PICA8, INC.

L2/L3 Configuration Guide

PicOS 2.0.4

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This guide provides the configuration commands of L2/L3 for PicOS 2.0.4.

L2/L3 Configuration Guide, PicOS 2.0.4

Table of Contents

Preface

Intended Audience

This guide is intended for data center administrators, system administrators, and customer service staffs responsible for monitoring or configuring PicOS L2/L3.

PicOS Documents

The PicOS documents are available on our Pica8 website:
http://www.pica8.com/documents

Organization

This configuration guide is organized as follows:

Chapter	Description
Chap 1. Overview	Provides an overview of the L2/L3 switch
Chap 2. System Management Configuration	Describes system management configurations
Chap 3. File Management Configuration	Describes file management configurations
Chap 4. Layer 2 Switching Configuration	Describes Layer 2 switching configuration steps
Chap 5. Layer 2 Switching Configuration	Describes Layer 3 routing configuration steps
Chap 6. Multicast Configuration	Describes multicast configuration steps
Chap 7. QoS Configuration	Describes QoS configuration steps
Chap 8. OpenFlow Configuration	Describes OpenFlow configuration steps

Chapter 1. Overview

This chapter provides an overview of PicOS L2/L3 features, including Layer 2 switching and Layer 3 routing.

L2/L3 Features List

PicOS L2/L3 supports Layer 2 switching (STP, RSTP, MSTP, MAC learning, Q-in-Q) and Layer 3 routing (static routing, RIPv2, OSPF, IGMP, PIM-SM, IPv6):

Table 1-1. L2/L3 Features List.

Category	Functional Requirement
System Management & Administration	Support for clock/date setting and NTP
	Support for inband IP access via any routed interface
	Support for DHCP client and DHCP relay
	Support for multiple local user accounts
	Support for SSHv2 protocol
	Ability to enable debugging for a specific module
	Support for Read Only and Read Write access SNMP
	Support for IPFIX, monitors data flow in specified server
Device Configuration, Software, & File Management	Device configuration can be saved to flash on the device
	Support for configuration versioning and rollback; compares the two configurations for differences
	Ability to import/export configuration files, device software, and logs from a file on a remote server (tftp/scp as possible options)
	Ping tool and Traceroute tool from CLI
	SSH tool and telnet tool from CLI
	Ability to view and configure MAC/ARP table information
Layer 2 Forwarding and Protocol	Support for LLDP protocols for detecting devices on a link
	Support for LACP protocol and hashing of traffic using Src/Dst MAC address, Src/Dst IP address, and Layer 4 port information
	Support for 802.1q trunked interfaces, for both single and LAG interfaces
	Support for 802.1q tagged/untagged interfaces and native tags
	Support for Q-in-Q
	Support for Jumbo Frame
	Support for 802.1d Spanning Tree Protocol (STP)
	Support for 802.1w rapid STP (RSTP) and Per-VLAN Spanning Tree (PVST)
	Support for 802.1s Multiple Spanning Tree protocol (MSTP)
	Support for functionality of BPDU Guard / Filter, etc.
	Support for storm-control for unicast, multicast, broadcast
	Support for ingress/egress port mirroring

	Support for 802.1p in Layer 2 forwarding
	Support for Flow control per-interface
	Support for IGMP snooping enable per-VLAN
	Support for IGMP snooping querier per-VLAN
Layer 3 Forwarding and Routing Protocol	Full support for dual stacked IPv4 and IPv6 addressing.
	Support for 6 members in a Layer 3 LAG interface
	Support for IPv4 and IPv6 static route configuration
	Support for OSPFv2 (IPv4)
	Support for stub, normal, and NSSA OSPF area types
	Support for up to 32 equal-cost routes in OSPF
	Support for RIP routing protocol
	Support for BGP routing protocol
	Support for 128 equal-cost routes in the device's routing/forwarding tables
	Support for ECMP routing with hashing of traffic using Src/Dst IP and Port
	Support the ToS and DSCP in Layer 3 forwarding
	Support for IGMP v1/v2
	Support for PIM-SM multicast routing
	Support for VRRP protocol

Chapter 2. System Management Configuration

This chapter describes the configuration steps of system management, including image updating, IPFIX, DHCP, and setting up a user account.

The Boot Process

Before receiving the switch's boot information, you should make sure the switch has been connected in the console port with the correct baud rate, data bits value, and stop bits value.

- The baud rate is **115200**.
- The data bits value is **8**.
- The stop bits value is **1**.

The output message of the boot-up is shown below:

```
U-Boot 1.3.0 (Mar  8 2011 - 16:39:03)

CPU:    8541, Version: 1.1, (0x80720011)
Core:   E500, Version: 2.0, (0x80200020)
Clock Configuration:
        CPU: 825 MHz, CCB: 330 MHz,
        DDR: 165 MHz, LBC:  41 MHz
L1:     D-cache 32 kB enabled
        I-cache 32 kB enabled
I2C:    ready
DRAM:   Initializing
initdram robin1
initdram robin2
robin before CFG_READ_SPD
robin after CFG_READ_SPD
initdram robin3
    DDR: 512 MB
FLASH: 32 MB
L2 cache 256KB: enabled
In:     serial
Out:    serial
Err:    serial
Net:    TSEC0, TSEC1
IDE:    Bus 0: OK
  Device 0: Model: CF 512MB Firm: 20060911 Ser#: TSS25016070309051750
            Type: Hard Disk
            Capacity: 495.1 MB = 0.4 GB (1014048 x 512)
Hit any key to stop autoboot:  5
```

In general, you should not have to disrupt the default boot process. The switch will read the image of the CF card and display the software menu as follows:

```
System initiating...Please wait...
    Please choose which to start: Pica8 XorPlus, OpenFlow, or System shell:
        (Will choose default entry if no input in 10 seconds.)
        [1]  Pica8 XorPlus   * default
        [2]  Open vSwitch
        [3]  System shell
        [4]  Boot menu editor
Enter your choice (1,2,3,4):
```

If you do not enter a number, the system will boot-up the default choice, XorPlus. Option 2, Open vSwitch, is an open source project ported to PICA8 switches (refer to PicOS OVS Configuration Guide for details). Option 3, System shell, is the save mode for debugging the system. Option 4, Boot menu editor, allows you to edit the default choice.

Enter the XorPlus CLI as shown below:

```
PicOS L2/L3 switch system is selected.
Switch Manager starting ... ...
PHY: 24520:00 - Link is Up - 1000/Full
PowerPC Book-E Watchdog Timer Enabled (wdt_period=29)
Waiting for synchronizing configuration.
Synchronizing configuration OK.
Pica8 PicOS Version 2.0
Welcome to PicOS L2/L3 on XorPlus
XorPlus>
```

If you must modify the baud rate of the switch, enter U-Boot and configure the baud rate and other parameters:

```
U-Boot 1.3.0 (Sep  8 2010 - 17:20:00)

CPU:   8541, Version: 1.1, (0x80720011)
Core:  E500, Version: 2.0, (0x80200020)
Clock Configuration:
       CPU: 825 MHz, CCB: 330 MHz,
       DDR: 165 MHz, LBC:  41 MHz
L1:    D-cache 32 kB enabled
       I-cache 32 kB enabled
I2C:   ready
DRAM:  Initializing
    DDR: 512 MB
FLASH: 32 MB
L2 cache 256KB: enabled
Set ethaddr MAC address = c8:0a:a9:04:49:1a
Set eth1addr MAC address = c8:0a:a9:04:49:1b
In:    serial
Out:   serial
Err:   serial
Net:   TSEC0, TSEC1
IDE:   Bus 0: OK
  Device 0: Model: CF Card Firm: Ver2.35 Ser#: 7DF70707030700224009
            Type: Hard Disk
            Capacity: 1923.9 MB = 1.8 GB (3940272 x 512)
Hit any key to stop autoboot:  0
=>
=>
=> printenv
flash_bootcmd=setenv bootargs root=/dev/ram console=ttyS0,$baudrate; bootm ffd00000 ff000000
ffee0000
cfcard_bootcmd=setenv bootargs root=/dev/ram console=ttyS0,$baudrate; ext2load ide 0:1 0x1000000
/uImage;ext2load ide 0:1 0x2000000 /uInitrd2m;ext2load ide 0:1 0x400000 /LB9A.dtb;bootm 1000000
2000000 400000
bootdelay=5
baudrate=115200
loads_echo=1
rootpath=/nfsroot
netmask=255.255.255.0
hostname=LB9A_X
loadaddr=4000000
ethact=TSEC0
ipaddr=10.10.50.60
gatewayip=10.10.50.1
serverip=10.10.50.16
bootfile=u-boot.bin
```

```
filesize=100000
fileaddr=2000000

=> set baudrate 115200
=> save
Saving Environment to Flash...
Un-Protected 1 sectors
Erasing Flash...
. done
Erased 1 sectors
Writing to Flash... done
Protected 1 sectors
=> reset
```

Operation Mode and Configuration Mode

(1) Operation mode

By default, the switch's operation mode is activated when it starts up.

```
Welcome to PicOS L2/L3 on XorPlus
XorPlus>
```

(2) Configuration mode

Activate the configuration mode by entering the **configure** command. For the remainder of this document, be sure to enter the configuration mode if you see the XorPlus# prompt.

```
XorPlus> configure
Entering configuration mode.
There are no other users in configuration mode.
[edit]
XorPlus#
```

Commit Failed and Exit Discard

(1) Exiting the configuration mode *without* uncommitted configurations

Switch to the execution mode from the configuration mode *without* any uncommitted configurations.

```
XorPlus# exit
XorPlus>
```

(2) Exiting the configuration mode *with* uncommitted configurations

Use the **exit discard** command to enter the execution mode from the configuration mode *with* any uncommitted or failed committed configurations.

