLT1 is a Level-1 device and OLT2 is a Level-1-2 device. OLT1 and OLT2 communicate with each other through the IS-IS IPv4/IPv6 protocol.

Network Diagram


Level-1
Level-1-2
19:1
VLAN ID of the VLANIF interface
19:1
Address of the VLANIF interface
Address of the VLANIF interface
OLT1
OLT2

15.1.3 Configuration Flow



15.1.4 Configuration Example of IS-IS IPv4

This section introduces how to configure the IS-IS IPv4 routing protocol.

15.1.4.1 Configuring Interfaces

Configure Layer 3 interfaces on two OLTs.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
Start VLAN ID	Start VLAN ID of the uplink interface	2016	2016
End VLAN ID	End VLAN ID of the uplink interface	-	-

Parameter	Description	Example	
		OLT1	OLT2
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink interface resides	1/19	1/19
Uplink interface number	Uplink interface number	1	1
VLAN ID	VLAN ID of the VLANIF interface	2016	2016
VLANIF interface address	IPv4 address of the VLANIF interface	30.1.1.10	30.1.1.20
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0

Procedure

1. Configure interface parameters for OLT1 and OLT2.

   - Configure interface parameters for OLT1.

```
Admin(config)#port vlan 2016 tag 1/19 1
Admin(config)#interface vlanif 2016
Admin(config-vlanif-2016)#ipv4 address 30.1.1.10 mask 255.255.255.0
Admin(config-vlanif-2016)#exit
Admin(config)#
```

   - Configure interface parameters for OLT2.

```
Admin(config)#port vlan 2016 tag 1/19 1
Admin(config)#interface vlanif 2016
Admin(config-vlanif-2016)#ipv4 address 30.1.1.20 mask 255.255.255.0
Admin(config-vlanif-2016)#exit
Admin(config)#
```

2. Check configurations of interfaces between OLT1 and OLT2.

   Ping 30.1.1.10 on OLT2.

```
Admin(config)#ping 30.1.1.10
PING 30.1.1.10 : 56 data bytes.
```

```
Press Ctrl-c to Stop.

Reply from 30.1.1.10 : bytes=56: icmp_seq=0 ttl=64 time<10 ms
Reply from 30.1.1.10 : bytes=56: icmp_seq=1 ttl=64 time<10 ms
Reply from 30.1.1.10 : bytes=56: icmp_seq=2 ttl=64 time<10 ms
Reply from 30.1.1.10 : bytes=56: icmp_seq=3 ttl=64 time<10 ms
Reply from 30.1.1.10 : bytes=56: icmp_seq=4 ttl=64 time<10 ms


----30.1.1.10 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 1/1/2
```

15.1.4.2 Configuring the IS-IS Protocol

Configure the IS-IS IPv4 on two OLTs to enable communications on the network.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
IS-IS route process name	Name of the IS-IS route process. It can be a string of characters including upper-case or lower-case letters, digits and underscore (_). Special characters such as # and @ are not allowed.	10	10
IS-IS route process attributes	◆ level-1: responsible for intra-area routes ◆ Level-1-2: responsible for routes of both Level-1 and Level-2 ◆ level-2: responsible for inter-area routes	level-1	level-1-2
IS-IS network entity name	Network entity name of the area in the IS-IS route process	10.0000.0002.0001.00	10.0000.0002.0002.00

Procedure

◆ Configure the IS-IS protocol for OLT1.

```
Admin(config)#router isis 10
Admin(config-isis-10)#is-type level-1
Admin(config-isis-10)#net 10.0000.0002.0001.00
Admin(config-isis-10)#exit
Admin(config)#interface vlanif 2016
Admin(config-vlanif-2016)#isis ipv4 router 10
```

- Configure the IS-IS protocol for OLT2.

```
Admin(config)#router isis 10
Admin(config-isis-10)#is-type level-1-2
Admin(config-isis-10)#net 10.0000.0002.0002.00
Admin(config-isis-10)#exit
Admin(config)#interface vlanif 2016
Admin(config-vlanif-2016)#isis ipv4 router 10
```

15.1.4.3 Verifying Configuration Results

Check configuration results of OLT1 and OLT2. OLT1 and OLT2 can communicate with each other through the IS-IS IPv4 protocol configurations.

- Verify the neighbor and route information of the IS-IS route process for OLT1.

```
Admin(config)#show isis neighbors
isis neighbors information :

Total number of L1 adjacencies: 1
Total number of L2 adjacencies: 0
Total number of adjacencies: 1
Tag 10:  VRF : default
System Id      Interface   SNPA           State Holdtime Type Protocol
0000.0002.0002 vlanif2016  34bf.9011.7788 Up    29       L1   IS-IS
Admin(config)#show ipv4 isis route
isis ipv4 routes information :

Codes: C-connected, E-external, L1-IS-IS level-1, L2-IS-IS level-2
       ia-IS-IS inter area, D-discard, e-external metric

Tag 10:  VRF : default
     Destination         Metric   Next-Hop     Interface      Tag
C    30.1.1.0/24         10       --           vlanif2016      0
```

- Verify the neighbor and route information of the IS-IS route process for OLT2.

```
Admin(config)#show isis neighbors
isis neighbors information :

Total number of L1 adjacencies: 1
Total number of L2 adjacencies: 0
Total number of adjacencies: 1
Tag 10:  VRF : default
```

```
System Id      Interface   SNPA           State Holdtime Type Protocol
0000.0002.0001 vlanif2016  48f9.7ce8.6de1 Up    8        L1   IS-IS
Admin(config)#show ipv4 isis route
isis ipv4 routes information :

Codes: C-connected, E-external, L1-IS-IS level-1, L2-IS-IS level-2
       ia-IS-IS inter area, D-discard, e-external metric

Tag 10:  VRF : default
     Destination         Metric   Next-Hop      Interface      Tag
C    30.1.1.0/24         10       --            vlanif2016      0
```

15.1.5 Configuration Example of IS-IS IPv6

This section introduces how to configure the IS-IS IPv6 routing protocol.

15.1.5.1 Configuring Interfaces

Configure Layer 3 interfaces on two OLTs.

Planning Data

Parameter	Description	Configuration Example	
		OLT1	OLT2
Start VLAN ID	Start VLAN ID of the uplink interface	2014	2014
End VLAN ID	End VLAN ID of the uplink interface	-	-
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink interface resides	1/19	1/19
Uplink interface number	Uplink interface number	1	1
VLAN ID	VLAN ID of the VLANIF interface	2014	2014
Enable / disable	Enable or disable the IPv6 address of the interface.	enable	enable

Parameter	Description	Configuration Example	
		OLT1	OLT2
VLANIF interface address	IPv6 address of the VLANIF interface	2014::2	2014::1
Subnet mask of the VLANIF interface address	Prefix length of the IPv6 address of the VLANIF interface	64	64

Procedure

1. Configure interface parameters for OLT1 and OLT2.

   - Configure interface parameters for OLT1.

```
Admin(config)#port vlan 2014 tag 1/19 1
Admin(config)#interface vlanif 2014
Admin(config-vlanif-2014)#ipv6 enable
Admin(config-vlanif-2014)#ipv6 address 2014::2 masklen 64
Admin(config-vlanif-2014)#exit
Admin(config)#
```

   - Configure interface parameters for OLT2.

```
Admin(config)#port vlan 2014 tag 1/19 1
Admin(config)#interface vlanif 2014
Admin(config-vlanif-2014)#ipv6 enable
Admin(config-vlanif-2014)#ipv6 address 2014::1 masklen 64
Admin(config-vlanif-2014)#exit
Admin(config)#
```

2. Check configurations of interfaces between OLT1 and OLT2.

   Ping 2014::1 on OLT1.

```
Admin(config)#ping -ipv6 2014::1
PING 2014::1 : 56 data bytes.
Press Ctrl-c to Stop.

Reply from 2014::1 : bytes=56: icmp_seq=0 time<10 ms
Reply from 2014::1 : bytes=56: icmp_seq=1 time<10 ms
Reply from 2014::1 : bytes=56: icmp_seq=2 time<10 ms
Reply from 2014::1 : bytes=56: icmp_seq=3 time<10 ms
Reply from 2014::1 : bytes=56: icmp_seq=4 time<10 ms



----2014::1 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 0/0/0
```

15.1.5.2 Configuring the IS-IS Protocol

Configure the IS-IS IPv6 protocol on two OLTs to enable communications on the network.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
IS-IS route process name	Name of the IS-IS route process. It can be a string of characters including upper-case or lower-case letters, digits and underscore (_). Special characters such as # and @ are not allowed.	15	15
IS-IS route process attributes	◆ level-1: responsible for intra-area routes ◆ Level-1-2: responsible for routes of both Level-1 and Level-2 ◆ level-2: responsible for inter-area routes	level-1	level-1-2
IS-IS network entity name	Network entity name of the area in the IS-IS route process	15.0000.0001.0002.00	15.0000.0001.0012.00

Procedure

◆ Configure the IS-IS protocol for OLT1.

```
Admin(config)#router isis 15
Admin(config-isis-15)#is-type level-1
Admin(config-isis-15)#net 15.0000.0001.0002.00
Admin(config-isis-15)#exit
Admin(config)#interface vlanif 2014
Admin(config-vlanif-2014)#isis ipv6 router 15
```

◆ Configure the IS-IS protocol for OLT2.

```
Admin(config)#router isis 15
Admin(config-isis-15)#is-type level-1-2
Admin(config-isis-15)#net 15.0000.0001.0012.00
Admin(config-isis-15)#exit
Admin(config)#interface vlanif 2014
Admin(config-vlanif-2014)#isis ipv6 router 15
```

15.1.5.3 Verifying Configuration Results

Check configuration results of OLT1 and OLT2. OLT1 and OLT2 can communicate with each other through the IS-IS IPv6 protocol configurations.

- Verify the neighbor and route information of the IS-IS route process for OLT1.

```
Admin(config)#show isis neighbors
isis neighbors information :

Total number of L1 adjacencies: 1
Total number of L2 adjacencies: 0
Total number of adjacencies: 1
Tag 15:  VRF : default
System Id      Interface   SNPA           State Holdtime Type Protocol
0000.0001.0012 vlanif2014  34bf.9011.7788 Up    28       L1   IS-IS
Admin(config)#show ipv6 isis route
isis ipv6 routes information :

Codes: C-connected, E-external, L1-IS-IS level-1, L2-IS-IS level-2
       ia-IS-IS inter area, D-discard, e-external metric

Tag 15:  VRF : default
C    2014::/64 [10]
      via ::, vlanif2014
```

- Verify the neighbor and route information of the IS-IS route process for OLT2.

```
Admin(config)#show isis neighbors
isis neighbors information :

Total number of L1 adjacencies: 1
Total number of L2 adjacencies: 0
Total number of adjacencies: 1
Tag 15:  VRF : default
System Id      Interface   SNPA           State Holdtime Type Protocol
0000.0001.0002 vlanif2014  48f9.7ce8.6de1 Up    9        L1   IS-IS
Admin(config)#show ipv6 isis route
isis ipv6 routes information :

Codes: C-connected, E-external, L1-IS-IS level-1, L2-IS-IS level-2
       ia-IS-IS inter area, D-discard, e-external metric

Tag 15:  VRF : default
C    2014::/64 [10]
```

```
via ::, vlanif2014
```

15.2 Configuring the OSPF Routing Protocol

This section introduces the background information, network scenario, configuration flow and configuration example of the OSPF routing protocol.

15.2.1 Background Information

Open shortest path first (OSPF) is an interior gateway protocol (IGP) based on the link state. It is generally applied to a single autonomous system (AS). All the OSPF routers in this AS maintain one database that describes the AS structure. This database keeps the states of all links in the routing domain. The OSPF router works out the OSPF routing table according to this database.

Currently, OSPFv2 is applied to IPv4, and OSPFv3 is applied to IPv6.

Features of the OSPF services:

- Wide application: OSPF supports networks of various scales. It can even apply to large-scale data exchange networks with hundreds of routers.
- Fast convergence: When the network topology changes, OSPF immediately sends link state update (LSU) packets to synchronize the change to the link state databases (LSBs) of all routers in the autonomous system.
- Loop-free: OSPF uses the SPF algorithm to calculate loop-free routes based on the collected link status.
- Area division: The network of the AS is divided into areas for easier management. The routes between the areas become more abstract, reducing the occupation of bandwidth in the network.
- Equal route: OSPF supports multiple equal routes to the same destination address.
- Routing hierarchy: OSPF uses four route types: intra-area routes, inter-area routes, Type 1 external routes, and Type 2 external routes, which are listed in descending order of priority.

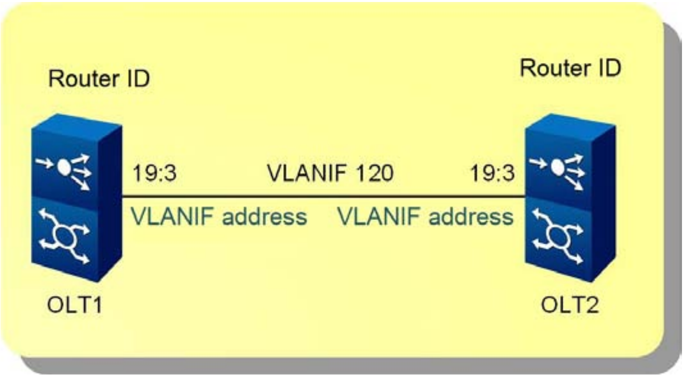
- Authentication: OSPF supports interface-based packet authentication, which ensures security of protocol packet exchange.
- Multicast: OSFP uses multicast addresses to send protocol packets on links supporting multicast. This minimizes the impact on other devices.

15.2.2 Network Scenario

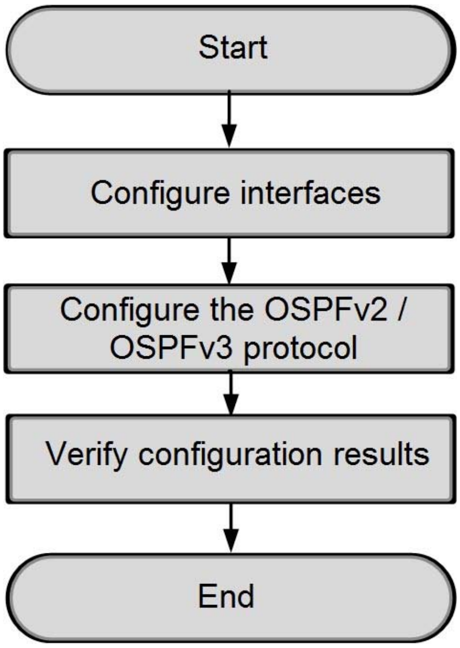
Service Planning

Two OLTs are interconnected through the uplink port 19:3. OLT1 and OLT2 communicate with each other through the OSPFv2 / OSPFv3 protocol configurations.

Network Diagram



15.2.3 Configuration Flow


Start
Configure interfaces
Configure the OSPFv2 / OSPFv3 protocol
Verify configuration results
End

15.2.4 Configuration Example of OSPFv2

This section introduces how to configure the OSPFv2 routing protocol.

15.2.4.1 Configuring Interfaces

Configure Layer 3 interfaces on two OLTs.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
Start VLAN ID	Start VLAN ID of the uplink port	120	120
End VLAN ID	End VLAN ID of the uplink port	-	-

Parameter	Description	Example	
		OLT1	OLT2
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19
Uplink interface number	Uplink interface number	3	3
VLAN ID	VLAN ID of the VLANIF interface	120	120
VLANIF interface address	IPv4 address of the VLANIF interface	120.1.1.3	120.1.1.2
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0

Procedure

1. Configure interface parameters for OLT1 and OLT2.

   - Configure interface parameters for OLT1.

```
Admin(config)#port vlan 120 tag 1/19 3
Admin(config)#interface vlanif 120
Admin(config-vlanif-120)#ipv4 address 120.1.1.3 mask 255.255.255.0
Admin(config-vlanif-120)#exit
Admin(config)#
```

   - Configure interface parameters for OLT2.

```
Admin(config)#port vlan 120 tag 1/19 3
Admin(config)#interface vlanif 120
Admin(config-vlanif-120)#ipv4 address 120.1.1.2 mask 255.255.255.0
Admin(config-vlanif-120)#exit
Admin(config)#
```

2. Check configurations of interfaces between OLT1 and OLT2.

   Ping 120.1.1.2 on OLT1.

```
Admin(config)#ping 120.1.1.2
PING 120.1.1.2 : 56 data bytes.
Press Ctrl-c to Stop.
```

```
Reply from 120.1.1.2 : bytes=56: icmp_seq=0 ttl=64 time<10 ms
Reply from 120.1.1.2 : bytes=56: icmp_seq=1 ttl=64 time<10 ms
Reply from 120.1.1.2 : bytes=56: icmp_seq=2 ttl=64 time<10 ms
Reply from 120.1.1.2 : bytes=56: icmp_seq=3 ttl=64 time<10 ms
Reply from 120.1.1.2 : bytes=56: icmp_seq=4 ttl=64 time<10 ms


----120.1.1.2 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 4/6/12
```

15.2.4.2 Configuring the OSPFv2 Protocol

Configure the OSPFv2 protocol on two OLTs to enable communications on the network.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
OSPFv2 route process ID	OSPFv2 route process ID. Value range: 1 to 65535	1	1
Router ID	ID of an OSPFv2 router, in the format of an IPv4 address	1.1.1.1	2.2.2.2
Network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	120.1.1.0	120.1.1.0
Subnet mask	Subnet mask of the network IP address	0.0.0.255	0.0.0.255
Area No.	OSPFv2 area number	0	0

Procedure

◆ Configure the OSPFv2 protocol for OLT1.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 1.1.1.1
Admin(config-ospf-1)#network 120.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#exit
Admin(config)#
```

◆ Configure the OSPFv2 protocol for OLT2.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 2.2.2.2
Admin(config-ospf-1)#network 120.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#exit
Admin(config)#
```

15.2.4.3 Verifying Configuration Results

Check configuration results of OLT1 and OLT2. Verify that OLT1 and OLT2 communicate with each other through the OSPFv2 protocol configurations.

- Verify neighbor information of the OSPFv2 route process for OLT1.

```
Admin(config)#show ipv4 ospf neighbor
Total number of full neighbors: 1
OSPF process 1 VRF(default):
Neighbor ID Pri State       Dead Time Address   Interface Instance ID
2.2.2.2       1 Full/Backup 00:00:34  120.1.1.2 vlanif120      0
```

- Verify neighbor information of the OSPFv2 route process for OLT2.

```
Admin(config)#show ipv4 ospf neighbor
Total number of full neighbors: 1
OSPF process 1 VRF(default):
Neighbor ID Pri State       Dead Time Address   Interface Instance ID
1.1.1.1       1 Full/DR     00:00:38  120.1.1.3 vlanif120      0
```

15.2.5 Configuration Example of OSPFv3

This section introduces how to configure the OSPFv3 routing protocol.

15.2.5.1 Configuring Interfaces

Configure Layer 3 interfaces on two OLTs.

Planning Data

Parameter	**Description**	**Example**	
		OLT1	**OLT2**
Start VLAN ID	Start VLAN ID of the uplink port	120	120
End VLAN ID	End VLAN ID of the uplink port	-	-

Parameter	Description	Example	
		OLT1	OLT2
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19
Uplink interface number	Uplink interface number	3	3
VLAN ID	VLAN ID of the VLANIF interface	120	120
Enable / disable	Enable or disable the IPv6 address of the interface.	enable	enable
VLANIF interface address	IPv6 address of the VLANIF interface	1200::1	1200::2
Subnet mask of the VLANIF interface address	Prefix length of the IPv6 address of the VLANIF interface	64	64

Procedure

1. Configure interface parameters for OLT1 and OLT2.

   - Configure interface parameters for OLT1.

```
Admin(config)#port vlan 120 tag 1/19 3
Admin(config)#interface vlanif 120
Admin(config-vlanif-120)#ipv6 enable
Admin(config-vlanif-120)#ipv6 address 1200::1 masklen 64
Admin(config-vlanif-120)#exit
Admin(config)#
```

   - Configure interface parameters for OLT2.

```
Admin(config)#port vlan 120 tag 1/19 3
Admin(config)#interface vlanif 120
Admin(config-vlanif-120)#ipv6 enable
Admin(config-vlanif-120)#ipv6 address 1200::2 masklen 64
Admin(config-vlanif-120)#exit
Admin(config)#
```

2. Check configurations of interfaces between OLT1 and OLT2.

   Ping 1200::2 on OLT1.

```
Admin(config)#ping -ipv6 1200::2
PING 1200::2 : 56 data bytes.
Press Ctrl-c to Stop.

Reply from 1200::2 : bytes=56: icmp_seq=0 time<10 ms
Reply from 1200::2 : bytes=56: icmp_seq=1 time<10 ms
Reply from 1200::2 : bytes=56: icmp_seq=2 time<10 ms
Reply from 1200::2 : bytes=56: icmp_seq=3 time<10 ms
Reply from 1200::2 : bytes=56: icmp_seq=4 time<10 ms


----1200::2 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 2/4/8
```

15.2.5.2 Configuring the OSPFv3 Protocol

Configure the OSPFv3 protocol on two OLTs to enable communications on the network.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
OSPFv3 process tag number	OSPFv3 process tag number. Value range: 1 to 63 bytes	1	1
Router ID	ID of an OSPFv3 router, in the format of an IPv4 address	11.11.11.11	22.22.22.22
VLAN ID	VLAN ID of the VLANIF interface	120	120
Area No.	OSPFv3 area number	0	0

Procedure

◆ Configure the OSPFv3 protocol for OLT1.

```
Admin(config)#router ipv6 ospf 1
Admin(config-ospfv3-1)#router-id 11.11.11.11
Admin(config-ospfv3-1)#exit
Admin(config)#interface vlanif 120
Admin(config-vlanif-120)#ipv6 router ospf area 0 tag 1
Admin(config-vlanif-120)#exit
Admin(config)#
```

- Configure the OSPFv3 protocol for OLT2.

```
Admin(config)#router ipv6 ospf 1
Admin(config-ospfv3-1)#router-id 22.22.22.22
Admin(config-ospfv3-1)#exit
Admin(config)#interface vlanif 120
Admin(config-vlanif-120)#ipv6 router ospf area 0 tag 1
Admin(config-vlanif-120)#exit
Admin(config)#
```

15.2.5.3 Verifying Configuration Results

Check configuration results of OLT1 and OLT2. Verify that OLT1 and OLT2 communicate with each other through the OSPFv3 protocol configurations.

- Verify neighbor information of the OSPFv3 route process for OLT1.

```
Admin(config)#show ospfv3 neighbor
ospfv3 neighbors information :

Total number of full neighbors: 1
OSPFv3 Process (1)
Neighbor ID  Pri   State        Dead Time  Interface  Instance ID
22.22.22.22    1   Full/Backup  00:00:32   vlanif120  0
```

- Verify neighbor information of the OSPFv3 route process for OLT2.

```
Admin(config)#show ospfv3 neighbor
ospfv3 neighbors information :

Total number of full neighbors: 1
OSPFv3 Process (1)
Neighbor ID  Pri   State        Dead Time  Interface  Instance ID
11.11.11.11    1   Full/DR      00:00:39   vlanif120  0
```

15.3 Configuring the BGP Routing Protocol

This section introduces the background information, network scenario, configuration flow and configuration example of the BGP routing protocol.

15.3.1 Background Information

The border gateway protocol (BGP) is an inter-AS dynamic routing protocol, which is used to transmit routing information among ASs. BGP is called an internal border gateway protocol (IBGP) when it runs within an AS and called an external border gateway protocol (EBGP) when it runs among ASs.

BGP has the following advantages:

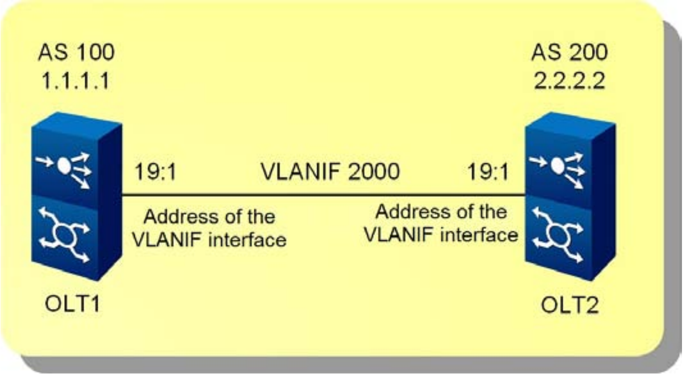
- It is an external gateway protocol (EGP) and is used to select optimal routes and control route propagation.
- It uses the TCP to transport route information at the transport layer, enhancing reliability of the network. It listens to TCP at port 179.
  - It selects routes among areas, requiring high stability of the protocol. Therefore, the TCP guarantees the stability of the BGP.
  - The BGP peers must be logically connected and communicate with each other through TCP. The local port number is random and the destination port number is 179.
- It transmits only the updated routes. This reduces the bandwidth used by BGP to transmit routes and is suitable for transmitting a large amount of routing information on the Internet.
- It supports loop avoidance.
  - Inter-AS: The BGP route carries the AS path information to mark the passing ASs and routes with the local AS number will be discarded. This avoids the inter-AS loop.
  - Intra-AS: The BGP does not advertise the route learned within its AS to its neighbors in the same AS. This avoids intra-AS loop.
- It provides abundant routing policies to flexibly filter and select routes.
- It provides a mechanism to avoid route flaps. This improves the stability of the network.
- It is scalable to support new development of the network.
- It supports classless inter-domain routing (CIDR).
- It is a distance vectoring routing protocol.

15.3.2 Network Scenario

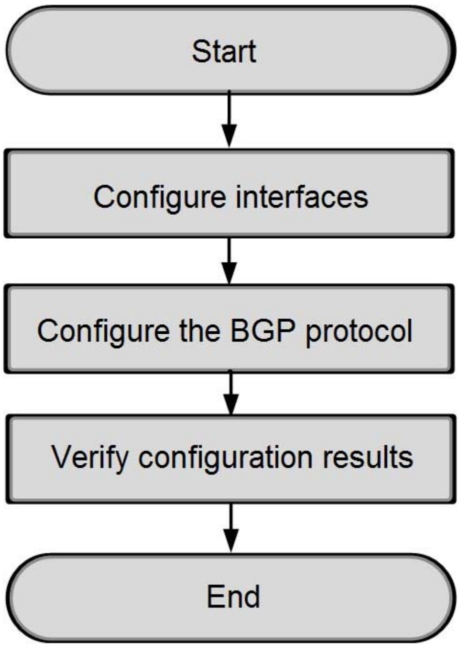
Service Planning

Two OLTs are interconnected through the uplink port 19:1. Create a BGP instance with AS being 100 on OLT1. Create a BGP instance with AS being 200 on OLT2. Configure the BGP IPv4/IPv6 protocol to set up an EBGP connection between OLT1 and OLT2.

Network Diagram


AS 100
1.1.1.1
AS 200
2.2.2.2
19:1
VLANIF 2000
19:1
Address of the VLANIF interface
Address of the VLANIF interface
OLT1
OLT2

15.3.3 Configuration Flow



15.3.4 Configuration Example of BGP IPv4

This section introduces how to configure the BGP IPv4 routing protocol.

15.3.4.1 Configuring Interfaces

Configure Layer 3 interfaces on two OLTs.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
Start VLAN ID	Start VLAN ID of the uplink interface	2000	2000
End VLAN ID	End VLAN ID of the uplink interface	-	-
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink interface resides	1/19	1/19
Uplink interface number	Uplink interface number	1	1
VLAN ID	VLAN ID of the VLANIF interface	2000	2000
VLANIF interface address	IPv4 address of the VLANIF interface	120.0.2.1	120.0.2.2
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0

Procedure

1. Configure interface parameters for OLT1 and OLT2.

   ▸ Configure interface parameters for OLT1.

```
Admin(config)#port vlan 2000 tag 1/19 1
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#ipv4 address 120.0.2.1 mask 255.255.255.0
Admin(config-vlanif-2000)#exit
Admin(config)#
```

- Configure interface parameters for OLT2.

```
Admin(config)#port vlan 2000 tag 1/19 1
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#ipv4 address 120.0.2.2 mask 255.255.255.0
Admin(config-vlanif-2000)#exit
Admin(config)#
```

2. Check configurations of interfaces between OLT1 and OLT2.

   Ping 120.0.2.2 on OLT1.

```
Admin(config)#ping 120.0.2.2
PING 120.0.2.2 : 56 data bytes.
Press Ctrl-c to Stop.

Reply from 120.0.2.2 : bytes=56: icmp_seq=0 ttl=64 time=11 ms
Reply from 120.0.2.2 : bytes=56: icmp_seq=1 ttl=64 time<10 ms
Reply from 120.0.2.2 : bytes=56: icmp_seq=2 ttl=64 time<10 ms
Reply from 120.0.2.2 : bytes=56: icmp_seq=3 ttl=64 time<10 ms
Reply from 120.0.2.2 : bytes=56: icmp_seq=4 ttl=64 time<10 ms


----120.0.2.2 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 4/5/11
```

15.3.4.2 Configuring the BGP Protocol

Configure the BGP IPv4 protocol on two OLTs to set up an EBGP connection.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
AS number	AS number. Value range: 1 to 4294967295	100	200
BGP route ID	Route ID that is manually configured, in the format of an IPv4 address	1.1.1.1	2.2.2.2
BGP peer	IP address of the BGP neighbor, in the format of an IPv4 address	120.0.2.2	120.0.2.1
	IP address of the BGP neighbor, in the format of an IPv6 address	-	-

Parameter	Description	Example	
		OLT1	OLT2
	Remote AS number of the BGP peer. Value range: 1 to 4294967295	200	100

Example

- Configure the BGP protocol for OLT1.

```
Admin(config)#router bgp 100
Admin(config-bgp-100)#bgp router-id 1.1.1.1
Admin(config-bgp-100)#neighbor 120.0.2.2 remote-as 200
Admin(config-bgp-100)#exit
Admin(config)#
```

- Configure the BGP protocol for OLT2.

```
Admin(config)#router bgp 200
Admin(config-bgp-200)#bgp router-id 2.2.2.2
Admin(config-bgp-200)#neighbor 120.0.2.1 remote-as 100
Admin(config-bgp-200)#exit
Admin(config)#
```

15.3.4.3 Verifying Configuration Results

Check configuration results of OLT1 and OLT2. Verify that an EBGP connection is set up between OLT1 and OLT2 through the BGP IPv4 protocol configurations.

- Verify the BGP neighbor information of OLT1.

```
Admin(config)#show bgp ipv4 summary
BGP router identifier 1.1.1.1, local AS number 100
BGP table version is 14
0 BGP AS-PATH entries
0 BGP community entries

Neighbor  V AS  MsgRcv MsgSen TblVer InQ OutQ    Up/Down State/PfxRcd
120.0.2.2 4 200  2       3      14    0    0  00:00:05             0

Total number of neighbors 1

Total number of Established sessions 1
```

- Verify the BGP neighbor information of OLT2.

```
Admin(config)#show bgp ipv4 summary
BGP router identifier 2.2.2.2, local AS number 200
BGP table version is 2
1 BGP AS-PATH entries
0 BGP community entries

Neighbor   V AS   MsgRcv MsgSen TblVer InQ OutQ    Up/Down State/PfxRcd
120.0.2.1  4 100    6       6       2    0    0  00:02:07            0

Total number of neighbors 1

Total number of Established sessions 1
```

15.3.5 Configuration Example of BGP IPv6

This section introduces how to configure the BGP IPv6 routing protocol.

15.3.5.1 Configuring Interfaces

Configure Layer 3 interfaces on two OLTs.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
Start VLAN ID	Start VLAN ID of the uplink interface	2000	2000
End VLAN ID	End VLAN ID of the uplink interface	-	-
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink interface resides	1/19	1/19
Uplink interface number	Uplink interface number	1	1
VLAN ID	VLAN ID of the VLANIF interface	2000	2000
Enable / disable	Enable or disable the IPv6 address of the interface.	enable	enable

Parameter	Description	Example	
		OLT1	OLT2
VLANIF interface address	IPv6 address of the VLANIF interface	2020:1::1	2020:1::2
Subnet mask of the VLANIF interface address	Prefix length of the IPv6 address of the VLANIF interface	64	64

Procedure

1. Configure interface parameters for OLT1 and OLT2.

   - Configure interface parameters for OLT1.

```
Admin(config)#port vlan 2000 tag 1/19 1
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#ipv6 enable
Admin(config-vlanif-2000)#ipv6 address 2020:1::1 masklen 64
Admin(config-vlanif-2000)#exit
Admin(config)#
```

   - Configure interface parameters for OLT2.

```
Admin(config)#port vlan 2000 tag 1/19 1
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#ipv6 enable
Admin(config-vlanif-2000)#ipv6 address 2020:1::2 masklen 64
Admin(config-vlanif-2000)#exit
Admin(config)#
```

2. Check configurations of interfaces between OLT1 and OLT2.

   Ping 2020:1::2 on OLT1.

```
Admin(config)#ping -ipv6 2020:1::2
PING 2020:1::2 : 56 data bytes.
Press Ctrl-c to Stop.

Reply from 2020:1::2 : bytes=56: icmp_seq=0 time<10 ms
Reply from 2020:1::2 : bytes=56: icmp_seq=1 time<10 ms
Reply from 2020:1::2 : bytes=56: icmp_seq=2 time<10 ms
Reply from 2020:1::2 : bytes=56: icmp_seq=3 time<10 ms
Reply from 2020:1::2 : bytes=56: icmp_seq=4 time<10 ms



----2020:1::2 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 3/4/9
```

15.3.5.2 Configuring the BGP Protocol

Configure the BGP IPv6 protocol on two OLTs to set up an EBGP connection.

Planning Data

Parameter	Description	Example	
		OLT1	OLT2
AS number	AS number. Value range: 1 to 4294967295	100	200
BGP route ID	Route ID that is manually configured, in the format of an IPv4 address	1.1.1.1	2.2.2.2
BGP peer	IP address of the BGP neighbor, in the format of an IPv4 address	-	-
	IP address of the BGP neighbor, in the format of an IPv6 address	2020:1::2	2020:1::1
	Remote AS number of the BGP peer. Value range: 1 to 4294967295	200	100

Procedure

◆ Configure the BGP protocol for OLT1.

```
Admin(config)#router bgp 100
Admin(config-bgp-100)#bgp router-id 1.1.1.1
Admin(config-bgp-100)#neighbor 2020:1::2 remote-as 200
Admin(config-bgp-100)#address-family ipv6 unicast
Admin(config-bgp-100-ipv6)#neighbor 2020:1::2 activate
Admin(config-bgp-100-ipv6)#exit
Admin(config-bgp-100)#exit
Admin(config)#
```

◆ Configure the BGP protocol for OLT2.

```
Admin(config)#router bgp 200
Admin(config-bgp-200)#bgp router-id 2.2.2.2
Admin(config-bgp-200)#neighbor 2020:1::1 remote-as 100
Admin(config-bgp-200)#address-family ipv6 unicast
Admin(config-bgp-200-ipv6)#neighbor 2020:1::1 activate
Admin(config-bgp-200-ipv6)#exit
Admin(config-bgp-200)#exit
Admin(config)#
```

15.3.5.3 Verifying Configuration Results

Check configuration results of OLT1 and OLT2. Verify that an EBGP connection is set up between OLT1 and OLT2 through the BGP IPv6 protocol configurations.

- Verify the BGP neighbor information of OLT1.

```
Admin(config)#show bgp ipv6 summary
BGP router identifier 1.1.1.1, local AS number 100
BGP table version is 1
0 BGP AS-PATH entries
0 BGP community entries

Neighbor  V AS   MsgRcv MsgSen TblVer InQ OutQ    Up/Down State/PfxRcd
2020:1::2 4 200   25      31       1    0    0  00:10:02             0

Total number of neighbors 1

Total number of Established sessions 1
```

- Verify the BGP neighbor information of OLT2.

```
Admin(config)#show bgp ipv6 summary
BGP router identifier 2.2.2.2, local AS number 200
BGP table version is 1
1 BGP AS-PATH entries
0 BGP community entries

Neighbor  V AS   MsgRcv MsgSen TblVer InQ OutQ    Up/Down State/PfxRcd
2020:1::1 4 100   26      24       1    0    0  00:09:06             0

Total number of neighbors 1

Total number of Established sessions 1
```

16 Configuring MPLS

This section introduces how to configure the MPLS services for the AN6000 Series.

☑ Configuring a Static LSP

☑ Configuring LDP LSP

☑ Configuring RSVP LSP

16.1 Configuring a Static LSP

This section introduces the background information, network scenario, configuration flow and configuration example of the static LSP.

16.1.1 Background

A static LSP is established when the administrator manually assigns labels to forwarding equivalence classes (FECs). On the device of each hop that the packet traverses, the administrator manually specifies the incoming and outgoing labels and establishes label forwarding table entries.

An AN6000 Series device can serve as an LER or LSR. It can also serve as an ingress node, an intermediate node or an egress node, depending on where the device resides in the network.

Packets can be only forwarded on one LSP unidirectionally. To ensure bidirectional transmission of MPLS services, two static LSPs are required. These two LSPs are in reverse directions with the ingress node and egress node exchanged. Their intermediate nodes can be the same, different, or even omitted, depending on the network demands.

Concepts related to the static LSP are as follows:

Concept	Description
FEC	Forwarding equivalence class. It refers to a group of data streams which have some similarities. These data streams are forwarded by the LSR in the same manner. For the AN6000 Series, FECs can be only classified based on the destination IP address.
Label	A label is a short, fixed-length, and physically contiguous identifier which is used to identify an FEC, usually of local significance. On one device, one label can represent only one FEC.
LSP	Label switched path. It refers to a path that a packet in a particular FEC traverses in an MPLS network.

Concept	Description
LSR	Label switching router. It refers to a network device which can exchange and forward MPLS labels. LSR is also called an MPLS node.
LER	Label edge router. It refers to an LSR on the edge of the MPLS domain. The LER is responsible for classifying the packets that enter the MPLS domain to FECs and adding labels to these FECs for forwarding in the MPLS domain. When the packets leave the MPLS domain, the FECs pop up the labels, resume the original packets, and then are forwarded accordingly.

The static LSP has the following features:

- For the static LSP, the label distribution protocol (LDP) is not used and control packets need not be exchanged, so less resource is occupied. Therefore, the static LSP is applied to stable small-scale networks with a simple topology architecture.
- The static LSP cannot be dynamically adjusted according to the topology change of the network. Normally, the administrator manually adjusts it.

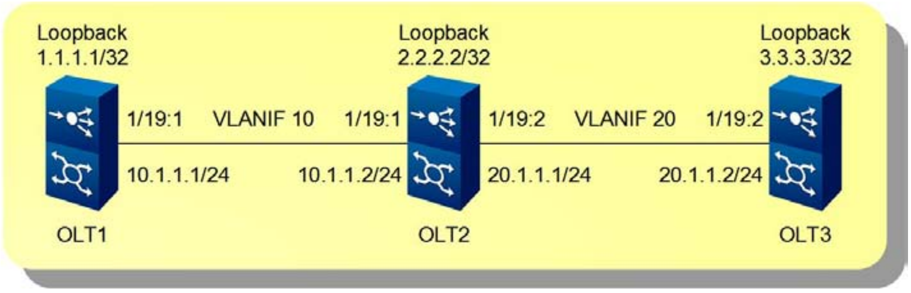
16.1.2 Network Scenario

Service Planning

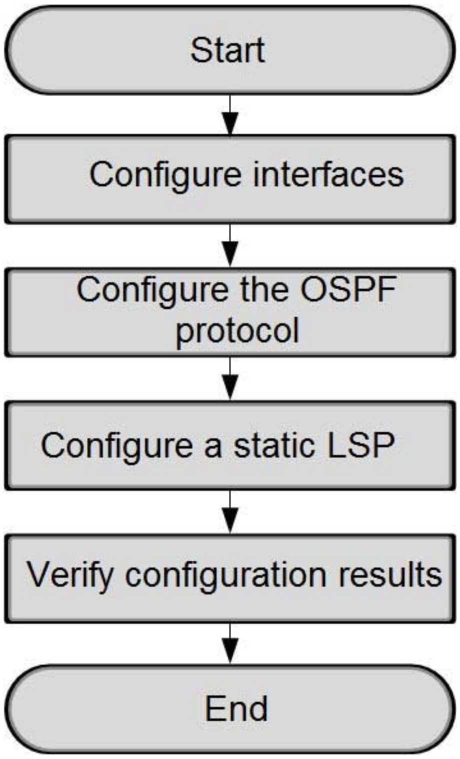
Three OLT devices are interconnected through uplink ports. Each sets up an adjacency and communicates with another through the OSPF protocol. A static LSP is configured between OLT1 and OLT3 to carry label services.

- LSP1 is a path from OLT1 to OLT3. The ingress node, transit node and egress node are OLT1, OLT2 and OLT3, respectively.
- LSP2 is a path from OLT3 to OLT1. The ingress node, transit node and egress node are OLT3, OLT2 and OLT1, respectively.

Network Diagram



16.1.3 Configuration Flow



16.1.4 Configuration Example

This section introduces how to configure the static LSP.

16.1.4.1 Configuring Interfaces

Configure Layer 3 interfaces on three OLTs.

Planning Data

Parameter	Description	Example			
		OLT1	OLT2		OLT3
Start VLAN ID	Start VLAN ID of the uplink port	10	10	20	20
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19	1/19	1/19
Port No.	Number of the uplink port	1	1	2	2
VLAN ID	VLAN ID of the VLANIF interface	10	10	20	20
VLANIF interface address	IPv4 address of the VLANIF interface	10.1.1.1	10.1.1.2	20.1.1.1	20.1.1.2
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Loopback interface address	IPv4 address of the loopback interface on the device	1.1.1.1	2.2.2.2		3.3.3.3
Subnet mask of the loopback interface address	Subnet mask of the IPv4 address of the loopback interface on the device	255.255.255.255	255.255.255.255		255.255.255.255

Procedure

1. Configure interface parameters for the ingress node OLT1.

```
Admin(config)#port vlan 10 tag 1/19 1
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#ipv4 address 10.1.1.1 mask 255.255.255.0
Admin(config-vlanif-10)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 1.1.1.1 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

2. Configure interface parameters for the transit node OLT2.

```
Admin(config)#port vlan 10 tag 1/19 1
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#ipv4 address 10.1.1.2 mask 255.255.255.0
Admin(config-vlanif-10)#exit
Admin(config)#port vlan 20 tag 1/19 2
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.1 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 2.2.2.2 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

3. Configure interface parameters for the egress node OLT3.

```
Admin(config)#port vlan 20 tag 1/19 2
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.2 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 3.3.3.3 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

16.1.4.2 Configuring the OSPF Protocol

Configure the OSPF protocol on three OLTs to enable communications between devices on the backbone network.

Planning Data

Parameter	Description	Example		
		OLT1	OLT2	OLT3
Instance number	OSPF instance number	1	1	1

Parameter	Description	Example						
		OLT1		OLT2			OLT3	
Router ID	Router ID of the OSPF, displayed in the format of an IP address	1.1.1.1		2.2.2.2			3.3.3.3	
Network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	10.1.1.0	1.1.1.1	10.1.1.0	20.1.1.0	2.2.2.2	20.1.1.0	3.3.3.3
Subnet mask	Subnet mask of the network IP address	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.0
Area No.	OSPF area number	0	0	0	0	0	0	0

Procedure

1. Configure the OSPF protocol for OLT1.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 1.1.1.1
Admin(config-ospf-1)#network 10.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 1.1.1.1 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

2. Configure the OSPF protocol for OLT2.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 2.2.2.2
Admin(config-ospf-1)#network 10.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 2.2.2.2 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

3. Configure the OSPF protocol for OLT3.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 3.3.3.3
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 3.3.3.3 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

4. Check the configuration result of the OSPF protocol.

1) OLT1 can ping 3.3.3.3 successfully.

```
Admin(config)#ping 3.3.3.3
PING 3.3.3.3 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 3.3.3.3 : bytes=56: icmp_seq=0 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

2) OLT3 can ping 1.1.1.1 successfully.

```
Admin(config)#ping 1.1.1.1
PING 1.1.1.1 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 1.1.1.1 : bytes=56: icmp_seq=0 ttl=63 time=10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

16.1.4.3 Configuring a Static LSP

A static LSP is manually configured by an administrator. It can work normally only when all the LSRs along the static LSP are configured. The LSR label distribution of the static LSP must obey the following principles: The value of the outgoing label of the previous node is equal to the value of the incoming label of the succeeding node.

The following uses LSP1 (OLT1→OLT2→OLT3) for example to introduce the configuration method.

Planning Data

Parameter	Description	Example		
		OLT1	OLT2	OLT3
Destination IP address	FEC and mask	3.3.3.3/32	3.3.3.3/32	-
Next-hop IP address	Next-hop IPv4 address of LSP	10.1.1.2	20.1.1.2	-
Incoming label	Incoming label of FEC	-	100	200
Ingress	Ingress of FEC	-	vlanif 10	vlanif 20
Outgoing label	Outgoing label of FEC	100	200	-
Egress	Egress of FEC	vlanif 10	vlanif 20	-

Procedure

1. Configure a static LSP for the ingress node OLT1.

```
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#mpls enable
Admin(config-vlanif-10)#exit
Admin(config)#mpls ftn-entry 3.3.3.3/32 100 10.1.1.2 vlanif10
```

2. Configure a static LSP for the intermediate node OLT2.

```
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#mpls enable
Admin(config-vlanif-10)#exit
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#exit
Admin(config)#mpls ilm-entry 100 vlanif10 swap 200 vlanif20 20.1.1.2 3.3.3.3/32
```

3. Configure a static LSP for the egress node OLT3.

```
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#exit
Admin(config)#mpls ilm-entry 200 vlanif20 pop
```

16.1.4.4 Verifying Configuration Results

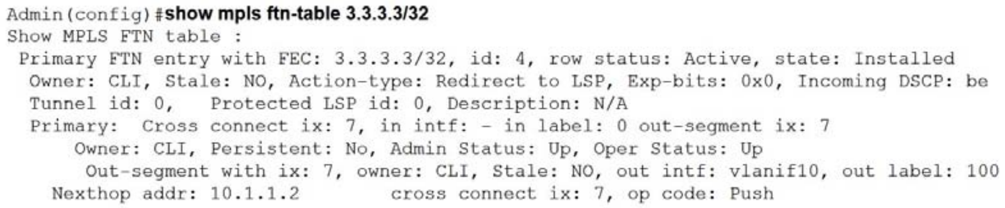
Check the static LSP configuration results of three OLTs, including the static LSP table entries, FTN table entries and ILM table entries.

1. Check the configuration result of the ingress node OLT1.

   1) Check the static LSP table entries of OLT1.

```
Admin(config)#show static-lsp
!static-lsp config -----------------------------------------
!
mpls ftn-entry 3.3.3.3/32 100 10.1.1.2 vlanif10
!
!
!
!static-lsp config end!-------------------------------------
```

   2) Check the FTN table entries of OLT1.



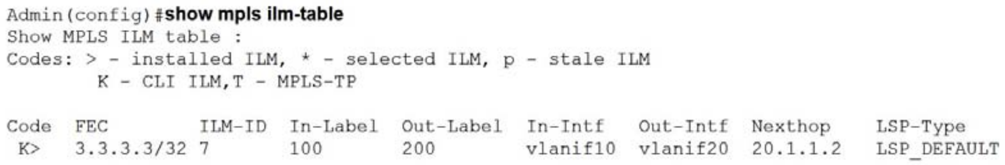
```
Admin(config)#show mpls ftn-table 3.3.3.3/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 3.3.3.3/32, id: 4, row status: Active, state: Installed
  Owner: CLI, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: be
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 7, in intf: - in label: 0 out-segment ix: 7
      Owner: CLI, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 7, owner: CLI, Stale: NO, out intf: vlanif10, out label: 100
    Nexthop addr: 10.1.1.2        cross connect ix: 7, op code: Push
```

2. Check the configuration result of the intermediate node OLT2.

    1) Check the static LSP table entries of OLT2.

```
Admin(config)#show static-lsp
!static-lsp config ----------------------------------------
!
!
mpls ilm-entry 100 vlanif10 swap 200 vlanif20 20.1.1.2 3.3.3.3/32
!
!
!static-lsp config end!------------------------------------
```

    2) Check the ILM table entries of OLT2.



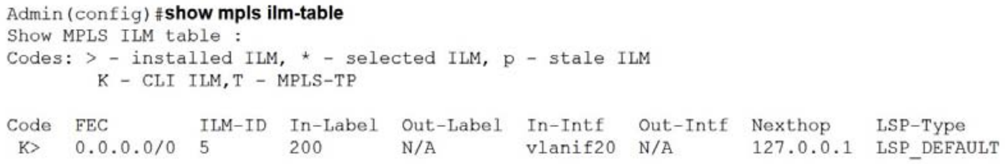
```
Admin(config)#show mpls ilm-table
Show MPLS ILM table :
Codes: > - installed ILM, * - selected ILM, p - stale ILM
        K - CLI ILM,T - MPLS-TP

Code  FEC         ILM-ID  In-Label  Out-Label  In-Intf   Out-Intf  Nexthop    LSP-Type
 K>   3.3.3.3/32  7       100       200        vlanif10  vlanif20  20.1.1.2   LSP_DEFAULT
```

3. Check the configuration result of the egress node OLT3.

    1) Check the static LSP table entries of OLT3.

```
Admin(config)#show static-lsp
!static-lsp config ----------------------------------------
!
!
mpls ilm-entry 200 vlanif20 pop
!
!
!static-lsp config end!------------------------------------
```

    2) Check the ILM table entries of the intermediate node OLT3.



```
Admin(config)#show mpls ilm-table
Show MPLS ILM table :
Codes: > - installed ILM, * - selected ILM, p - stale ILM
        K - CLI ILM,T - MPLS-TP

Code  FEC         ILM-ID  In-Label  Out-Label  In-Intf   Out-Intf  Nexthop    LSP-Type
 K>   0.0.0.0/0   5       200       N/A        vlanif20  N/A       127.0.0.1  LSP_DEFAULT
```

16.2 Configuring LDP LSP

This section introduces the background information, network scenario, configuration flow and configuration example of the LDP LSP.

16.2.1 Background Information

The LDP protocol is an MPLS label distribution protocol defined by the IETF. The LDP stipulates various types of packets for the label distribution process, and the related processing. The LSRs form an LSP that crosses the entire MPLS domain according to the local forwarding table, which correlates the incoming label, next-hop node, and outcoming label of each specific FEC.

The dynamic LSP can be created through LDP on the AN6000 Series.

Concepts related to the LDP are as follows:

Concept	Description
LDP adjacency	It indicates a TCP connection established after two LSRs transmit Hello messages to each other. ◆ Local adjacency: Indicates the adjacencies discovered by link Hello messages. ◆ Remote adjacency: Indicates the adjacencies discovered by target Hello messages.
LDP peers	They indicate two LSRs which have LDP sessions between them and use the LDP to switch label messages after the TCP connection is established. The LDP peers obtain labels from each other through LDP sessions.
LDP session	It indicates the process where two LDP peers switch labels with each other. The LDP session is a connection established based on the TCP. ◆ LDP local session: A session established between two LSRs which are adjacent. ◆ LDP remote session: A session established between two LSRs which can be adjacent or non-adjacent.

The LDP has the following features:

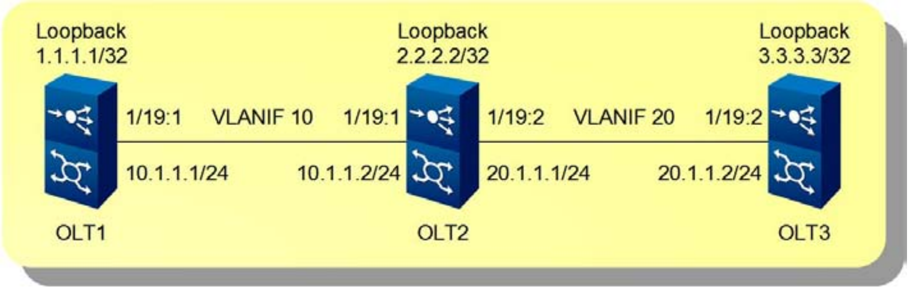
- Simple network and configurations
- LSP established by routing topology
- Large-capacity LSP

16.2.2 Network Scenario

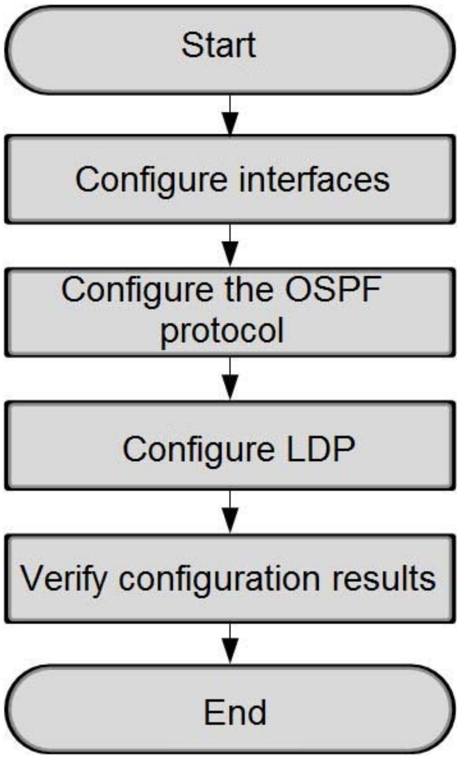
Service Planning

Three OLT devices are interconnected through uplink ports. Each sets up an adjacency and communicates with another through the OSPF protocol. A public network tunnel is configured through LDP between OLT1 and OLT3 to carry label services, and distribute and switch labels.

Network Diagram



16.2.3 Configuration Flow



16.2.4 Configuration Example

This section introduces how to configure the LDP LSP.

16.2.4.1 Configuring Interfaces

Configure Layer 3 interfaces on three OLTs.

Planning Data

Parameter	**Description**	**Example**			
		OLT1	**OLT2**		**OLT3**
Start VLAN ID	Start VLAN ID of the uplink port	10	10	20	20
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19	1/19	1/19
Port No.	Number of the uplink port	1	1	2	2
VLAN ID	VLAN ID of the VLANIF interface	10	10	20	20
VLANIF interface address	IPv4 address of the VLANIF interface	10.1.1.1	10.1.1.2	20.1.1.1	20.1.1.2
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0

Parameter	Description	Example		
		OLT1	OLT2	OLT3
Loopback interface address	IPv4 address of the loopback interface on the device	1.1.1.1	2.2.2.2	3.3.3.3
Subnet mask of the loopback interface address	Subnet mask of the IPv4 address of the loopback interface on the device	255.255.255.255	255.255.255.255	255.255.255.255

Procedure

1. Configure interface parameters for OLT1.

```
Admin(config)#port vlan 10 tag 1/19 1
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#ipv4 address 10.1.1.1 mask 255.255.255.0
Admin(config-vlanif-10)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 1.1.1.1 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

2. Configure interface parameters for OLT2.

```
Admin(config)#port vlan 10 tag 1/19 1
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#ipv4 address 10.1.1.2 mask 255.255.255.0
Admin(config-vlanif-10)#exit
Admin(config)#port vlan 20 tag 1/19 2
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.1 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 2.2.2.2 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

3. Configure interface parameters for OLT3.

```
Admin(config)#port vlan 20 tag 1/19 2
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.2 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 3.3.3.3 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

16.2.4.2 Configuring the OSPF Protocol

Configure the OSPF protocol on three OLTs to enable communications between devices on the backbone network.

Planning Data

Parameter	Description	Example						
		OLT1		OLT2			OLT3	
Instance number	OSPF instance number	1		1			1	
Router ID	Router ID of the OSPF, displayed in the format of an IP address	1.1.1.1		2.2.2.2			3.3.3.3	
Network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	10.1.1.0	1.1.1.1	10.1.1.0	20.1.1.0	2.2.2.2	20.1.1.0	3.3.3.3
Subnet mask	Subnet mask of the network IP address	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.0
Area No.	OSPF area number	0	0	0	0	0	0	0

Procedure

1. Configure the OSPF protocol for OLT1.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 1.1.1.1
Admin(config-ospf-1)#network 10.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 1.1.1.1 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

2. Configure the OSPF protocol for OLT2.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 2.2.2.2
Admin(config-ospf-1)#network 10.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 2.2.2.2 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

3. Configure the OSPF protocol for OLT3.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 3.3.3.3
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 3.3.3.3 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

4. Check the configuration result of the OSPF protocol.

    1) OLT1 can ping 3.3.3.3 successfully.

```
Admin(config)#ping 3.3.3.3
PING 3.3.3.3 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 3.3.3.3 : bytes=56: icmp_seq=0 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 3.3.3.3 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

    2) OLT3 can ping 1.1.1.1 successfully.

```
Admin(config)#ping 1.1.1.1
PING 1.1.1.1 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 1.1.1.1 : bytes=56: icmp_seq=0 ttl=63 time=10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 1.1.1.1 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

16.2.4.3 Configuring LDP Sessions

Configure MPLS LDP sessions between three OLTs. The LDP LSP is automatically created after the LDP session is set up.

Planning Data

Parameter	Description	Example		
		OLT1	OLT2	OLT3
Router ID	Router identifier	1.1.1.1	2.2.2.2	3.3.3.3
LDP transport address	Source transport address in LDP Hello messages, in the format of an IPv4 address	1.1.1.1	2.2.2.2	3.3.3.3

Parameter	Description	Example			
		OLT1	OLT2		OLT3
VLAN ID	VLAN ID of the VLANIF interface	10	10	20	20
Interface LDP enabling	Enable the IP address format of the LDP for an interface	ipv4	ipv4		ipv4
LDP remote address	IP address of the LDP remote peer, in the format of an IPv4 address	3.3.3.3	-		1.1.1.1

Procedure

1. Configure LDP local and remote sessions for OLT1.

```
Admin(config)#router ldp
Admin(config-router)#router-id 1.1.1.1
Admin(config-router)#transport-address ipv4 1.1.1.1
Admin(config-router)#exit
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#mpls enable
Admin(config-vlanif-10)#ldp enable ipv4
Admin(config-vlanif-10)#exit
Admin(config)#router ldp
Admin(config-router)#targeted-peer ipv4 3.3.3.3
Admin(config-router)#exit
```

2. Configure LDP local sessions for OLT2.

```
Admin(config)#router ldp
Admin(config-router)#router-id 2.2.2.2
Admin(config-router)#transport-address ipv4 2.2.2.2
Admin(config-router)#exit
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#mpls enable
Admin(config-vlanif-10)#ldp enable ipv4
Admin(config-vlanif-10)#exit
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#ldp enable ipv4
Admin(config-vlanif-20)#exit
```

3. Configure LDP local and remote sessions for OLT3.

```
Admin(config)#router ldp
Admin(config-router)#router-id 3.3.3.3
Admin(config-router)#transport-address ipv4 3.3.3.3
Admin(config-router)#exit
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#ldp enable ipv4
Admin(config-vlanif-20)#exit
Admin(config)#router ldp
Admin(config-router)#targeted-peer ipv4 1.1.1.1
Admin(config-router)#exit
```

16.2.4.4 Verifying Configuration Results

Check LDP configuration results for three OLTs, including LDP parameters and LDP session states.

1. Check the configuration result of OLT1.

    1) Check the LDP parameters of OLT1.

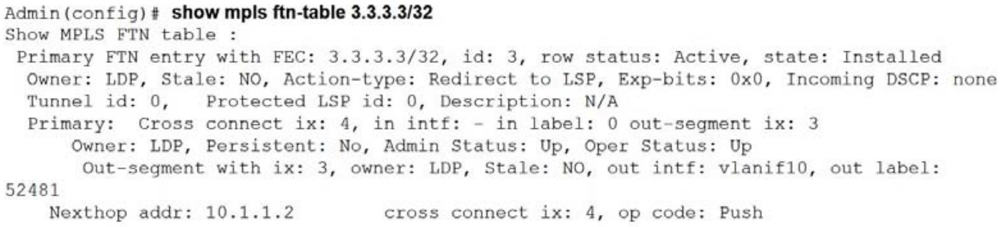
```
Admin(config)#show ldp param
Show LDP :
Router ID                 : 1.1.1.1
LDP Version               : 1
Global Merge Capability   : Merge Capable
Label Advertisement Mode : Downstream Unsolicited
Label Retention Mode      : Liberal
Label Control Mode        : Independent
Instance Loop Detection   : Off
Request Retry             : Off
Propagate Release         : Disabled
Graceful Restart          : Disabled
Hello Interval            : 5
Targeted Hello Interval   : 15
Hold time                 : 15
Targeted Hold time        : 45
Keepalive Interval        : 10
Keepalive Timeout         : 30
Request retry Timeout     : 5
Transport Address data    :
  Labelspace 0            : 1.1.1.1 (in use)
Import BGP routes         : No
```

    2) Check the LDP session states of OLT1, including states of local and remote sessions.

```
Admin(config)#show mpls ldp session
```

```
show mpls ldp session :
Peer IP Address            IF Name    My Role    State       KeepAlive
3.3.3.3                    vlanif10   Passive   OPERATIONAL   30
2.2.2.2                    vlanif10   Passive   OPERATIONAL   30
```

3) Check the FTN table entries from OLT1 to OLT3.



```
Admin(config)# show mpls ftn-table 3.3.3.3/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 3.3.3.3/32, id: 3, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 4, in intf: - in label: 0 out-segment ix: 3
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 3, owner: LDP, Stale: NO, out intf: vlanif10, out label:
52481
    Nexthop addr: 10.1.1.2        cross connect ix: 4, op code: Push
```

2. Check the configuration result of OLT2.

1) Check the LDP parameters of OLT2.

```
Admin(config)#show ldp param
Show LDP :
Router ID                 : 2.2.2.2
LDP Version               : 1
Global Merge Capability   : Merge Capable
Label Advertisement Mode : Downstream Unsolicited
Label Retention Mode      : Liberal
Label Control Mode        : Independent
Instance Loop Detection   : Off
Request Retry             : Off
Propagate Release         : Disabled
Graceful Restart          : Disabled
Hello Interval            : 5
Targeted Hello Interval   : 15
Hold time                 : 15
Targeted Hold time        : 45
Keepalive Interval        : 10
Keepalive Timeout         : 30
Request retry Timeout     : 5
Transport Address data    :
  Labelspace 0            : 2.2.2.2 (in use)
Import BGP routes         : No
```

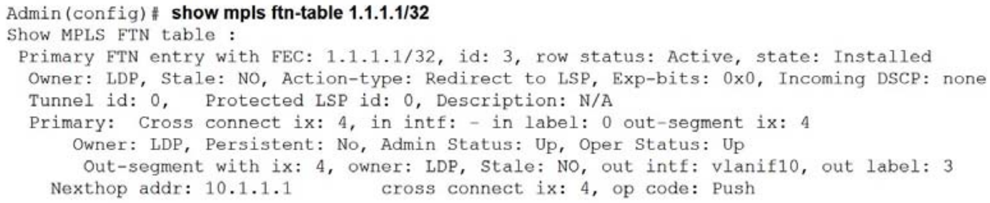
2) Check the LDP session states of OLT2.

```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address            IF Name    My Role    State       KeepAlive
3.3.3.3                    vlanif20   Passive   OPERATIONAL   30
```

```
1.1.1.1                    vlanif10   Active    OPERATIONAL   30
```

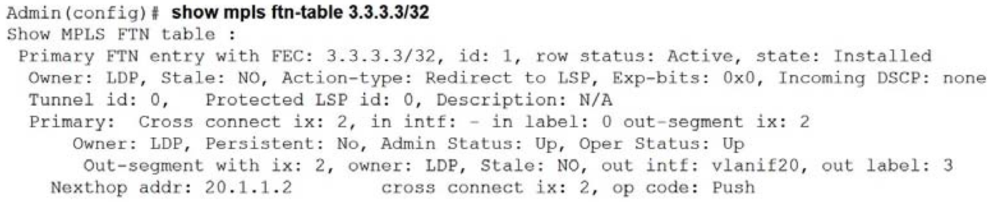
3) Check the FTN table entries of OLT2.

- Check the FTN table entries from OLT2 to OLT1.



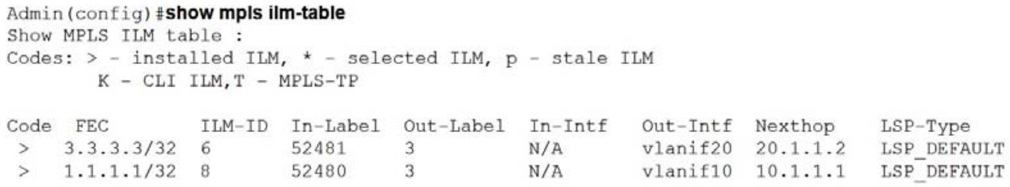
```
Admin(config)# show mpls ftn-table 1.1.1.1/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 1.1.1.1/32, id: 3, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 4, in intf: - in label: 0 out-segment ix: 4
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 4, owner: LDP, Stale: NO, out intf: vlanif10, out label: 3
    Nexthop addr: 10.1.1.1        cross connect ix: 4, op code: Push
```

- Check the FTN table entries from OLT2 to OLT3.



```
Admin(config)# show mpls ftn-table 3.3.3.3/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 3.3.3.3/32, id: 1, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 2, in intf: - in label: 0 out-segment ix: 2
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 2, owner: LDP, Stale: NO, out intf: vlanif20, out label: 3
    Nexthop addr: 20.1.1.2        cross connect ix: 2, op code: Push
```

4) Check the ILM table entries of OLT2.



```
Admin(config)#show mpls ilm-table
Show MPLS ILM table :
Codes: > - installed ILM, * - selected ILM, p - stale ILM
        K - CLI ILM,T - MPLS-TP

Code  FEC         ILM-ID  In-Label  Out-Label  In-Intf   Out-Intf  Nexthop   LSP-Type
 >    3.3.3.3/32  6       52481     3          N/A       vlanif20  20.1.1.2  LSP_DEFAULT
 >    1.1.1.1/32  8       52480     3          N/A       vlanif10  10.1.1.1  LSP_DEFAULT
```

3. Check the configuration result of OLT3.

1) Check the LDP parameters of OLT3.

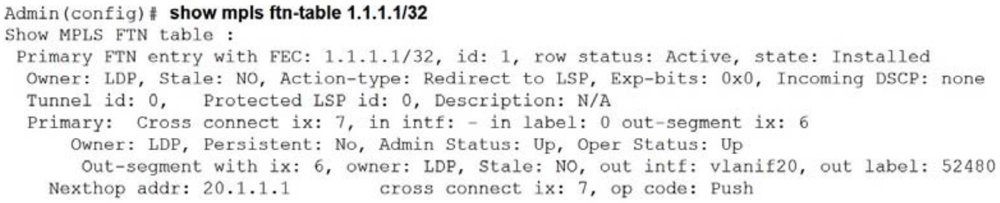
```
Admin(config)#show ldp param
Show LDP :
Router ID                 : 3.3.3.3
LDP Version               : 1
Global Merge Capability   : Merge Capable
Label Advertisement Mode  : Downstream Unsolicited
Label Retention Mode      : Liberal
Label Control Mode        : Independent
Instance Loop Detection   : Off
Request Retry             : Off
Propagate Release         : Disabled
Graceful Restart          : Disabled
Hello Interval            : 5
```

```
Targeted Hello Interval  : 15
Hold time                : 15
Targeted Hold time       : 45
Keepalive Interval       : 10
Keepalive Timeout        : 30
Request retry Timeout    : 5
Transport Address data   :
  Labelspace 0           : 3.3.3.3 (in use)
Import BGP routes        : No
```

2) Check the LDP session states of OLT3, including states of local and remote sessions.

```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address           IF Name    My Role    State       KeepAlive
2.2.2.2                   vlanif20   Active    OPERATIONAL   30
1.1.1.1                   vlanif20   Active    OPERATIONAL   30
```

3) Check the FTN table entries from OLT3 to OLT1.



```
Admin(config)# show mpls ftn-table 1.1.1.1/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 1.1.1.1/32, id: 1, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 7, in intf: - in label: 0 out-segment ix: 6
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 6, owner: LDP, Stale: NO, out intf: vlanif20, out label: 52480
    Nexthop addr: 20.1.1.1        cross connect ix: 7, op code: Push
```

16.3 Configuring RSVP LSP

This section introduces the background information, network scenario, configuration flow and configuration example of the RSVP LSP.

16.3.1 Background Information

Resource Reservation Protocol (RSVP) is a signaling protocol that is used to reserve resources on a network. As a network control protocol, RSVP works at the transmission layer, but does not participate in the transmission of application data. The RSVP signaling can carry the constraint parameters such as the bandwidth of the LSP, certain explicit routes, and color.

MPLS RSVP sets up label switched path (LSP) tunnels along specified paths to reserve resources. This enables network traffic to avoid the node where congestion occurs to balance network traffic.

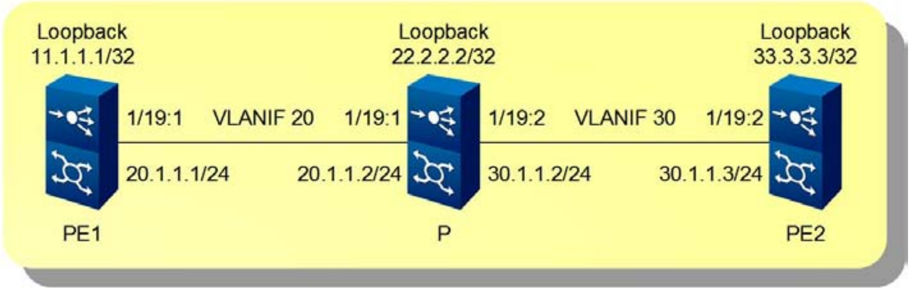
Dynamic LSPs can be created through RSVP on the AN6000 Series.

16.3.2 Network Scenario

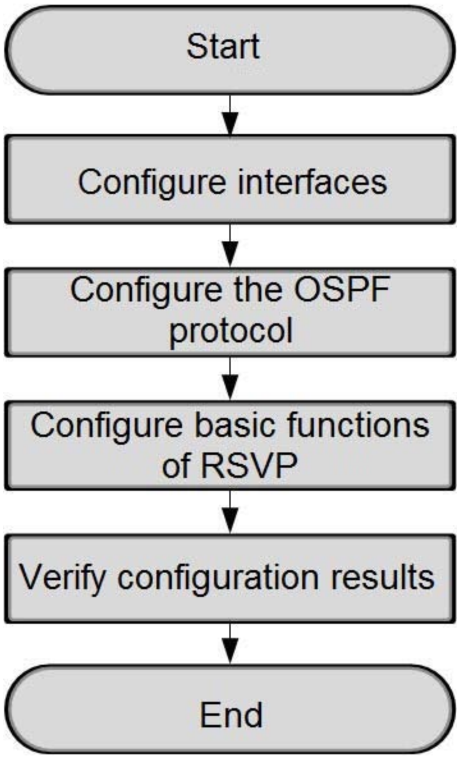
Service Planning

Three OLT devices are interconnected through uplink ports. Each sets up an adjacency and communicates with another through the OSPF protocol. PE1 and PE2 are edge routers on the backbone network. P is the core router on the backbone network. A public network tunnel is configured through RSVP between PE1 and PE2 to carry label services, and distribute and switch labels.

Network Diagram



16.3.3 Configuration Flow


Start
Configure interfaces
Configure the OSPF protocol
Configure basic functions of RSVP
Verify configuration results
End

16.3.4 Configuration Example

This section introduces how to configure the MPLS RSVP.

16.3.4.1 Configuring Interfaces

Configure interfaces on PE1, P and PE2.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
Start VLAN ID	Start VLAN ID of the uplink port	20	20	30	30

Parameter	Description	Example			
		PE1	P		PE2
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19	1/19	1/19
Port No.	Number of the uplink port	1	1	2	2
VLAN ID	VLAN ID of the VLANIF interface	20	20	30	30
VLANIF interface address	IPv4 address of the VLANIF interface	20.1.1.1	20.1.1.2	30.1.1.2	30.1.1.3
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Loopback interface address	IPv4 address of the loopback interface on the device	11.1.1.1	22.2.2.2		33.3.3.3
Subnet mask of the loopback interface address	Subnet mask of the IPv4 address of the loopback interface on the device	255.255.255.255	255.255.255.255		255.255.255.255

Procedure

1. Configure interface parameters for PE1.

```
Admin(config)#port vlan 20 tag 1/19 1
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.1 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 11.1.1.1 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

2. Configure interface parameters for P.

```
Admin(config)#port vlan 20 tag 1/19 1
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ip address 20.1.1.2 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#port vlan 30 tag 1/19 2
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#ip address 30.1.1.2 mask 255.255.255.0
Admin(config-vlanif-30)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 22.2.2.2 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

3. Configure interface parameters for PE2.

```
Admin(config)#port vlan 30 tag 1/19 2
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#ipv4 address 30.1.1.3 mask 255.255.255.0
Admin(config-vlanif-30)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 33.3.3.3 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

16.3.4.2 Configuring the OSPF Protocol

Configure the OSPF protocol on PE1, P and PE2 to enable communications between devices on the backbone network.

Planning Data

Parameter	Description	Example		
		PE1	P	PE2
Instance number	OSPF instance number	1	1	1
Router ID	ID of the OSPF router, displayed in the format of an IP address	11.1.1.1	22.2.2.2	33.3.3.3

Parameter	Description	Example						
		PE1		P			PE2	
Interface network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	20.1.1.0	11.1.1.1	20.1.1.0	30.1.1.0	22.2.2.2	30.1.1.0	33.3.3.3
Subnet mask	Subnet mask	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.0
Domain IP address	IP address of the OSPF area to which the uplink port belongs. It is represented in dotted decimal notation.	0	0	0	0	0	0	0

Procedure

1. Configure the OSPF protocol for PE1.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 11.1.1.1
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 11.1.1.1 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

2. Configure the OSPF protocol for P.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 22.2.2.2
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 30.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 22.2.2.2 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

3. Configure the OSPF protocol for PE2.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 33.3.3.3
Admin(config-ospf-1)#network 30.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 33.3.3.3 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

4. Check the configuration result of the OSPF protocol.

   1) PE1 can ping 33.3.3.3 successfully.

```
Admin(config)#ping 33.3.3.3
PING 33.3.3.3 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 33.3.3.3 : bytes=56: icmp_seq=0 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

   2) PE2 can ping 11.1.1.1 successfully.

```
Admin(config)#ping 11.1.1.1
PING 11.1.1.1 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 11.1.1.1 : bytes=56: icmp_seq=0 ttl=63 time=10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

16.3.4.3 Configuring Basic Functions of RSVP

Configuring RSVP functions enables network traffic to avoid the node where congestion occurs to balance network traffic.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
VLAN ID	VLAN ID of the interface	20	20	30	30
Trunk name	Trunk name	test	-	-	test1
LSP egress node address	IPv4 address of the LSP egress node	33.3.3.3	-	-	11.1.1.1
LSP ingress node address	IPv4 address of the LSP ingress node	11.1.1.1	-	-	33.3.3.3

Procedure

1. Configure RSVP functions for PE1.

```
Admin(config)#router rsvp
Admin(config-rsvp)#cspf disable
Admin(config-rsvp)#exit
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#rsvp enable
Admin(config-vlanif-20)#exit
Admin(config)#rsvp-trunk test ipv4
Admin(config-rsvp-trunk-test)#to 33.3.3.3
Admin(config-rsvp-trunk-test)#from 11.1.1.1
Admin(config-rsvp-trunk-test)#exit
```

2. Configure RSVP functions for P.

```
Admin(config)#router rsvp
Admin(config-rsvp)#cspf disable
Admin(config-rsvp)#exit
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#rsvp enable
Admin(config-vlanif-20)#exit
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#mpls enable
Admin(config-vlanif-30)#rsvp enable
Admin(config-vlanif-30)#exit
```

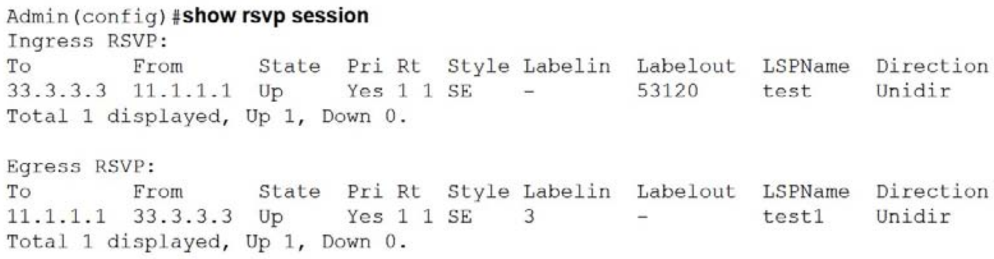
3. Configure RSVP functions for PE2.

```
Admin(config)#router rsvp
Admin(config-rsvp)#cspf disable
Admin(config-rsvp)#exit
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#mpls enable
Admin(config-vlanif-30)#rsvp enable
Admin(config-vlanif-30)#exit
Admin(config)#rsvp-trunk test1 ipv4
Admin(config-rsvp-trunk-test1)#to 11.1.1.1
Admin(config-rsvp-trunk-test1)#from 33.3.3.3
Admin(config-rsvp-trunk-test1)#exit
```

16.3.4.4 Verifying Configuration Results

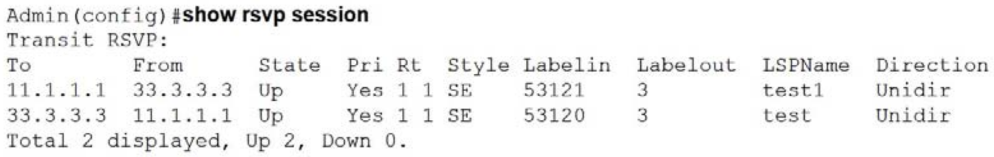
Check RSVP configuration results of PE1, P and PE2.

1. Check the RSVP session on PE1.



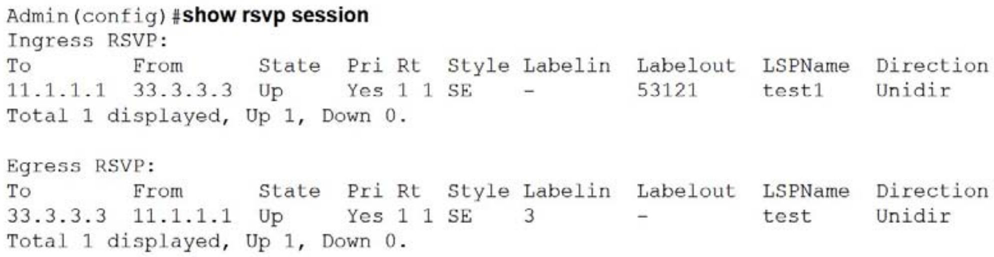
```
Admin(config)#show rsvp session
Ingress RSVP:
To        From      State  Pri Rt  Style Labelin  Labelout  LSPName  Direction
33.3.3.3  11.1.1.1  Up     Yes 1 1 SE    -        53120     test     Unidir
Total 1 displayed, Up 1, Down 0.

Egress RSVP:
To        From      State  Pri Rt  Style Labelin  Labelout  LSPName  Direction
11.1.1.1  33.3.3.3  Up     Yes 1 1 SE    3        -         test1    Unidir
Total 1 displayed, Up 1, Down 0.
```

2. Check the RSVP session on P.



```
Admin(config)#show rsvp session
Transit RSVP:
To        From      State  Pri Rt  Style Labelin  Labelout  LSPName  Direction
11.1.1.1  33.3.3.3  Up     Yes 1 1 SE    53121    3         test1    Unidir
33.3.3.3  11.1.1.1  Up     Yes 1 1 SE    53120    3         test     Unidir
Total 2 displayed, Up 2, Down 0.
```

3. Check the RSVP session on PE2.



```
Admin(config)#show rsvp session
Ingress RSVP:
To        From      State  Pri Rt  Style Labelin  Labelout  LSPName  Direction
11.1.1.1  33.3.3.3  Up     Yes 1 1 SE    -        53121     test1    Unidir
Total 1 displayed, Up 1, Down 0.