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 disable true
 [edit]
XorPlus# exit
ERROR: There are uncommitted changes.
Use "commit" to commit the changes, or "exit discard" to discard them.
XorPlus# exit discard
XorPlus>
```

Configuring DHCP and a Static IP Address

(1) Enabling DHCP

By default, DHCP is enabled on the management interface eth0. You can enable DHCP manually with the following CLI command:

```
XorPlus# set interface management-ethernet eth0 address dhcp
[edit]
```

```
XorPlus# commit
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring a static IP address and gateway
Configure your management interface eth0 with a static IP address.

```
XorPlus# set interface management-ethernet eth0 address 192.168.1.5/24
[edit]
XorPlus# set interface management-ethernet eth0 gateway 192.168.1.1
[edit]
XorPlus# commit
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring DHCP relay

(1) Enabling DHCP relay in a VLAN interface
When you enable DHCP relay in a VLAN interface, the switch will relay the received DHCP request to the specified DHCP server via routing.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 192.168.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 192.168.2.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 dhcp-relay disable false
[edit]
XorPlus# set vlan-interface interface vlan-2 dhcp-relay dhcp-servers-address1 192.168.2.100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring a User Account

There are two types of user accounts, super-user and read-only. By default, the newly created user account is read-only.

(1) Creating a user class and password

```
XorPlus# set system login user ychen authentication plain-text-password pica8
[edit]
XorPlus# set system login user ychen class super-user
[edit]
XorPlus# commit
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring a telnet announcement

```
XorPlus# set system login announcement "welcome the switch-1101"
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring AAA (Authentication/Authorization/Accounting)

PicOS L2/L3 supports AAA (Authentication/Authorization/Accounting). A user who is authenticated by the AAA server (referred to as "admin" in our guide) may configure the switch.

Configure the local switch and server as shown below:

(1) Configuring AAA in the switch

```
XorPlus# set system aaa tacacs-plus disable false
[edit]
XorPlus# set system aaa tacacs-plus key pica8
[edit]
XorPlus# set system aaa tacacs-plus server-ip 10.10.53.53
[edit]
XorPlus# commit
Commit OK.
Save done.
[edit]
XorPlus# set system aaa tacacs-plus authorization true
[edit]
XorPlus# set system aaa tacacs-plus accounting true
XorPlus# commit
```

(2) Displaying AAA information

```
XorPlus# show system aaa tacacs-plus
Waiting for building configuration.
    authorization: true
    accounting: true
    server-ip 10.10.53.53
    key: "pica8"
```

(3) Configuring the AAA server

Configure the AAA server configuration file as follows:

```
key = pica8

# Accounting File
accounting file = /var/tmp/acctfile
default authentication = file /etc/passwd

user = admin {
    member = admins
}

group = admins {
      global = cleartext "password"
      service = exec {
                default attribute = permit
  }
}
user = operator {
      global = cleartext "operator"
      service = exec {
                default attribute = permit
  }
}
user = ychen {
      global = cleartext "ychen"
      member = admins
      service = exec {
                default attribute = permit
  }
}
```

Following the configuration above, the admin or operator can access the switch via telnet or SSH.
Any valid CLI commands executed by the admin or operator will be recorded to the specified accounting
file. In our example above, the accounting file is `/var/tmp/acctfile`.

(4) Configuring the local log-in

```
XorPlus# set system aaa local disable true
[edit]
XorPlus# commit
Commit OK.
Save done.
[edit]
```

In the configuration above, you cannot log in to the switch with a local account.

Configuring SSH and Telnet Parameters

(1) Configuring the SSH connection limit

```
XorPlus# set system services ssh protocol-version v2
[edit]
XorPlus# set system services ssh connection-limit 5
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Disabling telnet service

```
XorPlus# set system services telnet disable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Enabling and disabling inband service

By default, SSH and telnet with inband interfaces are disabled. You can enable inband service by entering the command below:

```
XorPlus# set system inband enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring the Log-in ACL

(1) Configuring the log-in ACL

Configure the ACL to control whether remote hosts within specified subnetworks are allowed to log in to the system. In our example, remote hosts from both subnetworks that we configured may log in.

```
XorPlus# set system login-acl network 192.168.1.0/24
[edit]
XorPlus# set system login-acl network 192.168.100.100/32
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring NTP and the Timezone Parameter

(1) Configuring the NTP server IP address

The L2/L3 switch synchronizes with the NTP server only when the configuration command lines are committed. You can change the NTP server IP address, as shown below:

```
XorPlus# set system ntp-server-ip 192.168.10.100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring the time zone

Configure the time zone as follows (we selected **Pacific/Kosrae** for our example):

```
XorPlus# set system timezone Pacific/Kosrae
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring the system clock

```
XorPlus> set date 2012.01.01-23:59
Sun Jan  1 23:59:00 UTC 2012
XorPlus>.
```

The clock will be set in the hardware.

Configuring IPFIX

(1) Configuring IPFIX parameters
By default, IPFIX is disabled. You can enable IPFIX and configure its parameters as shown below. Make sure the switch can connect to the IPFIX collector server correctly.

```
XorPlus# set protocols ipfix collector 192.168.2.10 udp-port 9999
[edit]
XorPlus# set protocols ipfix interfaces ingress ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring sFlow

(1) Globally enabling sFlow
By default, sFlow is disabled. You can enable sFlow and configure its parameters. Check that the switch can connect to the sFlow collector server correctly, and be sure to configure the sFlow **agent-id** and **source-address** at the same time that you enable sFlow, as shown below:

```
XorPlus# set protocols sflow disable false
[edit]
XorPlus# set protocols sflow agent-id 10.10.50.248
[edit]
XorPlus# set protocols sflow source-address 10.10.50.248
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring sFlow parameters
You can configure global parameters for sFlow, including agent-id, collector IP, polling-interval, sampling-rate, and source-address.

```
XorPlus# set protocols sflow agent-id 10.10.50.248
[edit]
```

```
XorPlus# set protocols sflow collector 10.10.50.221 udp-port 6343
[edit]
XorPlus# set protocols sflow polling-interval 30
[edit]
XorPlus# set protocols sflow sampling-rate ingress 2000
[edit]
XorPlus# set protocols sflow sampling-rate egress 2000
[edit]
XorPlus# set protocols sflow header-len 128
[edit]
XorPlus# set protocols sflow source-address 10.10.50.248
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show sflow
sFlow              : Enabled
Agent ID           : 10.10.50.248
Source Address     : 10.10.50.248
Sample rate ingress: 1:2000
Sample rate egress : 1:2000
Polling interval   : 30 seconds
Header Length      : 128
XorPlus#
XorPlus# run show sflow collector
Collector address    UDP-port    No of Samples
-----------------    --------    -------------
10.10.50.221         6343        5336
XorPlus#
```

(3) Configuring sFlow on a specific interface

You can configure sFlow parameters on a specific interface:

```
XorPlus# set protocols sflow interface ge-1/1/1 polling-interval 100
[edit]
XorPlus# set protocols sflow interface ge-1/1/1 sampling-rate egress 1800
[edit]
XorPlus# set protocols sflow interface ge-1/1/1 sampling-rate ingress 1500
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show sflow interface
```

Interface	Status	Sample rate		Polling interval	Header length
		Ingress	Egress		
---------	------	-------	-------	----------------	-------------
ge-1/1/1	Enabled	1500	1800	100	64
ge-1/1/10	Enabled	2000	2000	30	64
ge-1/1/11	Enabled	2000	2000	30	64
ge-1/1/12	Enabled	2000	2000	30	64
ge-1/1/13	Enabled	2000	2000	30	64
ge-1/1/14	Enabled	2000	2000	30	64
ge-1/1/15	Enabled	2000	2000	30	64
ge-1/1/16	Enabled	2000	2000	30	64
ge-1/1/17	Enabled	2000	2000	30	64
ge-1/1/18	Enabled	2000	2000	30	64
ge-1/1/19	Enabled	2000	2000	30	64
ge-1/1/2	Enabled	2000	2000	30	64

In the current version, sFlow samples only the ingress traffic of each interface. You can monitor the traffic with sFlowTrend as follows:

Figure 2-1. sFlowTrend tools.

Configuring SNMP

(1) Configuring SNMP parameters

By default, SNMP is disabled. You can enable SNMP and configure its parameters (e.g. community, contact, location) as shown below:

```
XorPlus# set protocols snmp community Pica8-data-center
[edit]
XorPlus# set protocols snmp community Pica8-data-center authorization read-only
[edit]
XorPlus# set protocols snmp contact support@pica8.com
[edit]
XorPlus# set protocols snmp location Beijing
[edit]
XorPlus# set protocols snmp trap-group targets 10.10.1.1
[edit]
XorPlus# set protocols snmp trap-group version v2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring an SNMP ACL

By default, all hosts can "snmpwalk" the information of the switch. Configure an SNMP ACL to control which hosts within the subnetwork may snmpwalk the switch.

```
XorPlus# set system snmp-acl network 1.1.1.0/24
[edit]
```

```
XorPlus# set system snmp-acl network 2.2.2.0/24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring the Syslog Log Level

(1) Configuring the syslog level

There are 5 system syslog levels: Fatal, Error, Warning, Info, and Trace (listed in order, from most severe to least severe). By default, the system is set to a log level of Warning, but can be changed to a different log level.

In the example below, the system will log messages for Info, Warning, Error, and Fatal, since the system syslog level is set to Info.

```
XorPlus# set system log-level info
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You can display the log messages on the console screen by entering the following command:

```
XorPlus# exit
XorPlus> syslog monitor on
```

If the switch's syslog level is Trace, the traceoptions of the modules should be turned on, as shown below. You can also turn on the OSPF traceoptions for debugging.

```
XorPlus# set protocols ospf4 traceoptions flag all disable false
[edit]
XorPlus# set system log-level trace
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# exit
XorPlus> syslog monitor on
```

(2) Configuring the SNMP logging facility

In accordance with the syslog standard, the logging facility can be configured as **[0, 7]**.

```
XorPlus# set system log-facility 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
Oct 17 15:22:42 XorPlus local0.warn : admin logined the switch
Oct 17 15:22:50 XorPlus local0.warn pica_sh: Tacacs send acct body send failed: wrote -1 of 127:
Connection refused
```

```
XorPlus# set system log-facility 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
Oct 17 15:22:42 XorPlus local2.warn : admin logined the switch
```

Configuring the Syslog Disk

(1) Configuring the syslog host

After you configure the syslog server IP address, the log files will be sent to the syslog server.

```
XorPlus# set system syslog host 192.168.1.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring syslog for local storage

You can configure syslog messages to be stored in RAM or in a local SD card.

```
XorPlus# set system syslog local-file disk
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set system syslog local-file ram
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Updating the PicOS Software and Platform

You can separate the system's PicOS Platform and PicOS Software and update them respectively. Generally, **rootfs.tar.gz** will include both the PicOS Platform and PisOS Software, and **pica.tar.gz** will include only the PicOS Software.

(1) Displaying the system version

```
XorPlus# run show version
Copyright (C) 2009-2013 Pica8, Inc.
Base ethernet MAC Address   : 08:9e:01:61:65:80
Hardware model              : P-3290
PicOS Version               : 2.0
Revision ID                 : 10863
```

(2) Updating the PicOS Software

```
XorPlus> file tftp get remote-file pica.tar.gz local-file pica.tar.gz ip-address 1.1.5.6
XorPlus> configure
XorPlus# save running-to-startup  (//save the current config to startup config if necessary)
XorPlus# run request system reboot
```

The image will be placed under the local installation directory (**/cftmp**). The system will decompress **pica.tar.gz** automatically when rebooted, updating only the PicOS Software.

(3) Updating the PicOS Platform

```
XorPlus> file tftp get remote-file rootfs.tar.gz local-file pica.tar.gz ip-address 1.1.5.6
XorPlus> configure
XorPlus# save running-to-startup   (//save the current config to startup config if necessary)
XorPlus# run request system reboot
```

The image will be placed under the local installation directory (**/cftmp**). The system will decompress **rootfs.tar.gz** automatically when rebooted, updating both the PicOS Platform and PicOS Software.

Displaying System Information

You can display your system's information, including fan, power supply unit, and serial number information.

(1) Displaying the system fan

```
XorPlus> show system fan
Sensor Temperature:
    Sensor 1 Temperature : 42 Centigrade
    Sensor 2 Temperature : 39 Centigrade
    Sensor 3 Temperature : 46 Centigrade
    Sensor 4 Temperature : 33 Centigrade
Fan Status:
    Fan 1 speed = 12529 RPM, PWM = 79
    Fan 2 speed = 12413 RPM, PWM = 79
    Fan 3 speed = 12300 RPM, PWM = 79
```

(2) Displaying the system power supply unit

```
XorPlus> show system rpsu
RPSU 1:
    TEMPERATURE_1 : N/A
RPSU 2:
    TEMPERATURE_1 : 38.00 Centigrade
    TEMPERATURE_2 : 40.00 Centigrade
    FAN_SPEED    : 10784.0 RPM
    FAN_PWM      : 60
```

(3) Displaying the system serial number

```
XorPlus> show system serial-number
MotherBoard Serial Number : QTFCXI2460009
RPSU 1 Serial Number      : N/A
RPSU 2 Serial Number      : 601G10103C370ZG
SFP te-1/1/49             :
    Vendor Name          : PICA8
    Serial Number        : 78613B10987
    Module Type          : SR/850nm
    Cable Length         : 80m
SFP te-1/1/50             :
    Vendor Name          : JESS-LINK
    Serial Number        : 12344D0001
```

```
    Cable Length          : 5m
SFP te-1/1/51             :
    Vendor Name           : DELTA
    Serial Number         : 084109000017
    Module Type           : SR/850nm
    Cable Length          : 80m
SFP te-1/1/52             :
    Vendor Name           : JESS-LINK
    Serial Number         : 12344D0002
    Cable Length          : 5m
```

(4) Displaying additional system information

```
XorPlus# run show system temperature
Temperature: 41 Centigrade
XorPlus#
XorPlus# run show system uptime
 01:21:33 up 50 min, load average: 0.04, 0.06, 0.07
XorPlus#
XorPlus# run show system cpu-usage
Cpu usage: 15%
XorPlus#
XorPlus# run show system rollback ?
Possible completions:
  compare                       Show the difference between tow rolled back configurations
  file                          Show rolled back configuration file
  list                          Show rolled back file list
XorPlus# run show system rollback compare to 02
637,639d636
< open-flow {
<     working-mode: "l2/l3-mode"
< }
753c750
<         enable: true
---
>         enable: false
XorPlus#
XorPlus# run show system rollback file 02
/*XORP Configuration File, v1.0*/
interface {
    ecmp {
        max-path: 4
        hash-mapping {
            field {
                ingress-interface {
                    disable: true
                }
                vlan {
                    disable: true
                }
                ip-protocol {
                    disable: true
                }
                ip-source {
                    disable: false
                }
                ip-destination {
                    disable: false
                }
                port-source {
                    disable: false
                }
                port-destination {
                    disable: false
                }
            }
        }
```

```
XorPlus# run show system rollback list
-rw-rw-r-- 1 root  xorp 23478 Jul  7 22:55 /pica/config/pica.conf
-rw-rw-r-- 1 root  xorp 23595 Jul  7 22:28 /pica/config/pica.conf.01
-rw-rw-r-- 1 admin xorp 23595 Jul  7 22:27 /pica/config/pica.conf.02
-rw-rw-r-- 1 root  xorp 23595 Jul  7 22:26 /pica/config/pica.conf.03
```

Technical Support

Execute the diagnosis CLI, and receive technical support by sending the diagnosis result report to Pica8.