Egress RSVP:
To        From      State  Pri Rt  Style Labelin  Labelout  LSPName  Direction
33.3.3.3  11.1.1.1  Up     Yes 1 1 SE    3        -         test     Unidir
Total 1 displayed, Up 1, Down 0.
```

17 Configuring VPN

This chapter introduces how to configure the VPN services for the AN6000 Series.

☑ Configuring VPWS

☑ Configuring VPLS

☑ Configuring BGP / MPLS IPv4 VPN

17.1 Configuring VPWS

This section introduces the background information, network scenario, configuration flow and configuration example of the VPWS.

17.1.1 Background

Virtual Private Wire Service (VPWS) is a Layer 2 virtual private network (VPN) technology for point-to-point transmission. It implements one-to-one mappings between attachment circuits (ACs) and pseudo wires (PWs). By means of binding local ACs, PWs and the opposite ACs, the virtual circuits are formed to transparently transmit Layer 2 services between subscribers. As a virtual private line technology, the VPWS supports almost all the link layer protocols.

Concepts related to the VPWS network are as follows:

Concept	Description
AC	Attachment circuit, a connection between subscribers and service providers, that is, a link between a CE and a PE. The AC interfaces supported by the AN6000 Series include uplink ports and PON ports.
PW	Pseudo wire or virtual link, a bidirectional virtual connection between two VSIs residing on two PEs. It consists of a pair of unidirectional MPLS VCs transmitting in opposite directions. It is also called “an emulated circuit”.
Tunnel	A connection between a local PE and a remote PE, used to transparently transmit data between PEs. A tunnel can carry multiple PWs.
PW signaling	A type of signaling protocol used to negotiate PWs.

The VPWS has the following features:

- Extended operators’ network functions and service capabilities. The operator only needs one network to provide MPLS L2VPN services. Besides, the VPWS uses the MPLS-related enhanced technologies, such as traffic engineering and QoS, to provide different services of different levels. This meets various customer demands.
- Higher scalability.

    - In a non-MPLS ATM or FR network, Layer 2 VPN is provided by VC. For each AC, both the provider edge device (PE) and the provider core device (P) on the network need to maintain their complete VC information. Therefore, operators need to set up multiple VCs when they need to connect their devices to multiple CEs on a PE. Much VC information then needs to be maintained on PE and P devices.
    - In an MPLS L2VPN network, multiple VCs share one LSP through the label stack technology. Therefore, only one LSP entry needs to be maintained on the P device. This improves scalability of the system.

- Clear division of management and responsibility. In an MPLS L2VPN network, operators only provide Layer 2 connectivity. Subscribers are responsible for Layer 3 connectivity, such as routing. If subscribers configure incorrectly and a route flap occurs, the stability of the operator’s network is not affected.
- Multiple protocols supported. Since operators only provide Layer 2 connectivity, subscribers can use any of Layer 3 protocols, such as IPv4 and IPv6.
- Smooth upgrade of the network. With VPWS, subscribers do not even learn the existence of the MPLS L2VPN. When operators upgrade the network from the traditional Layer 2 VPN such as ATM and FR to the MPLS L2VPN, subscribers do not need to update any configurations, except that there may be data loss for a short time during network switching.

17.1.2 Network Scenario

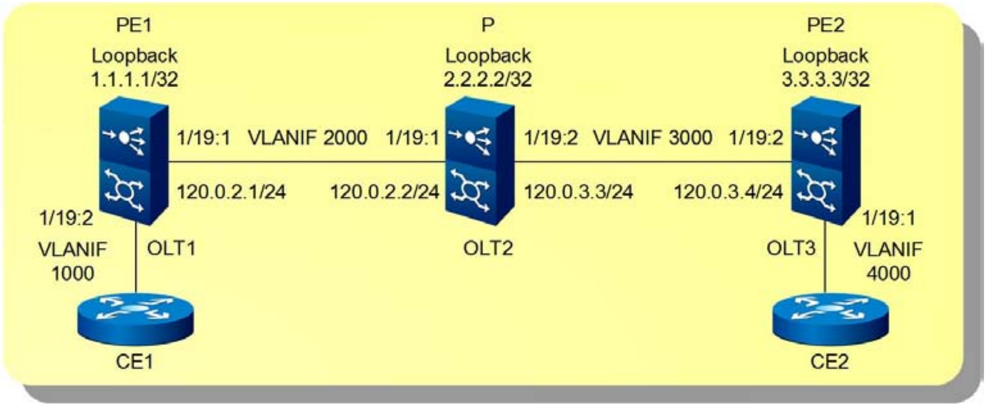
Service Planning

Three OLTs are interconnected through uplink ports. Each sets up an adjacency and communicates with another through the OSPF protocol. Serving as edge routers on the backbone network, PE1 and PE2 use uplink ports to connect to CE1 and CE2 respectively to access VPN services. P serves as the core router on the backbone network to achieve routing and expedited forwarding.

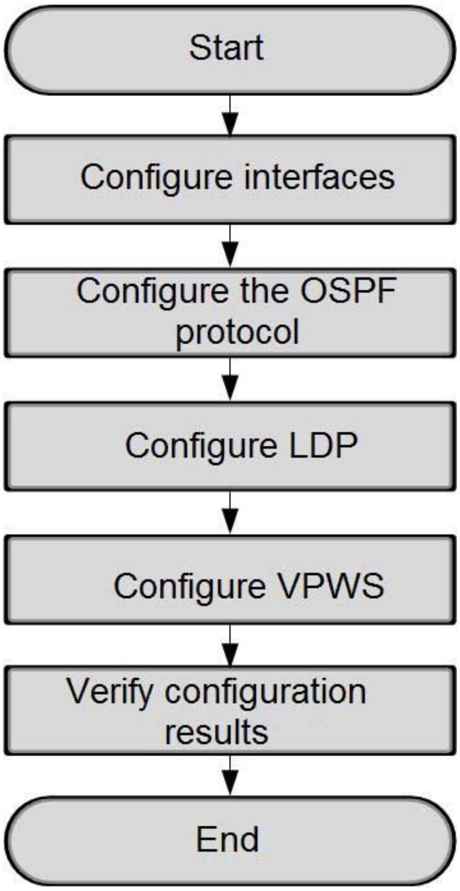
Note:

The AC interfaces supported by the AN6000 Series include uplink ports and PON ports. In this scenario, the devices use the uplink ports as the AC interfaces.

Network Diagram



17.1.3 Configuration Flow



17.1.4 Configuration Example

This section introduces how to configure the VPWS.

17.1.4.1 Configuring Interfaces

Configure interfaces on PE1, P and PE2.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
Start VLAN ID	Start VLAN ID of the uplink interface	2000	2000	3000	3000

Parameter	Description	Example			
		PE1	P		PE2
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink interface resides	1/19	1/19	1/19	1/19
Port No.	Number of the uplink port	1	1	2	2
VLAN ID	VLAN ID of the VLANIF interface	2000	2000	3000	3000
VLANIF interface address	IPv4 address of the VLANIF interface	120.0.2.1	120.0.2.2	120.0.3.3	120.0.3.4
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Loopback interface address	IPv4 address of the loopback interface on the device	1.1.1.1	2.2.2.2		3.3.3.3
Subnet mask of the loopback interface address	Subnet mask of the IPv4 address of the loopback interface on the device	255.255.255.255	255.255.255.255		255.255.255.255

Procedure

1. Configure interface parameters for PE1.

```
Admin(config)#port vlan 2000 tag 1/19 1
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#ipv4 address 120.0.2.1 mask 255.255.255.0
Admin(config-vlanif-2000)#exit
Admin(config)#interface loopback 1
Admin(config-if-loopback-1)#ipv4 address 1.1.1.1 mask 255.255.255.255
Admin(config-if-loopback-1)#exit
```

2. Configure interface parameters for P.

```
Admin(config)#port vlan 2000 tag 1/19 1
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#ipv4 address 120.0.2.2 mask 255.255.255.0
Admin(config-vlanif-2000)#exit
Admin(config)#port vlan 3000 tag 1/19 2
Admin(config)#interface vlanif 3000
Admin(config-vlanif-3000)#ipv4 address 120.0.3.3 mask 255.255.255.0
Admin(config-vlanif-3000)#exit
Admin(config)#interface loopback 2
Admin(config-if-loopback-2)#ipv4 address 2.2.2.2 mask 255.255.255.255
Admin(config-if-loopback-2)#exit
```

3. Configure interface parameters for PE2.

```
Admin(config)#port vlan 3000 tag 1/19 2
Admin(config)#interface vlanif 3000
Admin(config-vlanif-3000)#ipv4 address 120.0.3.4 mask 255.255.255.0
Admin(config-vlanif-3000)#exit
Admin(config)#interface loopback 3
Admin(config-if-loopback-3)#ipv4 address 3.3.3.3 mask 255.255.255.255
Admin(config-if-loopback-3)#exit
```

17.1.4.2 Configuring the OSPF Protocol

Configure the OSPF protocol on PE1, P and PE2 to enable communications between devices on the backbone network.

Planning Data

Parameter	**Description**	**Example**		
		PE1	**P**	**PE2**
Instance number	OSPF instance number	10	10	10
Router ID	Router ID of the OSPF, displayed in the format of an IP address	1.1.1.1	2.2.2.2	3.3.3.3

Parameter	Description	Example						
		PE1		P			PE2	
Network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	120.0.2.0	1.1.1.1	120.0.2.0	120.0.3.0	2.2.2.2	120.0.3.0	3.3.3.3
Subnet mask	Subnet mask of the network IP address	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.0
Area No.	OSPF area number	0	0	0	0	0	0	0

Procedure

1. Configure the OSPF protocol for PE1.

```
Admin(config)#router ospf 10
Admin(config-ospf-10)#router-id 1.1.1.1
Admin(config-ospf-10)#network 120.0.2.0 0.0.0.255 area 0
Admin(config-ospf-10)#network 1.1.1.1 0.0.0.0 area 0
Admin(config-ospf-10)#exit
```

2. Configure the OSPF protocol for P.

```
Admin(config)#router ospf 10
Admin(config-ospf-10)#router-id 2.2.2.2
Admin(config-ospf-10)#network 120.0.2.0 0.0.0.255 area 0
Admin(config-ospf-10)#network 120.0.3.0 0.0.0.255 area 0
Admin(config-ospf-10)#network 2.2.2.2 0.0.0.0 area 0
Admin(config-ospf-10)#exit
```

3. Configure the OSPF protocol for PE2.

```
Admin(config)#router ospf 10
Admin(config-ospf-10)#router-id 3.3.3.3
Admin(config-ospf-10)#network 120.0.3.0 0.0.0.255 area 0
Admin(config-ospf-10)#network 3.3.3.3 0.0.0.0 area 0
Admin(config-ospf-10)#exit
```

17.1.4.3 Configuring LDP Sessions

Set up LDP sessions between PEs. If PEs are not directly connected, you need to set up MPLS LDP remote sessions.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
Router ID	Router identifier	1.1.1.1	2.2.2.2		3.3.3.3
LDP transport address	Source transport address in LDP Hello messages, in the format of an IPv4 address	1.1.1.1	2.2.2.2		3.3.3.3
VLAN ID	VLAN ID of the VLANIF interface	2000	2000	3000	3000
Interface LDP enabling	Enable the IP address format of the LDP for an interface	ipv4	ipv4		ipv4
LDP remote address	IP address of the targeted peer, in the format of an IPv4 address	3.3.3.3	-		1.1.1.1

Procedure

1. Configure LDP local and remote sessions for PE1.

```
Admin(config)#router ldp
Admin(config-router)#router-id 1.1.1.1
Admin(config-router)#transport-address ipv4 1.1.1.1
Admin(config-router)#exit
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#mpls enable
Admin(config-vlanif-2000)#ldp enable ipv4
Admin(config-vlanif-2000)#exit
Admin(config)#router ldp
Admin(config-router)#targeted-peer ipv4 3.3.3.3
Admin(config-router)#exit
```

2. Configure LDP local sessions for P.

```
Admin(config)#router ldp
Admin(config-router)#router-id 2.2.2.2
Admin(config-router)#transport-address ipv4 2.2.2.2
Admin(config-router)#exit
Admin(config)#interface vlanif 2000
Admin(config-vlanif-2000)#mpls enable
Admin(config-vlanif-2000)#ldp enable ipv4
Admin(config-vlanif-2000)#exit
Admin(config)#interface vlanif 3000
Admin(config-vlanif-3000)#mpls enable
Admin(config-vlanif-3000)#ldp enable ipv4
Admin(config-vlanif-3000)#exit
```

3. Configure LDP local and remote sessions for PE2.

```
Admin(config)#router ldp
Admin(config-router)#router-id 3.3.3.3
Admin(config-router)#transport-address ipv4 3.3.3.3
Admin(config-router)#exit
Admin(config)#interface vlanif 3000
Admin(config-vlanif-3000)#mpls enable
Admin(config-vlanif-3000)#ldp enable ipv4
Admin(config-vlanif-3000)#exit
Admin(config)#router ldp
Admin(config-router)#targeted-peer ipv4 1.1.1.1
Admin(config-router)#exit
```

17.1.4.4 Configuring VPWS Services

Set point-to-point connections so that PE devices can communicate with each other.

Planning Data

Parameter	Description	Example	
		PE1	PE2
VC name	Name of VPWS VC	test	test
VC ID	ID of VPWS VC	1	1
Peer IP	IPv4 address of the PW remote peer	3.3.3.3	1.1.1.1
PW encapsulation mode	◆ tagged: encapsulated in Tag mode ◆ raw: encapsulated in Raw mode	tagged	tagged
VLAN ID	VLAN ID of the AC interface	1000	4000
Tag processing mode of VLAN	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number of the card where the AC interface resides	1/19	1/19

Parameter	Description	Example	
		PE1	PE2
Port No.	Number of the AC port	2	1
AC access mode	Packet encapsulation mode for AC ◆ vlan: VLAN access ◆ ethernet: Ethernet access	vlan	vlan

Procedure

1. Configure VPWS services for PE1 and bind VPWS VC to the AC interface.

```
Admin(config)#mpls l2-circuit test 1 3.3.3.3 mode tagged
Admin(config)#port vlan 1000 tag 1/19 2
Admin(config)#interface vlanif 1000
Admin(config-vlanif-1000)#mpls-l2-circuit test vlan
Admin(config-vlanif-1000)#exit
```

2. Configure VPWS services for PE2 and bind VPWS VC to the AC interface.

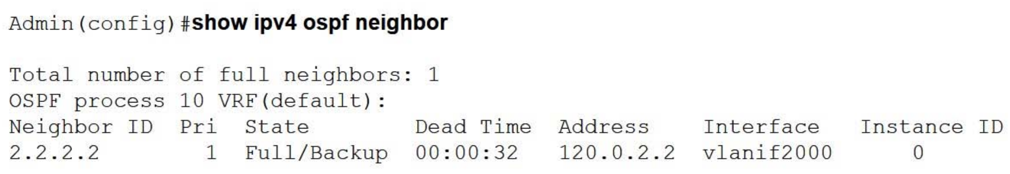
```
Admin(config)#mpls l2-circuit test 1 1.1.1.1 mode tagged
Admin(config)#port vlan 4000 tag 1/19 1
Admin(config)#interface vlanif 4000
Admin(config-vlanif-4000)#mpls-l2-circuit test vlan
Admin(config-vlanif-4000)#exit
```

17.1.4.5 Verifying Configuration Results

Check VPWS configuration results for the three devices.

◆ Check the VPWS configuration results of PE1 and PE2, including the OSPF neighbor information, LDP session information, VC forwarding table and FTN table. The ways to verify the configuration results for PE1 and PE2 are the same. The following uses PE1 for example.

1) Check the OSPF neighbor information of PE1.

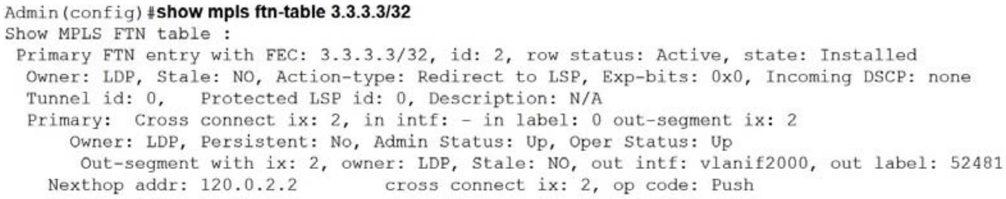


```
Admin(config)#show ipv4 ospf neighbor

Total number of full neighbors: 1
OSPF process 10 VRF(default):
Neighbor ID  Pri  State        Dead Time  Address    Interface   Instance ID
2.2.2.2        1  Full/Backup  00:00:32   120.0.2.2  vlanif2000      0
```

2) Check the LDP session information of PE1. The LDP sessions are set up between PE1 and PE2, and between PE1 and P. Both sessions are operational. Their adjacency relations are set up correctly.

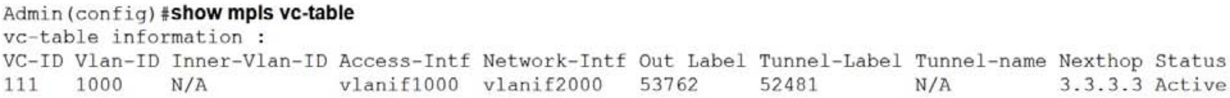
```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address           IF Name     My Role    State       KeepAlive
3.3.3.3                   vlanif2000  Passive   OPERATIONAL   30
2.2.2.2                   vlanif2000  Passive   OPERATIONAL   30
```

3) Check the FTN table with mappings between PE1 and PE2. You can view the outer label information.



```
Admin(config)#show mpls ftn-table 3.3.3.3/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 3.3.3.3/32, id: 2, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 2, in intf: - in label: 0 out-segment ix: 2
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 2, owner: LDP, Stale: NO, out intf: vlanif2000, out label: 52481
    Nexthop addr: 120.0.2.2        cross connect ix: 2, op code: Push
```

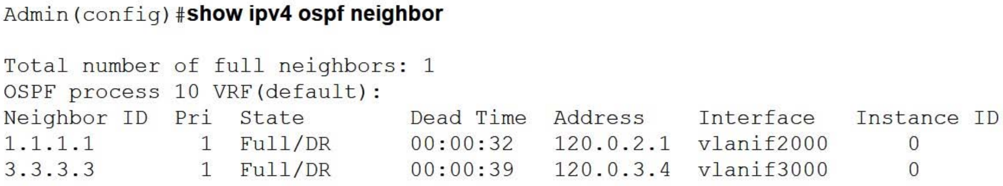
4) Check the VPWS VC forwarding table of PE1. You can view the inner label information.



```
Admin(config)#show mpls vc-table
vc-table information :
VC-ID Vlan-ID Inner-Vlan-ID Access-Intf Network-Intf Out Label Tunnel-Label Tunnel-name Nexthop Status
111   1000    N/A           vlanif1000  vlanif2000   53762     52481        N/A         3.3.3.3 Active
```

◆ Check the configuration result of P, including the OSPF neighbor information, LDP session information, FTN table and ILM table.

1) Check the OSPF neighbor information of P.



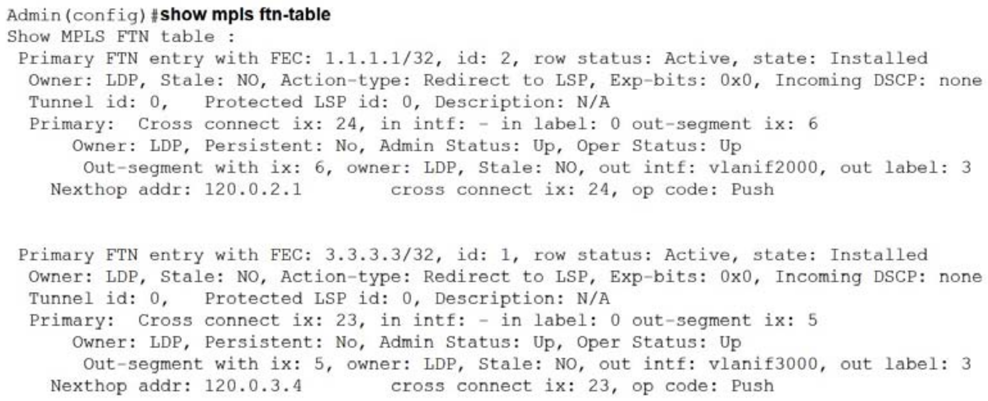
```
Admin(config)#show ipv4 ospf neighbor

Total number of full neighbors: 1
OSPF process 10 VRF(default):
Neighbor ID  Pri  State        Dead Time  Address    Interface   Instance ID
1.1.1.1        1  Full/DR      00:00:32   120.0.2.1  vlanif2000      0
3.3.3.3        1  Full/DR      00:00:39   120.0.3.4  vlanif3000      0
```

2) Check the LDP session information of P. The LDP sessions are set up between P and PE1, and between P and PE2. Both sessions are operational. Their adjacency relations are set up correctly.

```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address           IF Name     My Role    State       KeepAlive
1.1.1.1                   vlanif2000  Active    OPERATIONAL   30
```

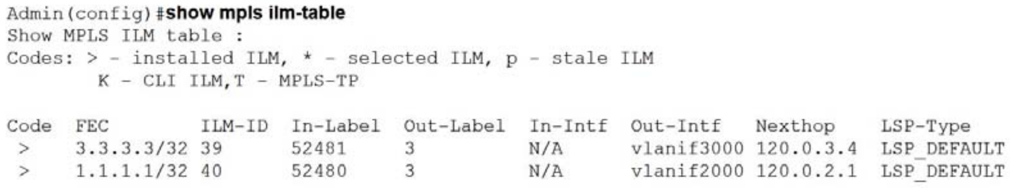
```
3.3.3.3                   vlanif3000 Passive   OPERATIONAL   30
```

3) Check the FTN table of P, including the FECs of PE1 and PE2.



```
Admin(config)#show mpls ftn-table
Show MPLS FTN table :
 Primary FTN entry with FEC: 1.1.1.1/32, id: 2, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 24, in intf: - in label: 0 out-segment ix: 6
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 6, owner: LDP, Stale: NO, out intf: vlanif2000, out label: 3
    Nexthop addr: 120.0.2.1        cross connect ix: 24, op code: Push


 Primary FTN entry with FEC: 3.3.3.3/32, id: 1, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 23, in intf: - in label: 0 out-segment ix: 5
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 5, owner: LDP, Stale: NO, out intf: vlanif3000, out label: 3
    Nexthop addr: 120.0.3.4        cross connect ix: 23, op code: Push
```

Check the ILM table of P, including the FECs of PE1 and PE2.



```
Admin(config)#show mpls ilm-table
Show MPLS ILM table :
Codes: > - installed ILM, * - selected ILM, p - stale ILM
        K - CLI ILM,T - MPLS-TP

Code  FEC         ILM-ID  In-Label  Out-Label  In-Intf  Out-Intf   Nexthop   LSP-Type
 >    3.3.3.3/32  39      52481     3          N/A      vlanif3000 120.0.3.4 LSP_DEFAULT
 >    1.1.1.1/32  40      52480     3          N/A      vlanif2000 120.0.2.1 LSP_DEFAULT
```

17.2 Configuring VPLS

This section introduces the background information, network scenario, configuration flow and configuration example of the VPLS.

17.2.1 Background

Virtual Private LAN Service (VPLS) is a Layer 2 VPN technology for emulating a LAN. In VPLS, an NE can be regarded as a virtual switching instance (VSI) for each L2VPN. This VSI helps achieve many-to-many mappings between ACs and PWs, and connect multiple Ethernet LANs to enable them to work as one LAN. With such VPLS technology, service providers provide Ethernet-based multipoint services to subscribers through the MPLS backbone network.

Concepts related to the VPLS network are as follows:

Concept	Description
AC	Attachment circuit, a connection between subscribers and service providers, that is, a link between a CE and a PE. The AC interfaces supported by the AN6000 Series include uplink ports and PON ports.
VSI	Virtual switch instance, an instance through which the physical access links of VPLS can be mapped to the virtual links. Each VSI provides an independent VPLS service. These services are then forwarded based on MAC addresses and VLAN tags as Layer 2 packets. The VSI works as an Ethernet bridge and can terminate a PW.
PW	Pseudo wire or virtual link, a bidirectional virtual connection between two VSIs residing on two PEs. It consists of a pair of unidirectional MPLS VCs transmitting in opposite directions. It is also called “an emulated circuit”.
Tunnel	A connection between a local PE and a remote PE, used to transparently transmit data between PEs. A tunnel can carry multiple PWs.

The VPLS has the following features:

- The VPLS integrates multiple technologies such as IP/MPLS and L2VPN Ethernet switching to support point-to-point, point-to-multipoint, and multipoint-to-multipoint services. It also supports carrier-class Ethernet services in large-scale networks.
- The VPLS uses Ethernet interfaces on the UNI side and helps deploy services fast and flexibly.
- The VPLS enables subscribers to control and maintain the route policy of the network, simplifying network management of operators.
- All the subscriber routers, that is, CEs, in a VPLS are on the same subnet, which makes it easier to plan IP addressing.
- Subscribers do not need to learn the existence of VPLS, or participate in IP addressing or routing.

17.2.2 Network Scenario

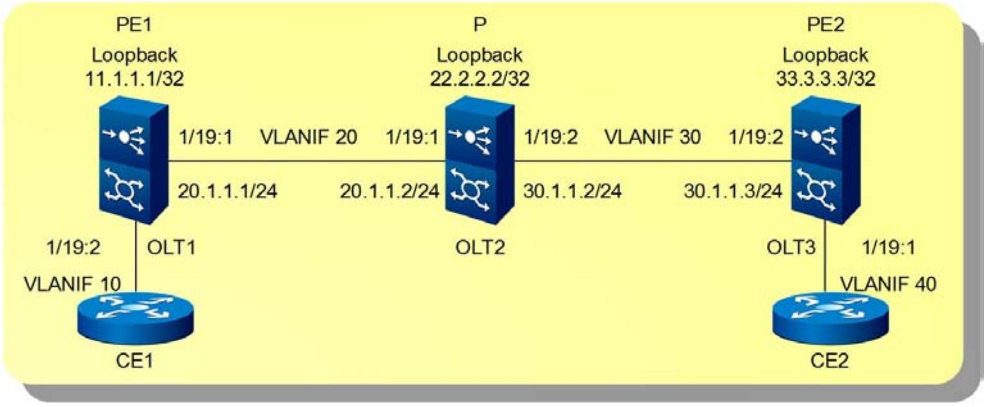
Service Planning

Three OLTs are interconnected through uplink ports. Each sets up an adjacency and communicates with another through the OSPF protocol. Serving as edge routers on the backbone network, PE1 and PE2 use uplink ports to connect to CE1 and CE2 respectively to access VPN services. P serves as the core router on the backbone network to achieve routing and expedited forwarding.

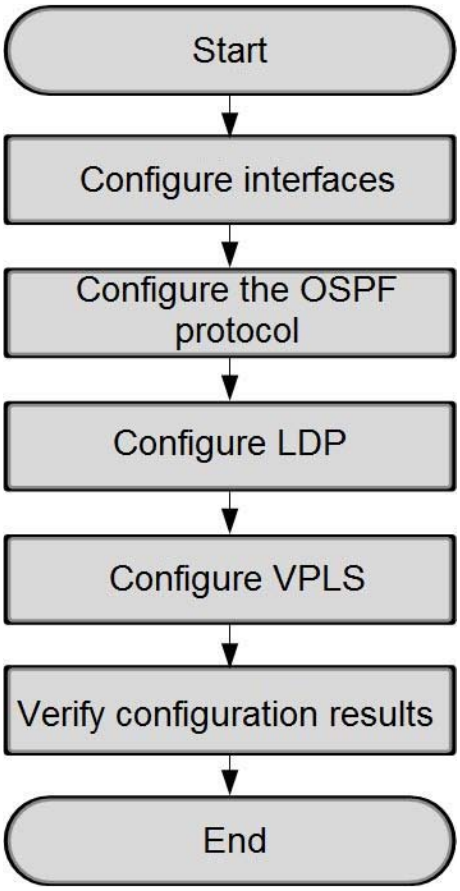
Note:

The AC interfaces supported by the AN6000 Series include uplink ports and PON ports. In this scenario, the devices use the uplink ports as the AC interfaces.

Network Diagram



17.2.3 Configuration Flow



17.2.4 Configuration Example

This section introduces how to configure the VPLS.

17.2.4.1 Configuring Interfaces

Configure interfaces on PE1, P and PE2.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
Start VLAN ID	Start VLAN ID of the uplink port	20	20	30	30

Parameter	Description	Example			
		PE1	P		PE2
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19	1/19	1/19
Port No.	Number of the uplink port	1	1	2	1
VLAN ID	VLAN ID of the VLANIF interface	20	20	30	30
VLANIF interface address	IPv4 address of the VLANIF interface	20.1.1.1	20.1.1.2	30.1.1.2	30.1.1.3
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Loopback interface address	IPv4 address of the loopback interface on the device	11.1.1.1	22.2.2.2		33.3.3.3
Subnet mask of the loopback interface address	Subnet mask of the IPv4 address of the loopback interface on the device	255.255.255.255	255.255.255.255		255.255.255.255

Procedure

1. Configure interface parameters for PE1.

```
Admin(config)#port vlan 20 tag 1/19 1
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.1 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 11.1.1.1 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

2. Configure interface parameters for P.

```
Admin(config)#port vlan 20 tag 1/19 1
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#ipv4 address 20.1.1.2 mask 255.255.255.0
Admin(config-vlanif-20)#exit
Admin(config)#port vlan 30 tag 1/19 2
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#ipv4 address 30.1.1.2 mask 255.255.255.0
Admin(config-vlanif-30)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 22.2.2.2 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

3. Configure interface parameters for PE2.

```
Admin(config)#port vlan 30 tag 1/19 2
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#ipv4 address 30.1.1.1 mask 255.255.255.0
Admin(config-vlanif-30)#exit
Admin(config)#interface loopback 9
Admin(config-if-loopback-9)#ipv4 address 33.3.3.3 mask 255.255.255.255
Admin(config-if-loopback-9)#exit
```

17.2.4.2 Configuring the OSPF Protocol

Configure the OSPF protocol on PE1, P and PE2 to enable communications between devices on the backbone network.

Planning Data

Parameter	**Description**	**Example**		
		PE1	**P**	**PE2**
Instance number	OSPF instance number	1	1	1
Router ID	Router ID of the OSPF, displayed in the format of an IP address	11.1.1.1	22.2.2.2	33.3.3.3

Parameter	Description	Example						
		PE1		P			PE2	
Network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	20.1.1.0	11.1.1.1	20.1.1.0	30.1.1.0	22.2.2.2	30.1.1.0	33.3.3.3
Subnet mask	Subnet mask of the network IP address	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.0
Area No.	OSPF area number	0	0	0	0	0	0	0

Procedure

1. Configure the OSPF protocol for PE1.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 11.1.1.1
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 11.1.1.1 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

2. Configure the OSPF protocol for P.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 22.2.2.2
Admin(config-ospf-1)#network 20.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 30.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 22.2.2.2 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

3. Configure the OSPF protocol for PE2.

```
Admin(config)#router ospf 1
Admin(config-ospf-1)#router-id 33.3.3.3
Admin(config-ospf-1)#network 30.1.1.0 0.0.0.255 area 0
Admin(config-ospf-1)#network 33.3.3.3 0.0.0.0 area 0
Admin(config-ospf-1)#exit
```

4. Check the configuration result of the OSPF protocol.

   1) PE1 can ping 33.3.3.3 successfully.

```
Admin(config)#ping 33.3.3.3
PING 33.3.3.3 : 56 data bytes.
Press Ctrl-c to Stop.
```

```
Reply from 33.3.3.3 : bytes=56: icmp_seq=0 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 33.3.3.3 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

2) PE2 can ping 11.1.1.1 successfully.

```
Admin(config)#ping 11.1.1.1
PING 11.1.1.1 : 56 data bytes.
Press Ctrl-c to Stop.
Reply from 11.1.1.1 : bytes=56: icmp_seq=0 ttl=63 time=10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=1 ttl=63 time<10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=2 ttl=63 time<10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=3 ttl=63 time<10 ms
Reply from 11.1.1.1 : bytes=56: icmp_seq=4 ttl=63 time<10 ms
```

17.2.4.3 Configuring LDP Sessions

To enable communications between all the PEs in a VPLS network through PWs, you need to set up an LDP session between any two PEs. If PEs are not directly connected, you need to set up MPLS LDP remote sessions.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
Router ID	Router identifier	11.1.1.1	22.2.2.2		33.3.3.3
LDP transport address	Source transport address in LDP Hello messages, in the format of an IPv4 address	11.1.1.1	22.2.2.2		33.3.3.3
VLAN ID	VLAN ID of the VLANIF interface	20	20	30	30
Interface LDP enabling	Enable the IP address format of the LDP for an interface	ipv4	ipv4		ipv4
LDP remote address	IP address of the targeted peer, in the format of an IPv4 address	33.3.3.3	-		11.1.1.1

Procedure

1. Configure LDP local and remote sessions for PE1.

```
Admin(config)#router ldp
Admin(config-router)#router-id 11.1.1.1
Admin(config-router)#transport-address ipv4 11.1.1.1
Admin(config-router)#exit
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#ldp enable ipv4
Admin(config-vlanif-20)#exit
Admin(config)#router ldp
Admin(config-router)#targeted-peer ipv4 33.3.3.3
Admin(config-router)#exit
```

2. Configure LDP local sessions for P.

```
Admin(config)#router ldp
Admin(config-router)#router-id 22.2.2.2
Admin(config-router)#transport-address ipv4 22.2.2.2
Admin(config)#interface vlanif 20
Admin(config-vlanif-20)#mpls enable
Admin(config-vlanif-20)#ldp enable ipv4
Admin(config-vlanif-20)#exit
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#mpls enable
Admin(config-vlanif-30)#ldp enable ipv4
Admin(config-vlanif-30)#exit
```

3. Configure LDP local and remote sessions for PE2.

```
Admin(config)#router ldp
Admin(config-router)#router-id 33.3.3.3
Admin(config-router)#transport-address ipv4 33.3.3.3
Admin(config-router)#exit
Admin(config)#interface vlanif 30
Admin(config-vlanif-30)#mpls enable
Admin(config-vlanif-30)#ldp enable ipv4
Admin(config-vlanif-30)#exit
Admin(config)#router ldp
Admin(config-router)#targeted-peer ipv4 11.1.1.1
Admin(config-router)#exit
```

17.2.4.4 Configuring VPLS Services

Create a VPLS instance and bind an AC interface on a PE to it. In this way, traffic on a CE can connect to the VPLS network through this AC interface.

Planning Data

Parameter	Description	Example	
		PE1	PE2
Instance name	Name of the VPLS instance	test	test
Instance ID	ID of the VPLS instance	2	2
Peer IP	IP address of the PW remote peer	33.3.3.3	11.1.1.1
VLAN ID	VLAN ID of the AC interface	10	40
Tag processing mode of VLAN	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag
Subrack No./slot No.	Subrack number and slot number of the card where the AC interface resides	1/19	1/19
Port No.	Number of the AC port	2	1
AC access mode	Packet encapsulation mode for AC ◆ vlan: VLAN access ◆ ethernet: Ethernet access	vlan	vlan

Procedure

1. Configure VPLS services for PE1.

```
Admin(config)#mpls vpls test 2
Admin(config-vpls-test)#signaling ldp
Admin(config-vpls-ldpsig-test)#vpls-peer 33.3.3.3
Admin(config-vpls-ldpsig-test)#exit
Admin(config-vpls-test)#exit
Admin(config)#port vlan 10 tag 1/19 2
Admin(config)#interface vlanif 10
Admin(config-vlanif-10)#mpls-vpls test vlan
Admin(config-vlanif-10)#exit
```

2. Configure VPLS services for PE2.

```
Admin(config)#mpls vpls test 2
Admin(config-vpls-test)#signaling ldp
Admin(config-vpls-ldpsig-test)#vpls-peer 11.1.1.1
Admin(config-vpls-ldpsig-test)#exit
Admin(config-vpls-test)#exit
Admin(config)#port vlan 40 tag 1/19 1
Admin(config)#interface vlanif 40
Admin(config-vlanif-40)#mpls-vpls test vlan
Admin(config-vlanif-40)#exit
```

17.2.4.5 Verifying Configuration Results

Check VPLS configuration results of the three devices.

- Check the VPLS configuration results of PE1 and PE2, including the OSPF neighbor information, LDP session information, VPLS label forwarding information and FTN table. The ways to verify the configuration results for PE1 and PE2 are the same. The following uses PE1 for example.

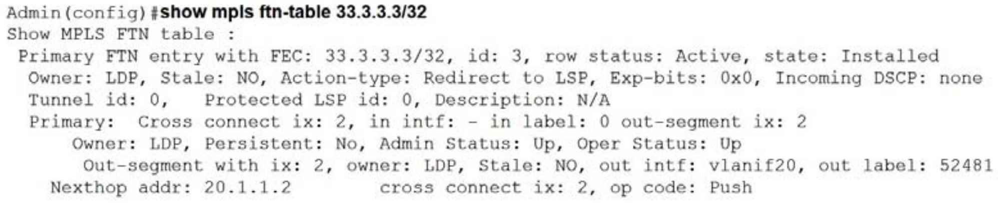
  1) Check the OSPF neighbor information of PE1.

```
Admin(config)#show ipv4 ospf neighbor

Total number of full neighbors: 1
OSPF process 10 VRF(default):
Neighbor ID  Pri  State        Dead Time  Address    Interface   Instance ID
22.2.2.2       1  Full/Backup  00:00:31   20.1.1.2   vlanif20         0
```

  2) Check the LDP session information of PE1. The LDP sessions are set up between PE1 and PE2, and between PE1 and P. Both sessions are operational. Their adjacency relations are set up correctly.

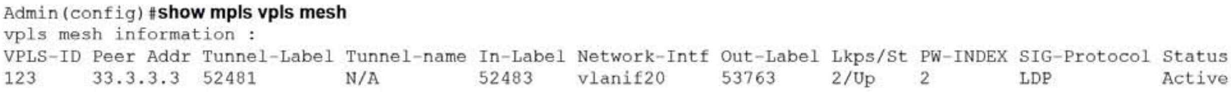
```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address          IF Name    My Role    State        KeepAlive
33.3.3.3                 vlanif20   Passive   OPERATIONAL   30
22.2.2.2                 vlanif20   Passive   OPERATIONAL   30
```

  3) Check the FTN table with mappings between PE1 and PE2. You can view the outer label information.



```
Admin(config)#show mpls ftn-table 33.3.3.3/32
Show MPLS FTN table :
 Primary FTN entry with FEC: 33.3.3.3/32, id: 3, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 2, in intf: - in label: 0 out-segment ix: 2
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 2, owner: LDP, Stale: NO, out intf: vlanif20, out label: 52481
    Nexthop addr: 20.1.1.2        cross connect ix: 2, op code: Push
```

4) Check the VPLS label forwarding information of PE1. You can view the inner label information.



```
Admin(config)#show mpls vpls mesh
vpls mesh information :
VPLS-ID Peer Addr Tunnel-Label Tunnel-name In-Label Network-Intf Out-Label Lkps/St PW-INDEX SIG-Protocol Status
123     33.3.3.3  52481        N/A         52483    vlanif20     53763     2/Up    2        LDP          Active
```

◆ Check the configuration result of P, including the OSPF neighbor information, LDP session information, FTN table and ILM table.

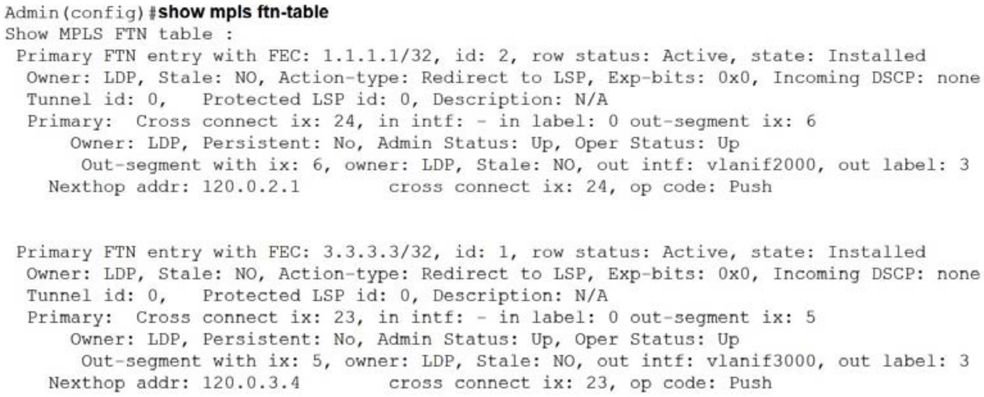
1) Check the OSPF neighbor information of P.

```
Admin(config)#show ipv4 ospf neighbor

Total number of full neighbors: 1
OSPF process 10 VRF(default):
Neighbor ID  Pri  State        Dead Time  Address    Interface   Instance ID
11.1.1.1       1  Full/DR      00:00:35   20.1.1.1   vlanif20         0
33.3.3.3       1  Full/Backup  00:00:31   30.1.1.3   vlanif30         0
```

2) Check the LDP session information of P. The LDP sessions are set up between P and PE1, and between P and PE2. Both sessions are operational. Their adjacency relations are set up correctly.

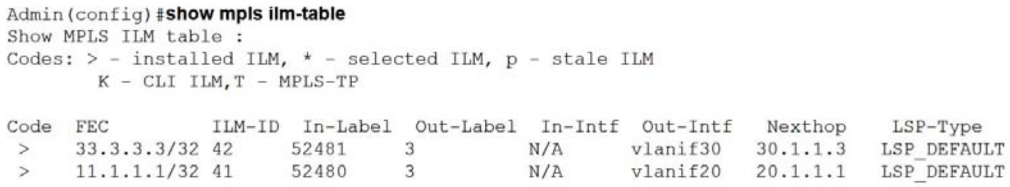
```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address           IF Name    My Role    State       KeepAlive
33.3.3.3                  vlanif30   Passive   OPERATIONAL   30
11.1.1.1                  vlanif20   Active    OPERATIONAL   30
```

3) Check the FTN table of P, including the FECs of PE1 and PE2.



```
Admin(config)#show mpls ftn-table
Show MPLS FTN table :
 Primary FTN entry with FEC: 1.1.1.1/32, id: 2, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 24, in intf: - in label: 0 out-segment ix: 6
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 6, owner: LDP, Stale: NO, out intf: vlanif2000, out label: 3
    Nexthop addr: 120.0.2.1        cross connect ix: 24, op code: Push


 Primary FTN entry with FEC: 3.3.3.3/32, id: 1, row status: Active, state: Installed
  Owner: LDP, Stale: NO, Action-type: Redirect to LSP, Exp-bits: 0x0, Incoming DSCP: none
  Tunnel id: 0,   Protected LSP id: 0, Description: N/A
  Primary:  Cross connect ix: 23, in intf: - in label: 0 out-segment ix: 5
      Owner: LDP, Persistent: No, Admin Status: Up, Oper Status: Up
       Out-segment with ix: 5, owner: LDP, Stale: NO, out intf: vlanif3000, out label: 3
    Nexthop addr: 120.0.3.4        cross connect ix: 23, op code: Push
```

4) Check the ILM table of P, including the FECs of PE1 and PE2.



```
Admin(config)#show mpls ilm-table
Show MPLS ILM table :
Codes: > - installed ILM, * - selected ILM, p - stale ILM
       K - CLI ILM,T - MPLS-TP

Code  FEC          ILM-ID  In-Label  Out-Label  In-Intf  Out-Intf   Nexthop    LSP-Type
 >    33.3.3.3/32 42      52481     3          N/A      vlanif30   30.1.1.3  LSP_DEFAULT
 >    11.1.1.1/32 41      52480     3          N/A      vlanif20   20.1.1.1  LSP_DEFAULT
```

17.3 Configuring BGP / MPLS IPv4 VPN

This section introduces the background information, network scenario, configuration flow and configuration example of the BGP / MPLS IPv4 VPN routing protocol.

17.3.1 Background Information

BGP/MPLS IPv4 VPN is a type of Layer 3 virtual private networks (L3VPN). It uses the border gateway protocol (BGP) to advertise VPN routes and uses multiprotocol label switch (MPLS) to forward VPN packets on backbone networks of service providers (SPs).

BGP/MPLS IPv4 VPN consists of CE, PE and P.