(1) Executing the diagnosis CLI

```
XorPlus> show tech_support
Start......

Item 1: Display system version finished!
Item 2: Display system interface finished!
Item 3: Display system configuration finished!
Item 4: Display system config files finished!
Item 5: Display system process finished!
Item 6: Display system fdb table finished!
Item 7: Display system fdb entries finished!
Item 8: Display system ospf neighbors finished!
Item 9: Display system ospf interfaces finished!
Item 10: Display system route table finished!
Item 11: Get error event from log!
Item 12: Display system hard-route table finished!
Item 13: Display system hard-route for host finished!
Item 14: Dispaly system spanning tree interfaces finished!
Item 15: Dispaly system spanning tree  bridge finished!
Item 16: Display system vlans table finished!
Item 17: Display system vlan-interfaces finished!
Item 18: Display system core-dump finished!
Item 19: Display system uptime finished!
Item 20: Display system arp table finished!

The information has been stored in /tmp/XorPlus-201307052220-techSupport.log, please forward to
support@pica8.com
XorPlus>
```

Flushing ARP and the Neighbor Table

You can manually flush the ARP entry and the IPv6 neighbor table.

(1) Flushing the ARP entry

```
XorPlus> flush arp all
XorPlus> flush arp ip-address 192.168.1.1
```

Rebooting the System

Reboot the system as follows:

(1) Rebooting the system

```
XorPlus> request system reboot

U-Boot 1.3.0 (Apr 11 2011 - 10:41:10)

CPU:   8541, Version: 1.1, (0x80720011)
Core:  E500, Version: 2.0, (0x80200020)
Clock Configuration:
```

```
        CPU: 825 MHz, CCB: 330 MHz,
        DDR: 165 MHz, LBC:  41 MHz
L1:    D-cache 32 kB enabled
       I-cache 32 kB enabled
I2C:   ready
DRAM:  Initializing
    DDR: 512 MB
FLASH: 32 MB
L2 cache 256KB: enabled
Set ethaddr MAC address = 60:eb:69:d2:9c:d8
In:    serial
Out:   serial
Err:   serial
Net:   TSEC0
IDE:   Bus 0: OK
  Device 0: Model: TRANSCEND Firm: 20091130 Ser#: 20100723    C4130E83
             Type: Hard Disk
             Capacity: 1911.6 MB = 1.8 GB (3915072 x 512)
```

Displaying the Debugging Message

You can configure the debugging message in your current window.

(1) Syslog monitor on

```
XorPlus> syslog monitor on
Nov 21 2000 22:27:39 XorPlus local0.warn : [SIF]Interface ge-1/1/3, changed state to up
Nov 21 2000 22:27:41 XorPlus local0.warn : root logined the switch
Nov 21 2000 22:41:18 XorPlus local0.info xinetd[1102]: START: telnet pid=7650 from=10.10.50.16
Nov 21 2000 22:41:23 XorPlus authpriv.debug login[7651]: pam_unix(login:account): account admin
has password changed in future
Nov 21 2000 22:41:26 XorPlus local0.warn : admin logined the switch
Nov 21 2000 22:55:58 XorPlus local0.info xinetd[1102]: START: telnet pid=8039 from=10.10.51.16
Nov 21 2000 22:56:01 XorPlus authpriv.debug login[8040]: pam_unix(login:account): account root
has password changed in future
Nov 21 2000 23:31:13 XorPlus local0.info xinetd[1102]: START: telnet pid=9028 from=10.10.50.16
Nov 21 2000 23:31:16 XorPlus authpriv.debug login[9029]: pam_unix(login:account): account admin
has password changed in future
Nov 21 2000 23:31:21 XorPlus local0.warn : admin logined the switch
XorPlus>
```

Installing Software

You can install software that you'd like to have in your Debian system (e.g. make, python, g++) as shown below:

(1) Updating the software list on the source server

```
 root@XorPlus#apt-get update
Hit http://ftp.tw.debian.org stable Release.gpg
Hit http://ftp.tw.debian.org stable Release
Hit http://ftp.tw.debian.org stable/main powerpc Packages
Hit http://ftp.tw.debian.org stable/main Translation-en
Reading package lists... Done
root@XorPlus#
```

(2) Installing new software

```
root@XorPlus#apt-get install make
Reading package lists... Done
Building dependency tree
Reading state information... Done
Suggested packages:
  make-doc
```

```
The following NEW packages will be installed:
  make
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 399 kB of archives.
After this operation, 1165 kB of additional disk space will be used.
WARNING: The following packages cannot be authenticated!
  make
Authentication warning overridden.
Get:1 http://ftp.tw.debian.org/debian/ stable/main make powerpc 3.81-8.2 [399 kB]
Fetched 399 kB in 6s (64.1 kB/s)
Selecting previously unselected package make.
(Reading database ... 16155 files and directories currently installed.)
Unpacking make (from .../make_3.81-8.2_powerpc.deb) ...
Processing triggers for man-db ...
fopen: Permission denied
Setting up make (3.81-8.2) ...
root@XorPlus#

root@XorPlus#apt-get install python
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  file libexpat1 libmagic1 mime-support python-minimal python2.7 python2.7-minimal
Suggested packages:
  python-doc python-tk python2.7-doc binutils binfmt-support
The following NEW packages will be installed:
  file libexpat1 libmagic1 mime-support python python-minimal python2.7 python2.7-minimal
0 upgraded, 8 newly installed, 0 to remove and 0 not upgraded.
Need to get 5045 kB of archives.
After this operation, 18.3 MB of additional disk space will be used.
Do you want to continue [Y/n]? Y
WARNING: The following packages cannot be authenticated!
  libmagic1 libexpat1 file mime-support python2.7-minimal python2.7 python-minimal python
Authentication warning overridden.
Get:1 http://ftp.tw.debian.org/debian/ stable/main libmagic1 powerpc 5.11-2 [201 kB]
Get:2 http://ftp.tw.debian.org/debian/ stable/main libexpat1 powerpc 2.1.0-1 [142 kB]
Get:3 http://ftp.tw.debian.org/debian/ stable/main file powerpc 5.11-2 [51.7 kB]
Get:4 http://ftp.tw.debian.org/debian/ stable/main mime-support all 3.52-1 [35.5 kB]
Get:5 http://ftp.tw.debian.org/debian/ stable/main python2.7-minimal powerpc 2.7.3-6 [1753 kB]
Get:6 http://ftp.tw.debian.org/debian/ stable/main python2.7 powerpc 2.7.3-6 [2639 kB]
Get:7 http://ftp.tw.debian.org/debian/ stable/main python-minimal all 2.7.3-4 [42.6 kB]
Get:8 http://ftp.tw.debian.org/debian/ stable/main python all 2.7.3-4 [180 kB]
Fetched 5045 kB in 18s (267 kB/s)
Selecting previously unselected package libmagic1:powerpc.
(Reading database ... 16189 files and directories currently installed.)
Unpacking libmagic1:powerpc (from .../libmagic1_5.11-2_powerpc.deb) ...
Selecting previously unselected package libexpat1:powerpc.
Unpacking libexpat1:powerpc (from .../libexpat1_2.1.0-1_powerpc.deb) ...
Selecting previously unselected package file.
Unpacking file (from .../file_5.11-2_powerpc.deb) ...
Selecting previously unselected package mime-support.
Unpacking mime-support (from .../mime-support_3.52-1_all.deb) ...
Selecting previously unselected package python2.7-minimal.
Unpacking python2.7-minimal (from .../python2.7-minimal_2.7.3-6_powerpc.deb) ...
Selecting previously unselected package python2.7.
Unpacking python2.7 (from .../python2.7_2.7.3-6_powerpc.deb) ...
Selecting previously unselected package python-minimal.
Unpacking python-minimal (from .../python-minimal_2.7.3-4_all.deb) ...
Selecting previously unselected package python.
Unpacking python (from .../python_2.7.3-4_all.deb) ...
Processing triggers for man-db ...
fopen: Permission denied
Setting up libmagic1:powerpc (5.11-2) ...
Setting up libexpat1:powerpc (2.1.0-1) ...
Setting up file (5.11-2) ...
Setting up mime-support (3.52-1) ...
Setting up python2.7-minimal (2.7.3-6) ...
```

```
Linking and byte-compiling packages for runtime python2.7...
Setting up python2.7 (2.7.3-6) ...
Setting up python-minimal (2.7.3-4) ...
Setting up python (2.7.3-4) ...
root@XorPlus#

root@XorPlus#apt-get install g++
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  g++-4.6 libstdc++6-4.6-dev
Suggested packages:
  g++-multilib g++-4.6-multilib gcc-4.6-doc libstdc++6-4.6-dbg libstdc++6-4.6-doc
The following NEW packages will be installed:
  g++ g++-4.6 libstdc++6-4.6-dev
0 upgraded, 3 newly installed, 0 to remove and 17 not upgraded.
Need to get 0 B/8383 kB of archives.
After this operation, 24.4 MB of additional disk space will be used.
Do you want to continue [Y/n]? Y
WARNING: The following packages cannot be authenticated!
  libstdc++6-4.6-dev g++-4.6 g++
Authentication warning overridden.
Selecting previously unselected package libstdc++6-4.6-dev.
(Reading database ... 19555 files and directories currently installed.)
Unpacking libstdc++6-4.6-dev (from .../libstdc++6-4.6-dev_4.6.3-14_powerpc.deb) ...
Selecting previously unselected package g++-4.6.
Unpacking g++-4.6 (from .../g++-4.6_4.6.3-14_powerpc.deb) ...
Selecting previously unselected package g++.
Unpacking g++ (from .../g++_4%3a4.6.3-8_powerpc.deb) ...
Processing triggers for man-db ...
Setting up libstdc++6-4.6-dev (4.6.3-14) ...
Setting up g++-4.6 (4.6.3-14) ...
Setting up g++ (4:4.6.3-8) ...
update-alternatives: using /usr/bin/g++ to provide /usr/bin/c++ (c++) in auto mode
root@XorPlus#
```

Chapter 3. File Management Configuration

This chapter describes the configuration files and how to save, rollback, and manage them. With our provided scripts, you can configure multiple switches from a centralized management server.