- CE (Customer Edge): It provides interfaces for direct connection to the service provider (SP) network. A CE can be a router, switch, or host. Usually, CE does not learn the existence of VPN. It does not support MPLS, either.
- PE (Provider Edge): It refers to an edge device on the service provider network, which is directly connected to the CE. In MPLS networks, all the operations related to VPN are performed on PEs. This requires high performance of PEs.
- P (Provider): It refers to a backbone device on the service provider's network, which is not directly connected to CEs. Ps only need to have the basic MPLS forwarding capability, and do not need to maintain the VPN information.

PEs and Ps are managed by service providers. CE devices are normally managed by subscribers, unless subscribers authorize the management privilege to the service provider. A PE device can connect to multiple CE devices. A CE device can connect to multiple PE devices provided by one or different service providers.

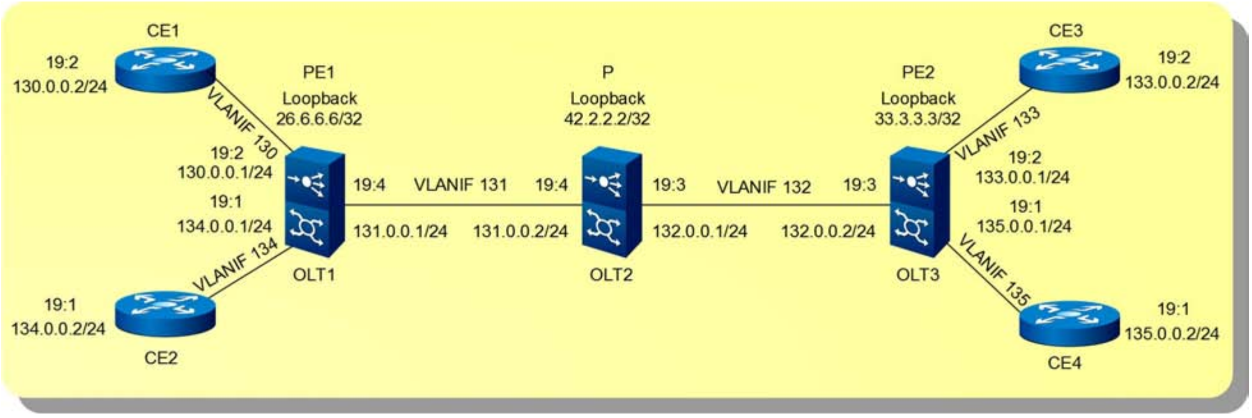
17.3.2 Network Scenario

Service Planning

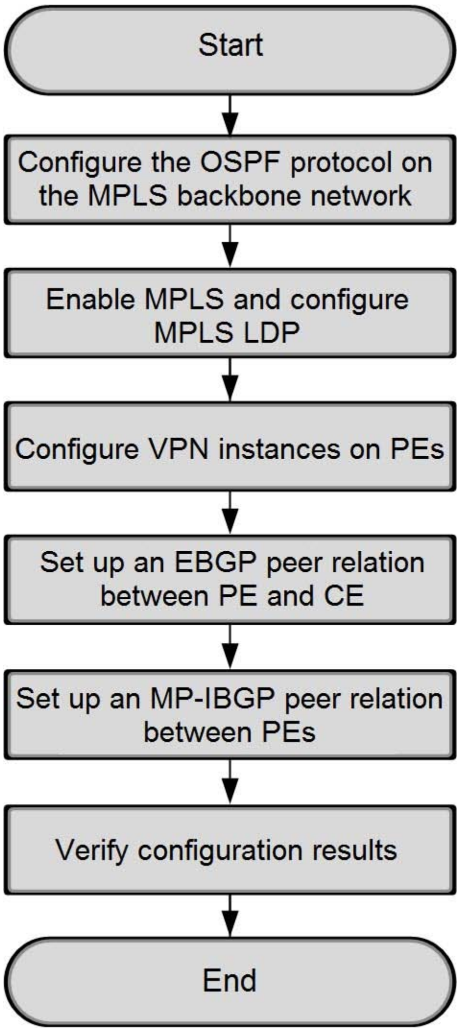
Three OLTs serve as PE1, P and PE2, respectively. They are interconnected with each other through uplink ports. PE1 and PE2 are edge routers on the backbone network. PE1 connects to CE1 and CE2 through uplink ports. PE2 connects to CE3 and CE4 through uplink ports. As the core router on the backbone network, P implements routing and expedited forwarding. CE1 and CE3, belonging to vpna, connect to the research and development area of the headquarter and that of the branch respectively. CE2 and CE4, belonging to vpnb, connect to the non-research and development area of the headquarter and that of the branch respectively. Deploying BGP/MPLS IP VPN enables safe intercommunication between the headquarter and the branches. This deployment also isolates the data in the research and development area from that in the non-research and development area.

1. Configure the OSPF protocol on PE1, P and PE2 to enable communications between devices on the backbone network.
2. Enable MPLS on PE1, P and PE2 and configure MPLS LDP protocols. Then, the MPLS LSP public tunnels are set up to transmit VPN data.
3. Configure VPN instances on PE1 and PE2. The VPN-target attributes of vpna and vpnb are 111:1 and 222:2, respectively. This enables data communication within a VPN and data isolation among different VPNs. Meanwhile, bind the ports connected to CEs to the corresponding VPN instances to connect VPN subscribers.
4. Configure EBGP between PEs and CEs to exchange VPN routing information.
5. Configure MP-IBGP between PE1 and PE2 to exchange VPN routing information.

Network Diagram



17.3.3 Configuration Flow


Start
Configure the OSPF protocol on the MPLS backbone network
Enable MPLS and configure MPLS LDP
Configure VPN instances on PEs
Set up an EBGP peer relation between PE and CE
Set up an MP-IBGP peer relation between PEs
Verify configuration results
End

17.3.4 Configuration Example

This section introduces how to configure the BGP/MPLS IPv4 VPN.

17.3.4.1 Configuring the OSPF Protocol on the MPLS Backbone Network

Configure interfaces and the OSPF protocol for PE1, P and PE2. In this way, devices on the backbone network communicate with each other.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
Start VLAN ID	Start VLAN ID of the uplink port	131	131	132	132
End VLAN ID	End VLAN ID of the uplink port	-	-	-	-
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag
Subrack No. /slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19	1/19	1/19

Parameter	Description	Example						
		PE1		P			PE2	
Uplink port number	Uplink port number	4		4	3		3	
VLAN ID	VLAN ID of the VLANIF interface	131		131	132		132	
VLANIF interface address	IPv4 address of the VLANIF interface	131.0.0.1		131.0.0.2	132.0.0.1		132.0.0.2	
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0		255.255.255.0	255.255.255.0		255.255.255.0	
Loopback interface address	IPv4 address of the loopback interface on the device	26.6.6.6		42.2.2.2			33.3.3.3	
Subnet mask of the loopback interface address	Subnet mask of the IPv4 address of the loopback interface on the device	255.255.255.255		255.255.255.255			255.255.255.255	
OSPF route process ID	OSPF route process ID	130		130			130	
Network IP address	Network IP address of the interface that needs to run the OSPF protocol. This network should be an IP network configured with VLANIF interfaces.	131.0.0.0	26.6.6.6	131.0.0.0	132.0.0.0	42.2.2.2	132.0.0.0	33.3.3.3
Subnet mask	Subnet mask of the network IP address	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.255	0.0.0.0	0.0.0.255	0.0.0.0
Area No.	OSPF area number	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0

Procedure

◆ Configure interfaces and the OSPF protocol for PE1.

1) Configure interface parameters for PE1.

```
Admin(config)#port vlan 131 tag 1/19 4
Admin(config)#interface vlanif 131
Admin(config-vlanif-131)#ipv4 address 131.0.0.1 mask 255.255.255.0
Admin(config-vlanif-131)#exit
Admin(config)#interface loopback 1
Admin(config-if-loopback-1)#ipv4 address 26.6.6.6 mask 255.255.255.255
Admin(config-if-loopback-1)#exit
Admin(config)#
```

2) Configure the OSPF protocol for PE1.

```
Admin(config)#router ospf 130
Admin(config-ospf-130)#network 131.0.0.0 0.0.0.255 area 0.0.0.0
Admin(config-ospf-130)#network 26.6.6.6 0.0.0.0 area 0.0.0.0
Admin(config-ospf-130)#exit
Admin(config)#
```

◆ Configure interfaces and the OSPF protocol for P.

1) Configure interface parameters for P.

```
Admin(config)#port vlan 131 tag 1/19 4
Admin(config)#interface vlanif 131
Admin(config-vlanif-131)#ipv4 address 131.0.0.2 mask 255.255.255.0
Admin(config-vlanif-131)#exit
Admin(config)#port vlan 132 tag 1/19 3
Admin(config)#interface vlanif 132
Admin(config-vlanif-132)#ipv4 address 132.0.0.1 mask 255.255.255.0
Admin(config-vlanif-132)#exit
Admin(config)#interface loopback 1
Admin(config-if-loopback-1)#ipv4 address 42.2.2.2 mask 255.255.255.255
Admin(config-if-loopback-1)#exit
Admin(config)#
```

2) Configure the OSPF protocol for P.

```
Admin(config)#router ospf 130
Admin(config-ospf-130)#network 131.0.0.0 0.0.0.255 area 0.0.0.0
Admin(config-ospf-130)#network 132.0.0.0 0.0.0.255 area 0.0.0.0
Admin(config-ospf-130)#network 42.2.2.2 0.0.0.0 area 0.0.0.0
Admin(config-ospf-130)#exit
Admin(config)#
```

◆ Configure interface parameters and the OSPF protocol for PE2.

1) Configure interface parameters for PE2.

```
Admin(config)#port vlan 132 tag 1/19 3
Admin(config)#interface vlanif 132
Admin(config-vlanif-132)#ipv4 address 132.0.0.2 mask 255.255.255.0
Admin(config-vlanif-132)#exit
Admin(config)#interface loopback 1
Admin(config-if-loopback-1)#ipv4 address 33.3.3.3 mask 255.255.255.255
Admin(config-if-loopback-1)#exit
Admin(config)#
```

2) Configure the OSPF protocol for PE2.

```
Admin(config)#router ospf 130
Admin(config-ospf-130)#network 132.0.0.0 0.0.0.255 area 0.0.0.0
Admin(config-ospf-130)#network 33.3.3.3 0.0.0.0 area 0.0.0.0
Admin(config-ospf-130)#exit
Admin(config)#
```

17.3.4.2 Enabling MPLS and Configuring MPLS LDP

Enable MPLS on PE1, P and PE2 and configure MPLS LDP protocols. Then, the MPLS LSP public tunnels are set up to transmit VPN data.

Planning Data

Parameter	Description	Example			
		PE1	P		PE2
VLAN ID	VLAN ID of the VLANIF interface	131	131	132	132
Router ID	Router identifier	26.6.6.6	42.2.2.2		33.3.3.3
LDP transport address	Source transport address in LDP Hello messages, in the format of an IPv4 address	26.6.6.6	42.2.2.2		33.3.3.3
Interface LDP enabling	Enable the IP address format of the LDP for an interface	ipv4	ipv4		ipv4

Procedure

◆ Enable MPLS and configure MPLS LDP for PE1.

```
Admin(config)#interface vlanif 131
Admin(config-vlanif-131)#mpls enable
Admin(config-vlanif-131)#exit
Admin(config)#router ldp
Admin(config-router)#router-id 26.6.6.6
Admin(config-router)#transport-address ipv4 26.6.6.6
Admin(config-router)#exit
Admin(config)#interface vlanif 131
Admin(config-vlanif-131)#ldp enable ipv4
Admin(config-vlanif-131)#exit
Admin(config)#
```

- Enable MPLS and configure MPLS LDP for P.

```
Admin(config)#interface vlanif 131
Admin(config-vlanif-131)#mpls enable
Admin(config-vlanif-131)#exit
Admin(config)#interface vlanif 132
Admin(config-vlanif-132)#mpls enable
Admin(config-vlanif-132)#exit
Admin(config)#router ldp
Admin(config-router)#router-id 42.2.2.2
Admin(config-router)#transport-address ipv4 42.2.2.2
Admin(config-router)#exit
Admin(config)#interface vlanif 131
Admin(config-vlanif-131)#ldp enable ipv4
Admin(config-vlanif-131)#exit
Admin(config)#interface vlanif 132
Admin(config-vlanif-132)#ldp enable ipv4
Admin(config-vlanif-132)#exit
Admin(config)#
```

- Enable MPLS and configure MPLS LDP for PE2.

```
Admin(config)#interface vlanif 132
Admin(config-vlanif-132)#mpls enable
Admin(config-vlanif-132)#exit
Admin(config)#router ldp
Admin(config-router)#router-id 33.3.3.3
Admin(config-router)#transport-address ipv4 33.3.3.3
Admin(config-router)#exit
Admin(config)#interface vlanif 132
Admin(config-vlanif-132)#ldp enable ipv4
Admin(config-vlanif-132)#exit
Admin(config)#
```

17.3.4.3 Configuring VPN Instances on PEs

Configure VPN instances on PE1 and PE2, and connect CEs to PEs.

Planning Data

Parameter	Description	Example			
		PE1		PE2	
VPN route forwarding instance	Name of the VPN route forwarding instance	vpna	vpnb	vpna	vpnb
RD value	An exclusive RD value for VRF	100:1	100:2	200:1	200:2
import extended community attribute	Extended community attribute of the route in the ingress direction	111:1	222:2	111:1	222:2
export extended community attribute	Extended community attribute of the route to the destination VPN in the egress direction	111:1	222:2	111:1	222:2
VLAN ID	VLAN ID of the VLANIF interface	130	134	133	135
VLANIF interface address	IPv4 address of the VLANIF interface	130.0.0.1	134.0.0.1	133.0.0.1	135.0.0.1
Subnet mask of the VLANIF interface address	Subnet mask of the IPv4 address of the VLANIF interface	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Start VLAN ID	Start VLAN ID of the uplink port	130	134	133	135
End VLAN ID	End VLAN ID of the uplink port	-	-	-	-
VLAN tag processing for uplink services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag	tag	tag	tag

Parameter	Description	Example			
		PE1		PE2	
Subrack No./slot No.	Subrack number and slot number for the card where the uplink port resides	1/19	1/19	1/19	1/19
Uplink port number	Uplink port number	2	1	2	1

Procedure

- Configure the interface and VPN instance for PE1.
  - Configure the interface and VPN instance for PE1, and connect CE1 to PE1.

```
Admin(config)#ip vrf vpna
Admin(config-vrf-vpna-1)#rd 100:1
Admin(config-vrf-vpna-1)#route-target import 111:1
Admin(config-vrf-vpna-1)#route-target export 111:1
Admin(config-vrf-vpna-1)#exit
Admin(config)#interface vlanif 130
Admin(config-vlanif-130)#ip vrf forwarding vpna
Admin(config-vlanif-130)#ipv4 address 130.0.0.1 mask 255.255.255.0
Admin(config-vlanif-130)#exit
Admin(config)#port vlan 130 tag 1/19 2
Admin(config)#
```

  - Configure the interface and VPN instance for PE1, and connect CE2 to PE1.

```
Admin(config)#ip vrf vpnb
Admin(config-vrf-vpnb-1)#rd 100:2
Admin(config-vrf-vpnb-1)#route-target import 222:2
Admin(config-vrf-vpnb-1)#route-target export 222:2
Admin(config-vrf-vpnb-1)#exit
Admin(config)#interface vlanif 134
Admin(config-vlanif-134)#ip vrf forwarding vpnb
Admin(config-vlanif-134)#ipv4 address 134.0.0.1 mask 255.255.255.0
Admin(config-vlanif-134)#exit
Admin(config)#port vlan 134 tag 1/19 1
Admin(config)#
```

- Configure the interface and VPN instance for PE2.
  - Configure the interface and VPN instance for PE2, and connect CE3 to PE2.

```
Admin(config)#ip vrf vpna
Admin(config-vrf-vpna-1)#rd 200:1
Admin(config-vrf-vpna-1)#route-target import 111:1
Admin(config-vrf-vpna-1)#route-target export 111:1
Admin(config-vrf-vpna-1)#exit
Admin(config)#interface vlanif 133
Admin(config-vlanif-133)#ip vrf forwarding vpna
Admin(config-vlanif-133)#ipv4 address 133.0.0.1 mask 255.255.255.0
Admin(config-vlanif-133)#exit
Admin(config)#port vlan 133 tag 1/19 2
Admin(config)#
```

- Configure the interface and VPN instance for PE2, and connect CE4 to PE2.

```
Admin(config)#ip vrf vpnb
Admin(config-vrf-vpnb-1)#rd 200:2
Admin(config-vrf-vpnb-1)#route-target import 222:2
Admin(config-vrf-vpnb-1)#route-target export 222:2
Admin(config-vrf-vpnb-1)#exit
Admin(config)#interface vlanif 135
Admin(config-vlanif-135)#ip vrf forwarding vpnb
Admin(config-vlanif-135)#ipv4 address 135.0.0.1 mask 255.255.255.0
Admin(config-vlanif-135)#exit
Admin(config)#port vlan 135 tag 1/19 1
Admin(config)#
```

17.3.4.4 Setting up an EBGP Peer Relation Between PE and CE

Set up an EBGP peer relation between PE and CE to create a VPN route.

Planning Data

Parameter	Description	Example							
		PE1		PE2		CE1	CE2	CE3	CE4
AS number	AS number. Value range: 1 to 4294967295	65210		65210		65200	45200	55200	35200
VPN route forwarding instance	Name of the VPN route forwarding instance	vpna	vpnb	vpna	vpnb	-	-	-	-
BGP peer	IP address of the BGP neighbor, in the format of an IPv4 address	130.0.0.2	134.0.0.2	133.0.0.2	135.0.0.2	130.0.0.1	134.0.0.1	133.0.0.1	135.0.0.1

Parameter	Description	Example							
		PE1		PE2		CE1	CE2	CE3	CE4
	IP address of the BGP neighbor, in the format of an IPv6 address	-	-	-	-	-	-	-	-
	Remote AS number of the BGP peer. Value range: 1 to 4294967295	65200	45200	55200	35200	65210	65210	65210	65210

Procedure

- Configure the BGP protocol for PE1.

```
Admin(config)#router bgp 65210
Admin(config-bgp-65210)#address-family ipv4 vrf vpna
Admin(config-bgp-65210-ipv4-vpna)#redistribute connected
Admin(config-bgp-65210-ipv4-vpna)#neighbor 130.0.0.2 remote-as 65200
Admin(config-bgp-65210-ipv4-vpna)#neighbor 130.0.0.2 activate
Admin(config-bgp-65210-ipv4-vpna)#exit
Admin(config-bgp-65210)#address-family ipv4 vrf vpnb
Admin(config-bgp-65210-ipv4-vpnb)#address-family ipv4 vrf vpnb
Admin(config-bgp-65210-ipv4-vpnb)#redistribute connected
Admin(config-bgp-65210-ipv4-vpnb)#neighbor 134.0.0.2 remote-as 45200
Admin(config-bgp-65210-ipv4-vpnb)#neighbor 134.0.0.2 activate
Admin(config-bgp-65210-ipv4-vpnb)#exit
Admin(config-bgp-65210)#exit
Admin(config)#
```

- Configure the BGP protocol for PE2.

```
Admin(config)#router bgp 65210
Admin(config-bgp-65210)#address-family ipv4 vrf vpna
Admin(config-bgp-65210-ipv4-vpna)#redistribute connected
Admin(config-bgp-65210-ipv4-vpna)#neighbor 133.0.0.2 remote-as 55200
Admin(config-bgp-65210-ipv4-vpna)#neighbor 133.0.0.2 activate
Admin(config-bgp-65210-ipv4-vpna)#exit
Admin(config-bgp-65210)#address-family ipv4 vrf vpnb
Admin(config-bgp-65210-ipv4-vpnb)#redistribute connected
Admin(config-bgp-65210-ipv4-vpnb)#neighbor 135.0.0.2 remote-as 35200
Admin(config-bgp-65210-ipv4-vpnb)#neighbor 135.0.0.2 activate
Admin(config-bgp-65210-ipv4-vpnb)#exit
Admin(config-bgp-65210)#exit
Admin(config)#
```

- Configure the BGP protocol for CE1.

```
Admin(config)#router bgp 65200
Admin(config-bgp-65200)#neighbor 130.0.0.1 remote-as 65210
Admin(config-bgp-65200)#address-family ipv4
Admin(config-bgp-65200-ipv4)#redistribute connected
Admin(config-bgp-65200-ipv4)#exit
Admin(config-bgp-65200)#exit
Admin(config)#
```

- Configure the BGP protocol for CE2.

```
Admin(config)#router bgp 45200
Admin(config-bgp-45200)#neighbor 134.0.0.1 remote-as 65210
Admin(config-bgp-45200)#address-family ipv4
Admin(config-bgp-45200-ipv4)#redistribute connected
Admin(config-bgp-45200-ipv4)#exit
Admin(config-bgp-45200)#exit
Admin(config)#
```

- Configure the BGP protocol for CE3.

```
Admin(config)#router bgp 55200
Admin(config-bgp-55200)#neighbor 133.0.0.1 remote-as 65210
Admin(config-bgp-55200)#address-family ipv4
Admin(config-bgp-55200-ipv4)#redistribute connected
Admin(config-bgp-55200-ipv4)#exit
Admin(config-bgp-55200)#exit
Admin(config)#
```

- Configure the BGP protocol for CE4.

```
Admin(config)#router bgp 35200
Admin(config-bgp-35200)#neighbor 135.0.0.1 remote-as 65210
Admin(config-bgp-35200)#address-family ipv4
Admin(config-bgp-35200-ipv4)#redistribute connected
Admin(config-bgp-35200-ipv4)#exit
Admin(config-bgp-35200)#exit
Admin(config)#
```

17.3.4.5 Setting up an MP-IBGP Peer Relation Between PEs

Set up an MP-IBGP peer relation between PE1 and PE2 to exchange VPN route information.

Planning Data

Parameter	Description	Example	
		PE1	PE2
AS number	AS number. Value range: 1 to 4294967295	65210	65210
BGP peer	IP address of the BGP neighbor, in the format of an IPv4 address	33.3.3.3	26.6.6.6
	IP address of the BGP neighbor, in the format of an IPv6 address	-	-
	Remote AS number of the BGP peer. Value range: 1 to 4294967295	65210	65210
Packet transmission source IP address	IP address of the packet transmission source for the BGP neighbor	26.6.6.6	33.3.3.3

Procedure

- Configure the BGP protocol for PE1.

```
Admin(config)#router bgp 65210
Admin(config-bgp-65210)#neighbor 33.3.3.3 remote-as 65210
Admin(config-bgp-65210)#neighbor 33.3.3.3 update-source 26.6.6.6
Admin(config-bgp-65210)#address-family vpnv4 unicast
Admin(config-bgp-65210-vpnv4)#neighbor 33.3.3.3 activate
Admin(config-bgp-65210-vpnv4)#exit
Admin(config-bgp-65210)#exit
Admin(config)#
```

- Configure the BGP protocol for PE2.

```
Admin(config)#router bgp 65210
Admin(config-bgp-65210)#neighbor 26.6.6.6 remote-as 65210
Admin(config-bgp-65210)#neighbor 26.6.6.6 update-source 33.3.3.3
Admin(config-bgp-65210)#address-family vpnv4 unicast
Admin(config-bgp-65210-vpnv4)#neighbor 26.6.6.6 activate
Admin(config-bgp-65210-vpnv4)#exit
Admin(config-bgp-65210)#exit
Admin(config)#
```

17.3.4.6 Verifying Configuration Results

1. Check configuration results of PE1, P and PE2. Verify that the devices on the backbone network communicate with each other through the OSPF configuration. The following takes PE1 for example.

Set up OSPF adjacencies between PE1, P and PE2. The adjacency states are "Full" and each can learn the route of Loopback1 from one another.

```
Admin(config)#show ipv4 ospf neighbor
Total number of full neighbors: 1
OSPF process 130 VRF(default):
Neighbor ID  Pri  State    Dead Time  Address    Interface  Instance ID
42.2.2.2       1  Full/DR  00:00:39   131.0.0.2  vlanif131  0
Admin(config)#show ipv4 route ospf
Ipv4 routes information :
IP Route Table for VRF "default"
O       33.3.3.3/32 [110/30] via 131.0.0.2, vlanif131, 00:32:52
O       42.2.2.2/32 [110/20] via 131.0.0.2, vlanif131, 00:32:52
O       132.0.0.0/24 [110/20] via 131.0.0.2, vlanif131, 00:32:52
```

2. Check MPLS LDP configuration results of PE1, P and PE2. The following uses PE1 for example.

   Set up LDP sessions between PE1 and P, and between P and PE2. Set **State** to **OPERATIONAL**.

```
Admin(config)#show mpls ldp session
show mpls ldp session :
Peer IP Address      IF Name    My Role    State       KeepAlive
42.2.2.2             vlanif131  Passive   OPERATIONAL   30
33.3.3.3             vlanif131  Passive   OPERATIONAL   30
```

3. Check VPN instance configuration results of PE1 and PE2. All PEs ping the connected CEs successfully. The following uses PE1 for example.

```
Admin(config)#show ip vrf
VRF     ID    Router-id    R D     Interfaces
vpna    1                 100:1     vlanif130

vpnb    2                 100:2     vlanif134
Admin(config)#ping -v vpna 130.0.0.2
PING 130.0.0.2 : 56 data bytes.
Press Ctrl-c to Stop.

Reply from 130.0.0.2 : bytes=56: icmp_seq=0 ttl=64 time<10 ms
Reply from 130.0.0.2 : bytes=56: icmp_seq=1 ttl=64 time<10 ms
Reply from 130.0.0.2 : bytes=56: icmp_seq=2 ttl=64 time<10 ms
Reply from 130.0.0.2 : bytes=56: icmp_seq=3 ttl=64 time<10 ms
Reply from 130.0.0.2 : bytes=56: icmp_seq=4 ttl=64 time<10 ms
```

4. Check BGP neighbor information of PE1, PE2, CE1, CE2, CE3 and CE4. The following uses PE1 for example.

Set up a BGP peer relation between PE and CE. Set **BGP state** to **Established**.

```
Admin(config)#show bgp neighbors
BGP neighbor is 130.0.0.2, vrf vpna, remote AS 65200, local AS 65210,
external link
  BGP version 4, remote router ID 192.0.0.1
  BGP state = Established, up for 00:38:05
  Last read 00:38:05, hold time is 90, keepalive interval is 30 seconds
  Neighbor capabilities:
    Route refresh: advertised
    Address family IPv4 Unicast: advertised
  Received 79 messages, 0 notifications, 0 in queue
  Sent 80 messages, 0 notifications, 0 in queue
  Route refresh request: received 0, sent 0
  Minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 1, neighbor version 1
  Index 1, Offset 0, Mask 0x2
  Community attribute sent to this neighbor (standard)
  0 accepted prefixes
  0 announced prefixes

 Connections established 1; dropped 0
Local host: 130.0.0.1, Local port: 63820
Foreign host: 130.0.0.2, Foreign port: 179
Nexthop: 130.0.0.1
Nexthop global: ::
Nexthop local: ::
BGP connection: non shared network
```

5. Check BGP neighbor information of PE1 and PE2. The following uses PE1 for example.

   Set up a BGP peer relation between PE1 and PE2. Set **BGP state** to **Established**.

```
Admin(config)#show bgp neighbors
BGP neighbor is 33.3.3.3, remote AS 65210, local AS 65210, internal link
  BGP version 4, remote router ID 33.3.3.3
  BGP state = Established, up for 00:38:12
  Last read 00:38:12, hold time is 90, keepalive interval is 30 seconds
  Neighbor capabilities:
    Route refresh: advertised and received (old and new)
    Address family IPv4 Unicast: advertised and received
    Address family VPNv4 Unicast: advertised and received
  Received 79 messages, 0 notifications, 0 in queue
  Sent 80 messages, 0 notifications, 0 in queue
  Route refresh request: received 0, sent 0
  Minimum time between advertisement runs is 5 seconds
  Update source is 26.6.6.6
 For address family: IPv4 Unicast
  BGP table version 2, neighbor version 2
  Index 1, Offset 0, Mask 0x2
  AIGP is enabled
  Community attribute sent to this neighbor (both)
  0 accepted prefixes
  0 announced prefixes

 For address family: VPNv4 Unicast
  BGP table version 2, neighbor version 2
  Index 1, Offset 0, Mask 0x2
  AIGP is enabled
  Community attribute sent to this neighbor (both)
  1 accepted prefixes
  1 announced prefixes

 Connections established 1; dropped 0
Local host: 26.6.6.6, Local port: 179
Foreign host: 33.3.3.3, Foreign port: 63978
Nexthop: 26.6.6.6
Nexthop global: ::
Nexthop local: ::
BGP connection: non shared network

BGP neighbor is 130.0.0.2, vrf vpna, remote AS 65200, local AS 65210,
external link
  BGP version 4, remote router ID 192.0.0.1
  BGP state = Established, up for 00:38:05
  Last read 00:38:05, hold time is 90, keepalive interval is 30 seconds
  Neighbor capabilities:
    Route refresh: advertised
    Address family IPv4 Unicast: advertised
  Received 79 messages, 0 notifications, 0 in queue
  Sent 80 messages, 0 notifications, 0 in queue
  Route refresh request: received 0, sent 0
  Minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 1, neighbor version 1
  Index 1, Offset 0, Mask 0x2
  Community attribute sent to this neighbor (standard)
  0 accepted prefixes
  0 announced prefixes

 Connections established 1; dropped 0
Local host: 130.0.0.1, Local port: 63820
Foreign host: 130.0.0.2, Foreign port: 179
Nexthop: 130.0.0.1
Nexthop global: ::
Nexthop local: ::
BGP connection: non shared network
```

6. Check the route to the opposite CE. The following uses PE1 for example.

```
Admin(config)#show ipv4 route vrf vpna
Ipv4 routes information :
Codes: K - kernel, C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2,
       ia - IS-IS inter area
       * - candidate default

IP Route Table for VRF "vpna"
C       130.0.0.0/24 is directly connected, vlanif130
B       133.0.0.0/24 [200/0] via 33.3.3.3, 00:00:04

Gateway of last resort is not set
Admin(config)#show ipv4 route vrf vpnb
Ipv4 routes information :
Codes: K - kernel, C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2,
       ia - IS-IS inter area
       * - candidate default

IP Route Table for VRF "vpnb"
C       134.0.0.0/24 is directly connected, vlanif134
B       135.0.0.0/24 [200/0] via 33.3.3.3, 00:10:04

Gateway of last resort is not set
```

7. CEs in the same VPN can ping each other successfully. However, CEs in different VPNs fail to ping each other. In the following example, CE1 can ping CE3 successfully but fails to ping CE4.

```
Admin(config)#ping 133.0.0.2
PING 133.0.0.2 : 56 data bytes.
Press Ctrl-c to Stop.

Reply from 133.0.0.2 : bytes=56: icmp_seq=0 ttl=62 time=12 ms
Reply from 133.0.0.2 : bytes=56: icmp_seq=1 ttl=62 time<10 ms
Reply from 133.0.0.2 : bytes=56: icmp_seq=2 ttl=62 time<10 ms
Reply from 133.0.0.2 : bytes=56: icmp_seq=3 ttl=62 time<10 ms
Reply from 133.0.0.2 : bytes=56: icmp_seq=4 ttl=62 time<10 ms


----133.0.0.2 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

round-trip(ms) min/avg/max = 6/7/12
Admin(config)#ping 135.0.0.2
PING 135.0.0.2 : 56 data bytes.
Press Ctrl-c to Stop.

Request time out.
Request time out.
Request time out.
Request time out.
Request time out.


----135.0.0.2 PING Statistics----
5 packets transmitted, 0 packets received, 100% packet loss
```

18 Configuring Ethernet P2P Services

This chapter gives an example to introduce how to configure P2P Services for the AN6000 Series.

18.1 Background

P2P refers to signal transmission in point-to-point mode. Each subscriber is connected to a telecommunications room at the central office end or far end through an independent cable to enable Ethernet access.

The AN6000 Series enable the following Ethernet access applications through the P2P service card (PXNA):

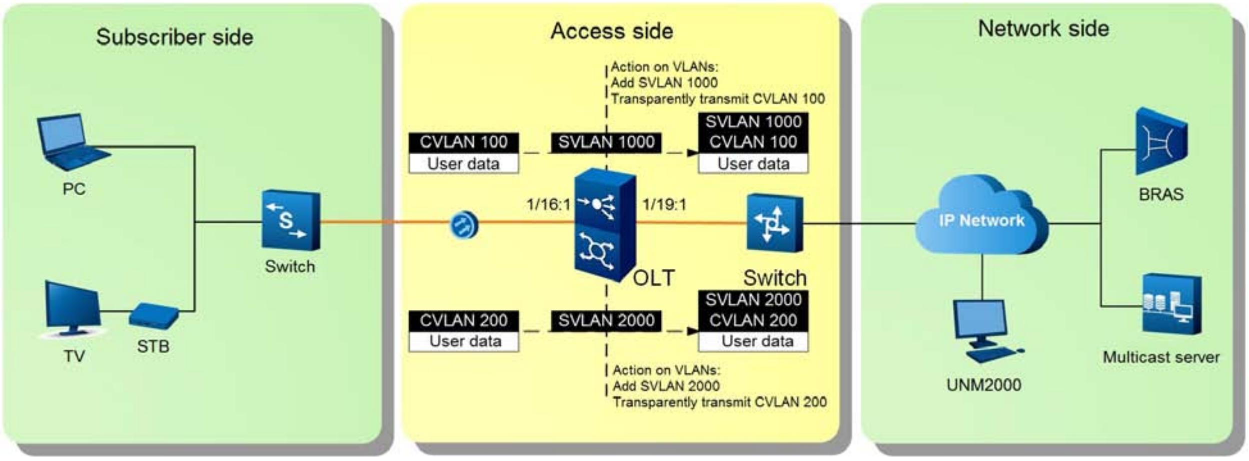
- A P2P service card (PXNA) can receive the P2P service directly or via cascade networking at the same time.
- 10GE ports of a P2P service card (PXNA) can be connected to devices such as switch, DSLAM, CBU and SBU to provision FTTH, FTTC, FTTB, FTTO and FTTM services.

18.2 Network Scenario

Service Planning

An OLT connects to a switch via a PXNA card, and then connects to subscribers via the switch. The subscribers need to access Internet and watch IPTV programs via set-top boxes.

Network Diagram



18.3 Configuration Flow

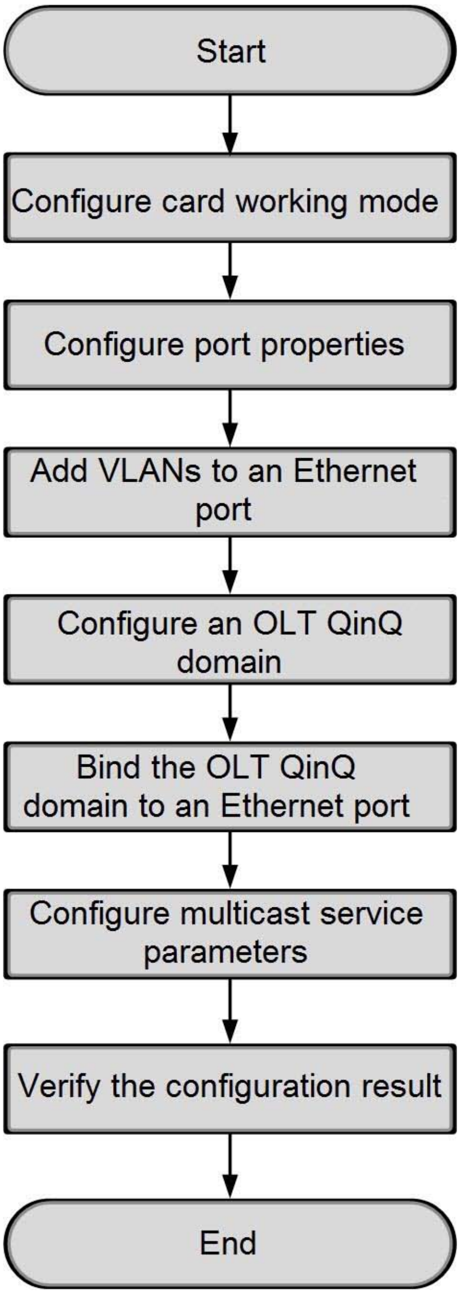
Prerequisites

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Caution:

The uplink service VLAN (SVLAN) has been added to the uplink ports and all slots.

Configuration Flow


Start
Configure card working mode
Configure port properties
Add VLANs to an Ethernet port
Configure an OLT QinQ domain
Bind the OLT QinQ domain to an Ethernet port
Configure multicast service parameters
Verify the configuration result
End

18.4 Configuring Card Working Mode

Configure working mode of the Ethernet service card.

◆ In uplink mode, the PXNA card serves as an uplink card.

- In downlink mode, the PXNA card serves as a P2P card, allowing subscriber access and cascading between devices.

⚠ Caution:

When the working mode of a card changes, all the card configurations will be cleared.

Planning Data

Parameter	Description	Example
Subrack No./slot No.	Subrack number and slot number of the Ethernet service card	1/16
pxna-work-mode	Working mode of the Ethernet service card; default value: user ◆ Uplink: uplink mode. In this mode, all the ports are used for connection to upper layer devices only. ◆ user: downlink mode. In this mode, all the ports are used for subscriber access or device cascading only.	user

Procedure

1. Set the working mode of the Ethernet service card to “user”.

```
Admin(config)#pxna-work-mode 1/16 user
```

18.5 Configuring Port Properties

Configure properties of an Ethernet service port.

Planning Data

Parameter	Description	Example
auto-neg enable	Enable (default): auto-negotiation	enable
port type	After inserting an optical / electrical module into an Ethernet port, you need to set the port to a correct interface mode. The default setting is xfi. ◆ sgmii: GE electrical module mode ◆ serdes: GE optical module mode ◆ xfi: 10GE optical module mode	xfi

Procedure

1. Configure properties of the Ethernet service port.

```
Admin(config)#interface eth 1/16/1
Admin(config-if-eth-1/16/1)#auto-neg enable
Admin(config-if-eth-1/16/1)#port type xfi
```

18.6 Adding VLANs to an Ethernet Port

Add SVLAN and CVLAN to an Ethernet port of the OLT.

Planning Data

Parameter	Description	Example
VLAN ID	VLAN IDs, including SVLAN and CVLAN IDs	◆ Data CVLAN: 100 ◆ Data SVLAN: 1000 ◆ IPTV CVLAN: 200 ◆ IPTV SVLAN: 2000
VLAN tag processing for Ethernet services	◆ untag: In this mode, tags of uplink packets are stripped automatically when they pass a port and the packets are further transmitted in untagged mode, while downlink untagged packets are added with corresponding tags when they pass the port. ◆ tag: In this mode, tags of the uplink / downlink data packets are not processed when they pass the port.	tag
Subrack No./slot No.	Number of the subrack / slot housing the card where the Ethernet port resides	1/16
Port No.	Number of the Ethernet port used	1

Procedure

1. Add the data service to the Ethernet port and all slots.

```
Admin(config)#port vlan 100 tag 1/16 1
Admin(config)#port vlan 1000 tag 1/16 1
Admin(config)#port vlan 200 tag 1/16 1
Admin(config)#port vlan 2000 tag 1/16 1
```

18.7 Configuring an OLT QinQ Domain

The items to be configured for local end QinQ domain include service type, parameters related to CVLAN and SVLAN, and upstream / downstream rule clause.

Configuration Rules

- When configuring QinQ for the PXNA card, you can add up to eight QinQ rules to each QinQ domain, that is, up to 1536 QinQ rules in total, in the following conditions: Default setting (match if present) for MAC address is used in the upstream rule clause, and both original CoS (VLAN Layer 1) and new CoS (VLAN Layer 2) are set to null.
- If other settings are used for the upstream rule clause, or either original CoS (VLAN Layer 1) or new CoS (VLAN Layer 2) is not null, or selective QinQ supporting VLAN CoS matching is used, you can configure 128 IPv4 QinQ rules or 64 IPv6 QinQ rules at most.
- The PXNA card does not support a QinQ rule based on VLAN range.
- If you want the QinQ rule to match VLAN only, without verification of the CoS value, leave the CoS blank in the UNM2000 configuration, and set it to null in CLI configuration.

Planning Data

Parameter		Description	Example	
oltqinq-domain		Name of the QinQ domain	abc	
service-count		QinQ service quantity; value range: 1 to 8.	2	
Upstream / downstream rules for the QinQ domain	service	Upstream / downstream service index. The quantity of services should be the same as that of upstream / downstream rule clauses. Value range:1 to 8.	1	2

Parameter		Description	Example	
	classification upstream / downstream field-id	Upstream / downstream rule type. Altogether 27 options are available, and the default value is 1. ◆ 1: DA (destination MAC address) ◆ 2: SA (source MAC address) ◆ 3: ethtype (Ethernet type) ◆ 4: vlan4 (Layer 4 VLAN) ◆ 5: vlan3 (Layer 3 VLAN) ◆ 6: vlan2 (Layer 2 VLAN) ◆ 7: vlan1 (Layer 1 VLAN) ◆ 8: TOS (service type) ◆ 10: TTL (Time-to-Live) ◆ 11: protocol type ◆ 12: sip (source IP address) ◆ 14: dip (destination IP address) ◆ 16: L4srcport (Layer 4 source port number) ◆ 17: L4dstport (Layer 4 destination port number) ◆ 18: cos4 (priority 4) ◆ 19: cos3 (priority 3) ◆ 20: cos2 (priority 2) ◆ 21: cos1 (priority 1) ◆ 22: based on the destination IPv6 address prefix classification ◆ 23: based on the source IPv6 address prefix classification ◆ 24: based on the IP version (v4 or v6) classification ◆ 25: based on the IP priority field (IPv6) classification ◆ 26: based on the IP flow label field (IPv6) classification ◆ 27: based on next packet header (IPv6) classification	Upstream rule type: 1 Downstream rule type: 2	Upstream rule type: 1 Downstream rule type: 2
	value	Value of the selected upstream / downstream rule type. Enter the value according to the rule type.	000000000000	000000000000

Parameter		Description	Example			
	condition	Upstream / downstream rule operator; value range: 0 to 7; default value: 5 ◆ 0: Never (never match) ◆ 1: = (equal to) ◆ 2: != (not equal to) ◆ 3: <= (smaller than or equal to) ◆ 4: >= (larger than or equal to) ◆ 5: Exist (match if present) ◆ 6: No exist (match if not present) ◆ 7: Always (always match)	5		5	
Service VLAN for the QinQ domain	vlan	Current VLAN layer. Services can be configured with up to four VLAN layers. Value range: 1 to 4.	1	2	1	2
	user-vlanid	Original ID of the VLAN layer; null: no configuration	100	null	200	null
	user-cos (original CoS value)	null: no configuration; value range: 0 to 7; default value: 0	0	null	0	null
	Action on the VLAN	◆ add: adding ◆ translation: translation ◆ transparent: transparent transmission	trans-parent	add	trans-parent	add
	tpid	Tag protocol ID; value range: 1 to 65534	33024	33024	33024	33024
	cos (new CoS value)	Default setting: null ◆ null: no configuration ◆ user-cos: the new CoS value is the same with the original CoS value. ◆ Value range: 0 to 7	null	null	null	null
	vlanid (new VLAN ID)	New ID of the VLAN layer; null: no configuration; value range: 1 to 4085	null	1000	null	2000

Procedure

1. Create a QinQ domain named "abc".

```
Admin(config)#oltqinq-domain add abc
```

2. Set the service quantity to 2 for the QinQ domain abc.

```
Admin(config)#oltqinq-domain modify abc service-count 2
```

3. Configure data service parameters for the OLT QinQ domain abc, setting the service index to 1.

1) Configure the upstream rule for the data service. Set the rule type to 1 (destination MAC address), the condition to 5 (match if present), and the rule value to the MAC address 000000000000.

```
Admin(config)#oltqinq-domain abc service 1 classification upstream field-id 1 value
000000000000 condition 5 serv-id 1
```

2) Configure the downstream rule for the data service. Set the rule type to 2 (source MAC address), the condition to 5 (match if present), and the rule value to the MAC address 000000000000.

```
Admin(config)#oltqinq-domain abc service 1 classification downstream field-id 2 value
000000000000 condition 5
```

3) Configure the VLAN for the data service in the QinQ domain. Set the action on VLAN layer 1 to transparent transmission of CVLAN 100, with the original CoS value being null, and the TPID being 33024. Set the action on VLAN layer 2 to adding SVLAN 1000, with the TPID being 33024, and the CoS value being null.

```
Admin(config)#oltqinq-domain abc service 1 vlan 1 user-vlanid 100 user-cos 0
transparent tpid 33024 cos null vlanid null vlan 2 user-vlanid null user-cos null add tpid
33024 cos null vlanid 1000
```

4. Configure multicast service parameters for the OLT QinQ domain abc, setting the service index to 2.

1) Configure the upstream rule for the multicast service. Set the rule type to 1 (destination MAC address), the condition to 5 (match if present), and the rule value to the MAC address 000000000000.

```
Admin(config)#oltqinq-domain abc service 2 classification upstream field-id 1 value
000000000000 condition 5 serv-id 2
```

2) Configure the downstream rule for the multicast service. Set the rule type to 2 (source MAC address), the condition to 5 (match if present), and the rule value to the MAC address 000000000000.

```
Admin(config)#oltqinq-domain abc service 2 classification downstream field-id 2 value
000000000000 condition 5
```

3) Configure the VLAN for the multicast service in the QinQ domain. Set the action on VLAN layer 1 to transparent transmission of CVLAN 200, with the original CoS value being null, and the TPID being 33024. Set the action on VLAN layer 2 to adding SVLAN 2000, with the TPID being 33024, and the CoS value being null.

```
Admin(config)#oltqinq-domain abc service 2 vlan 1 user-vlanid 200 user-cos 0
transparent tpid 33024 cos null vlanid null vlan 2 user-vlanid null user-cos null add tpid
33024 cos null vlanid 2000
```

18.8 Binding an OLT QinQ Domain to an Ethernet Port

Bind an OLT QinQ domain to an Ethernet port.

Planning Data

Parameter	Description	Example
oltqinq-domain	Name of the QinQ domain bound to the Ethernet port	abc

Procedure

1. Bind domain "abc" to Ethernet port 1 in slot 16 of subrack 1.

```
Admin(config)#interface eth 1/16/1
Admin(config-if-eth-1/16/1)#oltqinq-domain abc
```

18.9 Configuring Multicast Service Parameters

Configure basic parameters including multicast protocol version, multicast mode and multicast VLAN for multicast services.

Note:

For more configurations of multicast services, see Configuring Multicast Services.

Planning Data

Parameter	Description	Example
igmp version	◆ v1: IGMPv1 ◆ v2: IGMPv2 ◆ v3: IGMPv3	v2
igmp mode	◆ proxy-proxy ◆ snooping ◆ proxy-snooping ◆ disable	proxy-proxy
igmp vlan	Make sure the multicast VLAN is within the range of the local VLAN. Value range: 1 to 4085.	2000

Procedure

1. Set the multicast protocol version to IGMPv2, multicast mode to proxy-proxy, and multicast VLAN to 2000.

```
Admin(config)#igmp
Admin(config-igmp)#igmp version v2
Admin(config-igmp)#igmp mode proxy-proxy
Admin(config-igmp)#igmp vlan 2000
```

18.10 Configuration Result

The subscribers accessing the system via the switch can access Internet and watch IPTV programs for multicast VLAN 2000 as expected.

19 Configuring Network Protection

19.1 Configuring MSTP Services

This section introduces how to configure the MSTP services for the AN6000 Series.

19.1.1 Background Information

In the Layer 2 switching network, a loop in the network will cause infinite loop and proliferation of packets, which leads to broadcast storm and occupies all bandwidth available so that the network becomes unusable. As defined by the IEEE 802.1s, the MSTP (Multiple Spanning Tree Protocol) is compatible with STP and RSTP, and can compensate for the defects of them.

The MSTP is applied to the access network as follows:

- The MSTP features fast convergence, and allows the traffics in different VLANs to be forwarded along their own paths, so as to provide a better load balancing mechanism for redundancy links.
- The MSTP prunes a loop network into a loop-free tree network. This helps avoid infinite loop and proliferation of packets.

19.1.2 Network Scenario

Service Planning

The OLT equipment and two switches make up an MSTP network. Two spanning trees corresponding to different VLAN IDs are configured.

Network Diagram

Figure 19-1 shows the network diagram for the MSTP services.

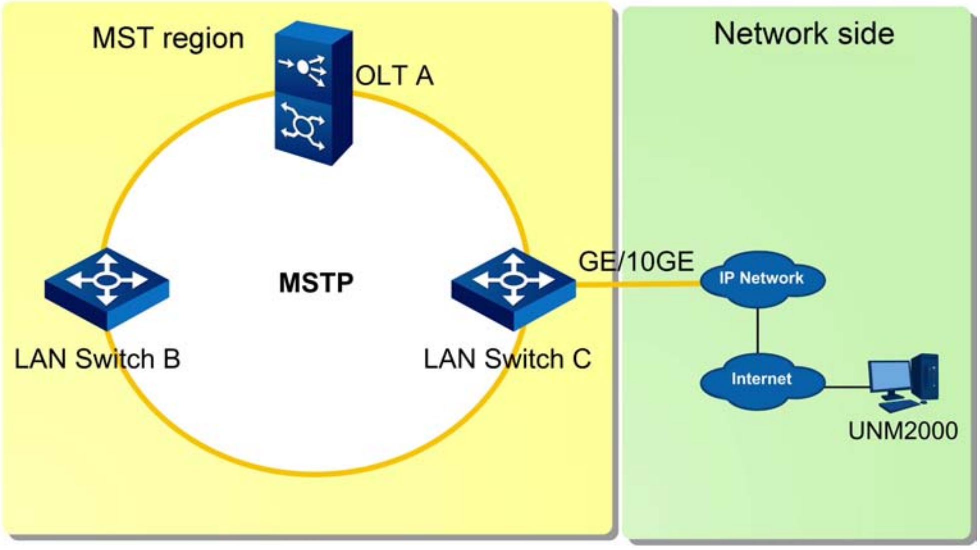


Figure 19-1 Network Diagram for the MSTP Service

A is the OLT equipment running the MSTP in the MST region; B and C are switches; and C is the root of the region.

Each MST region can have multiple spanning trees (MST), and each spanning tree corresponds to a spanning tree instance. Accordingly, an MST region may have multiple spanning tree instances (MSTI). In this example, VLAN 10 is mapped to MST1, while other VLANs are mapped to MST0.

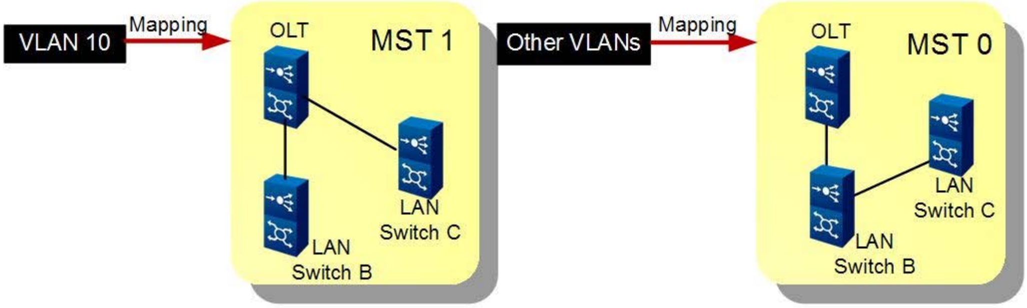


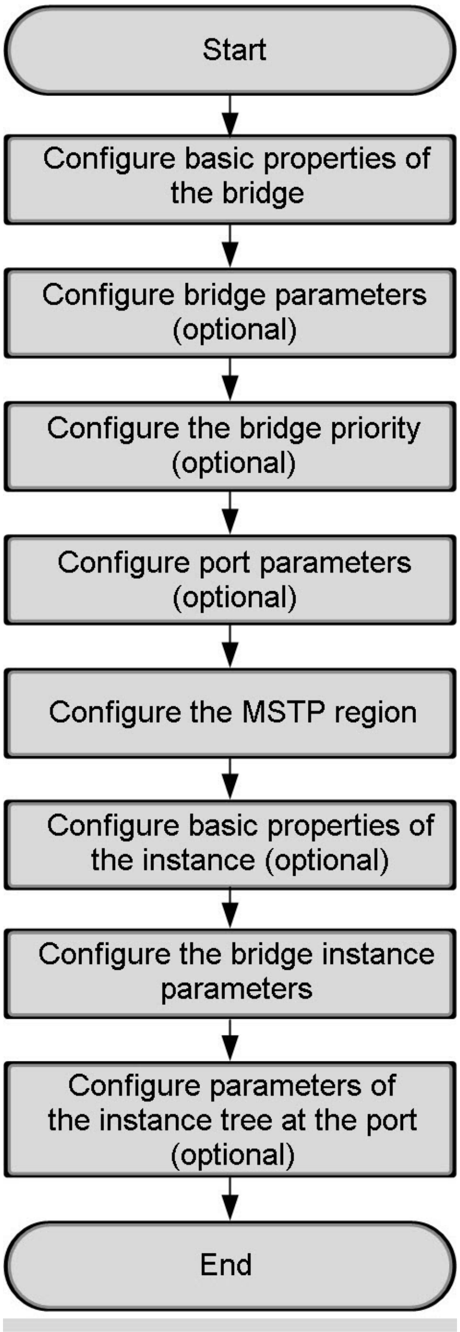
Figure 19-2 Mappings Between Spanning Trees and VLANs

19.1.3 Configuration Flow

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

Note:

Default values are recommended for the optional configuration items.


Start
Configure basic properties of the bridge
Configure bridge parameters (optional)
Configure the bridge priority (optional)
Configure port parameters (optional)
Configure the MSTP region
Configure basic properties of the instance (optional)
Configure the bridge instance parameters
Configure parameters of the instance tree at the port (optional)
End

19.1.4 Configuring Basic Properties of the Bridge

Command Format

Enable / disable the STP function.

```
stp [enable|disable]
stp port <frameid/slotid/portid> [enable|disable]
stp link-aggregation <group-id> [enable|disable]
```

Configure the STP protocol mode.

```
stp mode [mstp|rstp|stp]
```

Configure the MSTP region name.

```
stp region-name <name>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Enabling / disabling the STP function	`stp [enable|disable]`	The STP function switch	Mandatory	enable
	`port <frameid/slotid/portid>`	Subrack No. / slot No. / PON port No.	Mandatory	1/19/1
	`link-aggregation <group-id>`	The Trunk group ID. The value ranges from 1 to 16.	Mandatory	1
Configuring the STP protocol mode	`stp mode [mstp|rstp|stp]`	The STP protocol mode	Mandatory	mstp
Configuring the MSTP region name	`region-name <name>`	The MSTP region name. The value contains 1 to 32 characters. The default setting is the MAC address of the current equipment.	Mandatory	fiberhome

Example

1. Enable the STP globally.

```
Admin(config)#stp enable
```

2. Enable the STP for PON Port 1 in Slot 19 of Subrack 1.

```
Admin(config)#stp port 1/19/1 enable
```

3. Enable the STP for Trunk group 1.

```
Admin(config)#stp link-aggregation 1 enable
```

4. Set the STP protocol mode to MSTP.

```
Admin(config)#stp mode mstp
```

5. Set the MSTP region name to "fiberhome".

```
Admin(config)#stp region-name fiberhome
Admin(config)#
```

19.1.5 Configuring Bridge Parameters (Optional)

Command Format

```
stp timer forward-delay <time>
stp timer hello <time>
stp timer max-age <time>
stp time-factor <factor>
```

Data Planning

Procedure	Parameter	Description	Attribute	Example
Configuring the bridge parameter "forward-time"	`forward-delay <time>`	The forwarding delay (unit: second). The value ranges from 4 to 30.	Mandatory	20
Configuring the bridge parameter "hello-time"	`hello <time>`	The Hello message interval (unit: second). The value ranges from 1 to 10.	Mandatory	5
Configuring the bridge parameter "max-age"	`max-age <time>`	The maximum interval for root bridge messages (unit: second). The value ranges from 6 to 40.	Optional	20
Configuring the bridge parameter "time-factor"	`time-factor <factor>`	The maximum number of hops for protocol packets. The value ranges from 1 to 40.	Optional	25

Example

1. Set the bridge parameter "forward-time" to 20.

```
Admin(config)#stp timer forward-delay 20
```

2. Set the bridge parameter "hello-time" to 5.

```
Admin(config)#stp timer hello 5
```

3. Set the bridge parameter "max-age" to 20.

```
Admin(config)#stp timer max-age 20
```

4. Set the bridge parameter "time-factor" to 25.

```
Admin(config)#stp time-factor 25
Admin(config)#
```

19.1.6 Configuring the Bridge Priority (Optional)

Command Format

```
stp priority <priority-value>
```

Planning Data

Parameter	Description	Attribute	Example
priority <priority-value>	The bridge priority value. It is a multiple of 4096, ranging from 0 to 61440.	Mandatory	8192

Example

Set the bridge priority to 8192.

```
Admin(config)#stp priority 8192
Admin(config)#
```

19.1.7 Configuring Port Parameters (Optional)

Command Format

Configure the edge port of the current port.

```
stp port <frameid/slotid/portid> edged-port [enable|disable]
```

Configure the edge port of the Trunk group.

```
stp link-aggregation <group-id> edged-port [enable|disable]
```

Configure the link type of the port.

```
stp port <frameid/slotid/portid> point-to-point [enable|disable]
```

Configure the link type of the Trunk group.

```
stp link-aggregation <group-id> point-to-point [enable|disable]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the edge port of the current port	`port <frameid/slotid/-portid>`	Subrack No. / slot No. / port No.	Mandatory	1/19/1
	`edged-port [enable|disable]`	◆ enable: auto-negotiation ◆ disable: edge port The default setting is "enable" (auto-negotiation).	Mandatory	enable
Configuring the edge port of the Trunk group	`link-aggregation <group-id>`	The Trunk group ID. The value ranges from 1 to 16.	Mandatory	1
	`edged-port [enable|disable]`	◆ enable: auto-negotiation ◆ disable: edge port The default setting is "enable" (auto-negotiation).	Mandatory	enable
Configuring the link type of the port	`port <frameid/slotid/-portid>`	Subrack No. / slot No. / port No.	Mandatory	1/19/1
	`point-to-point [enable|disable]`	◆ enable: point-to-point ◆ disable: shared The default setting is "disable" (shared).	Mandatory	enable
Configuring the link type of the Trunk group	`link-aggregation <group-id>`	The Trunk group ID. The value ranges from 1 to 16.	Mandatory	1
	`point-to-point [enable|disable]`	◆ enable: point-to-point ◆ disable: shared The default setting is "disable" (shared).	Mandatory	enable

Example

1. Configure the edge port of the current port.

```
Admin(config)#stp port 1/19/1 edged-port enable
```

2. Configure the edge port of the Trunk group.

```
Admin(config)#stp link-aggregation 1 edged-port enable
```

3. Configure the link type of the port.

```
Admin(config)#stp port 1/19/1 point-to-point enable
```

4. Configure the link type of the Trunk group.

```
Admin(config)#stp link-aggregation 1 point-to-point enable
Admin(config)#
```

19.1.8 Configuring the MST Region

Command Format

Configure the revision level of the MSTP.

```
stp revision-level <level>
```

Planning Data

Parameter	Description	Attribute	Example
`revision-level <level>`	The revision level of the MSTP. The value ranges from 0 to 65535.	Mandatory	100

Example

Set the revision level of the MSTP to 100.

```
Admin(config)#stp revision-level 100
Admin(config)#
```

19.1.9 Configuring Basic Properties of the Instance (Optional)

Command Format

```
stp instance <instanceid> vlan <vlanlist>
```

Planning Data

Parameter	Description	Attribute	Example
`instance <instanceid>`	The instance ID, ranging from 1 to 64.	Mandatory	1
`vlan <vlanlist>`	The VLAN ID added to the instance	Mandatory	100

Example

Add the VLAN ID 100 to Instance 1.

```
Admin(config)#stp instance 1 vlan 100
Admin(config)#
```

19.1.10 Configuring Parameters for the Bridge Instance

Command Format

```
stp instance <instanceid> priority <priority-value>
```

Planning Data

Parameter	Description	Attribute	Example
instance <instanceid>	The instance ID, ranging from 0 to 64.	Mandatory	1
priority <priority-value>	The priority of the instance. It is an integral multiple of 4096, ranging from 0 to 61440, and the default value is 32768.	Mandatory	4096

Example

Set the priority of Instance1 to 4096.

```
Admin(config)#stp instance 1 priority 4096
Admin(config)#
```

19.1.11 Configuring Instance Tree Parameters for the Port (Optional)

Command Format

Configure the path cost of the port.

```
stp port <frameid/slotid/portid> instance <instanceid> cost <cost>
```

Configure the path cost of the Trunk group.

```
stp link-aggregation <group-id> instance <instanceid> cost <cost>
```

Configure the priority of the port.

```
stp port <frameid/slotid/portid> instance <instanceid> priority <priority>
```

Configure the priority of the Trunk group.

```
stp link-aggregation <group-id> instance <instanceid> priority <priority>
```

Data Planning

Procedure	Parameter	Description	Attribute	Example
Configuring the path cost of the port	`port <frameid/slotid/portid>`	The subrack number / slot number / port number.	Mandatory	1/19/1
	`instance <instanceid>`	The instance ID, ranging from 0 to 64.	Mandatory	1
	`cost <cost>`	The path cost of the port. The value ranges from 1 to 200000000, and the default value is 0.	Mandatory	2000
Configuring the path cost of the Trunk group	`link-aggregation <group-id>`	The Trunk group ID. The value ranges from 1 to 16.	Mandatory	1
	`instance <instanceid>`	The instance ID, ranging from 0 to 64.	Mandatory	1
	`cost <cost>`	The path cost of the port. The value ranges from 1 to 200000000, and the default value is 0.	Mandatory	2000
Configuring the priority of the port	`port <frameid/slotid/portid>`	The subrack number / slot number / port number.	Mandatory	1/19/1
	`instance <instanceid>`	The instance ID, ranging from 0 to 64.	Mandatory	1
	`priority <priority>`	The priority of the port. It is an integral multiple of 16, ranging from 0 to 240, and the default value is 128.	Mandatory	160
Configuring the priority of the Trunk group	`link-aggregation <group-id>`	The Trunk group ID. The value ranges from 1 to 16.	Mandatory	1
	`instance <instanceid>`	The instance ID, ranging from 0 to 64.	Mandatory	1
	`priority <priority>`	The priority of the port. It is an integral multiple of 16, ranging from 0 to 240, and the default value is 128.	Mandatory	160

Example

1. Configure the path cost of the port.

```
Admin(config)#stp port 1/19/1 instance 1 cost 2000
```

2. Configure the path cost of the Trunk group.

```
Admin(config)#stp link-aggregation 1 instance 1 cost 2000
```

3. Configure the priority of the port.

```
Admin(config)#stp port 1/19/1 instance 1 priority 160
```

4. Configure the priority of the Trunk group.

```
Admin(config)#stp link-aggregation 1 instance 1 priority 160
Admin(config)#
```

19.2 Configuring LACP

This section introduces how to configure the LACP for the AN6000 Series.

19.2.1 Background Information

Link aggregation means binding two or more physical interfaces together to form a logical data link. The logical link provides higher bandwidth and more throughput with bandwidth of the physical interfaces combined. When a link is faulty, the service data can be automatically switched to another link, which provides higher reliability of data links.

The LACP protocol based on the IEEE802.3ad standard is a protocol that implements dynamic link aggregation. The LACP protocol exchanges information with the far end via the link aggregation control protocol data unit (LACPDU). After being enabled with the LACP protocol, a port sends the LACPDU to notify the far end of its information such as system priority, system MAC address, port priority, port number and operation key. After receiving the information, the far end compares it with the information of other ports, and selects the ports that can be aggregated. In this way, both ends agree on the ports to join or leave a dynamic aggregation group.

The ports enabled with the LACP can work in two modes: **passive** and **active**.

- In the passive mode, the port does not send the LACPDU messages proactively. After receiving the LACP messages from the far end, the port comes into the protocol computation status.
- In the active mode, the port proactively sends the LACPDU messages to the far end, and makes LACP computations.

The LACP can be classified into static LACP and dynamic LACP in the application layer. Here we focus on the static LACP. The static LACP aggregation group is created by the user. When creating the group, the user designates some specific ports and has the LACP protocol run on them. The link aggregation group then comes into being through negotiation between these designated ports and the ports connected to them on the far end. Therefore, members of an aggregation group must be limited to the designated ports. When the link at a member port is interrupted or the port is in the duplex mode, the rate parameters of the port are inconsistent with those of other ports. In this case, the member port leaves the aggregation group. When conditions are met, the port rejoins the aggregation group. To delete a member from an aggregation group, manual operation of the user is required.

The AN6000 Series equipment supports intra-card LACP and inter-card LACP. Multiple Ethernet ports on a card or different cards can be bound together to form link aggregation.

19.2.2 Configuration Rules

- The AN6000 Series equipment supports two aggregation modes: manual aggregation and static LACP.
- Before configuring the LACP, make sure that the property settings such as port rate, duplex type, MTU value and uplink mode for the desired ports are consistent.
- Before configuring the LACP, make sure that the member ports are not configured with service VLANs.

19.2.3 Network Scenario

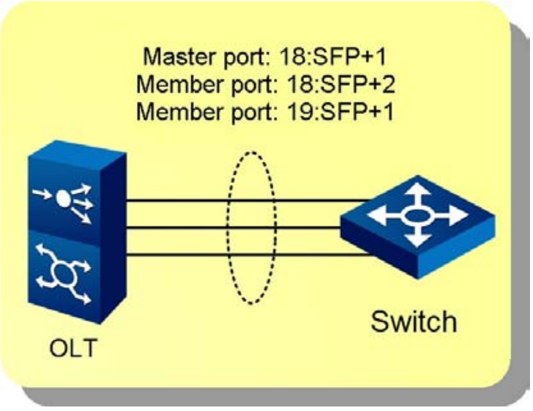
Here we use inter-card LACP as an example.

Service Planning

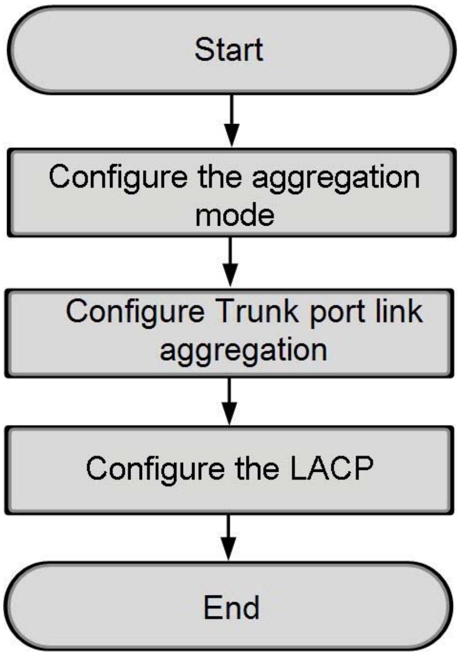
Set three uplink ports (18:SFP+1, 18:SFP+2, and 19:SFP+1) of the OLT equipment as the member ports of the LACP protection group to enable link backup. Port 18: SFP+1 serves as the master port, and the other two the member ones.

Network Diagram

The figure below shows the network for the LACP function.



19.2.4 Configuration Flow


Start
Configure the aggregation mode
Configure Trunk port link aggregation
Configure the LACP
End

19.2.5 Configuring the Aggregation Mode

Command Format

```
link-aggregation <frameid/slotid/portid> {[mode] [smac|dmac|sdmac|sip|
dip|sdip]}*1 {[workmode] [lacp-static]}*1 {[max-member-num] <num>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/portid>`	Subrack No. / slot No. / port No.	Mandatory	1/18/1
`{[mode] [smac|dmac|sdmac|sip|dip|sdip]}*1`	The load balancing mode of the aggregation group ◆ smac: the source MAC address ◆ dmac: the destination MAC address ◆ sdmac: the source and destination MAC addresses ◆ sip: the source IP address ◆ dip: the destination IP address ◆ sdip: the source and destination IP addresses	Optional	smac
`{[workmode] [lacp-static]}*1`	Static LACP	Optional	lacp-static
`{[max-member-num] <num>}*1`	The maximum quantity of member ports, ranging from 0 to 20.	Optional	20

Example

Configure the static LACP aggregation mode based on the source MAC address for port 1 in slot 18 of subrack 1, setting the maximum quantity of member ports to 20.

```
Admin(config)#link-aggregation 1/18/1 mode smac workmode lacp-static max-member-num 20
Admin(config)#
```

19.2.6 Configuring Trunk Port Link Aggregation

Caution:

The PXNA card supports intra-card link aggregation. When used as an uplink card, the PXNA card can be configured with link aggregation only on its uplink ports.

Format

```
link-aggregation add-member <frameid/slotid/portid> <frameid/slotid/portid> {<frameid/slotid/portid>}*6
link-aggregation delete-member <frameid/slotid/portid> {<frameid/slotid/portid>}*7
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/-portid>`	Master port, in the format of subrack No./slot No. /port No.	Mandatory	1/18/1
`<frameid/slotid/-portid>`	Member port, in the format of subrack No./slot No. /port No.	Mandatory	1/18/2
`{<frameid/slotid/-portid>}*6`	Member port, in the format of subrack No./slot No. /port No.	Optional	1/19/1

Example

1. Configure the Trunk port link aggregation, adding the master port 1/18/1 and member ports 1/18/2 and 1/19/1 to the Trunk group.

```
Admin(config)#link-aggregation add-member 1/18/1 1/18/2 1/19/1
```

2. Delete the Trunk group member 1/18/1. (Use this command format to delete a port.)

```
Admin(config)#link-aggregation delete-member 1/18/1
Admin(config)#
```

19.2.7 Configuring the LACP

Command Format

Enable the LACP function.

```
lacp [enable|disable]
```

Configure the priority of the LACP system.

```
lacp priority <value> system
```

Configure the priority of the LACP port.

```
lacp priority <value> port <frameid/slotid/portid>
```

Configure the timer of the LACP port.

```
lacp timeout [fast|slow] port <frameid/slotid/portid>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Enabling / disabling the LACP function	`lacp [enable|disable]`	Enabling or disabling the LACP function globally	Mandatory	enable
Configuring the priority of the LACP system	`priority <value>`	The LACP system priority. The value ranges from 0 to 65534, and the default value is 32768. The smaller is the value, the higher is the priority.	Mandatory	120
Configuring the priority of the LACP port	`priority <value>`	The LACP port priority. The value ranges from 0 to 65534, and the default value is 32768. The smaller is the value, the higher is the priority.	Mandatory	120
	`port <frameid/slotid/portid>`	Subrack No. / slot No. / port No.	Mandatory	1/18/1
Configuring the timer of the LACP port	`timeout [fast|slow]`	◆ fast: Specifies the short-period timeout mode for packet receiving of the LACP port. ◆ slow: Specifies the long-period timeout mode for packet receiving of the LACP port.	Mandatory	fast

Procedure	Parameter	Description	Attribute	Example
	`port <frameid/slotid/portid>`	Subrack No. / slot No. / port No.	Mandatory	1/18/1

Example

1. Enable the LACP function.

```
Admin(config)#lacp enable
```

2. Set the priority of the LACP system to 120.

```
Admin(config)#lacp priority 120 system
```

3. Set the priority of port 1 in slot 18 of subrack 1 to 120.

```
Admin(config)#lacp priority 120 port 1/18/1
```

4. Set the timer type of port 1 in slot 18 of subrack 1 to short timer.

```
Admin(config)#lacp timeout fast port 1/18/1
Admin(config)#
```

19.3 Configuring ERPS

This section introduces how to configure the ERPS for the AN6000 Series.

19.3.1 Background Information

The Ethernet Ring Protection Switching (ERPS) is an Ethernet ring protection technology defined in the ITU-T G.8032 protocol. The fast switching mechanism and universality of the protocol can protect the link efficiently and guarantee the operation quality of the service.

Components of the ERPS Ring

At the physical layer, all the equipment (such as the OLT) on the ring nodes should have the ERPS function enabled and constitute one or more physical rings to use the ERPS protocol. The ports on the ring are called ring ports. The ERPS protocol controls connection and disconnection of the ring ports to form link redundancy and handle faults.

At the logical layer, ERPS instances should be created for the equipment on the ring nodes to run the ERPS function. Besides, each ERPS ring needs to be assigned with an exclusive signaling VLAN as a channel for transmitting protocol messages (R-APS message).

Several instances can be created for a physical ring, so that the link can be used in several ERPS rings.

Port Role and Status

There are two types of ring ports on the ERPS ring: RPL owner port and common port.

- RPL owner port: Each ERPS ring has only one RPL owner port. When the link is in normal status, the port is blocked (discarded) to prevent link loops. When the link is faulty, the port is unblocked to forward service messages. When the fault is cleared, the port is blocked again, and the updated status of the port is announced to other ports.
- Common port: The common port forwards service messages, monitors the status of the link directly connected with it, and announces its status to the ports on other nodes. When detecting a fault, the common port triggers the ERPS link protection mechanism to enable the backup link.

The link that is disconnected as the RPL owner port is blocked becomes the ring protection link (RPL).

The ERPS ring port has two statuses:

- A port in the discarding status (being blocked) cannot forward any service messages, but can forward R-APS messages and other Ethernet link protection protocol messages (such as CFM defined in IEEE 802.3ag).
- A port in the forwarding status (being unblocked) can forward service and protocol messages normally.

R-APS Message

As defined by the ITU-T G.8032 standard, the ring automatic protection switching (R-APS) messages are used to inform the ring node equipment of the change in connection status of the links on the ring.

Message Name	Generation Time	Meaning
R-APS (SF)	When the link is faulty	SF means signal failure, indicating that the link signal is lost. The message is sent by the port detecting the link fault. When receiving the SF message, the RPL Owner node will unblock the RPL Owner port .
R-APS (NR)	When the link is normal	NR means no request, indicating that the link is normal and there is no need for requiring change of the port status.
R-APS (NR, NB)	The link returns to normal and the RPL Owner port is blocked again.	It is similar to R-APS (NR), but can only be sent by the RPL Owner port, indicating that the port is blocked again.

Timer

The ITU-T G.8032 protocol defines multiple timers, which are used as the buffer time for the protocol to control the link status changes. This helps avoid the link flapping caused by the port misjudgment on the link status, as a result of delay in transmitting signaling messages or fault correction.

The names, starting time and functions of the timers are described as follows:

Timer Name	Starting Time	Function
WTR timer	It is started when the RPL Owner port receives R-APS (NR) messages.	Reserve the buffer time, and do not block the RPL Owner port until the physical and logical statuses of all ports and links return to normal.
Guard timer	It is started when a faulty node detects that the fault is cleared.	When the guard timer is running, the port does not receive any R-APS (SF) messages from other ports. In this way, the guard timer can prevent the port from receiving or forwarding outdated R-APS (SF) messages. Receiving or forwarding of these outdated R-APS messages may result in further change of the whole link status.
Hold-off timer	It is started when a ring node is faulty.	The hold-off timer holds off the transmission of R-APS (SF) messages. In the set period, the fault will not be detected by the ERPS protocol. If the fault persists at the expiration of the hold-off time, link protection will be implemented based on the ERPS protocol.

19.3.2 Configuration Rules

- Only one RPL owner port needs to be configured on an ERPS ring.
- While configuring tangent rings, make sure the RPL owner port is configured on the equipment at a non-tangent point.

19.3.3 Configuring Single-Ring Single-Instance Protection

This section uses an example to introduce how to configure a single-ring single-instance protection.

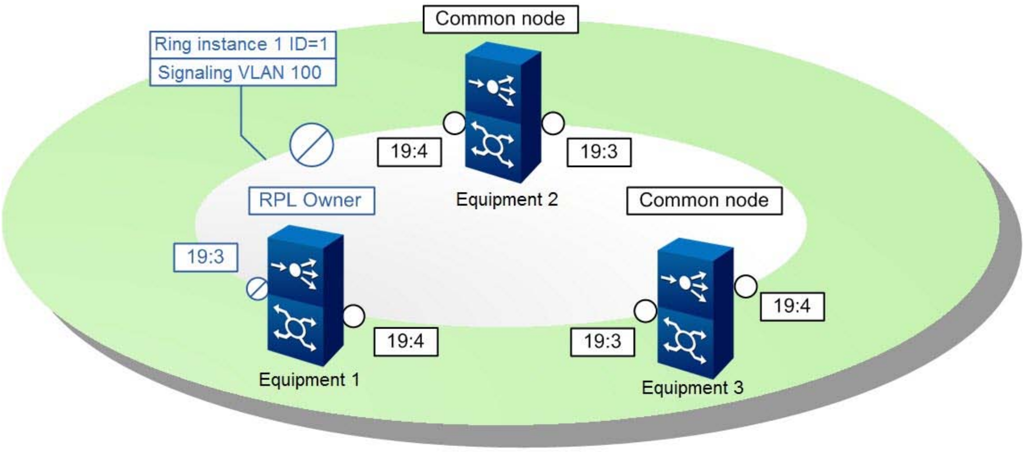
19.3.3.1 Network Scenario

Service Planning

Three OLT devices make up an ERPS protection ring. The link between Equipment 1 and 2 is an RPL link. This ERPS ring protects a single service via one ring instance. The service VLAN ID is 200, and the signaling VLAN ID on the ring is 100.

Network Diagram

The network for the single-ring single-instance ERPS is shown in the figure below.



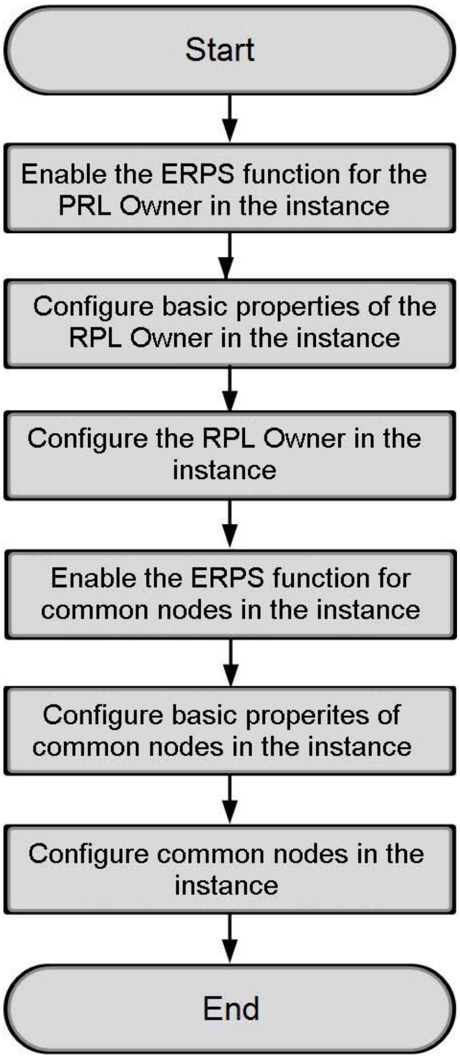
Equipment 1 serves as the RPL Owner of the ERPS ring. Port 19:3 of Equipment 1 serves as the RPL Port and is blocked.

When the network is normal, the service flow is forwarded in the direction of **Equipment 1→Equipment 3→Equipment 2**.

When the network between Equipment 1 and Equipment 3 is faulty, the blocked RPL port will be unblocked, so that the service flow can be forwarded in the direction of **Equipment 1→Equipment 2→Equipment 3**. When the fault is cleared and the RPL owner has confirmed the link status, the RPL port will be blocked again, and the service flow will be switched back to the original direction.

19.3.3.2 Configuration Flow

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.


Start
Enable the ERPS function for the PRL Owner in the instance
Configure basic properties of the RPL Owner in the instance
Configure the RPL Owner in the instance
Enable the ERPS function for common nodes in the instance
Configure basic properites of common nodes in the instance
Configure common nodes in the instance
End

19.3.3.3 Enabling the ERPS Function for the RPL Owner in the Instance

Command Format

```
erps mode [enable|disable]
```

Planning Data

Parameter	Description	Attribute	Example
erps mode [enable|disable]	Enabling or disabling the ERPS function	Mandatory	enable

Example

Enable the ERPS function.

```
Admin(config)#erps mode enable
Admin(config)#
```

19.3.3.4 Configuring Basic Properties of the RPL Owner in the Instance

Command Format

Configure the mappings between the VLANs and the ERPS instance.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the mappings between the VLANs and the ERPS instance	`erps instance <instance-id>`	The ERPS instance ID, ranging from 1 to 64.	Mandatory	1
	`vlan-id <vlanid>`	The starting value of the VLAN ID range to be mapped	Mandatory	100
	`{to <vlanid-end>}*1`	The ending value of the VLAN ID range	Optional	200
Creating an ERPS ring	`ring <ring-id>`	The ring ID, ranging from 1 to 239	Mandatory	1
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	A node can act as common node or RPL owner.	Mandatory	rpl-owner

Example

1. Map VLANs 100 to 200 to ERPS Instance 1.

```
Admin(config)#erps instance 1 vlan-id 100 to 200
```

2. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

3. Set Equipment 1 in Ring Instance 1 to RPL owner.

```
Admin(config)#erps ring 1 erps-role rpl-owner
Admin(config)#
```

19.3.3.5 Configuring the RPL Owner in the Instance

Note:

Default values are recommended for the optional configuration items.

Command Format

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	100
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance ID. The value ranges from 1 to 64.	Mandatory	1
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19
	`primary-port <value>`	The first uplink port	Mandatory	3
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	rpl-port
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19
	`second-port <value>`	No. of the second port	Mandatory	4

Procedure	Parameter	Description	Attribute	Example
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-

Example

1. Set the signaling VLAN ID of the ERPS ring instance to 100.

```
Admin(config)#erps ring 1 control-vlan 100
```

2. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

3. Associate the ERPS ring instance with the VLAN Instance 1.

```
Admin(config)#erps ring 1 protect-inst 1
```

4. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

5. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

6. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

7. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

8. Set the first port of the RPL owner device in the ERPS ring instance to RPL port.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role rpl-port
```

9. Set the second port of the RPL owner device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
Admin(config)#
```

19.3.3.6 Enabling the ERPS Function for Common Nodes in the Instance

Command Format

```
erps mode [enable|disable]
```

Data Planning

Parameter	Description	Attribute	Example
`erps mode [enable|disable]`	Enable or disable the ERPS function.	Mandatory	enable

Example

Enable the ERPS function.