Managing Configuration Files

You can copy, delete, or rename any configuration files in the system, but do *not* delete the system files.

(1) Listing directory files

You can display the files of a specified directory:

```
XorPlus> file list /
drwxr-xr-x    2 root      xorp         4096 Sep 25 00:54 bin
drwxr-xr-x    2 root      xorp         4096 Sep 24 06:21 boot
drwxr-xr-x    2 root      xorp         4096 Sep 23 17:05 cftmp
-rwxr-xr-x    1 root      xorp        40559 Sep 23 17:05 config.bcm
drwxr-xr-x    4 root      root         4096 Sep 25 00:54 dev
drwxr-xr-x    7 root      xorp         4096 Sep 25 00:55 etc
drwxr-xr-x    4 root      xorp         4096 Sep 24 06:21 lib
lrwxrwxrwx    1 root      root           11 Sep 24 06:21 linuxrc -> bin/busybox
drwxr-xr-x    5 root      xorp         4096 Sep 24 06:21 mnt
drwxr-xr-x    2 root      xorp         4096 Sep 23 17:05 opt
drwxr-xr-x    5 root      xorp         4096 Sep 24 06:21 ovs
drwxr-xr-x   14 root      xorp         4096 Sep 24 06:23 pica
dr-xr-xr-x   52 root      root            0 Jan  1  1970 proc
-rwxr-xr-x    1 root      xorp        59012 Sep 23 17:05 rc.soc
drwxr-xr-x    2 root      xorp         4096 Sep 24 06:21 sbin
drwxr-xr-x   11 root      root            0 Jan  1  1970 sys
drwxrwxrwx    8 root      xorp         1024 Sep 25 00:55 tmp
drwxr-xr-x    7 root      xorp         4096 Sep 24 06:22 usr
drwxr-xr-x    7 root      xorp         4096 Sep 24 06:23 var
XorPlus> file list /tmp
drwxrwxr-x    5 root      xorp         1024 Sep 25 00:54 home
drwxrwxr-x    2 root      xorp         1024 Sep 25 00:54 log
drwx------    2 root      root        12288 Sep 25 00:54 lost+found
drwxrwxr-x    3 root      xorp         1024 Sep 25 00:55 run
drwxrwxr-x    2 root      xorp         1024 Sep 25 00:54 snmp
drwxrwxr-x    2 root      xorp         1024 Sep 25 00:56 system
```

(2) Displaying file contents

Display the contents of a specified file:

```
--    1 root      root          410 Sep 24 06:23 boot.lst
-rw-rw-r--    1 root      xorp        16006 Sep 24 07:44 pica.conf
-rw-rw-r--    1 root      xorp        16003 Sep 24 07:22 pica.conf.01
-rw-rw-r--    1 root      xorp        15826 Sep 24 07:19 pica.conf.02
-rw-rw-r--    1 root      xorp        15536 Sep 24 07:18 pica.conf.03
-rw-rw-r--    1 root      xorp        15915 Sep 24 07:18 pica.conf.04
-rw-rw-r--    1 root      xorp        15567 Sep 24 07:09 pica.conf.05
-rw-rw-r--    1 root      xorp        15188 Sep 24 06:44 pica.conf.06
-rw-rw-r--    1 root      xorp        14953 Sep 24 06:35 pica.conf.07
drwxrwxrwx    2 root      root         4096 Sep 24 06:25 root
XorPlus> file show /pica/config/pica.conf
/*XORP Configuration File, v1.0*/
interface {
```

```
    ecmp {
        max-path: 4
        hash-mapping {
            field {
                ingress-interface {
                    disable: false
                }
                vlan {
                    disable: false
                }
                ip-protocol {
                    disable: false
                }
                ip-source {
                    disable: false
                }
                ip-destination {
                    disable: false
                }
                port-source {
                    disable: false
                }
                port-destination {
                    disable: false
                }
            }
        }
    }
}
```

(3) Additional file management commands
You can also copy, archive, checksum, compare, rename, and sync files.

```
XorPlus> file list /pica/config
-rw-r--r--    1 root      root          410 Sep 24 06:23 boot.lst
-rw-rw-r--    1 root      xorp        16006 Sep 24 07:44 pica.conf
-rw-rw-r--    1 root      xorp        16003 Sep 24 07:22 pica.conf.01
-rw-rw-r--    1 root      xorp        15826 Sep 24 07:19 pica.conf.02
-rw-rw-r--    1 root      xorp        15536 Sep 24 07:18 pica.conf.03
-rw-rw-r--    1 root      xorp        15915 Sep 24 07:18 pica.conf.04
-rw-rw-r--    1 root      xorp        15567 Sep 24 07:09 pica.conf.05
-rw-rw-r--    1 root      xorp        15188 Sep 24 06:44 pica.conf.06
-rw-rw-r--    1 root      xorp        14953 Sep 24 06:35 pica.conf.07
drwxrwxrwx    2 root      root         4096 Sep 24 06:25 root
XorPlus> file copy /pica/config/pica.conf
Possible completions:
  <destination-file>           Copy files to and from the router
XorPlus> file copy /pica/config/pica.conf /pica/config/ychen.conf
XorPlus> file list /pica/config
-rw-r--r--    1 root      root          410 Sep 24 06:23 boot.lst
-rw-rw-r--    1 root      xorp        16006 Sep 24 07:44 pica.conf
-rw-rw-r--    1 root      xorp        16003 Sep 24 07:22 pica.conf.01
-rw-rw-r--    1 root      xorp        15826 Sep 24 07:19 pica.conf.02
-rw-rw-r--    1 root      xorp        15536 Sep 24 07:18 pica.conf.03
-rw-rw-r--    1 root      xorp        15915 Sep 24 07:18 pica.conf.04
-rw-rw-r--    1 root      xorp        15567 Sep 24 07:09 pica.conf.05
-rw-rw-r--    1 root      xorp        15188 Sep 24 06:44 pica.conf.06
-rw-rw-r--    1 root      xorp        14953 Sep 24 06:35 pica.conf.07
drwxrwxrwx    2 root      root         4096 Sep 24 06:25 root
-rw-rw-r--    1 root      root        16006 Sep 25 02:22 ychen.conf
XorPlus>
XorPlus> file rename /pica/config/ychen.conf /pica/config/ychen-1.conf
XorPlus> file list /pica/config
-rw-r--r--    1 root      root          410 Sep 24 06:23 boot.lst
-rw-rw-r--    1 root      xorp        16006 Sep 24 07:44 pica.conf
-rw-rw-r--    1 root      xorp        16003 Sep 24 07:22 pica.conf.01
-rw-rw-r--    1 root      xorp        15826 Sep 24 07:19 pica.conf.02
-rw-rw-r--    1 root      xorp        15536 Sep 24 07:18 pica.conf.03
```

```
-rw-rw-r--    1 root      xorp          15915 Sep 24 07:18 pica.conf.04
-rw-rw-r--    1 root      xorp          15567 Sep 24 07:09 pica.conf.05
-rw-rw-r--    1 root      xorp          15188 Sep 24 06:44 pica.conf.06
-rw-rw-r--    1 root      xorp          14953 Sep 24 06:35 pica.conf.07
drwxrwxrwx    2 root      root           4096 Sep 24 06:25 root
-rw-rw-r--    1 root      root          16006 Sep 25 02:22 ychen-1.conf
XorPlus>
XorPlus> file checksum /pica/config/ychen-1.conf
3559192236 16006 /pica/config/ychen-1.conf
XorPlus>
XorPlus> file sync
XorPlus>
XorPlus> file compare /pica/config/pica.conf /pica/config/pica.conf.01
--- /pica/config/pica.conf     Mon Sep 24 07:44:45 2012
+++ /pica/config/pica.conf.01  Mon Sep 24 07:22:37 2012
@@ -5,13 +5,13 @@
        hash-mapping {
            field {
                ingress-interface {
-                   disable: false
+                   disable: true
                }
                vlan {
-                   disable: false
+                   disable: true
                }
                ip-protocol {
-                   disable: false
+                   disable: true
                }
                ip-source {
                    disable: false
```