```
Admin(config)#erps mode enable
Admin(config)#
```

19.3.3.7 Configuring Basic Properties of Common Nodes in the Instance

Command Format

Configure the mappings between the VLANs and the ERPS instance.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the mappings between the VLANs and the ERPS instance	`erps instance <instance-id>`	The ERPS instance ID, ranging from 1 to 64.	Mandatory	1
	`vlan-id <vlanid>`	The starting value of the VLAN ID range to be mapped	Mandatory	100
	`{to <vlanid-end>}*1`	The ending value of the VLAN ID range	Optional	200
Creating an ERPS ring	`ring <ring-id>`	The ring ID, ranging from 1 to 239	Mandatory	1
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	A node can act as common node or RPL owner.	Mandatory	common

Example

1. Map VLANs 100 to 200 to ERPS Instance 1.

```
Admin(config)#erps instance 1 vlan-id 100 to 200
```

2. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

3. Set Equipment 2 and Equipment 3 in Ring Instance 1 to common nodes.

```
Admin(config)#erps ring 1 erps-role common
Admin(config)#
```

19.3.3.8 Configuring Common Nodes in the Instance

Note:

Default values are recommended for the optional configuration items.

Command Format

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the Signaling VLAN of the ERPS Ring Instance	`ring <ringid>`	The ring ID	Mandatory	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	100

Procedure	Parameter	Description	Attribute	Example
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	1
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive| nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19
	`primary-port <value>`	The first uplink port	Mandatory	3
	`role [common| rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19
	`second-port <value>`	No. of the second port	Mandatory	4
	`role [common| rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-

Example

1. Set the signaling VLAN ID of the ERPS ring instance to 100.

```
Admin(config)#erps ring 1 control-vlan 100
```

2. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

3. Associate the ERPS ring instance with the VLAN Instance 1.

```
Admin(config)#erps ring 1 protect-inst 1
```

4. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

5. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

6. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

7. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

8. Set the first port of the common device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role common
```

9. Set the second port of the common device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
Admin(config)#
```

19.3.4 Configuring Single-Ring Multi-Instance Protection

This section uses an example to introduce how to configure a single-ring multi-instance protection.

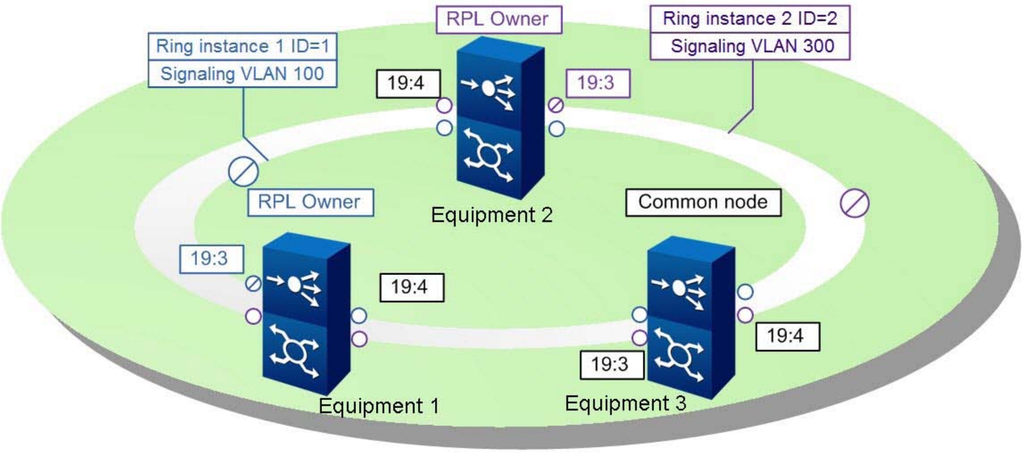
19.3.4.1 Network Scenario

Service Planning

Three OLT devices make up an ERPS protection ring. Two ERPS ring instances are created for the ring to protect different services.

Network Diagram

The network for the single-ring multi-instance ERPS is shown in the figure below.



The configuration in this example covers two parts: Ring Instance 1 and Ring Instance 2.

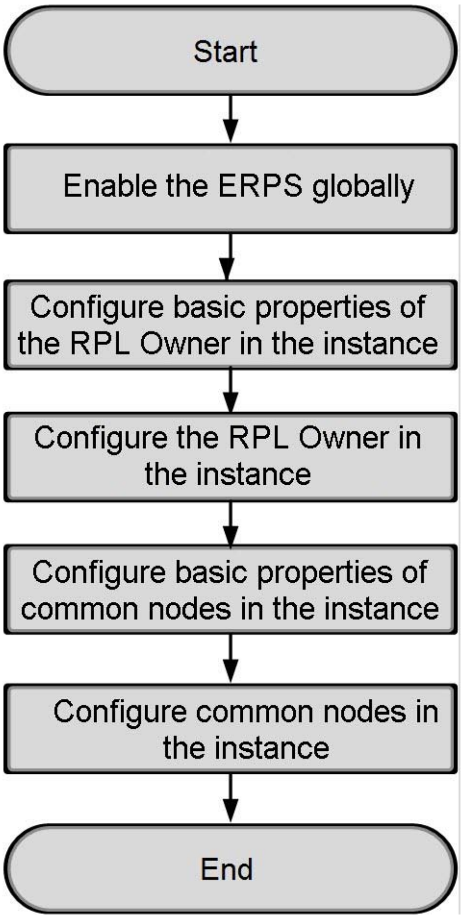
- Ring Instance 1 here is configured in the same way as that in the single-ring single-instance application. Equipment 1 serves as the RPL owner in Ring Instance 1; Port 19:3 servers as the RPL port and is blocked. With the signaling VLAN ID 100, Ring Instance 1 protects the service with the VLAN ID 100.
- In Ring Instance 2, Equipment 2 serves as the RPL owner; Port 19:3 servers as the RPL port and is blocked. With the signaling VLAN ID 300, Ring Instance 2 protects the service with the VLAN ID 300.

A physical port can be used in different ring instances logically. However, the role of the port is specific to ring instance. That is, the role of the port in one ring instance will not affect the role or message forwarding of the port in other ring instances.

19.3.4.2 Configuration Flow

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.

The figure below illustrates the flow of configuring an instance in the single-ring multi-instance application.


Start
Enable the ERPS globally
Configure basic properties of the RPL Owner in the instance
Configure the RPL Owner in the instance
Configure basic properties of common nodes in the instance
Configure common nodes in the instance
End

19.3.4.3 Enabling the ERPS Globally

Command Format

```
erps mode [enable|disable]
```

Planning Data

Parameter	Description	Attribute	Example
`erps mode [enable|disable]`	Enabling or disabling the ERPS function	Mandatory	enable

Example

Enable the ERPS function.

```
Admin(config)#erps mode enable
Admin(config)#
```

19.3.4.4 Configuring Basic Properties of the RPL Owner in Instance One

Command Format

Configure the mappings between the VLANs and the ERPS instance.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the mappings between the VLANs and the ERPS instance	`erps instance <instance-id>`	The ERPS instance ID, ranging from 1 to 64.	Mandatory	1
	`vlan-id <vlanid>`	The starting value of the VLAN ID range to be mapped	Mandatory	100
	`{to <vlanid-end>}*1`	The ending value of the VLAN ID range	Optional	-
Creating an ERPS ring	`ring <ring-id>`	The ring ID, ranging from 1 to 239	Mandatory	1
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	A node can act as common node or RPL owner.	Mandatory	rpl-owner

Example

1. Map the VLAN 100 to ERPS Instance 1.

```
Admin(config)#erps instance 1 vlan-id 100
```

2. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

3. Set Equipment 1 in Ring Instance 1 to RPL owner.

```
Admin(config)#erps ring 1 erps-role rpl-owner
Admin(config)#
```

19.3.4.5 Configuring the RPL Owner in Instance One

Note:

Default values are recommended for the optional configuration items.

Command Format

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	100
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	1
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive| nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19
	`primary-port <value>`	The first uplink port	Mandatory	3

Procedure	Parameter	Description	Attribute	Example
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	rpl-port
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19
	`second-port <value>`	No. of the second port	Mandatory	4
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-

Example

1. Set the signaling VLAN ID of the ERPS ring instance to 100.

```
Admin(config)#erps ring 1 control-vlan 100
```

2. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

3. Associate the ERPS ring instance with the VLAN Instance 1.

```
Admin(config)#erps ring 1 protect-inst 1
```

4. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

5. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

6. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

7. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

8. Set the first port of the RPL owner device in the ERPS ring instance to RPL port.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role rpl-port
```

9. Set the second port of the RPL owner device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
```

19.3.4.6 Configuring Basic Properties of Common Nodes in Instance One

Command Format

Configure the mappings between the VLANs and the ERPS instance.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the mappings between the VLANs and the ERPS instance	erps instance <instance-id>	The ERPS instance ID, ranging from 1 to 64.	Mandatory	1
	vlan-id <vlanid>	The starting value of the VLAN ID range to be mapped	Mandatory	100
	{to <vlanid-end>}*1	The ending value of the VLAN ID range	Optional	-
Creating an ERPS ring	ring <ring-id>	The ring ID, ranging from 1 to 239	Mandatory	1
Configuring roles of the nodes in the ERPS ring instance	erps-role [common|rpl-owner]	The node can act as a common node or RPL owner.	Mandatory	common

Example

1. Map the VLAN 100 to ERPS Instance 1.

```
Admin(config)#erps instance 1 vlan-id 100
```

2. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

3. Set Equipment 2 and Equipment 3 in Ring Instance 1 to common nodes.

```
Admin(config)#erps ring 1 erps-role common
Admin(config)#
```

19.3.4.7 Configuring Common Nodes in Instance One

Note:

Default values are recommended for the optional configuration items.

Command Format

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	100
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	1
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500

Procedure	Parameter	Description	Attribute	Example
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19
	`primary-port <value>`	The first uplink port	Mandatory	3
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19
	`second-port <value>`	No. of the second port	Mandatory	4
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-

Example

1. Set the signaling VLAN ID of the ERPS ring instance to 100.

```
Admin(config)#erps ring 1 control-vlan 100
```

2. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

3. Associate the ERPS ring instance with the VLAN Instance 1.

```
Admin(config)#erps ring 1 protect-inst 1
```

4. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

5. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

6. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

7. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

8. Set the first port of the common device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role common
```

9. Set the second port of the common device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
```

19.3.4.8 Configuring Basic Properties of the RPL Owner in Instance Two

Command Format

Configure the mappings between the VLANs and the ERPS instance.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the mappings between the VLANs and the ERPS instance	`erps instance <instance-id>`	The ERPS instance ID, ranging from 1 to 64.	Mandatory	2
	`vlan-id <vlanid>`	The starting value of the VLAN ID range to be mapped	Mandatory	300
	`{to <vlanid-end>}*1`	The ending value of the VLAN ID range	Optional	-
Creating an ERPS ring	`ring <ring-id>`	The ring ID, ranging from 1 to 239	Mandatory	1
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	A node can act as common node or RPL owner.	Mandatory	rpl-owner

Example

1. Map the VLAN 300 to ERPS Instance 2.

```
Admin(config)#erps instance 2 vlan-id 300
```

2. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

3. Set Equipment 2 in Ring Instance 2 to RPL owner.

```
Admin(config)#erps ring 1 erps-role rpl-owner
Admin(config)#
```

19.3.4.9 Configuring the RPL Owner in Instance Two

Note:

Default values are recommended for the optional configuration items.

Command Format

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	300
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	2
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000

Procedure	Parameter	Description	Attribute	Example
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19
	`primary-port <value>`	The first uplink port	Mandatory	3
	`role [common| rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	rpl-port
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19
	`second-port <value>`	No. of the second port	Mandatory	4
	`role [common| rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-

Example

1. Set the signaling VLAN ID of the ERPS ring instance to 300.

```
Admin(config)#erps ring 1 control-vlan 300
```

2. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

3. Associate the ERPS ring instance with the VLAN Instance 2.

```
Admin(config)#erps ring 1 protect-inst 2
```

4. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

5. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

6. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

7. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

8. Set the first port of the RPL owner device in the ERPS ring instance to RPL port.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role rpl-port
```

9. Set the second port of the RPL owner device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
```

19.3.4.10 Configuring Basic Properties of Common Nodes in Instance Two

Command Format

Configure the mappings between the VLANs and the ERPS instance.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the mappings between the VLANs and the ERPS instance	erps instance <instance-id>	The ERPS instance ID, ranging from 1 to 64.	Mandatory	2
	vlan-id <vlanid>	The starting value of the VLAN ID range to be mapped	Mandatory	300
	{to <vlanid-end>}*1	The ending value of the VLAN ID range	Optional	-
Creating an ERPS ring	ring <ring-id>	The ring ID, ranging from 1 to 239	Mandatory	1
Configuring roles of the nodes in the ERPS ring instance	erps-role [common|rpl-owner]	A node can act as common node or RPL owner.	Mandatory	common

Example

1. Map the VLAN 300 to ERPS Instance 2.

```
Admin(config)#erps instance 2 vlan-id 300
```

2. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

3. Set Equipment 1 and Equipment 3 in Ring Instance 2 to common nodes.

```
Admin(config)#erps ring 1 erps-role common
Admin(config)#
```

19.3.4.11 Configuring Common Nodes in Instance Two

Note:

Default values are recommended for the optional configuration items.

Command Format

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	300
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	2
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000

Procedure	Parameter	Description	Attribute	Example
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19
	`primary-port <value>`	The first uplink port	Mandatory	3
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19
	`second-port <value>`	No. of the second port	Mandatory	4
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-

Example

1. Set the signaling VLAN ID of the ERPS ring instance to 300.

```
Admin(config)#erps ring 1 control-vlan 300
```

2. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

3. Associate the ERPS ring instance with the VLAN Instance 2.

```
Admin(config)#erps ring 1 protect-inst 2
```

4. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

5. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

6. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

7. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

8. Set the first port of the common device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role common
```

9. Set the second port of the common device in the ERPS ring instance to common port.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
```

19.3.5 Configuring a Tangent Ring Protection

This section introduces how to configure a tangent ring protection.

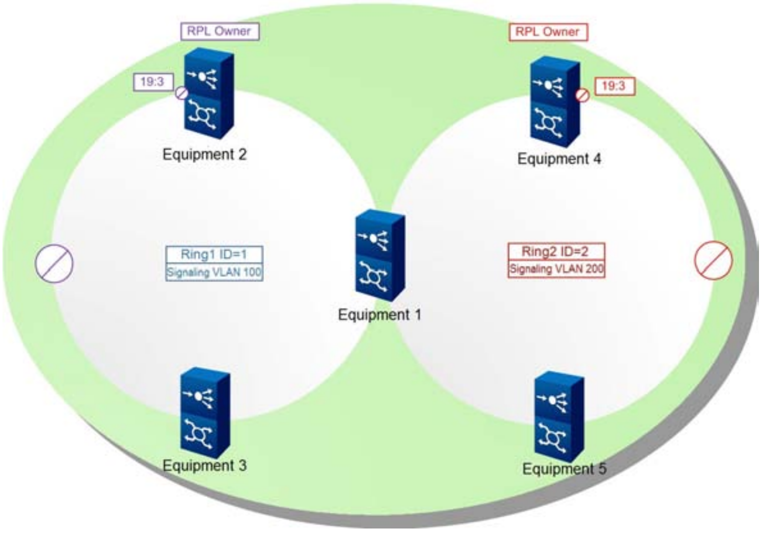
19.3.5.1 Network Scenario

Service Planning

Five OLT devices constitute two tangent ERPS protection rings, and each ring corresponds to an ERPS instance. The two instances protect different services.

Network Diagram

The figure below shows the network for the tangent-ring ERPS.



The configuration in this example covers three parts: the equipment at the non-tangent points of Ring 1 (including Equipment 2 and 3), the equipment at the non-tangent points of Ring 2 (including Equipment 4 and 5), and the equipment at the tangent point (Equipment 1).

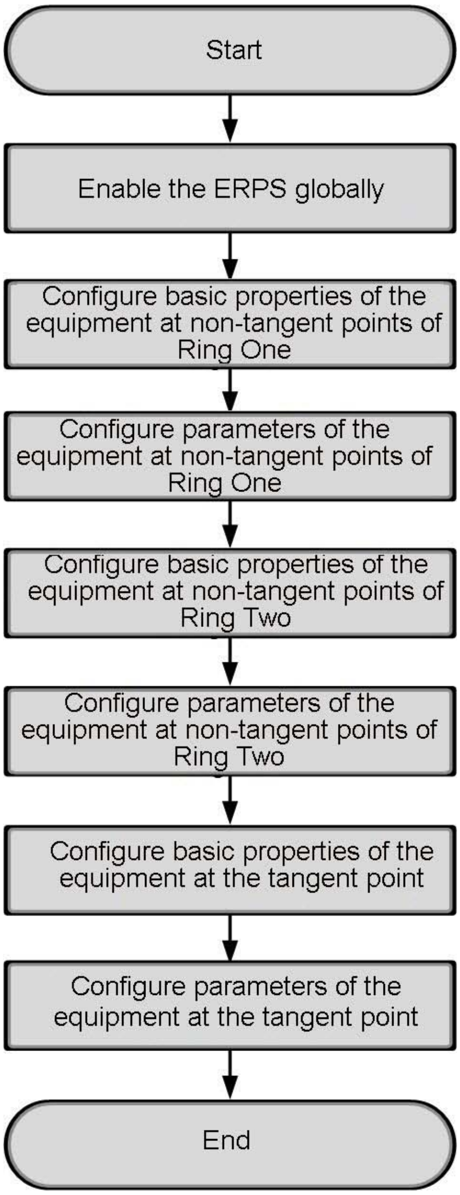
- Ring 1: Equipment 2 acts as the RPL Owner, and Port 19:3 as the RPL port which is blocked. With the signaling VLAN ID 100 and the ring ID 1, the ring protects the service with the VLAN ID 1000.
- Ring 2: Equipment 4 acts as the RPL owner, and Port 19:3 as the RPL port which is blocked. With the signaling VLAN ID 200 and the ring ID 2, the ring protects the service with the VLAN ID 2000.
- Equipment at the tangent point: Equipment 1 acts as the tangent point of the two rings. Two instances need to be created for the equipment to correspond to the signaling transmission for the two rings respectively.

The table below describes the mappings between the ERPS instances created for the equipment and the rings in the example.

Equipment Name	Equipment Role	Ring Corresponding to Instance 1	Ring Corresponding to Instance 2
Equipment 1	Equipment at the tangent point	Ring 1	Ring 2
Equipment 2	RPL owner of Ring 1	Ring 1	N/A
Equipment 3	Common node of Ring 1	Ring 1	N/A
Equipment 4	RPL owner of Ring 2	N/A	Ring 2
Equipment 5	Common node of Ring 2	N/A	Ring 2

19.3.5.2 Configuration Flow

The VLAN service channel has been created. Please refer to Basic Configurations for the creation method.


Start
Enable the ERPS globally
Configure basic properties of the equipment at non-tangent points of Ring One
Configure parameters of the equipment at non-tangent points of Ring One
Configure basic properties of the equipment at non-tangent points of Ring Two
Configure parameters of the equipment at non-tangent points of Ring Two
Configure basic properties of the equipment at the tangent point
Configure parameters of the equipment at the tangent point
End

19.3.5.3 Enabling the ERPS Globally

Command Format

```
erps mode [enable|disable]
```

Planning Data

Parameter	Description	Attribute	Example
`erps mode [enable|disable]`	Enabling or disabling the ERPS function	Mandatory	enable

Example

Enable the ERPS function.

```
Admin(config)#erps mode enable
Admin(config)#
```

19.3.5.4 Configuring Basic Properties of the Equipment at Non-Tangent Points of Ring One

Command Format

Configure the mappings between VLANs and ERPS instances.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Planning Data

Parameter	Description	Attribute	Example
erps instance <instance-id>	The ERPS instance ID, ranging from 1 to 64.	Mandatory	1
vlan-id <vlanid>	The starting value of the VLAN ID range to be mapped	Mandatory	100, 1000
{to <vlanid-end>}*1	The ending value of the VLAN ID range	Optional	-

Example

Map VLANs 100 and 1000 to ERPS Instance 1.

```
Admin(config)#erps instance 1 vlan-id 100
Admin(config)#erps instance 1 vlan-id 1000
Admin(config)#
```

19.3.5.5 Configuring Parameters of the Equipment at Non-Tangent Points of Ring One

Note:

Default values are recommended for the optional configuration items.

Command Format

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example	
				Equipment 2	Equipment 3
Creating an ERPS ring	`ring <ring-id>`	Ring id	Mandatory	1	1
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	A node can act as common node or RPL owner.	Mandatory	rpl-owner	common
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1	1
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	100	100
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	1	1
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000	1000

Procedure	Parameter	Description	Attribute	Example	
				Equipment 2	Equipment 3
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19	19
	`primary-port <value>`	The first uplink port	Mandatory	3	3
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	rpl-port	common
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19	19
	`second-port <value>`	No. of the second port	Mandatory	4	4
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-	-

Example

1. Create an ERPS ring.

```
Admin(config)#erps ring 1
```

2. Set Equipment 2 to RPL owner and Equipment 3 to common node in the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-role rpl-owner
Admin(config)#erps ring 1 erps-role common
Admin(config)#
```

3. Set the signaling VLAN ID of the ERPS ring instance to 100.

```
Admin(config)#erps ring 1 control-vlan 100
```

4. Set the management domain level to 7.

```
Admin(config)#erps ring 1 mel 7
```

5. Associate the ERPS ring instance with the VLAN Instance 1.

```
Admin(config)#erps ring 1 protect-inst 1
```

6. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 1 erps-mode revertive
```

7. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 1 wrt-time 5
```

8. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 1 holdoff-time 1000
```

9. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 1 guard-time 500
```

10. Set the first port of Equipment 2 to RPL port and the first port of Equipment 3 to common port in the ERPS ring instance.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role rpl-port
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role common
```

11. Set the second port of Equipment 2 and Equipment 3 to common port in the ERPS ring instance.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
Admin(config)#
```

19.3.5.6 Configuring Basic Properties of the Equipment at Non-Tangent Points of Ring Two

Command Format

Configure the mappings between VLANs and ERPS instances.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Planning Data

Parameter	Description	Attribute	Example
erps instance <instance-id>	The ERPS instance ID, ranging from 1 to 64.	Mandatory	2
vlan-id <vlanid>	The starting value of the VLAN ID range to be mapped	Mandatory	200, 2000
{to <vlanid-end>}*1	The ending value of the VLAN ID range	Optional	-

Example

Map VLANs 200 and 2000 to ERPS Instance 2.

```
Admin(config)#erps instance 2 vlan-id 200
Admin(config)#erps instance 2 vlan-id 2000
Admin(config)#
```

19.3.5.7 Configuring Parameters for the Equipment at Non-Tangent Points of Ring Two

Note:

Default values are recommended for the optional configuration items.

Command Format

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Configure the signaling VLAN for the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example	
				Equipment 4	Equipment 5
Creating an ERPS ring	`ring <ring-id>`	The ring ID	Mandatory	2	2
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	The node can act as a common node or RPL owner.	Mandatory	rpl-owner	common

Procedure	Parameter	Description	Attribute	Example	
				Equipment 4	Equipment 5
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	2	2
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	200	200
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	2	2
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000	1000
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19	19
	`primary-port <value>`	The first uplink port	Mandatory	3	3
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	rpl-port	common

Procedure	Parameter	Description	Attribute	Example	
				Equipment 4	Equipment 5
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19	19
	`second-port <value>`	No. of the second port	Mandatory	4	4
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-	-

Example

1. Create an ERPS ring.

```
Admin(config)#erps ring 2
```

2. Set Equipment 4 to RPL owner and Equipment 5 to common node in the ERPS ring instance.

```
Admin(config)#erps ring 2 erps-role rpl-owner
Admin(config)#erps ring 2 erps-role common
Admin(config)#
```

3. Set the signaling VLAN ID of the ERPS ring instance to 200.

```
Admin(config)#erps ring 2 control-vlan 200
```

4. Set the management domain level to 7.

```
Admin(config)#erps ring 2 mel 7
```

5. Associate the ERPS ring instance with the VLAN Instance 2.

```
Admin(config)#erps ring 2 protect-inst 2
```

6. Configure the switching mode for the ERPS ring instance.

```
Admin(config)#erps ring 2 erps-mode revertive
```

7. Set the wait-to-restore time for the ERPS ring instance to 5 minutes.

```
Admin(config)#erps ring 2 wrt-time 5
```

8. Set the hold-off time for the ERPS ring instance to 1000 ms.

```
Admin(config)#erps ring 2 holdoff-time 1000
```

9. Set the guard time for the ERPS ring instance to 500 ms.

```
Admin(config)#erps ring 2 guard-time 500
```

10. Set the first port of Equipment 4 to RPL port and the first port of Equipment 5 to common port in the ERPS ring instance.

```
Admin(config)#erps ring 2 primary-slot 19 primary-port 3 role rpl-port
Admin(config)#erps ring 2 primary-slot 19 primary-port 3 role common
```

11. Set the second port of Equipment 4 and Equipment 5 to common port in the ERPS ring instance.

```
Admin(config)#erps ring 2 second-slot 19 second-port 4 role common
Admin(config)#
```

19.3.5.8 Configuring Basic Properties of the Equipment at the Tangent Point

Command Format

Configure the mappings between VLANs and ERPS instances.

```
erps instance <instance-id> vlan-id <vlanid> {to <vlanid-end>}*1
```

Planning Data

Parameter	Description	Attribute	Example	
			Ring 1	Ring 2
erps instance <instance-id>	The ERPS instance ID, ranging from 1 to 64.	Mandatory	1	2
vlan-id <vlanid>	The starting value of the VLAN ID range to be mapped	Mandatory	100, 1000	200, 2000
{to <vlanid-end>}*1	The ending value of the VLAN ID range	Optional	-	-

Example

1. Map VLANs 100 and 1000 to ERPS Instance 1.

```
Admin(config)#erps instance 1 vlan-id 100
Admin(config)#erps instance 1 vlan-id 1000
```

2. Map VLANs 200 and 2000 to ERPS Instance 2.

```
Admin(config)#erps instance 2 vlan-id 200
Admin(config)#erps instance 2 vlan-id 2000
Admin(config)#
```

19.3.5.9 Configuring Parameters for Equipment at the Tangent Point

Note:

Default values are recommended for the optional configuration items.

Command Format

Create an ERPS ring.

```
erps ring <ring-id>
```

Configure the roles of the nodes in the ERPS ring instance.

```
erps ring <ring-id> erps-role [common|rpl-owner]
```

Configure the signaling VLAN of the ERPS ring instance.

```
erps ring <ringid> control-vlan <vlanid>
```

Configure the management domain level. (Optional)

```
erps ring <ring-id> mel <mel>
```

Associate the ERPS ring instance with the VLAN instance.

```
erps ring <ring-id> protect-inst <value>
```

Configure the switching mode for the ERPS ring instance. (Optional)

```
erps ring <ring-id> erps-mode [revertive|nonrevertive]
```

Configure the wait-to-restore time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> wrt-time <value>
```

Configure the hold-off time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> holdoff-time <value>
```

Configure the guard time for the ERPS ring instance. (Optional)

```
erps ring <ring-id> guard-time <value>
```

Configure properties of the first port in the ERPS ring instance.

```
erps ring <ring-id> primary-slot <value> primary-port <value> role [common|
rpl-port]
```

Configure properties of the second port in the ERPS ring instance.

```
erps ring <ring-id> second-slot <value> second-port <value> role [common|
rpl-port]
```

Configure the virtual channel VLAN for the ERPS ring instance. (Reserved function, configuration not required currently)

```
erps ring <ring-id> virtual-vlan <value>
```

Planning Data

Procedure	Parameter	Description	Attribute	Example	
				Ring 1	Ring 2
Creating an ERPS ring	`ring <ring-id>`	Ring id	Mandatory	1	2
Configuring roles of the nodes in the ERPS ring instance	`erps-role [common|rpl-owner]`	The node can act as a common node or RPL owner.	Mandatory	common	common
Configuring the signaling VLAN for the ERPS ring instance	`ring <ringid>`	The ring ID	Mandatory	1	2
	`control-vlan <vlanid>`	The signaling VLAN ID	Mandatory	100	200
Configuring the management domain level	`mel <mel>`	The maintenance entity level. The value ranges from 0 to 7.	Mandatory	7	7
Associating the ERPS ring instance with the VLAN instance	`protect-inst <value>`	The protection instance. The value ranges from 1 to 64.	Mandatory	1	2

Procedure	Parameter	Description	Attribute	Example	
				Ring 1	Ring 2
Configuring the switching mode for the ERPS ring instance	`erps-mode [revertive|nonrevertive]`	Switching mode ◆ revertive ◆ nonrevertive	Mandatory	revertive	revertive
Configuring the wait-to-restore time for the ERPS ring instance	`wrt-time <value>`	The wait-to-restore timer. The value ranges from 5 to 12 (unit: minute).	Mandatory	5	5
Configuring the hold-off time for the ERPS ring instance	`holdoff-time <value>`	The hold-off timer. The value ranges from 0 to 10000 (unit: millisecond).	Mandatory	1000	1000
Configuring the guard time for the ERPS ring instance	`guard-time <value>`	The guard timer. The value ranges from 10 to 2000 (unit: millisecond).	Mandatory	500	500
Configuring properties of the first port in the ERPS ring instance	`primary-slot <value>`	No. of the first slot	Mandatory	19	19
	`primary-port <value>`	The first uplink port	Mandatory	3	3
	`role [common|rpl-port]`	The role of the first port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common	common

Procedure	Parameter	Description	Attribute	Example	
				Ring 1	Ring 2
Configuring properties of the second port in the ERPS ring instance	`second-slot <value>`	No. of the second slot	Mandatory	19	19
	`second-port <value>`	No. of the second port	Mandatory	4	4
	`role [common|rpl-port]`	The role of the second port. It can be set to common port or RPL port. A ring instance can be configured with only one RPL port.	Mandatory	common	common
Configuring the virtual channel VLAN for the ERPS ring instance	`virtual-vlan <value>`	The virtual channel VLAN	Mandatory	-	-

Example

1. Create the ERPS ring for Equipment 1.

```
Admin(config)#erps ring 1
Admin(config)#erps ring 2
```

2. Set Equipment 1 to common node in the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 erps-role common
Admin(config)#erps ring 2 erps-role common
```

3. Set the signaling VLAN ID to 100 for the ERPS ring instance 1, and 200 for the ERPS ring instance 2.

```
Admin(config)#erps ring 1 control-vlan 100
Admin(config)#erps ring 2 control-vlan 200
```

4. Set the management domain level to 7 for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 mel 7
Admin(config)#erps ring 2 mel 7
```

5. Associate the ERPS ring instance 1 with the VLAN instance 1, and associate the ERPS ring instance 2 with the VLAN instance 2.

```
Admin(config)#erps ring 1 protect-inst 1
Admin(config)#erps ring 2 protect-inst 2
```

6. Configure the switching mode for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 erps-mode revertive
Admin(config)#erps ring 2 erps-mode revertive
```

7. Set the wait-to-restore time to 5 minutes for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 wrt-time 5
Admin(config)#erps ring 2 wrt-time 5
```

8. Set the hold-off time to 1000 ms for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 holdoff-time 1000
Admin(config)#erps ring 2 holdoff-time 1000
```

9. Set the guard time to 500 ms for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 guard-time 500
Admin(config)#erps ring 2 guard-time 500
```

10. Set the first port of Equipment 1 to common port for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 primary-slot 19 primary-port 3 role common
Admin(config)#erps ring 2 primary-slot 19 primary-port 3 role common
```

11. Set the second port of Equipment 1 to common port for the ERPS ring instances 1 and 2.

```
Admin(config)#erps ring 1 second-slot 19 second-port 4 role common
Admin(config)#erps ring 2 second-slot 19 second-port 4 role common
Admin(config)#
```

19.4 Configuring the PON Protection

This section introduces how to configure the PON protection for the AN6000 Series with examples.

19.4.1 Background Knowledge

The AN6000 Series equipment supports the type B and type C PON protection schemes.

- Type B protection: the redundancy protection for OLT PON ports and backbone fibers. It can be an intra-card protection or an inter-card protection. When an OLT PON port or a backbone fiber is faulty, services will be automatically switched over to another OLT PON port or backbone fiber. In this way, higher ODN network reliability is provided to guarantee that the services are uninterrupted.

- Type C protection: the redundancy protection for OLTs (in the dual-homing scenario), PON ports, backbone fibers, splitters and branch fibers. It can be a single-homing protection or a dual-homing protection. When one of the above-mentioned parts is faulty, services will be automatically switched over to another link.

Definitions of single-homing and dual-homing:

- Single-homing: An ONU is connected to two PON ports on one OLT through two backbone fibers.
- Dual-homing: An ONU is connected to two PON ports on two OLTs through two backbone fibers.

In type B protection, the protected services are revertive. After the faults are removed, the protected services will automatically return to the original working link after the wait-to-restore (WTR) time.

19.4.2 Configuration Rules

The following introduces how to configure the PON port protection group.

- A PON port protection group supports two PON ports only, that is, a master port and a member port.
- Two ports in a PON port protection group should be of the same type.
- When configuring a PON port protection group, the first PON port number is regarded as the master port by default; the second one is regarded as the member port.
- When configuring a PON port protection group, services are configured only for the master port, not for other ports.
- For EPON cards, a PON port protection (intra-card protection and inter-card protection) group should be composed of two odd-number PON ports (for example, PON port 1 and PON port 3) or two even-number PON port (for example, PON port 2 and PON port 4).
- For GPON cards, a PON port protection (intra-card protection and inter-card protection) group can be composed of any two PON ports.

The following introduces how to configure the hand-in-hand PON protection group.

- When configuring the hand-in-hand PON protection group, configure two PON ports (on two OLTs) as members of the protection group. The ONUs under them should have the same type and the same authorization number.
- When configuring the hand-in-hand PON protection group, configure the same service data manually on the two OLTs so that ONUs, after losing connection to the working OLT and a protection switching taking place, can resume connection to the protection OLT quickly and shorten the time of service interruption.

19.4.3 Example of Configuring the PON Port Protection

This section gives an example to introduce how to configure the PON port protection.

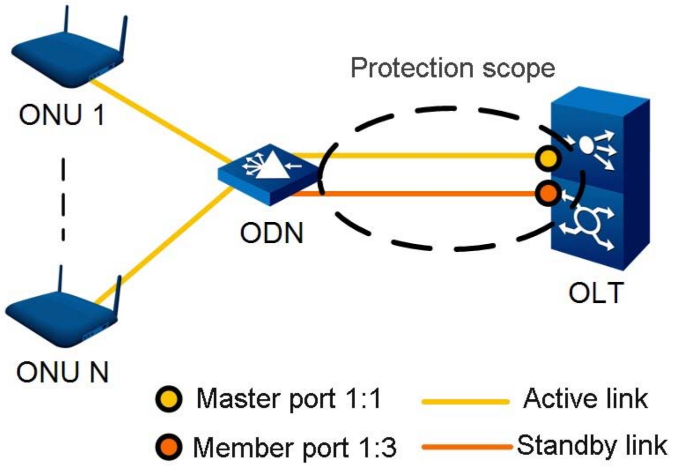
19.4.3.1 Network Scenario

Service Planning

Here we use type B single-homing protection as an example. Two PON ports (port 1:1 and port 1:3) on the same card in an OLT are configured as a PON port protection group, with port 1:1 as the master port and port 1:3 as the member port.

Network Diagram

The figure below shows the network for the PON port protection.



19.4.3.2 Configuring a PON Port Protection Group

Command Format

Configure a PON port protection group.

```
protect-group <group-no> master <frameid/slotid/portid> member <frameid/
slotid/portid> {mode [type-b|type-c|type-d] auto-resume [enable|disable]
<auto-resume-time>}*1
```

View a PON port protection group.

```
show protect-group <group-no>
```

Delete a PON port protection group.

```
no protect-group <group-no>
```

Planning Data

Parameter	Description	Attribute	Example
protect-group <group-no>	The PON port protection group number, ranging from 1 to 64.	Mandatory	1
master <frameid/slotid/-portid>	Master port, in the format of subrack No. / slot No. / PON port No.	Mandatory	1/1/1
member <frameid/slotid/-portid>	Member port, in the format of subrack No. / slot No. / PON port No.	Mandatory	1/1/3
mode [type-b|type-c|type-d]	Mode ◆ type-b: type B ◆ type-c: type C ◆ type-d: type D	Optional	type-b
auto-resume [enable|disable]	Enables or disables automatic return for the master port. This parameter can be configured only when type B is selected for the protection group mode.	Optional	enable
<auto-resume-time>	The WTR time (s), ranging from 180 to 3600. This parameter can be configured only when type B is selected for the protection group mode and automatic return is enabled for the master port.	Optional	300

Example

1. Configure a PON port protection group, setting port 1/1/1 as the master member and port 1/1/3 as the member port. Set the protection group mode to type B, enable automatic return for the master port and set the WTR time to 300s.

```
Admin(config)#protect-group 1 master 1/1/1 member 1/1/3 mode type-b auto-resume enable 300
Admin(config)#
```

2. View the configuration of a PON port protection group.

```
Admin(config)#show protect-group 1
----------Group [1] info----------
Group state: GEPON_PP_GROUP_WAITING_LINECARD_RESPONSE
Group mode: GEPON_PP_MODE_TYPEB
Group auto resume: enable
Group auto resume interval: 300

Master pon: slot 1 pon 1
Master pon use state: GEPON_PON_USE_STATE_DETECTING

Member pon: slot 1 pon 3
Member pon use state: GEPON_PON_USE_STATE_DETECTING
Admin(config)#
```

3. Delete a PON port protection group.

```
Admin(config)#no protect-group 1
Admin(config)#
```

19.4.4 Example of Configuring the Hand-in-Hand PON Protection

This section introduces how to configure the hand-in-hand PON protection with examples.

Configuration Rules

The desired ONU should support dual-homing protection and have two PON ports.

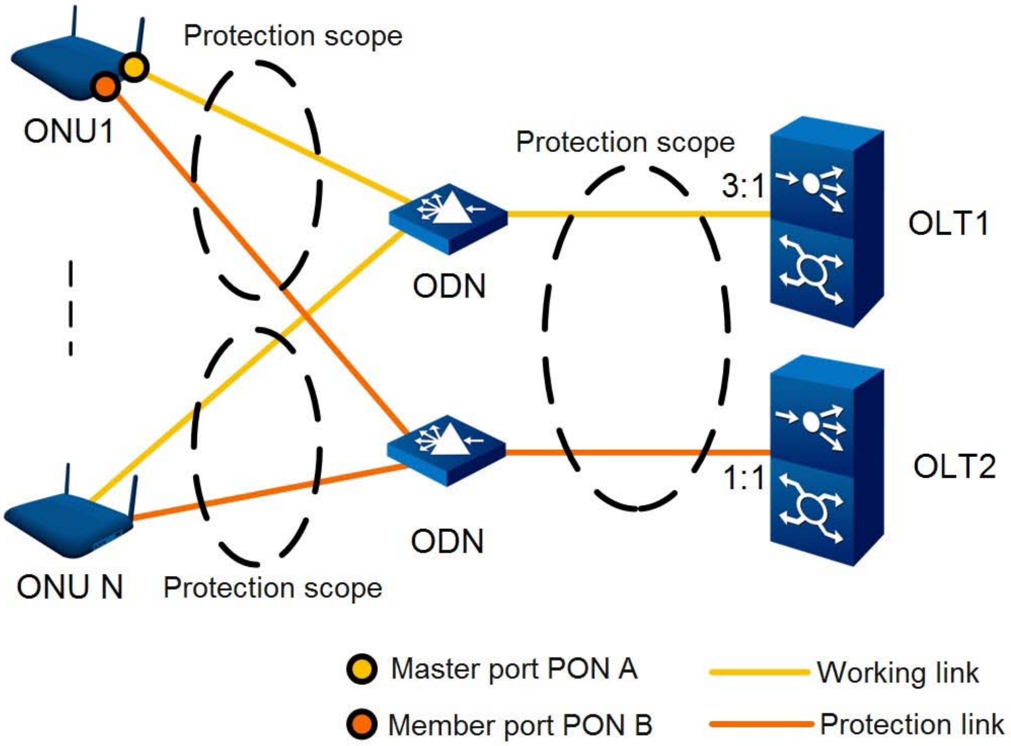
19.4.4.1 Network Scenario

Service Planning

Here we use type C dual-homing protection as an example. Two uplink PON ports on ONU1 which is connected with two PON ports (port 3:1 and port 1:1) on two OLTs are configured as a PON port protection group, with PON A as the master port and PON B as the member port.

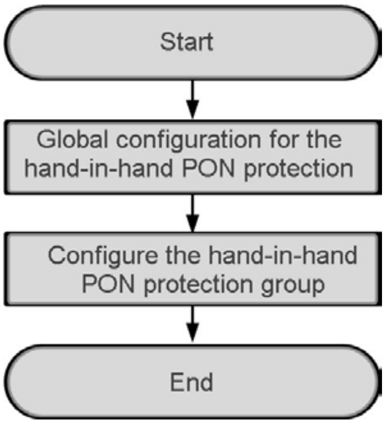
Network Diagram

The figure below shows the network for the hand-in-hand PON protection.



19.4.4.2 Configuration Flow

OLT1 and OLT2 in the network for the hand-in-hand PON protection are configured following the same procedure. The flowchart below shows how to configure OLT1.


Start
Global configuration for the hand-in-hand PON protection
Configure the hand-in-hand PON protection group
End

19.4.4.3 Configuring the Hand-in-Hand PON Protection Group Globally

Configuration Rules

To delete the global configuration for a configured hand-in-hand PON protection group, delete the hand-in-hand PON protection group first.

Command Format

Configure the hand-in-hand PON protection group globally.

```
handinhand-pp-local-config <oltip-type> <oltip-addr> <oltip-prefixlen>
```

View the global configuration for the hand-in-hand PON protection group.