Displaying Your Current Configuration

In L2/L3, you can display your non-default configuration with the **show** command. Display all configurations using the **show all** command.

```
XorPlus# show
Waiting for building configuration.
    interface {
        gigabit-ethernet "ge-1/1/1" {
            ether-options {
            }
        }
        gigabit-ethernet "ge-1/1/2" {
            ether-options {
            }
        }
        gigabit-ethernet "ge-1/1/3" {
            ether-options {
            }
            family {
                ethernet-switching {
                    native-vlan-id: 2
                }
            }
        }
        gigabit-ethernet "ge-1/1/4" {
            ether-options {
            }
            family {
                ethernet-switching {
                    native-vlan-id: 3
                }
            }
```

```
                    }
            gigabit-ethernet "ge-1/1/5" {
                ether-options {
                }
        }
……….
XorPlus#
XorPlus# show all
Waiting for building configuration.
    interface {
        ecmp_path_max: 4
        gigabit-ethernet "ge-1/1/1" {
            mtu: 1514
            disable: false
            ether-options {
                flow-control: true
            }
        }
        gigabit-ethernet "ge-1/1/2" {
            mtu: 1514
            disable: false
            ether-options {
                flow-control: true
            }
        }
        gigabit-ethernet "ge-1/1/3" {
            mtu: 1514
            disable: false
            ether-options {
                flow-control: true
            }
            family {
                ethernet-switching {
                    native-vlan-id: 2
                    port-mode: "access"
                }
            }
        }
```

Saving your Current Configuration as the Default Configuration

You can save your current configuration as the startup configuration. The system loads the startup configuration file after booting up.

```
XorPlus# save running-to-startup
Save done.
[edit]
XorPlus#
```

Rolling Back a Configuration

● Each time you commit a configuration in L2/L3, a rollback configuration file is created (e.g., if you commit the configuration 10 times, then **pica.conf.01**~**pica.conf.10** will be created). You can rollback any one of these configurations if you wish.

● The maximum rollback file is limited to 50. The current configuration is located in **pica.conf**.

```
XorPlus# rollback 1
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Managing Configuration Files

- You can display, copy, delete, rename, or compare the configuration files as shown below.

- **pica_startup.boot** denotes the startup and default configuration file.

- **pica.conf** denotes the current configuration file.

```
XorPlus> file list pica/config
-rw-r--r--    1 root        root           344 Apr  1 02:27 boot.lst
-rw-rw-r--    1 root        xorp         10750 Apr  9 09:20 pica.conf
-rw-rw-r--    1 root        xorp         10749 Apr  9 09:17 pica.conf.01
-rw-rw-r--    1 root        xorp         10619 Apr  9 09:15 pica.conf.02
-rw-rw-r--    1 root        xorp         10023 Apr  9 08:56 pica.conf.03
-rw-rw-r--    1 root        xorp          9902 Apr  9 08:56 pica.conf.04
-rw-rw-r--    1 root        xorp         10238 Apr  9 08:43 pica.conf.05
-rw-rw-r--    1 root        xorp         10057 Apr  9 08:43 pica.conf.06
-rw-rw-r--    1 root        xorp         11796 Apr  9 08:37 pica.conf.07
-rw-rw-r--    1 root        xorp         11796 Apr  9 07:05 pica.conf.08
-rw-rw-r--    1 root        xorp         11364 Apr  9 07:02 pica.conf.09
-rw-rw-r--    1 root        xorp         10057 Apr  9 07:02 pica.conf.10
-rw-rw-r--    1 root        xorp          9625 Apr  9 07:02 pica.conf.11
-rw-rw-r--    1 root        xorp          9322 Apr  9 07:02 pica.conf.12
-rw-rw-r--    1 root        xorp         10599 Apr  9 06:34 pica.conf.13
-rw-rw-r--    1 root        xorp          9947 Apr  9 06:34 pica.conf.14
-rw-rw-r--    1 root        xorp          9947 Apr  9 06:34 pica.conf.15
-rw-rw-r--    1 root        xorp          9848 Apr  9 06:34 pica.conf.16
-rw-rw-r--    1 root        xorp          9947 Apr  9 06:34 pica.conf.17
-rw-rw-r--    1 root        xorp         10599 Apr  9 06:33 pica.conf.18
-rw-rw-r--    1 root        xorp          9912 Apr  9 06:33 pica.conf.19
-rw-rw-r--    1 root        xorp          9702 Apr  9 06:33 pica.conf.20
-rw-rw-r--    1 root        xorp         10604 Apr  8 07:47 pica.conf.21
-rw-rw-r--    1 root        xorp         10402 Apr  8 07:47 pica.conf.22
-rw-rw-r--    1 root        xorp         10402 Apr  8 07:27 pica.conf.23
-rw-rw-r--    1 root        xorp         10390 Apr  8 06:47 pica.conf.24
-rw-rw-r--    1 root        xorp         10392 Apr  8 06:32 pica.conf.25
-rw-rw-r--    1 root        xorp         10023 Apr  8 06:25 pica.conf.26
-rw-rw-r--    1 root        xorp         10024 Apr  8 06:08 pica.conf.27
-rw-rw-r--    1 root        xorp         10305 Apr  8 03:27 pica.conf.28
-rw-rw-r--    1 root        xorp          9774 Apr  8 03:21 pica.conf.29
-rw-rw-r--    1 root        xorp          9958 Apr  8 03:20 pica.conf.30
-rw-rw-r--    1 root        xorp          9854 Apr  8 03:16 pica.conf.31
-rw-rw-r--    1 root        xorp          9567 Apr  8 03:08 pica.conf.32
-rw-rw-r--    1 root        xorp          9498 Apr  8 02:57 pica.conf.33
-rw-rw-r--    1 root        xorp          9257 Apr  7 10:52 pica.conf.34
-rw-rw-r--    1 root        xorp          9073 Apr  7 10:52 pica.conf.35
-rw-rw-r--    1 root        xorp          9311 Apr  7 10:46 pica.conf.36
-rw-rw-r--    1 root        xorp          9149 Apr  7 10:45 pica.conf.37
-rw-rw-r--    1 root        xorp         10750 Apr  9 09:32 pica_startup.boot
drwxrwxrwx    2 root        root          4096 Apr  1 02:28 root
XorPlus>
XorPlus> file compare pica/config/pica.conf pica/config/pica.conf.01
--- pica/config/pica.conf        Sat Apr  9 09:20:39 2011
+++ pica/config/pica.conf.01     Sat Apr  9 09:17:44 2011
@@ -410,8 +410,8 @@
                 interface "ge-1/1/3"
             }
             querier {
-                enable: true
-                address: 10.10.1.1
+                enable: false
+                address: 0.0.0.0
                 other-querier-timer: 1
                 version: 2
```

L2/L3 Configuration Guide

```
                    }
XorPlus>
```

Saving, Applying, and Loading Configuration Files

You can save your current configuration to a file and load or apply it later. You can **load** only a complete configuration file as your new configuration file, but you may **apply** an incomplete configuration file to your running configuration file.

```
XorPlus# save ychen.conf
Save done.
[edit]
XorPlus# load ychen.config
Possible completions:
  <text>                      Local file name
  ychen.conf                  Size: 10750, Last changed: Sat Apr  9 09:52:11 2011
XorPlus# load ychen.conf
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# apply ychen.config
Possible completions:
  <text>                      Local file name
  ychen.conf                  Size: 10750, Last changed: Sat Apr  9 09:52:11 2011
XorPlus# apply ychen.conf
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Chapter 4. Layer 2 Switching Configuration

This chapter describes the configuration steps of Layer 2 switching, including MAC address learning, LLDP, LACP, 802.1Q VLAN, flow control, mirroring, storm control, and the Spanning Tree Protocol (STP/RSTP/MSTP).

Configuring LLDP (Link Layer Discovery Protocol)

- LLDP is a standard link-layer discovery protocol which can broadcast its capability, IP address, ID, and interface name as TLVs (Type/Length/Value) in LLDPDUs (Link Layer Discovery Protocol Data Units).

- An LLDPDU includes 4 basic TLVs and several optional TLVs. Basic TLVs include the Chassis ID, Port ID, TTL, and End TLVs.

- In L2/L3, you can select the following optional TLVs:

Table 3-1. Supported TLVs of L2/L3.

TLV Name	Description
mac-phy-cfg	MAC address of the system
management-address	Management IP address of the system
port-description	The port description of system
port-vlan	The VLAN ID of the port
system-capabilities	System capability (e.g. switching, routing)
system-description	System description
system-name	System name

(1) Configuring the LLDP mode

LLDP supports 4 modes: TxRx, Tx_only, Rx_only, and Disabled. In TxRx mode, the system transmits *and* receives LLDPDUs. In Tx_only, the system only transmits LLDPDUs. In Rx_only, the system only receives LLDPDUs. In Disabled, the system will not transmit or receive any LLDPDUs.

You can configure the system as shown below:

```
XorPlus# set protocols lldp enable true
[edit]
XorPlus# set protocols lldp interface ge-1/1/1 status tx_rx
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Selecting optional TLVs

```
XorPlus# set protocols lldp tlv-select mac-phy-cfg true
[edit]
XorPlus# set protocols lldp tlv-select management-address true
[edit]
XorPlus# set protocols lldp tlv-select port-description true
[edit]
XorPlus# set protocols lldp tlv-select system-capabilities true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Displaying LLDP information

```
XorPlus# show protocols lldp
Waiting for building configuration.
    enable: true
    tlv-select {
    }
```

(4) Configuring other parameters

You can configure other parameters (e.g. advertisement-interval, hold-time-multiplier, reinit-delay, transmit-delay) in a similar manner.

Static Link Aggregation Configuration

- You can configure up to 24 LAGs in L2/L3, and each LAG can have up to 8 member ports.

- Both static and LACP LAGs can support the hashing of traffic using the Src/Dst MAC address, the Src/Dst IP address, and Layer 4 port information.

- If all member ports of a LAN are link-down, the LAG will be link-down. The LAG will become link-up when at least one member port is link-up.

- The logical function and configuration of LAGs are same as those of a physical port.

(1) Configuring static LAGs

```
XorPlus# set interface aggregate-ethernet ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 ether-options 802.3ad ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 ether-options 802.3ad ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 ether-options 802.3ad ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 ether-options 802.3ad ae1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Displaying static LAG information

```
XorPlus# run show interface aggregate-ethernet ae1
Physical interface: ae1, Enabled, Physical link is Up
Interface index: 53
Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Current address: c8:0a:a9:9e:14:9f, Hardware address: c8:0a:a9:9e:14:9f
Traffic statistics:
  Input Packets............................176
  Output Packets...........................16
  Input Octets.............................12888
  Output Octets............................1594
Aggregated link protocol: STATIC
  Members          Status          Port Speed
  ---------        --------        ----------
  ge-1/1/1         Down            Auto
  ge-1/1/2         Down            Auto
  ge-1/1/3         Up              Auto
  ge-1/1/4         Up              Auto
```

Link Aggregation Control Protocol (LACP) Configuration

- LACP (802.3ad) provides the dynamic link aggregation function.

- The LACPDU includes the LACP system priority, the system's MAC, the port priority and I.D. The port, included in the LACP LAG, will transmit the LACPDU to its neighbors.

- The configuration of the LACP LAG is similar to that of the static LAG.

- **min-selected-port** denotes that the LAG is up only when no fewer than the defined number of ports are up. Below, our defined number is 4.

(1) Configuring LACP LAGs

```
XorPlus# set interface aggregate-ethernet ae1 aggregated-ether-options lacp enable true
[edit]
XorPlus# set interface aggregate-ethernet ae1 aggregated-ether-options min-selected-port 4
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 ether-options 802.3ad ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 ether-options 802.3ad ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 ether-options 802.3ad ae1
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 ether-options 802.3ad ae1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Displaying LACP LAG information

```
XorPlus# run show interface aggregate-ethernet ae1
Physical interface: ae1, Enabled, Physical link is Down
Interface index: 53
Description:
Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto
```

```
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Current address: 60:eb:69:d2:9c:d7, Hardware address: 60:eb:69:d2:9c:d7
Traffic statistics:
  5 sec input rate 0 bits/sec, 0 packets/sec
  5 sec output rate 0 bits/sec, 0 packets/sec
  Input Packets...........................0
  Output Packets..........................0
  Input Octets............................0
  Output Octets...........................0
Aggregated link protocol: LACP
Minimum number of selected ports: 4
  Members          Status          Port Speed
  ---------        ----------      ----------
  ge-1/1/1         up(active)      Auto
  ge-1/1/2         up(active)      Auto
  ge-1/1/3         up(active)      Auto
  ge-1/1/4         up(active)      Auto
```

Ethernet Port Configuration

You can disable and enable the Ethernet port, as well as configure its MTU, rate-limit, and flow control.

(1) Shutting down the Ethernet port

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 disable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring the MTU and rate-limit

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 rate-limiting egress kilobits 10000
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 mtu 1200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Enabling port flow control

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 ether-options flow-control true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring port speed

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 speed 100
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Displaying port information

```
XorPlus# run show interface gigabit-ethernet ge-1/1/1 detail
Physical interface: ge-1/1/1, Enabled, Physical link is Up
Interface index: 1
Link-level type: Ethernet, MTU: 1514, Speed: 1Gb/s, Duplex: Full
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Interface rate limit  ingress:0, egress:0
Current address: c8:0a:a9:04:49:19, Hardware address: c8:0a:a9:04:49:19
Traffic statistics:
  Input Packets............................35748
  Output Packets...........................35143881241
  Input Octets.............................3923150
  Output Octets............................2266956387852
MAC statistics:
  Multicast packets RX and TX..............199565932
  Broadcast packets RX and TX..............4968094
  Undersize packets RX and TX..............0
  Fragments packets RX and TX..............0
  Packets RX and TX 64 Octets..............35088774487
  Packets RX and TX 65-127 Octets..........27771
  Packets RX and TX 128-255 Octets.........2574126
  Packets RX and TX 256-511 Octets.........52540605
  Packets RX and TX 512-1023 Octets........0
  Packets RX and TX 1024-1518 Octets.......0
XorPlus# run clear interface statistics all
```

Storm Control in Ethernet Port Configuration

You can configure unicast, multicast, and broadcast storm control in packets per second.

(1) Configuring storm control

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 storm-control broadcast pps 10000
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 storm-control multicast pps 10000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Static MAC entries and Dynamic MAC Address Learning

You can configure a static MAC entry in the FDB, and manage dynamic MAC address learning (e.g. configuring aging time, deleting the dynamic MAC address entry).

(1) Configuring a static MAC entry and managing the FDB

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 static-ethernet-switching mac-address
22:22:22:22:22:22 vlan 1
[edit]
XorPlus# set interface ethernet-switching-options mac-table-aging-time 60
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show ethernet-switching table
Total entries in switching table:   2
Static entries in switching table:  0
Dynamic entries in switching table: 2
VLAN    MAC address          Type      Age      Interfaces
----    -----------------    -------   ----     ----------
1       00:22:be:96:f2:83    Dynamic   60       ge-1/1/1
1       00:22:be:96:f2:84    Dynamic   60       ge-1/1/2

XorPlus# run clear ethernet-switching table all
XorPlus# run show ethernet-switching table
Total entries in switching table:   0
Static entries in switching table:  0
Dynamic entries in switching table: 0
VLAN    MAC address          Type      Age      Interfaces
----    -----------------    -------   ----     ----------

XorPlus#
```

Cut-through Mode Configuration

By default, the switch forwards the packets in cut-through switching mode. You can configure the switch to store-and-forward mode with the commands below.

(1) Configuring your switch to store-and-forward mode

```
XorPlus# set interface cut_through_mode false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring Mirroring

You can configure one (1) mirror to analyze traffic. Configure the source/destination port (also called the input/output port).

(1)   Configuring a mirror to analyze traffic

```
XorPlus# set interface ethernet-switching-options analyzer 111 input egress ge-1/1/1
[edit]
XorPlus# set interface ethernet-switching-options analyzer 111 input ingress ge-1/1/1
[edit]
XorPlus# set interface ethernet-switching-options analyzer 111 input egress ge-1/1/2
[edit]
XorPlus# set interface ethernet-switching-options analyzer 111 input ingress ge-1/1/2
[edit]
XorPlus# set interface ethernet-switching-options analyzer 111 output  ge-1/1/3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

```
XorPlus# run show analyzer 111
Analyzer name: 111
Output interface: <ge-1/1/3>
Ingress monitored interfaces: <ge-1/1/1> <ge-1/1/2>
Egress monitored interfaces: <ge-1/1/1> <ge-1/1/2>
XorPlus#
```

The output port does not belong to any VLAN, and will not participate in Layer 2 or Layer 3 forwarding.

802.1Q Basic Port Configuration

- IEEE 802.1Q, or VLAN tagging, is a networking standard that defines VLAN. You can configure a port as either a trunk or access port, and with the native VLAN ID. You can also add the port to more than one VLAN if the port is in trunk mode.

- Access ports belong to native VLANs, while trunk ports can belong to more than one VLAN (including the native VLAN.)

(1) Configuring the access/trunk mode

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring the native VLAN ID
The native VLAN ID is the ID of default VLAN that the port belongs to. Every port should be included in at least one VLAN.