```
show handinhand-pp-local-config
```

Delete the hand-in-hand PON protection group.

```
no handinhand-pp-local-config
```

Planning Data

Parameter	Description	Attribute	Example
`<oltip-type>`	The IP type of the hand-in-hand local OLT ◆ 1: IPv4 ◆ 2: IPv6 ◆ 3: IPv4z ◆ 4: IPv6z ◆ 16: DNS	Mandatory	1
`<oltip-addr>`	The management IP address of the hand-in-hand local OLT	Mandatory	10.182.24.55
`<oltip-prefixlen>`	The IP mask length of the hand-in-hand local OLT ◆ IPv4 and IPv4z: 0 to 32 ◆ IPv6 and IPv6z: 0 to 128 ◆ DNS: 1 to 255	Mandatory	4

Example

1. Configure the hand-in-hand PON protection group globally, setting the IP type of the local OLT to IPv4, IP address to 10.182.24.55 and IP mask length to 4.

```
Admin(config)#handinhand-pp-local-config 1 10.182.24.55 4
Admin(config)#
```

2. View the global configuration for the hand-in-hand PON protection group.

```
Admin(config)#show handinhand-pp-local-config
local ip address: 10.182.24.55 iptype 1 prefixlen 4
Admin(config)#
```

3. Delete the global configuration for the hand-in-hand PON protection group.

```
Admin(config)#no handinhand-pp-local-config
Admin(config)#
```

19.4.4.4 Configuring a Hand-in-Hand PON Protection Group

Configuration Rules

Perform the global configuration before configuring a hand-in-hand PON protection group.

Command Format

Configure a hand-in-hand PON protection group.

```
handinhand-pp-group <group-idx> <enable-status> <protection-group-mode>
<slotno> <ponno> <peer-oltip-type> <peer-oltip-addr> <peer-oltip-
prefixlen> <peer-slotno> <peer-ponno>
```

View a hand-in-hand PON protection group.

```
show handinhand-pp-group {<groupid>}*1
```

Delete a hand-in-hand PON protection group.

```
no handinhand-pp-group <groupid>
```

Planning Data

Parameter	Description	Attribute	Example
<group-idx>	The hand-in-hand PON protection group number, ranging from 1 to 128.	Mandatory	1
<enable-status>	Enables or disables the hand-in-hand PON protection. ◆ 0: disable ◆ 1: enable	Mandatory	1
<protection-group-mode>	The mode of the protection group. 2: type C	Mandatory	2
<slotno>	The slot No. of the local OLT	Mandatory	3
<ponno>	The PON port No. of the local OLT	Mandatory	1
<peer-oltip-type>	The IP type of the peer OLT ◆ 1: IPv4 ◆ 2: IPv6 ◆ 3: IPv4z ◆ 4: IPv6z ◆ 16: DNS	Mandatory	1
<peer-oltip-addr>	The management IP address of the peer OLT	Mandatory	2.2.2.2
<peer-oltip-prefixlen>	The IP mask length of the peer OLT ◆ IPv4 and IPv4z: 0 to 32 ◆ IPv6 and IPv6z: 0 to 128 ◆ DNS: 1 to 255	Mandatory	4
<peer-slotno>	The slot No. of the peer OLT	Mandatory	1
<peer-ponno>	The PON port No. of the peer OLT	Mandatory	1

Example

1. Configure a hand-in-hand PON protection group.

```
Admin(config)#handinhand-pp-group 1 1 2 3 1 1 2.2.2.2 4 1 1
Admin(config)#
```

2. View a hand-in-hand PON protection group.

```
Admin(config)#show handinhand-pp-group 1
Hand in Hand Group id : 1
Enable status: Enable
Protection group mode: Type C
Self OLT pon is : slotno 3  ponno 1
Peer OLT IP Config is:2.2.2.2 iptype 1 prefix 4
Peer OLT pon is : slotno 1  ponno 1
Admin(config)#
```

3. Delete a hand-in-hand PON protection group.

```
Admin(config)#no handinhand-pp-group 1
Admin(config)#
```

19.4.5 Example of Forced Switching

When OLTs and ONUs are working normally, you can perform forced switching as needed.

- Type B protection supports the forced switching of a PON port protection group.
- Type C protection supports the forced switching of an ONU.

19.4.5.1 Forced Switching of the PON Port Protection Group

Command Format

```
protect-group force-switch <group-no>
```

Planning Data

Parameter	Description	Attribute	Example
<group-no>	The serial number of the PON port protection group	Mandatory	1

Example

Configure forced switching for the PON port protection group 1.

```
Admin(config)#protect-group force-switch 1
Admin(config)#
```

19.4.5.2 Forced Switching of the ONU

Command Format

```
onu force-switch <onuid>
```

Planning Data

Parameter	Description	Attribute	Example
<onuid>	ONU authorization No.	Mandatory	1

Example

Configure forced switching for the services over ONU 1 under PON port 3 in slot 1 of subrack 1.

```
Admin(config-if-pon-1/3/1)#onu force-switch 1
set ok!
Admin(config-if-pon-1/3/1)#
```

20 Configuring Agile-PON

This section introduces how to configure the Agile-PON function of the GFOA card on the AN6000 Series device.

☑ Configuring Agile-PON Ports

☑ Configuring Agile-PON Licenses

20.1 Configuring Agile-PON Ports

This section introduces how to configure Agile-PON ports.

20.1.1 Background Information

Agile-PON is a flexible PON solution developed by FiberHome for GPON and XG (S)-PON applications. It allows a service card to integrate multiple PON technologies by using different PON optical modules. In this way, OLT resources in the current network can be fully exploited, which facilitates smooth evolution from GPON to XG(S)-PON for operators.

As an Agile-PON service card, the GFOA card can work in multiple service modes to support the Agile-PON function. The working modes of its ports can be configured automatically or manually.

- GPON mode
- GPON & XG-PON Combo mode
- GPON & XGS-PON Combo mode

Automatically: The information of the optical module of the PON port on the GFOA card can be automatically identified so that the service mode of the port can be switched accordingly.

Manually: The service mode of the port on the GFOA card can be manually configured according to the actual requirements.

20.1.2 Configuring Service Modes of Agile-PON Ports

Configuration Rules

- Automatic configuration mode
  - If ONUs under the PON ports on the GFOA card are not authorized, the GPON mode can be switched to the GPON ＆ XG-PON Combo or GPON ＆ XGS-PON Combo mode, and vice versa.

- If ONUs under the PON ports of the GFOA card are authorized, the GPON ＆ XG-PON Combo or GPON ＆ XGS-PON Combo mode cannot be switched to the GPON mode.

- Manual configuration mode

  Switching among the GPON, GPON ＆ XG-PON Combo and GPON ＆ XGS-PON Combo modes is allowed. However, a port works normally only if the optical module actually inserted matches the set port service mode.

Command Format

Configure service modes of the Agile-PON ports for the GFOA card.

```
agile-mode [auto|gpon|xg-combo|xg-pon|xgs-combo]
```

View service modes of the Agile-PON ports for the GFOA card.

```
show agile-mode <frame/slot>
```

Planning Data

Parameter	Description	Attribute	Example
agile-mode [auto|gpon|xg-pon|xg-combo|xgs-combo]	Service modes of Agile-PON ports ◆ Auto: Automatic configuration mode. The service mode is automatically configured according to the actual service mode reported by the GFOA service card. ◆ gpon: GPON mode ◆ xg-combo: GPON ＆ XG-PON Combo mode ◆ xg-pon: XG-PON mode (The GFOA card does not support the XG-PON mode) ◆ xgs-combo: GPON ＆ XGS-PON Combo mode	Mandatory	xg-combo
<frame/slot>	Subrack No./slot No.	Mandatory	1/3

Example

1. Set PON port 1 on the GFOA card in slot 3 of subrack 1 to the GPON ＆ XG-PON Combo mode.

```
Admin(config)#interface pon 1/3/1
Admin(config-if-pon-1/3/1)#agile-mode xg-combo
set ok !
Admin(config-if-pon-1/3/1)#exit
Admin(config)#
```

2. View the port mode configuration of the GFOA card in slot 3 of subrack 1.

```
Admin(config)#show agile-mode 1/3
NO.   PONNO    CFGMODE      REALMODE
--------------------------------------------
 1       1     xg-combo         xg-combo
 2       2     auto             gpon
 3       3     auto             gpon
 4       4     auto             gpon
 5       5     auto             gpon
 6       6     auto             gpon
 7       7     auto             gpon
 8       8     auto             gpon
 9       9     auto             gpon
10      10     auto             gpon
11      11     auto             gpon
12      12     auto             gpon
13      13     auto             gpon
14      14     auto             gpon
15      15     auto             gpon
16      16     auto             gpon
Admin(config)#
```

Result Description

Parameter	Description
PONNO	PON No.
CFGMODE	Modes that can be manually configured, including auto, gpon, xg-pon, xg-combo and xgs-combo.
REALMODE	Actual modes reported by the service card, including auto, gpon, xg-pon, xg-combo and xgs-combo.

20.2 Configuring Agile-PON Licenses

This section introduces how to configure Agile-PON licenses.

20.2.1 Background Information

Through Agile-PON licenses, you can define the quantity of ports working in GPON ＆ XG-PON Combo mode or GPON ＆ XGS-PON Combo mode for GFOA, the Agile-PON service card. In this manner, you can set ports in desired working modes in different phases according to service requirements.

20.2.2 Configuring Management Mode

Note:

To configure Agile-PON licenses in local management mode, you need to configure an in-band management IP address of the equipment first. The in-band management IP address and the MAC address of the core switch card automatically generate an ESN. With this ESN, you can apply for licenses for local management.

Command Format

Configure the management mode of the Agile-PON licenses.

```
license-manage-switch [local|network]
```

View the management mode of the Agile-PON licenses.

```
show license-manage-switch
```

Planning Data

Parameter	Description	Attribute	Example
`license-manage-switch [local|network]`	Management modes of the Agile-PON licenses ◆ local: Local management mode. In this mode, you can run a command to check license resources. The equipment manages its own licenses and does not report any license information to the EMS. ◆ network: Network management mode. In this mode, you can view license resources through the EMS. Therefore, you need to apply for licenses from the EMS for the equipment.	Mandatory	local

Example

1. Set the management mode of the Agile-PON licenses to local.

```
Admin(config)#license-manage-switch local
set local license manage success!
ESN of Master core card is: 10.182.24.5-48:f9:7c:e8:da:35
ESN of Slave core card is: 10.182.24.5-48:f9:7c:e8:da:33
Admin(config)#
```

2. View the management mode of the Agile-PON licenses.

```
Admin(config)#show license-manage-switch
It's local agile pon license manage mode now!
Admin(config)#
```

20.2.3 Importing, Verifying and Validating License Files

Caution:

- The quantity of licenses of the active and standby core switch cards should be the same. If not, for example, the standby card has fewer licenses than the licenses already used, the GFOA card will release some licenses of the PON ports after forcible switching.
- If licenses in a license file imported to the equipment are fewer than those already used, after the file takes effect, the GFOA card will release some licenses of the PON ports due to insufficient licenses imported.

Command Format

Import a license file to the active core switch card.

```
load program [system|config|script|ver-file|boot|patch|cpld|fpga|license]
<filename> [tftp|ftp|sftp] <ipaddr> {<username> <password>}*1
```

Import a license file to the standby core switch card.

```
load program backup [system|patch|cpld|boot|fpga|license] <filename>
[tftp|ftp|sftp]<ipaddr> {<username> <password>}*1
```

Check whether a license file is effective.

```
show load program state
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Importing a license file to the active core switch card	[system|config|script|ver-file|boot|patch|cpld|fpga|license]	File types of the core switch cards ◆ system: system image file ◆ config: configuration file ◆ script: batch command line file ◆ ver_file: version file ◆ boot: system boot file ◆ patch: system patch file ◆ cpld: system CPLD file ◆ fpga: FPGA upgrade file ◆ license: license file in .bin format to be imported to the equipment	Mandatory	license
	<filename>	File name	Mandatory	10_182_24_5.bin
	[tftp|ftp|sftp]	FTP protocol type	Mandatory	ftp
	<ipaddr>	IP address of the FTP server	Mandatory	10.32.154.108
	{<username> <password>}*1	Username and password of the FTP server	Optional	1, 1
Importing a license file to the standby core switch card	[system|patch|cpld|boot|fpga|license]	File types of the core switch cards ◆ system: system image file ◆ patch: system patch file ◆ cpld: system CPLD file ◆ boot: system boot file ◆ fpga: FPGA upgrade file ◆ license: license file in .bin format to be imported to the equipment	Mandatory	license
	<filename>	File name	Mandatory	10_182_24_5.bin
	[tftp|ftp|sftp]	FTP protocol type	Mandatory	ftp
	<ipaddr>	IP address of the FTP server	Mandatory	10.32.154.108
	{<username> <password>}*1	Username and password of the FTP server	Optional	1, 1

Example

1. Import a license file into the active core switch card. Set the IP address of the FTP server to 10.32.154.108, username to 1, password to 1, and file name to 10_182_24_5.bin.

```
Admin(config)#load program license 10_182_24_5.bin ftp 10.32.154.108 1 1
Trying download config file from ftp server, please wait...

Do not reboot or remove the card.
You can use this cmd to know the upgrade result:
show load program state
Admin(config)#
```

2. Check whether the license file of the active core switch card is effective.

```
Admin(config)#show load program state
The states of core upgrade :
Slot 09 : success, license has taken effect.
Admin(config)#
```

3. Import a license file into the standby core switch card. Set the IP address of the FTP server to 10.32.154.108, username to 1, password to 1, and file name to 10_182_24_5.bin.

```
Admin(config)#load program backup license 10_182_24_5.bin ftp 10.32.154.108 1 1

Do not reboot or remove the card.
You can use this cmd to know the upgrade result:
show load program state
Admin(config)#
```

4. Check whether the license file of the standby core switch card is effective.

```
Admin(config)#show load program state
The states of core upgrade :
Slot 10 : success, license has taken effect.
Admin(config)#
```

20.2.4 Viewing License Resources

Command Format

```
show license-source
```

Example

View license resources.

```
Admin(config)#show license-source
SOURCE TYPE       TOTAL      USED      APPLY
  XG-PON            2          0         0
 XGS-PON            2          0         0
Admin(config)#
```

Result Description

Parameter	Description
SOURCE TYPE	Working modes of the Agile-PON ports ◆ XG-PON: GPON & XG-PON Combo mode ◆ XGS-PON: GPON & XGS-PON Combo mode
TOTAL	Number of licenses assigned to this device
USED	Number of licenses that are being used
APPLY	Number of licenses that are being applied for

20.2.5 Viewing License Application Status of All PON Ports on the GFOA Card

Command Format

```
show agile-pon-license [<slotid>|all]
```

Planning Data

Parameter	Description	Attribute	Example
[<slotid>|all]	◆ <slotid>: slot number of the GFOA card ◆ all: all GFOA cards	Mandatory	all

Example

View license application status of all PON ports on the GFOA card.

```
Admin(config)#show agile-pon-license all
---------------------AN6000-17---------------------
SLOT   PON   CONFIG_MOD   APPLY_MOD   LICNESE_FLAG    APPLY_FLAG
  3     1      g-pon        -----        FAILED           NO
  3     2       g-pon         -----         FAILED            NO
  3     3       g-pon         -----         FAILED            NO
  3     4       g-pon         -----         FAILED            NO
  3     5       g-pon         -----         FAILED            NO
  3     6       g-pon         -----         FAILED            NO
  3     7       g-pon         -----         FAILED            NO
  3     8       g-pon         -----         FAILED            NO
  3     9       g-pon         -----         FAILED            NO
  3    10       g-pon         -----         FAILED            NO
  3    11       g-pon         -----         FAILED            NO
  3    12       g-pon         -----         FAILED            NO
  3    13       g-pon         -----         FAILED            NO
  3    14       g-pon         -----         FAILED            NO
  3    15       g-pon         -----         FAILED            NO
  3    16       g-pon         -----         FAILED            NO

----------------------END----------------------
Admin(config)#
```

Result Description

Parameter	Description
SLOT	Slot number of the GFOA card
PON	PON port number of the GFOA card
CONFIG_MOD	Type of the license that is currently used on the PON port ◆ g-pon: GPON mode ◆ xg-pon: GPON & XG-PON Combo mode ◆ xgs-pon: GPON & XGS-PON Combo mode
APPLY_MOD	Type of the license (other than the current one) that is being applied for and will be used on the PON port ◆ g-pon: GPON mode ◆ xg-pon: GPON & XG-PON Combo mode ◆ xgs-pon: GPON & XGS-PON Combo mode
LICNESE_FLAG	License status ◆ SUCCESS: You have applied for a license successfully. ◆ FAILED: You have failed to apply for a license.
APPLY_FLAG	Application status ◆ Yes: applying ◆ No: not applied

21 Configuring Traffic Classification

This chapter introduces how to configure traffic classification for the AN6000 Series.

21.1 Background Information

Traffic classification refers to classification of packets according to their features and certain rules to differentiate the services, process the services in different ways, and provide different quality of services. For example, to provide Internet, voice and IPTV services for the same user, you need to classify the service packets into three service flows.

21.2 Configuration Rules

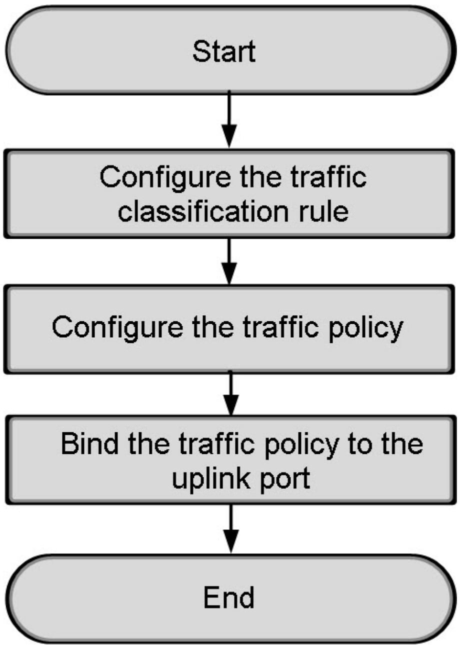
Configure the traffic classification rules. When a traffic flow complies with the configured rules, the equipment will react according to the set rules.

- When the traffic classification object is an uplink port, only the downlink traffic policy and downlink rule are valid.
- When the traffic classification object is a main card port, only the uplink traffic policy and uplink rule are valid.
- When the traffic classification object is an ONU port, both the uplink and downlink traffic policies and the uplink and downlink rules are valid.

21.3 Configuration Example for Traffic Classification Based on the L4 Source Port

This section introduces the traffic classification configuration example based on L4 source port.

21.3.1 Configuration Flow


Start
Configure the traffic classification rule
Configure the traffic policy
Bind the traffic policy to the uplink port
End

21.3.2 Configuring Traffic Classification Rules

Format

```
flow-rule-profile add <name> {[id] <id>}*1 {[src-mac|dst-mac|src-ipv4-addr|dst-ipv4-addr|svlan|eth-type|ip-protocol-type|cos|tos-dscp|l4-src-port|l4-dst-port|ttl|cvlan|ip-ver|traff-class|traff-label|ipv6-next-header|src-ipv6-addr|dst-ipv6-addr|ponid|onuid] [range|value_mask|equal|not_equal|exist_match|not_exist_match] <value1> [<value2>|null]}*8
```

Planning Data

Parameter	Description	Attribute	Example
`flow-rule-profile add <name>`	Rule name	Mandatory	rule0
`{[id] <id>}*1`	Rule ID; value range:1 to 256. Specify an ID for the rule profile to be added. If you do not specify it, the system will assign one automatically.	Optional	8

Parameter	Description	Attribute	Example
[src-mac|dst-mac|src-ipv4-addr|dst-ipv4-addr|svlan|eth-type|ip-protocol-type|cos|tos-dscp|l4-src-port|l4-dst-port|ttl|cvlan|ip-ver|traff-class|traff-label|ipv6-next-header|src-ipv6-addr|dst-ipv6-addr|ponid|onuid]	Rule type. You can select one from the following list: ◆ src-mac: based on the source MAC address ◆ dst-mac: based on the destination MAC address ◆ src-ipv4-addr: based on the source IPv4 address ◆ dst-ipv4-addr: based on the destination IPv4 address ◆ svlan: based on the SVLAN ◆ eth-type: based on the Ethernet type ◆ ip-protocol-type: based on the IP protocol type ◆ cos: based on the Ethernet priority ◆ tos-dscp: based on the TOS/DSCP ◆ l4-src-port: based on the L4 source port number ◆ l4-dst-port: based on the L4 destination port number ◆ ttl: based on the TTL ◆ cvlan: based on the CVLAN ◆ ip-ver: based on the IP version number ◆ traff-class: based on the IPv6 traffic class ◆ traff-label: based on the IPv6 traffic label ◆ ipv6-next-header: based on the IPv6 next header ◆ src-ipv6-addr: based on the source IPv6 address ◆ dst-ipv6-addr: based on the destination IPv6 address ◆ ponid: based on the PON port ◆ onuid: based on the ONU	Optional	l4-src-port
[range|value_mask|equal|not_equal|exist_match|not_exist_match]	Matching type. Set the logical condition for	Optional	equal

Parameter	Description	Attribute	Example
	rule matching. You can select one from the following list: ◆ equal ◆ not_equal: not equal to ◆ exist_match: match if present ◆ not_exist_match: match if not present ◆ value_mask: value plus mask ◆ range		
`<value1>`	Rule value for rule matching	Optional	3
`[<value2>|null]`	Rule value 2 for rule matching. Set it to "null" for matching types other than "range" and "value_mask".	Optional	null

Example

Configure a traffic rule profile with the ID 8. Configure one rule (at most eight rules can be configured) for the profile, setting the rule name to rule0, the rule type to be based on the L4 source port number, the matching type to equal, the rule value to 3, and the rule value 2 to null.

```
Admin(config)#flow-rule-profile add rule0 id 8 l4-src-port equal 3 null
```

21.3.3 Configuring the Traffic Policy

Command Format

```
flow-policy-profile add <name> {[id] <id>}*1 {[pri] <1-12>}*1 {[acl]
[enable|disable]}*1 {[forward] [enable|disable]}*1 {[re-cos] [enable|
disable]}*1 {[cos] <0-7>}*1 {[re-dscp] [enable|disable]}*1 {[dscp] <0-63>}
*1 {[re-traff] [enable|disable]}*1 {[traff] <traff>}*1 {[re-queue] [enable|
disable]}*1 {[queue] <0-7>}*1 {[re-port] [enable|disable]}*1 {[rdport]
<port>}*1 {[flow-mirr] [enable|disable]}*1 {[mirrport] <port>}*1 {[rate-
limit] [enable|disable]}*1 {[cir] <cir>}*1 {[cbs] <cbs>}*1 {[ebs] <ebs>}*1
{[pir] <pir>}*1 {[re-vlan] [enable|disable]}*1 {[vlanact] [add|tras]}*1
{[vid] <1-4095>}*1 {[re-mirror] [enable|disable]}*1
```

Planning Data

Parameter	Description	Attribute	Example
`flow-policy-profile add <name>`	The name of the policy profile	Mandatory	policy5
`{[id] <id>}*1`	The ID of the policy profile	Optional	8
`{[pri] <1-12>}*1`	The policy priority level, ranging from 1 to 12. The value "1" stands for the lowest priority level, and "12" the highest one.	Optional	3
`{[acl] [enable|disable]}*1`	The ACL function switch	Optional	enable
`{[forward] [enable|disable]}*1`	The forwarding flag. Configure this item according to the network planning of the operator. It cannot be configured when the ACL function is disabled. ◆ enable: Only the traffic matching the set rule is forwarded, while other traffics are discarded. ◆ disable: The traffic matching the rule is discarded, while other traffics are forwarded.	Optional	enable
`{[re-cos] [enable|disable]}*1`	The CoS re-marking flag. It is used to enable or disable the re-marking function. The default setting is "disable".	Optional	-
`{[cos] <0-7>}*1`	The priority label, ranging from 0 to 7. This parameter cannot be configured when the CoS re-marking flag is set to "disable".	Optional	-
`{[re-dscp] [enable|disable]}*1`	The DSCP re-marking flag. The default setting is "disable".	Optional	-
`{[dscp] <0-63>}*1`	The DSCP. The value ranges from 0 to 63, and the default value is 0. This parameter cannot be configured when DSCP re-marking is disabled.	Optional	-
`{[re-traff] [enable|disable]}*1`	The re-marking traffic class switch. The default setting is "disable".	Optional	-
`{[traff] <traff>}*1`	The communication classification. The value ranges from 0 to 255, and the default value is 0. This parameter cannot be configured when re-marking traffic class is disabled.	Optional	-
`{[re-queue] [enable|disable]}*1`	The queue mapping function switch. The default setting is "disable".	Optional	-
`{[queue] <0-7>}*1`	The queues mapped. The value ranges from 0 to 7, and the default value is 0. This parameter cannot be configured when queue mapping is disabled.	Optional	-

Parameter	Description	Attribute	Example
`{[re-port] [enable|disable]}*1`	The port re-direction function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
`{[rdport] <port>}*1`	The R port number	Optional	-
`{[flow-mirr] [enable|disable]}*1`	The port mirroring function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
`{[mirrport] <port>}*1`	The M port number	Optional	-
`{[rate-limit] [enable|disable]}*1`	The rate limit switch. The default setting is "disable".	Optional	-
`{[cir] <cir>}*1`	The committed information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[cbs] <cbs>}*1`	The committed burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[ebs] <ebs>}*1`	The excess burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[pir] <pir>}*1`	The peak information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[re-vlan] [enable|disable]}*1`	The VLAN re-marking function switch	Optional	-
`{[vlanact] [add|tras]}*1`	VLAN action ◆ add: adding ◆ tras: translation	Optional	-
`{[vid] <1-4095>}*1`	VLAN value	Optional	-
`{[re-mirror] [enable|disable]}*1`	The remote mirroring function switch	Optional	-

Example

Configure a traffic policy profile with the name policy5, the ID 8, and the priority 3. Enable the ACL, set the forwarding flag to "enable" (forward the traffics matching the rules and discard those that do not match), and use default settings for all the other policy items.

```
Admin(config)#flow-policy-profile add policy5 id 8 pri 3 acl enable forward enable
Admin(config)#
```

21.3.4 Binding the Traffic Policy to an Uplink Port

Command Format

```
flow-policy <frameid/slotid/portid> {policy-profile <policy-profile-id>
rule-profile <rule-profile-id>}*8
```

Planning Data

Parameter	Description	Attribute	Example
<frameid/slotid/portid>	Subrack No. / slot No. / uplink port No.	Mandatory	1/19/1
policy-profile <policy-profile-id>	The ID of the traffic policy profile	Optional	8
rule-profile <rule-profile-id>	The ID of the traffic rule profile	Optional	8

Example

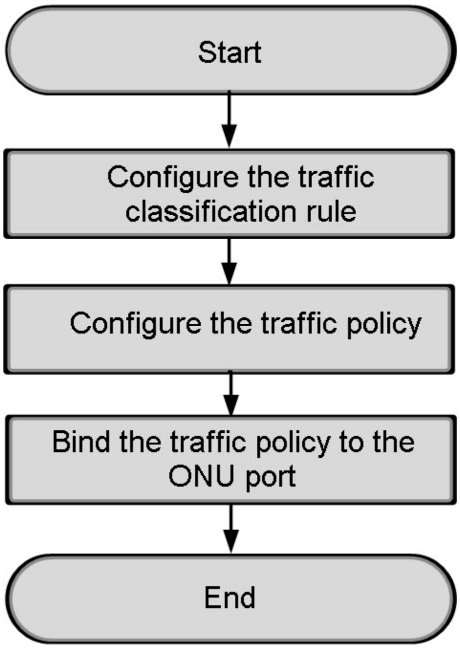
Bind a traffic policy to port 1 in slot 19 of subrack 1. The traffic policy profile ID and the traffic rule profile ID are 8.

```
Admin(config)#flow-policy 1/19/1 policy-profile 8 rule-profile 8
Admin(config)#
```

21.4 Configuration Example for Traffic Classification Based on the SVLAN

This section introduces the traffic classification configuration example based on the SVLAN.

21.4.1 Configuration Flow


Start
Configure the traffic classification rule
Configure the traffic policy
Bind the traffic policy to the ONU port
End

21.4.2 Configuring Traffic Classification Rules

Format

```
flow-rule-profile add <name> {[id] <id>}*1 {[src-mac|dst-mac|src-ipv4-addr|dst-ipv4-addr|svlan|eth-type|ip-protocol-type|cos|tos-dscp|l4-src-port|l4-dst-port|ttl|cvlan|ip-ver|traff-class|traff-label|ipv6-next-header|src-ipv6-addr|dst-ipv6-addr|ponid|onuid] [range|value_mask|equal|not_equal|exist_match|not_exist_match] <value1> [<value2>|null]}*8
```

Planning Data

Parameter	Description	Attribute	Example
`flow-rule-profile add <name>`	Rule name	Mandatory	rule1
`{[id] <id>}*1`	Rule ID; value range:1 to 256. Specify an ID for the rule profile to be added. If you do not specify it, the system will assign one automatically.	Optional	9

Parameter	Description	Attribute	Example
[src-mac|dst-mac|src-ipv4-addr|dst-ipv4-addr|svlan|eth-type|ip-protocol-type|cos|tos-dscp|l4-src-port|l4-dst-port|ttl|cvlan|ip-ver|traff-class|traff-label|ipv6-next-header|src-ipv6-addr|dst-ipv6-addr|ponid|onuid]	Rule type. You can select one from the following list: ◆ src-mac: based on the source MAC address ◆ dst-mac: based on the destination MAC address ◆ src-ipv4-addr: based on the source IPv4 address ◆ dst-ipv4-addr: based on the destination IPv4 address ◆ svlan: based on the SVLAN ◆ eth-type: based on the Ethernet type ◆ ip-protocol-type: based on the IP protocol type ◆ cos: based on the Ethernet priority ◆ tos-dscp: based on the TOS/DSCP ◆ l4-src-port: based on the L4 source port number ◆ l4-dst-port: based on the L4 destination port number ◆ ttl: based on the TTL ◆ cvlan: based on the CVLAN ◆ ip-ver: based on the IP version number ◆ traff-class: based on the IPv6 traffic class ◆ traff-label: based on the IPv6 traffic label ◆ ipv6-next-header: based on the IPv6 next header ◆ src-ipv6-addr: based on the source IPv6 address ◆ dst-ipv6-addr: based on the destination IPv6 address ◆ ponid: based on the PON port ◆ onuid: based on the ONU	Optional	svlan
[range|value_mask|equal|not_equal|exist_match|not_exist_match]	Matching type. Set the logical condition for rule matching. You can select one from the following list: ◆ equal ◆ not_equal: not equal to ◆ exist_match: match if present ◆ not_exist_match: match if not present ◆ value_mask: value plus mask ◆ range	Optional	equal

Parameter	Description	Attribute	Example
`<value1>`	Rule value for rule matching	Optional	300
`[<value2>|null]`	Rule value 2 for rule matching. Set it to "null" for matching types other than "range" and "value_mask".	Optional	null

Example

Configure a traffic rule profile with the ID 9. Configure one rule (at most eight rules can be configured) for the profile, setting the rule name to rule1, the rule type to be based on the SVLAN, the matching type to equal, the rule value to 300, and the rule value 2 to null.

```
Admin(config)#flow-rule-profile add rule1 id 9 svlan equal 300 null
```

21.4.3 Configuring the Traffic Policy

Command Format

```
flow-policy-profile add <name> {[id] <id>}*1 {[pri] <1-12>}*1 {[acl] [enable|disable]}*1 {[forward] [enable|disable]}*1 {[re-cos] [enable|disable]}*1 {[cos] <0-7>}*1 {[re-dscp] [enable|disable]}*1 {[dscp] <0-63>}*1 {[re-traff] [enable|disable]}*1 {[traff] <traff>}*1 {[re-queue] [enable|disable]}*1 {[queue] <0-7>}*1 {[re-port] [enable|disable]}*1 {[rdport] <port>}*1 {[flow-mirr] [enable|disable]}*1 {[mirrport] <port>}*1 {[rate-limit] [enable|disable]}*1 {[cir] <cir>}*1 {[cbs] <cbs>}*1 {[ebs] <ebs>}*1 {[pir] <pir>}*1 {[re-vlan] [enable|disable]}*1 {[vlanact] [add|tras]}*1 {[vid] <1-4095>}*1 {[re-mirror] [enable|disable]}*1
```

Planning Data

Parameter	Description	Attribute	Example
`flow-policy-profile add <name>`	The name of the policy profile	Mandatory	policy5
`{[id] <id>}*1`	The ID of the policy profile	Optional	8
`{[pri] <1-12>}*1`	The policy priority level, ranging from 1 to 12. The value "1" stands for the lowest priority level, and "12" the highest one.	Optional	3
`{[acl] [enable|disable]}*1`	The ACL function switch	Optional	enable

Parameter	Description	Attribute	Example
`{[forward] [enable|disable]}*1`	The forwarding flag. Configure this item according to the network planning of the operator. It cannot be configured when the ACL function is disabled. ◆ enable: Only the traffic matching the set rule is forwarded, while other traffics are discarded. ◆ disable: The traffic matching the rule is discarded, while other traffics are forwarded.	Optional	enable
`{[re-cos] [enable|disable]}*1`	The CoS re-marking flag. It is used to enable or disable the re-marking function. The default setting is "disable".	Optional	-
`{[cos] <0-7>}*1`	The priority label, ranging from 0 to 7. This parameter cannot be configured when the CoS re-marking flag is set to "disable".	Optional	-
`{[re-dscp] [enable|disable]}*1`	The DSCP re-marking flag. The default setting is "disable".	Optional	-
`{[dscp] <0-63>}*1`	The DSCP. The value ranges from 0 to 63, and the default value is 0. This parameter cannot be configured when DSCP re-marking is disabled.	Optional	-
`{[re-traff] [enable|disable]}*1`	The re-marking traffic class switch. The default setting is "disable".	Optional	-
`{[traff] <traff>}*1`	The communication classification. The value ranges from 0 to 255, and the default value is 0. This parameter cannot be configured when re-marking traffic class is disabled.	Optional	-
`{[re-queue] [enable|disable]}*1`	The queue mapping function switch. The default setting is "disable".	Optional	-
`{[queue] <0-7>}*1`	The queues mapped. The value ranges from 0 to 7, and the default value is 0. This parameter cannot be configured when queue mapping is disabled.	Optional	-
`{[re-port] [enable|disable]}*1`	The port re-direction function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
`{[rdport] <port>}*1`	The R port number	Optional	-
`{[flow-mirr] [enable|disable]}*1`	The port mirroring function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
`{[mirrport] <port>}*1`	The M port number	Optional	-

Parameter	Description	Attribute	Example
`{[rate-limit] [enable|disable]}*1`	The rate limit switch. The default setting is "disable".	Optional	-
`{[cir] <cir>}*1`	The committed information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[cbs] <cbs>}*1`	The committed burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[ebs] <ebs>}*1`	The excess burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[pir] <pir>}*1`	The peak information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[re-vlan] [enable|disable]}*1`	The VLAN re-marking function switch	Optional	-
`{[vlanact] [add|tras]}*1`	VLAN action ◆ add: adding ◆ tras: translation	Optional	-
`{[vid] <1-4095>}*1`	VLAN value	Optional	-
`{[re-mirror] [enable|disable]}*1`	The remote mirroring function switch	Optional	-

Example

Configure a traffic policy profile with the name policy5, the ID 8, and the priority 3. Enable the ACL, set the forwarding flag to "enable" (forward the traffics matching the rules and discard those that do not match), and use default settings for all the other policy items.

```
Admin(config)#flow-policy-profile add policy5 id 8 pri 3 acl enable forward enable
Admin(config)#
```

21.4.4 Binding the Traffic Policy to an ONU Port

Command Format

```
onu port flow-policy <onuid> eth <portno> {upstream-profile <uppolicyprf>
downstream-profile <downpolicyprf> upstream-rule-profile <upruleprf>
downstream-rule-profile <downruleprf>}*8
```

Planning Data

Parameter	Description	Attribute	Example
`<onuid>`	The ONU authorization number, ranging from 1 to 128.	Mandatory	1
`eth <portno>`	The ONU port number, ranging from 1 to 32.	Mandatory	1
`upstream-profile <uppolicyprf>`	The ID of the uplink traffic policy profile	Optional	8
`downstream-profile <downpolicyprf>`	The ID of the downlink traffic policy profile	Optional	8
`upstream-rule-profile <upruleprf>`	The ID of the uplink traffic rule profile	Optional	9
`downstream-rule-profile <downruleprf>`	The ID of the downlink traffic rule profile	Optional	9

Example

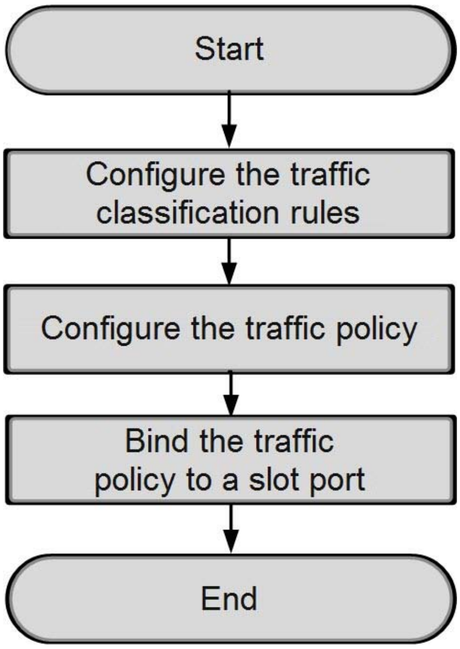
Bind a traffic policy to PON port 1 of ONU 1 connected to port 1 in slot 2 of subrack 1. The uplink and downlink traffic policy profile IDs are 8 and the uplink and downlink traffic rule profile IDs are 9.

```
Admin(config-if-pon-1/2/1)#onu port flow-policy 1 eth 1 upstream-profile 8
downstream-profile 8 upstream-rule-profile 9 downstream-rule-profile 9
Admin(config-if-pon-1/2/1)#
```

21.5 Configuration Example for Traffic Classification Based on the PON Port

This section introduces the traffic classification configuration example based on the PON port.

21.5.1 Configuration Flow


Start
Configure the traffic classification rules
Configure the traffic policy
Bind the traffic policy to a slot port
End

21.5.2 Configuring the Traffic Classification Rules

Command Format

```
flow-rule-profile add <name> {[id] <id>}*1 {[src-mac|dst-mac|src-ipv4-addr|dst-ipv4-addr|svlan|eth-type|ip-protocol-type|cos|tos-dscp|l4-src-port|l4-dst-port|ttl|cvlan|ip-ver|traff-class|traff-label|ipv6-next-header|src-ipv6-addr|dst-ipv6-addr|ponid|onuid] [range|value_mask|equal|not_equal|exist_match|not_exist_match] <value1> [<value2>|null]}*8
```

Planning Data

Parameter	Description	Attribute	Example
`flow-rule-profile add <name>`	The rule name	Mandatory	rule2
`{[id] <id>}*1`	The rule ID. Specify the ID of the rule profile to be added. If this parameter is not configured, the system assigns a profile ID automatically. The value ranges from 1 to 256.	Optional	5

Parameter	Description	Attribute	Example
[src-mac|dst-mac|src-ipv4-addr|dst-ipv4-addr|svlan|eth-type|ip-protocol-type|cos|tos-dscp|l4-src-port|l4-dst-port|ttl|cvlan|ip-ver|traff-class|traff-label|ipv6-next-header|src-ipv6-addr|dst-ipv6-addr|ponid|onuid]	The rule domain type. This parameter is used to set the rule type. You can select one from the following list of rule types: ◆ src-mac: based on the source MAC address ◆ dst-mac: based on the destination MAC address ◆ src-ipv4-addr: based on the source IPv4 address ◆ dst-ipv4-addr: based on the destination IPv4 address ◆ svlan: based on the SVLAN ◆ eth-type: based on the Ethernet type ◆ ip-protocol-type: based on the IP protocol type ◆ cos: based on the Ethernet priority ◆ tos-dscp: based on the TOS/DSCP ◆ l4-src-port: based on the L4 source port number ◆ l4-dst-port: based on the L4 destination port number ◆ ttl: based on the TTL ◆ cvlan: based on the CVLAN ◆ ip-ver: based on the IP version number ◆ traff-class: based on the IPv6 traffic classification ◆ traff-label: based on the IPv6 traffic label ◆ ipv6-next-header: based on the IPv6 next header ◆ src-ipv6-addr: based on the source IPv6 address ◆ dst-ipv6-addr: based on the destination IPv6 address ◆ ponid: based on the PON port ◆ onuid: based on the ONU	Optional	ponid
[range|value_mask|equal|not_equal|exist_match|not_exist_match]	The matching type. This parameter is used to set the logical conditions for rule	Optional	equal

Parameter	Description	Attribute	Example
	matching. You can select one from the following list of matching types: ◆ equal ◆ not_equal: not equal to ◆ exist_match: existing means matching ◆ not_exist_match: not existing means matching ◆ value_mask: value plus mask ◆ range		
`<value1>`	The rule domain value for rule matching	Optional	1
`[<value2>|null]`	The rule domain value 2 for rule matching. When the matching type is set to "range" or "value_mask", this parameter cannot be set to "null". For other matching types, this parameter should be set to "null".	Optional	null

Example

Configure a traffic rule profile with the profile ID 5. Configure one rule (at most eight rules can be configured) for the profile, setting the rule name to rule2, the rule type to be based on the PON port, the matching type to equal, the rule domain value to 1, and the rule domain value 2 to null.

```
Admin(config)#flow-rule-profile add rule2 id 5 ponid equal 1 null
```

21.5.3 Configuring the Traffic Policy

Command Format

```
flow-policy-profile add <name> {[id] <id>}*1 {[pri] <1-12>}*1 {[acl] [enable|disable]}*1 {[forward] [enable|disable]}*1 {[re-cos] [enable|disable]}*1 {[cos] <0-7>}*1 {[re-dscp] [enable|disable]}*1 {[dscp] <0-63>}*1 {[re-traff] [enable|disable]}*1 {[traff] <traff>}*1 {[re-queue] [enable|disable]}*1 {[queue] <0-7>}*1 {[re-port] [enable|disable]}*1 {[rdport] <port>}*1 {[flow-mirr] [enable|disable]}*1 {[mirrport] <port>}*1 {[rate-limit] [enable|disable]}*1 {[cir] <cir>}*1 {[cbs] <cbs>}*1 {[ebs] <ebs>}*1 {[pir] <pir>}*1 {[re-vlan] [enable|disable]}*1 {[vlanact] [add|tras]}*1 {[vid] <1-4095>}*1 {[re-mirror] [enable|disable]}*1
```

Planning Data

Parameter	Description	Attribute	Example
`flow-policy-profile add <name>`	The name of the policy profile	Mandatory	policy5
`{[id] <id>}*1`	The ID of the policy profile	Optional	8
`{[pri] <1-12>}*1`	The policy priority level, ranging from 1 to 12. The value "1" stands for the lowest priority level, and "12" the highest one.	Optional	3
`{[acl] [enable|disable]}*1`	The ACL function switch	Optional	enable
`{[forward] [enable|disable]}*1`	The forwarding flag. Configure this item according to the network planning of the operator. It cannot be configured when the ACL function is disabled. ◆ enable: Only the traffic matching the set rule is forwarded, while other traffics are discarded. ◆ disable: The traffic matching the rule is discarded, while other traffics are forwarded.	Optional	enable
`{[re-cos] [enable|disable]}*1`	The CoS re-marking flag. It is used to enable or disable the re-marking function. The default setting is "disable".	Optional	-
`{[cos] <0-7>}*1`	The priority label, ranging from 0 to 7. This parameter cannot be configured when the CoS re-marking flag is set to "disable".	Optional	-
`{[re-dscp] [enable|disable]}*1`	The DSCP re-marking flag. The default setting is "disable".	Optional	-
`{[dscp] <0-63>}*1`	The DSCP. The value ranges from 0 to 63, and the default value is 0. This parameter cannot be configured when DSCP re-marking is disabled.	Optional	-
`{[re-traff] [enable|disable]}*1`	The re-marking traffic class switch. The default setting is "disable".	Optional	-
`{[traff] <traff>}*1`	The communication classification. The value ranges from 0 to 255, and the default value is 0. This parameter cannot be configured when re-marking traffic class is disabled.	Optional	-
`{[re-queue] [enable|disable]}*1`	The queue mapping function switch. The default setting is "disable".	Optional	-
`{[queue] <0-7>}*1`	The queues mapped. The value ranges from 0 to 7, and the default value is 0. This parameter cannot be configured when queue mapping is disabled.	Optional	-

Parameter	Description	Attribute	Example
{[re-port] [enable|disable]}*1	The port re-direction function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
{[rdport] <port>}*1	The R port number	Optional	-
{[flow-mirr] [enable|disable]}*1	The port mirroring function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
{[mirrport] <port>}*1	The M port number	Optional	-
{[rate-limit] [enable|disable]}*1	The rate limit switch. The default setting is "disable".	Optional	-
{[cir] <cir>}*1	The committed information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
{[cbs] <cbs>}*1	The committed burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
{[ebs] <ebs>}*1	The excess burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
{[pir] <pir>}*1	The peak information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
{[re-vlan] [enable|disable]}*1	The VLAN re-marking function switch	Optional	-
{[vlanact] [add|tras]}*1	VLAN action ◆ add: adding ◆ tras: translation	Optional	-
{[vid] <1-4095>}*1	VLAN value	Optional	-
{[re-mirror] [enable|disable]}*1	The remote mirroring function switch	Optional	-

Example

Configure a traffic policy profile with the name policy5, the ID 8, and the priority 3. Enable the ACL, set the forwarding flag to "enable" (forward the traffics matching the rules and discard those that do not match), and use default settings for all the other policy items.

```
Admin(config)#flow-policy-profile add policy5 id 8 pri 3 acl enable forward enable
Admin(config)#
```

21.5.4 Binding the Traffic Policy to a Slot Port

Command Format

```
flow-policy <frameid/slotid/portid> {policy-profile <policy-profile-id>
rule-profile <rule-profile-id>}*8
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/portid>`	Subrack No. / slot No. / uplink port No. (the uplink port No. must be 0)	Mandatory	1/1/0
`policy-profile <policy-profile-id>`	The ID of the traffic policy profile	Optional	8
`rule-profile <rule-profile-id>`	The ID of the traffic rule profile	Optional	5

Example

Bind a traffic policy to slot 1 of subrack 1. The traffic policy profile ID is 8 and the traffic rule profile ID is 5.

```
Admin(config)#flow-policy 1/1/0 policy-profile 8 rule-profile 5
Admin(config)#
```

22 Configuring Subscriber Line Identifiers

This chapter introduces how to configure subscriber line identifiers for the AN6000 Series.

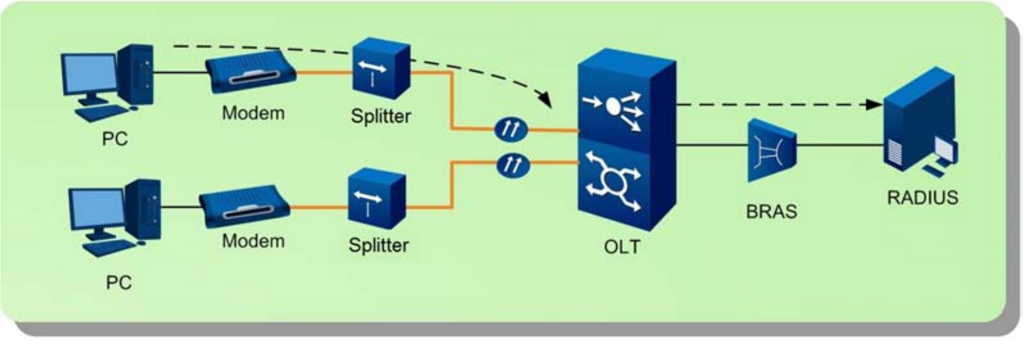
☑ Background Information

☑ Configuration Rules

☑ Configuration Example of Subscriber Line Identifiers

22.1 Background Information

The figure below illustrates the signal flow of subscriber line identifiers.



1. The OLT system captures specific messages (DHCP DISCOVER, DHCP REQUEST, PADI and PADR) in the uplink direction and adds the line identifier information to the messages based on the configured format. The identifier information is the physical information of the subscribers sending the messages.
2. The OLT equipment forwards the messages inserted with the identifier information to the broadband remote access server (BRAS). After receiving the messages, the BRAS adds the line information to the messages and forward them to the remote authorization dial-in user service (RADIUS) server.
3. The RADIUS server performs the authentication, authorization and accounting (AAA) function based on the identifier information.

Note:

The background knowledge mentioned above is based on the protocol DHCP in the IPv4 environment.

22.2 Configuration Rules

See below for details about custom line identifiers.

- The system defines some custom identifier variables. You can use these variables in different combinations to enhance flexibility of the identification function. Table 22-1 lists the custom identifier variables defined by the system.

Table 22-1 Custom Identifier Variables

Identifier	Meaning	Identifier	Meaning
%s	User outer VLAN	%o	ONU authorization No.
%c	User inner VLAN	%n	ONU type
%a	Access node identifier	%T	MDU ONU slot No.
%r	Rack No. of the access node	%M	MDU ONU sub-slot No.
%f	Subrack No. of the access node	%P	MDU ONU UNI port No.
%S	Slot No. of the access node	%t	ONU user port type
%p	PON port No. of the access node	%X	Port VPI or SVLAN
%m	ONU identifier (MAC) of the access node	%x	Port VCI or CVLAN
%u	Uplink port type	%I	IAD IP address
%L	Service card type	%A	IAD MAC address
%O	IP address of OLT management VLAN	%B	Access type: OLT, DSL or LAN

- The custom format is subject to the following restrictions.
  - In the custom format, a variable identifier must be separated from the subsequent character string or variable by a delimiter. The delimiter should be one of the characters listed in Table 22-2.

Table 22-2 List of Delimiters

Separator	Meaning
	Space
.	Decimal point
/	Slash
;	Semicolon
:	Colon
{	Open curly bracket
}	Close curly bracket
<	Open angle bracket
>	Close angle bracket
[	Open square bracket
]	Close square bracket

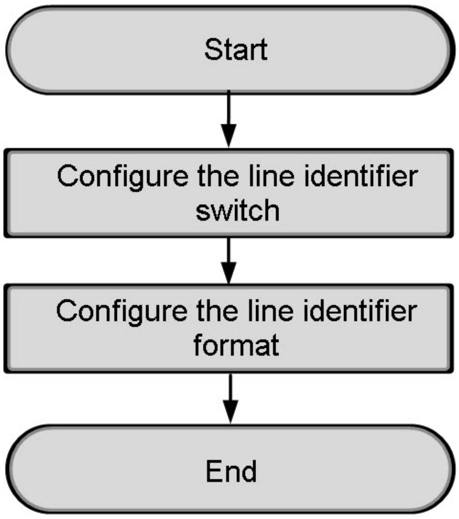
  - The character string in the custom format should contain no more than 256 characters.

- The aforesaid delimiters are not allowed in the values of variables.

22.3 Configuration Example of Subscriber Line Identifiers

This section uses an example to introduce how to configure subscriber line identifiers.

22.3.1 Configuration Flow


Start
Configure the line identifier switch
Configure the line identifier format
End

22.3.2 Configuring the Line Identifier Switch

Command Format

Enable or disable the DHCP Option 82 function.

```
dhcp option82 [enable|disable]
```

Enable or disable the PPPoE Plus function.

```
pppoe-plus [enable|disable]
```

Enable or disable the DHCP Option18 / Option37 function.

```
dhcp [option18|option37] [enable|disable]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Enabling or disabling the DHCP Option 82 function	`dhcp option82 [enable|disable]`	◆ enable: Enable the function. ◆ disable: Disable the function.	Mandatory	enable
Enabling or disabling the PPPoE Plus function	`pppoe-plus [enable|disable]`	◆ enable: Enable the function. ◆ disable: Disable the function.	Mandatory	disable
Enabling or disabling the DHCP Option18 / Option37 function	`[option18|option37]`	◆ option18: the Option18 service ◆ option37: the Option37 service	Mandatory	option18
	`[enable|disable]`	◆ enable: Enable the function. ◆ disable: Disable the function.	Mandatory	enable

Example

1. Enable the DHCP Option 82 function.

```
Admin(config)#dhcp option82 enable
```

2. Disable the PPPoE Plus function.

```
Admin(config)#pppoe-plus disable
```

3. Enable the DHCP Option 18 function.

```
Admin(config)#dhcp option18 enable
Admin(config)#
```

22.3.3 Configuring the Line Identifier Format

Command Format

```
line [circuit-id|remote-id] format [<format-str>|ctc|cnc]
```

Data Planning

<table>
<tr><th>Parameter</th><th>Description</th><th>Attribute</th><th colspan="3">Example</th></tr>
<tr><td>[circuit-id|remote-id]</td><td>◆ circuit-id: the line identifier format
◆ remote-id: the remote end identifier format</td><td>Mandatory</td><td>circuit-id</td><td>circuit-id</td><td>remote-id</td></tr>
<tr><td>format [<format-str>|ctc|cnc]</td><td>◆ <format-str>: the custom format
◆ ctc: the CTC format, which means the standard of China Telecom Corporation
◆ cnc: the CNC format, which means the standard of China Netcom Corporation</td><td>Mandatory</td><td>ctc</td><td>/%a.%b.%L/%_fiber-home</td><td>/%a.%b.%L/%_fiber-home</td></tr>
</table>

Example

1. Set the line identifier format to "ctc".

```
Admin(config)#line circuit-id format ctc
```

2. Set the line identifier to the custom format "/%a.%b.%L/%_fiberhome".

```
Admin(config)#line circuit-id format /%a.%b.%L/%_fiberhome
Format accepted.
Admin(config)#
```

3. Set the remote end identifier to the custom format "/%a.%b.%L/%_fiberhome".

```
Admin(config)#line remote-id format /%a.%b.%L/%_fiberhome
Admin(config)#
```

23 Configuring the Remote Mirroring Function

The AN6000 Series equipment supports configuring the remote mirroring function, encapsulating the mirrored data and sending them to a remote server.

☑ Enabling / Disabling the Remote Mirroring Function

☑ Configuring the Remote Mirroring Server

23.1 Enabling / Disabling the Remote Mirroring Function

Command Format

Enable or disable the remote mirroring function.

```
flow-policy-profile add <name> {[id] <id>}*1 {[pri] <1-12>}*1 {[acl] [enable|disable]}*1 {[forward] [enable|disable]}*1 {[re-cos] [enable|disable]}*1 {[cos] <0-7>}*1 {[re-dscp] [enable|disable]}*1 {[dscp] <0-63>}*1 {[re-traff] [enable|disable]}*1 {[traff] <traff>}*1 {[re-queue] [enable|disable]}*1 {[queue] <0-7>}*1 {[re-port] [enable|disable]}*1 {[rdport] <port>}*1 {[flow-mirr] [enable|disable]}*1 {[mirrport] <port>}*1 {[rate-limit] [enable|disable]}*1 {[cir] <cir>}*1 {[cbs] <cbs>}*1 {[ebs] <ebs>}*1 {[pir] <pir>}*1 {[re-vlan] [enable|disable]}*1 {[vlanact] [add|tras]}*1 {[vid] <1-4095>}*1 {[re-mirror] [enable|disable]}*1
```

View the enabling / disabling of the remote mirroring function.

```
show flow-policy-profile id <prfid>
show flow-policy-profile name <prfname>
```

Planning Data

Parameter	Description	Attribute	Example
`flow-policy-profile add <name>`	The name of the policy profile	Mandatory	policy8
`{[id] <id>}*1`	The ID of the policy profile	Optional	12
`{[pri] <1-12>}*1`	The policy priority level, ranging from 1 to 12. The value "1" stands for the lowest priority level, and "12" the highest one.	Optional	-
`{[acl] [enable|disable]}*1`	The ACL function switch	Optional	-
`{[forward] [enable|disable]}*1`	The forwarding flag. Configure this item according to the network planning of the operator. It cannot be configured when the ACL function is disabled. ◆ enable: Only the traffic matching the set rule is forwarded, while other traffics are discarded. ◆ disable: The traffic matching the rule is discarded, while other traffics are forwarded.	Optional	-
`{[re-cos] [enable|disable]}*1`	The CoS re-marking flag. It is used to enable or disable the re-marking function. The default setting is "disable".	Optional	-

Parameter	Description	Attribute	Example
{[cos] <0-7>}*1	The priority label, ranging from 0 to 7. This parameter cannot be configured when the CoS re-marking flag is set to "disable".	Optional	-
{[re-dscp] [enable|disable]}*1	The DSCP re-marking flag. The default setting is "disable".	Optional	-
{[dscp] <0-63>}*1	The DSCP. The value ranges from 0 to 63, and the default value is 0. This parameter cannot be configured when DSCP re-marking is disabled.	Optional	-
{[re-traff] [enable|disable]}*1	The re-marking traffic class switch. The default setting is "disable".	Optional	-
{[traff] <traff>}*1	The communication classification. The value ranges from 0 to 255, and the default value is 0. This parameter cannot be configured when re-marking traffic class is disabled.	Optional	-
{[re-queue] [enable|disable]}*1	The queue mapping function switch. The default setting is "disable".	Optional	-
{[queue] <0-7>}*1	The queues mapped. The value ranges from 0 to 7, and the default value is 0. This parameter cannot be configured when queue mapping is disabled.	Optional	-
{[re-port] [enable|disable]}*1	The port re-direction function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
{[rdport] <port>}*1	The R port number	Optional	-
{[flow-mirr] [enable|disable]}*1	The port mirroring function switch. The ID of the policy profile should be configured before this parameter is set. Otherwise, this function is disabled.	Optional	-
{[mirrport] <port>}*1	The M port number	Optional	-
{[rate-limit] [enable|disable]}*1	The rate limit switch. The default setting is "disable".	Optional	-
{[cir] <cir>}*1	The committed information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
{[cbs] <cbs>}*1	The committed burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-

Parameter	Description	Attribute	Example
`{[ebs] <ebs>}*1`	The excess burst size (unit: byte). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[pir] <pir>}*1`	The peak information rate (unit: kbit/s). The value ranges from 0 to 2147483647, and the default value is 0. This parameter cannot be configured when the rate limit is disabled.	Optional	-
`{[re-vlan] [enable|disable]}*1`	The VLAN re-marking function switch	Optional	-
`{[vlanact] [add|tras]}*1`	VLAN action ◆ add: adding ◆ tras: translation	Optional	-
`{[vid] <1-4095>}*1`	VLAN value	Optional	-
`{[re-mirror] [enable|disable]}*1`	The remote mirroring function switch	Optional	enable

Example

1. Enable the remote mirroring function.

```
Admin(config)#flow-policy-profile add policy8 id 12 re-mirror enable
Admin(config)#
```

2. View the enabling / disabling of the remote mirroring function.

```
Admin(config)#show flow-policy-profile name policy8
------------------------------------------
Flow_policy_profile id : 12    name policy8    priority 1
Acl disable
Forward enable
Remark cos: disable,cos: 0
Remark dscp: disable,dscp: 0
Remark traffic class: disable,traffic class: 0
Remark queue: disable,queue: 0
Redirect port: disable,redirect to port: 1
Flow mirror: disable,mirror to port: 1
Rate limit: disable,cir: 0    ,cbs: 0    ,ebs: 0    ,pir: 0
Remark vlan: disable,vlan action: 0    ,vid: 1
Remote mirror: enable.
Admin(config)#
```

23.2 Configuring the Remote Mirroring Server

Command Format

```
mirror remote-server-config server-ip <ip-address> priority <priority> dscp
<dscp> src-port <src-port> dest-port <dest-port>
```

Planning Data

Parameter	Description	Attribute	Example
`server-ip <ip-address>`	The IP address of the remote server.	Mandatory	1.1.1.1
`priority <priority>`	The priority of the Ethernet encapsulation 8021P, ranging from 0 to 7.	Mandatory	3
`dscp <dscp>`	The IP-layer DSCP priority, ranging from 0 to 63.	Mandatory	5
`src-port <src-port>`	The outer encapsulation UDP source port number, ranging from 0 to 65535.	Mandatory	18
`dest-port <dest-port>`	The outer encapsulation UDP destination port number, ranging from 0 to 65535.	Mandatory	38

Example

Configure a remote mirroring server, setting the server's IP address to 1.1.1.1, 8021P priority to 3, DSCP priority to 5, UDP source port number to 18 and UDP destination port number to 38.

```
Admin(config)#mirror remote-server-config server-ip 1.1.1.1 priority 3 dscp 5 src-port 18
dest-port 38
Admin(config)#
```

24 Configuring TACACS+

This chapter introduces how to configure TACACS+ for the AN6000 Series.

☑ Background Information

☑ Configuration Flow

☑ Configuring Information about the TACACS+ Server

☑ Configuring the Authentication Mode

☑ Configuring the Authorization Mode

☑ Configuring the Accounting Mode

24.1 Background Information

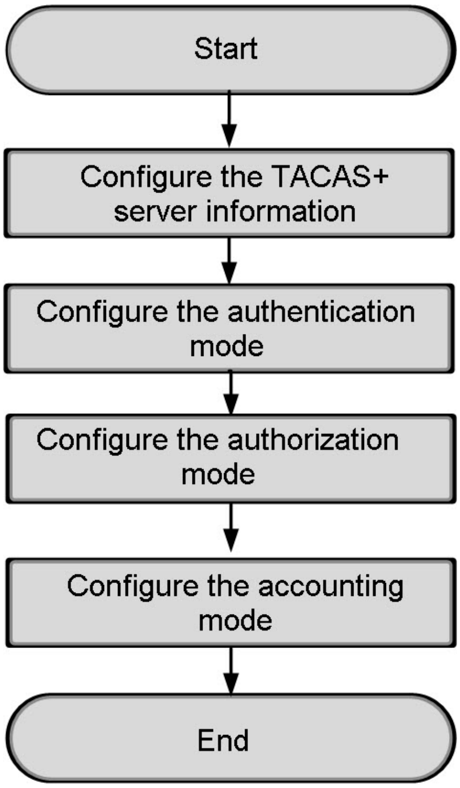
The TACACS+ (Terminal Access Controller Access-Control System Plus) protocol is a user access control protocol based on the C-S mode. The protocol is mainly used for user authentication, authorization and accounting (i.e., the AAA function). The protocol is based on TCP for service transmission and uses Port 49 for communication.

The AAA function is a network security management mechanism integrating three functions: authentication, authorization and accounting. The following describes each function in details.

- Authentication: confirms whether the user's identity is valid.
- Authorization: assigns varied access authorities to different users, restricting the operations and services available to them.
- Accounting: records the user operation information such as the types of services used by the user, the destination address of the access, the access duration and the flow statistics, and calculates the charges based on the aforesaid records.

In the aforesaid application, the OLT serves as the access equipment to allow the communication between the user and the TACACS+ server. It authenticates, authorizes and accounts the user access according to the user information on the TACACS+ server to enable user access control based on the TACACS+ protocol.

24.2 Configuration Flow


Start
Configure the TACAS+ server information
Configure the authentication mode
Configure the authorization mode
Configure the accounting mode
End

24.3 Configuring Information about the TACACS+ Server

Command Format

```
tacacs-server host <A.B.C.D> [key|port|timeout] <value>
```

Planning Data

Parameter	Description	Attribute	Example		
`host <A.B.C.D>`	The destination IP address of IP messages	Mandatory	10.10.10.10	10.10.10.10	10.10.10.10
`[key|port|timeout]`	◆ key: the encrypted key for interaction with the server. The key contains 0 to 255 characters. ◆ port: the port for interaction with the server. The value ranges from 1 to 65535. ◆ timeout: the timeout period for establishing connection with the server. The value ranges from 3 to 10 seconds.	Mandatory	port	key	timeout
`<value>`	Value	Mandatory	49	123	10

Example

1. Configure the TACACS+ sever, setting its IP address to 10.10.10.10 and the interaction port to 49.

```
Admin(config-aaa)#tacacs-server host 10.10.10.10 port 49
server_ip:10.10.10.10
Admin(config-aaa)#
```

2. Configure the TACACS+ sever, setting its IP address to 10.10.10.10 and the key to 123.

```
Admin(config-aaa)#tacacs-server host 10.10.10.10 key 123
server_ip:10.10.10.10
Admin(config-aaa)#
```

3. Configure the TACACS+ sever, setting its IP address to 10.10.10.10 and the timeout period to 10 seconds.

```
Admin(config-aaa)#tacacs-server host 10.10.10.10 timeout 10
server_ip:10.10.10.10
Admin(config-aaa)#
```

24.4 Configuring the Authentication Mode

Command Format

```
aaa authentication-mode [local|radius|tacacs]
```

Planning Data

Parameter	Description	Attribute	Example
`[local|radius|tacacs]`	◆ local: the local authentication mode ◆ radius: the RADIUS authentication mode ◆ tacacs: the TACACS authentication mode	Mandatory	tacacs

Example

Set the authentication mode to TACACS.

```
Admin(config-aaa)#aaa authentication-mode tacacs
Admin(config-aaa)#
```

24.5 Configuring the Authorization Mode

Command Format

Configure the user authorization mode.

```
aaa authorization-mode [none|tacacs]
```

Configure the command line authorization mode.

```
aaa authorization-mode command [none|tacacs]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the user authorization mode	`[none|tacacs]`	◆ none: the non-authorization mode ◆ tacas: the TACACS authorization mode	Mandatory	tacacs
Configuring the command line authorization mode	`command [none|tacacs]`	◆ none: the non-authorization mode ◆ tacas: the TACACS authorization mode	Mandatory	tacacs

Example

1. Set the user authorization mode to TACACS.

```
Admin(config-aaa)#aaa authorization-mode tacacs
```

2. Set the command line authorization mode to TACACS.

```
Admin(config-aaa)#aaa authorization-mode command tacacs
Admin(config-aaa)#
```

24.6 Configuring the Accounting Mode

Command Format

Configure the user accounting mode.

```
aaa accounting-mode [none|radius|tacacs]
```

Configure the command line accounting mode.

```
aaa accounting-mode command [none|tacacs]
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Configuring the user accounting mode	`[none|radius|tacacs]`	◆ none: the non-accounting mode ◆ radius: the RADIUS accounting mode ◆ tacacs: the TACACS accounting mode	Mandatory	tacacs
Configuring the command line accounting mode	`command [none|tacacs]`	◆ none: the non-accounting mode ◆ tacacs: the TACACS accounting mode	Mandatory	tacacs

Example

1. Set the user accounting mode to TACACS.

```
Admin(config-aaa)#aaa accounting-mode tacacs
```

2. Set the command line accounting mode to TACACS.

```
Admin(config-aaa)#aaa accounting-mode command tacacs
Admin(config-aaa)#
```

25 Configuring RADIUS

This chapter introduces how to configure RADIUS for the AN6000 Series.

25.1 Background Information

The OLT equipment serves as the RADIUS client end to provide access service for remote access users and enables their interaction with the RADIUS server. The RADIUS server stores the identity and authorization information of the users and records their access operations to provide the user authentication, authorization and accounting (AAA) services.

Generally, when the RADIUS server authenticates a user, the equipment proxy authentication functions such as NAS will be used. The RADIUS client and server authenticate the interactive information between them by sharing the key. The user password is transmitted over the network in the form of cipher text which enhances the security. The RADIUS protocol combines the authentication and authorization processes. Namely, the response messages carry the authorization information as well.

The interaction procedures are as follows:

1. The user enters the user name and password.
2. The RADIUS client end, based on the user name and password obtained, sends the access-request packets to the RADIUS server.
3. The RADIUS server compares the user information received with the information stored in the user database. If the authentication succeeds, the RADIUS server will send the user's authority information to the RADIUS client end via the access-accept packets. If the authentication fails, the RADIUS server will return the access-reject response packets.
4. The RADIUS client end accepts or rejects the user based on the authentication result received. If the user is accepted, the RADIUS client end sends the accounting-request packets to the RADIUS server for starting accounting, and the "status-type" becomes "start".
5. The RADIUS server returns the accounting-response packets for starting accounting.
6. The RADIUS client end sends the accounting-request packets to the RADIUS server for stopping accounting, and the "status-type" becomes "stop".
7. The RADIUS server returns the accounting-response packets for stopping accounting.

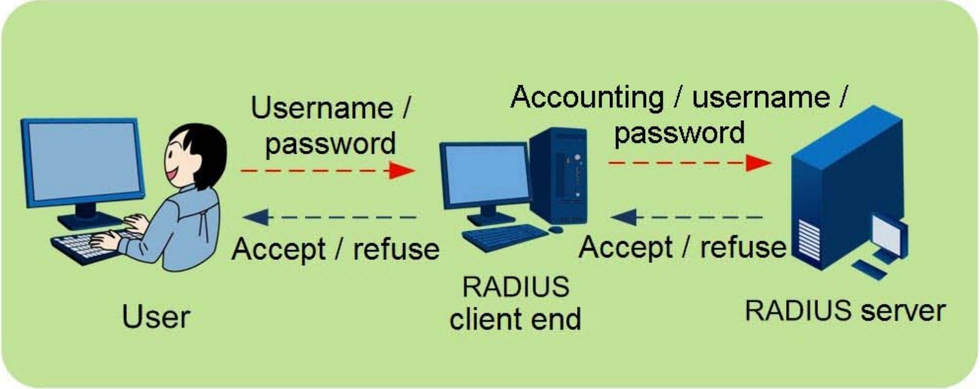
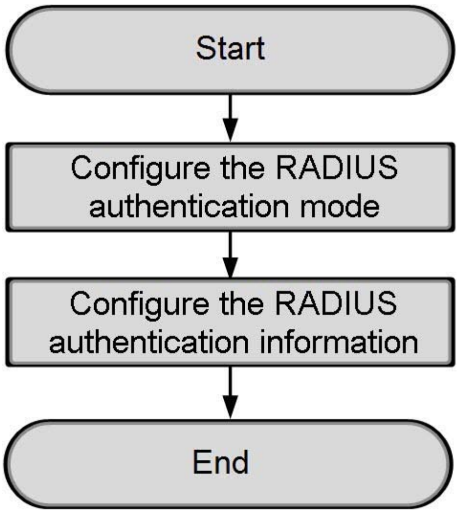


Figure 25-1 Principle of RADIUS Protocol Interaction

25.2 Configuration Flow


Start
Configure the RADIUS authentication mode
Configure the RADIUS authentication information
End

25.3 Configuring the RADIUS Authentication Mode

Command Format

```
aaa authentication-mode [local|radius|tacacs]
```

Planning Data

Parameter	Description	Attribute	Example
`[local|radius|tacacs]`	◆ local: the local authentication mode ◆ radius: the RADIUS authentication mode ◆ tacacs: the TACACS authentication mode	Mandatory	radius

Example

Set the authentication mode to RADIUS.

```
Admin(config-aaa)#aaa authentication-mode radius
Admin(config-aaa)#
```

25.4 Configuring the RADIUS Authentication Information

Command Format

```
radius server ip-address <ipaddr> [key|auth-port|acct-port|timeout|
retransmit] <value>
```

Data Planning

Parameter	Description	Attribute	Example
`ip-address <ipaddr>`	The IP address of the RADIUS authentication server.	Mandatory	10.1.1.1
`key`	The key.	Mandatory	123456
`auth-port`	The port number of the authentication server, ranging from 1 to 65535.	Optional	1812
`acct-port`	The port number of the accounting server, ranging from 1 to 65535.	Optional	1813
`timeout`	The timeout period (second), ranging from 3 to 10.	Optional	10
`retransmit`	The retransmission times, ranging from 1 to 5.	Optional	1

Example

1. Configure the IP address of the RADIUS authentication server to 10.1.1.1 and the key to 123456.

```
Admin(config)#radius server ip-address 10.1.1.1 key 123456
```

2. Configure the IP address of the RADIUS authentication server to 10.1.1.1 and the authentication server port to 1812.

```
Admin(config)#radius server ip-address 10.1.1.1 auth-port 1812
```

3. Configure the IP address of the RADIUS authentication server to 10.1.1.1 and the port of the accounting server to 1813.

```
Admin(config)#radius server ip-address 10.1.1.1 acct-port 1813
```

4. Configure the IP address of the RADIUS authentication server to 10.1.1.1 and the timeout period to 10 seconds.

```
Admin(config)#radius server ip-address 10.1.1.1 timeout 10
```

5. Configure the IP address of the RADIUS authentication server to 10.1.1.1 and the retransmission times to 1.

```
Admin(config)#radius server ip-address 10.1.1.1 retransmit 1
Admin(config)#
```

26 Detecting Optical Power

This chapter introduces how to detect optical power.

- ☑ Background Information
- ☑ Viewing the Information about the Optical Module at the PON Port
- ☑ Viewing Optical Module Parameters of an ONU

26.1 Background Information

10G EPON Optical Module

Item	Specification	
Module code	10/1.25G-20km-10G EPON OLT asymmetric-XFP (10G/1G BASE-PRX30)	10/1.25G-20km-10G EPON OLT symmetric-XFP (10G BASE-PR30)
Optical module type	10/1G BASE-PRX30	10G BASE-PR30
Output optical power	1490 nm: 2 dBm to 7 dBm 1577 nm: 2 dBm to 5 dBm	1490 nm: 2 dBm to 7 dBm 1577 nm: 2 dBm to 5 dBm

GPON Optical Module

Item	Specification		
Module code	2.5/1.25G-20km-GPON OLT-SFP (CLASS B+)	2.5/1.25G-20km-GPON OLT-SFP (CLASS C+)	2.5/1.25G-20km-GPON OLT-SFP (CLASS C++)
Optical module type	CLASS B+	CLASS C+	CLASS C++
Output optical power	2.5 dBm to 5 dBm (room temperature)	4 dBm to 7 dBm (room temperature)	5.5 dBm to 10 dBm (room temperature)

XG-PON Optical Module

Item	Specification
Module code	10/2.5G-20km-XG-PON OLT-SFP+ (N1 ODN CLASS)
Optical module type	N1 ODN CLASS
Output optical power	2 dBm to 6 dBm (full temperature range)

Combo PON Optical Module

Item	Specification			
Module code	10/2.5G:2.5/1.25G-20km-XG-PON:GPON OLT-XFP (D1 ODN CLASS)		10/2.5G:2.5/1.25G-20km-XG-PON:GPON OLT-XFP (D2 ODN CLASS)	
Optical module type	D1 ODN CLASS		D2 ODN CLASS	
Output optical power	GPON	1490 nm: 1.5 dBm to 5 dBm	GPON	1490 nm: 3 dBm to 7 dBm
	XG-PON	1577 nm: 1 dBm to 6 dBm	XG-PON	1577 nm: 5 dBm to 8 dBm

26.2 Viewing the Information about the Optical Module at the PON Port

Command Format

```
show optical info
```

Example

View the information about the optical module at PON Port 15 in Slot 1 of Subrack 1.

```
Admin(config-if-pon-1/1/15)#show optical info
----- PON OPTIC MODULE PAR INFO -----
NAME VALUE UNIT
---------------------------------------
TYPE : 20 (KM)
TEMPERATURE : 31.37 ('C)
VOLTAGE : 3.28 (V)
BIAS CURRENT : 29.71 (mA)
SEND POWER : 6.68 (Dbm)

ONU_NO RECV_POWER , ITEM=3
1 -16.19 (Dbm)
2 -14.63 (Dbm)
3 -16.45 (Dbm)
Admin(config-if-pon-1/1/15)#
```

Result Description

Parameter	Description
TYPE	The type of the optical module
TEMPERATURE	The temperature of the optical module
VOLTAGE	The voltage of the optical module
BIAS CURRENT	The bias current of the optical module
SEND POWER	The Tx optical power of the optical module
ONU_NO	The authorization number of the ONU under the PON port
RECV_POWER	The Rx optical power of the optical module

26.3 Viewing Optical Module Parameters of an ONU

Format

```
show onu optical-info <onuid>
```

Planning Data

Parameter	Description	Attribute	Example
<onuid>	ONU authorization number	Mandatory	1

Example

```
Admin(config-if-pon-1/1/15)#show onu optical-info 1
----- ONU OPTIC MODULE PAR INFO 1.15.1-----
NAME VALUE UNIT
---------------------------------------
TYPE : 20 (KM)
TEMPERATURE : 40.91 ('C)
VOLTAGE : 3.32 (V)
BIAS CURRENT : 12.64 (mA)
SEND POWER : 2.06 (Dbm)
RECV POWER : -20.21 (Dbm)
OLT RECV POWER : -16.19 (Dbm)
Admin(config-if-pon-1/1/15)#
```

Result Description

Parameter	Description
TYPE	Optical module type
TEMPERATURE	Temperature of the optical module
VOLTAGE	Voltage of the optical module
BIAS CURRENT	Bias current of the optical module
SEND POWER	Tx optical power of the optical module
RECV POWER	Rx optical power of the optical module
OLT RECV POWER	Rx optical power of the OLT

27 Commands for Upgrading the Device

This chapter introduces commands for upgrading the AN6000 Series.

- ☑ Commands for Upgrading Cards
- ☑ Commands for Upgrading the ONU
- ☑ Uploading the Configuration Data

27.1 Commands for Upgrading Cards

Command Format

Upgrade the core switch card (active).

```
load program [system|config|script|ver-file|boot|patch|cpld] <filename>
[tftp|ftp|sftp] <ipaddr> {<username> <password>}*1
```

Upgrade the core switch card (standby).

```
load program backup [system|patch|cpld|boot] <filename> [tftp|ftp|sftp]
<ipaddr> {<username> <password>}*1
```

Upgrade the service card / uplink card.

```
load program card [<frameid/slotid>|all] <filename> [tftp|ftp|sftp]
<ipaddr> {<username> <password>}*1
```

Planning Data

Procedure	Parameter	Description	Attribute	Example
Upgrading the core switch card (active)	[system|config|script|ver-file|boot|patch|cpld]	The file types for the core switch card ◆ system: the system image file ◆ config: the configuration file ◆ script: the batch command line file ◆ ver_file: the version file ◆ boot: the system boot file ◆ patch: the system patch file ◆ cpld: the system cpld file	Mandatory	system
	<filename>	File name	Mandatory	hb_hsca_1000_tst.bin
	[tftp|ftp|sftp]	The FTP protocol type	Mandatory	ftp
	<ipaddr>	The IP address of the FTP server	Mandatory	3.3.3.100
	{<username> <password>}*1	The username and password of the FTP server	Optional	1, 1
Upgrading the core switch card (standby)	[system|patch|cpld|boot]	The file types for the core switch card ◆ system: the system image file ◆ patch: the system patch file ◆ cpld: the system cpld file ◆ boot: the system boot file	Mandatory	system

Procedure	Parameter	Description	Attribute	Example
	`<filename>`	File name	Mandatory	hb_hsca_1000_tst.bin
	`[tftp|ftp|sftp]`	The FTP protocol type	Mandatory	ftp
	`<ipaddr>`	The IP address of the FTP server	Mandatory	3.3.3.100
	`{<username> <password>}*1`	The username and password of the FTP server	Optional	1, 1
Upgrading the service card / uplink card	`card [<frameid/slotid>|all]`	◆ <frameid/slotid>: subrack No. / slot No. ◆ all: all service cards or uplink cards	Mandatory	1/1
	`<filename>`	File name	Mandatory	hb_ex8a_1000_tst.bin
	`[tftp|ftp|sftp]`	The FTP protocol type	Mandatory	ftp
	`<ipaddr>`	The IP address of the FTP server	Mandatory	3.3.3.100
	`{<username> <password>}*1`	The username and password of the FTP server	Optional	1, 1

Example

1. Upgrade the system image file for the core switch card. The IP address of the FTP server is 3.3.3.100, the user name is 1, the password is 1, and the file name is hb_hsca_1000_tst.bin.

```
Admin(config)#load program system hb_hsca_1000_tst.bin ftp 3.3.3.100 1 1
```

2. Upgrade the system image file for the standby core switch card. The IP address of the FTP server is 3.3.3.100, the user name is 1, the password is 1, and the file name is hb_hsca_1000_tst.bin.

```
Admin(config)#load program backup system hb_hsca_1000_tst.bin ftp 3.3.3.100 1 1
```

3. Upgrade the service card in Slot 1 of Subrack 1. The IP address of the FTP server is 3.3.3.100, the user name is 1, the password is 1, and the upgrade file name is hb_ex8a_1000_tst.bin.

```
Admin(config)#load program card 1/1 hb_ex8a_1000_tst.bin ftp 3.3.3.100 1 1
Admin(config)#
```

27.2 Commands for Upgrading the ONU

Command Format

```
load onu-program <frameid/slotid/portid> <onulist> <filename> [tftp|ftp|
sftp] <ipaddr> {<username> <password>}*1
```

Planning Data

Parameter	Description	Attribute	Example
`<frameid/slotid/-portid>`	Subrack No. / slot No. / port No.	Mandatory	1/1/1
`<onulist>`	ONU authorization No.	Mandatory	1
`<filename>`	File name	Mandatory	gx8a.gz
`[tftp|ftp|sftp]`	The FTP protocol type	Mandatory	ftp
`<ipaddr>`	The IP address of the FTP server	Mandatory	3.3.3.100
`{<username> <password>}*1`	The username and password of the FTP server	Optional	1, 1

Example

Upgrade the file for ONU 1 under PON Port 1 in Slot 1 of Subrack 1. The IP address of the FTP server is 3.3.3.100, the user name is 1, the password is 1, and the FTP file name is gx8a.gz.

```
Admin(config)#load onu-program 1/1/1 1 gx8a.gz ftp 3.3.3.100 1 1
Admin(config)#
```

27.3 Uploading the Configuration Data

Command Format

```
upload program [system|config|showrun|igmplog|syslog|ver_file|patch]
<filename> [ftp|sftp|tftp] <server_ipaddr> {<username> <password>}*1
```

Planning Data

Parameter	Description	Attribute	Example
[system|config|showrun|igmplog|syslog|ver_file|patch]	File type ◆ system: the system image file ◆ config: the configuration file ◆ showrun: the running configuration file ◆ igmplog: the multicast log file ◆ syslog: the system log file ◆ ver_file: the version file ◆ patch: the system patch file	Mandatory	config
<filename>	File name	Mandatory	hb_hsca_1000_tst.bin
[ftp|sftp|tftp]	The FTP protocol type	Mandatory	ftp
<server_ipaddr>	The IP address of the FTP server	Mandatory	3.3.3.100
{<username> <password>}*1	The username and password of the FTP server	Optional	1, 1

Example

Export the configuration file in the Flash to the FTP server with the IP address 3.3.3.100. Set the server user name to 1, password to 1, and system file name to "hb_hsca_1000_tst.bin".

```
Admin(config)#upload program config hb_hsca_1000_tst.bin ftp 3.3.3.100 1 1
Admin(config)#
```

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