```
XorPlus# set vlans vlan-id 5
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 5
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show vlans vlan-id 5
VLAN ID: 5
VLAN Name: default
Description:
vlan-interface:
Number of member ports: 1
Tagged port: None
Untagged port: ge-1/1/1,
XorPlus#
```

(3) Adding a port to a VLAN

```
XorPlus# set vlans vlan-id 5
[edit]
XorPlus# set vlans vlan-id 6
[edit]
XorPlus# set vlans vlan-id 7
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 5
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 6
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 7
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show vlans
VlanID   Tag        Interfaces
------   --------   ----------------------------------------------------
1        tagged
         untagged   ge-1/1/2,  ge-1/1/3,  ge-1/1/4,  ge-1/1/5,  ge-1/1/6,
                    ge-1/1/7,  ge-1/1/8,  ge-1/1/9,  ge-1/1/10, ge-1/1/11,
                    ge-1/1/12, ge-1/1/13, ge-1/1/14, ge-1/1/15, ge-1/1/16,
                    ge-1/1/17, ge-1/1/18, ge-1/1/19, ge-1/1/20, ge-1/1/21,
                    ge-1/1/22, ge-1/1/23, ge-1/1/24, ge-1/1/25, ge-1/1/26,
                    ge-1/1/27, ge-1/1/28, ge-1/1/29, ge-1/1/30, ge-1/1/31,
                    ge-1/1/32, ge-1/1/33, ge-1/1/34, ge-1/1/35, ge-1/1/36,
                    ge-1/1/37, ge-1/1/38, ge-1/1/39, ge-1/1/40, ge-1/1/41,
                    ge-1/1/42, ge-1/1/43, ge-1/1/44, ge-1/1/45, ge-1/1/46,
                    ge-1/1/47, ge-1/1/48, te-1/1/49, te-1/1/50, te-1/1/51,
                    te-1/1/52,
5        tagged     ge-1/1/2,
         untagged   ge-1/1/1
6        tagged     ge-1/1/2,
         untagged
7        tagged     ge-1/1/2,
         untagged
XorPlus#
```

(4) Creating a VLAN within the VLAN range

You can create VLANs within the VLAN range, and then add ports to these VLANs.

```
XorPlus# set vlans vlan-id 2-4094
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 1-4094
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 1-4094
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 1-4094
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

VLAN Configuration Example

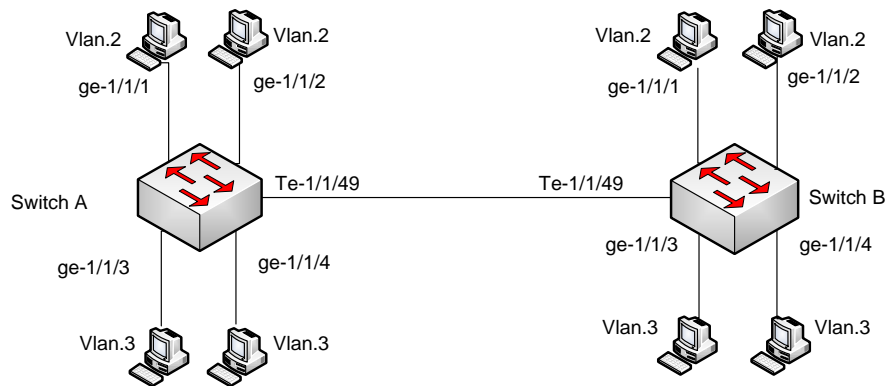In the following topology, the VLANs are configured for each switch.

Figure 4-1. VLAN configuration.

(1) Configuring Switch A

For Switch A, you should configure ge-1/1/1~ge-1/1/4 as access ports and te-1/1/49 as the trunk port, because the 10Gbit link will trunk the traffic of VLAN-2 and VLAN-3.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 2
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show vlans
VlanID   Tag        Interfaces
------   --------   --------------------------------------------------
1        tagged
         untagged   ge-1/1/5,  ge-1/1/6,  ge-1/1/7,  ge-1/1/8,  ge-1/1/9,
                    ge-1/1/10, ge-1/1/11, ge-1/1/12, ge-1/1/13, ge-1/1/14,
                    ge-1/1/15, ge-1/1/16, ge-1/1/17, ge-1/1/18, ge-1/1/19,
                    ge-1/1/20, ge-1/1/21, ge-1/1/22, ge-1/1/23, ge-1/1/24,
                    ge-1/1/25, ge-1/1/26, ge-1/1/27, ge-1/1/28, ge-1/1/29,
                    ge-1/1/30, ge-1/1/31, ge-1/1/32, ge-1/1/33, ge-1/1/34,
                    ge-1/1/35, ge-1/1/36, ge-1/1/37, ge-1/1/38, ge-1/1/39,
```

```
                          ge-1/1/40, ge-1/1/41, ge-1/1/42, ge-1/1/43, ge-1/1/44,
                          ge-1/1/45, ge-1/1/46, ge-1/1/47, ge-1/1/48, te-1/1/49,
                          te-1/1/50, te-1/1/51, te-1/1/52,
2        tagged      te-1/1/49,
         untagged    ge-1/1/1,  ge-1/1/2,
3        tagged      te-1/1/49,
         untagged    ge-1/1/3,  ge-1/1/4,
XorPlus#
```

(2) Configuring Switch B

For Switch B, configure ge-1/1/1~ge-1/1/4 as access ports and te-1/1/49 as the trunk port, because the 10Gbit link will trunk the traffic of VLAN-2 and VLAN-3.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching port-mode access
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 2
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show vlans
VlanID   Tag          Interfaces
------   --------     --------------------------------------------------
1        tagged
         untagged    ge-1/1/5,  ge-1/1/6,  ge-1/1/7,  ge-1/1/8,  ge-1/1/9,
                     ge-1/1/10, ge-1/1/11, ge-1/1/12, ge-1/1/13, ge-1/1/14,
                     ge-1/1/15, ge-1/1/16, ge-1/1/17, ge-1/1/18, ge-1/1/19,
                     ge-1/1/20, ge-1/1/21, ge-1/1/22, ge-1/1/23, ge-1/1/24,
                     ge-1/1/25, ge-1/1/26, ge-1/1/27, ge-1/1/28, ge-1/1/29,
                     ge-1/1/30, ge-1/1/31, ge-1/1/32, ge-1/1/33, ge-1/1/34,
                     ge-1/1/35, ge-1/1/36, ge-1/1/37, ge-1/1/38, ge-1/1/39,
                     ge-1/1/40, ge-1/1/41, ge-1/1/42, ge-1/1/43, ge-1/1/44,
                     ge-1/1/45, ge-1/1/46, ge-1/1/47, ge-1/1/48, te-1/1/49,
                     te-1/1/50, te-1/1/51, te-1/1/52,
2        tagged      te-1/1/49,
         untagged    ge-1/1/1,  ge-1/1/2,
3        tagged      te-1/1/49,
         untagged    ge-1/1/3,  ge-1/1/4,
```

Q-in-Q Basic Port Configuration

- Q-in-Q tunneling allows service providers on Ethernet access networks to extend a Layer 2 Ethernet connection between two customer sites. You can also use Q-in-Q tunneling to segregate or bundle customer traffic into fewer VLANs, or different VLANs, by adding another layer of 802.1Q tags.

- Q-in-Q tunneling is useful when customers have overlapping VLAN IDs, because the customer's 802.1Q VLAN tags are prepended by the service VLAN tag. The L2/L3 implementation of Q-in-Q tunneling supports the IEEE 802.1ad standard.

- The Q-in-Q tunneling external mode belongs to basic Q-in-Q, while the Q-in-Q tunneling internal mode belongs to selective Q-in-Q.

(1) Configuring the Q-in-Q tunneling internal/external mode

By default, Q-in-Q is disabled. You can enable it as shown below:

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
internal
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling mode
external
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Q-in-Q tunneling to map ingress customer VLANs to service VLANs

Selective Q-in-Q tunneling allows you to add different customer VLAN tags, based on different service VLAN tags.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling mode
internal
[edit]

XorPlus# set vlans dot1q-tunneling ingress t1 from untag enabled true
XorPlus# set vlans dot1q-tunneling ingress t1 then customer-vlan 10
XorPlus# set vlans dot1q-tunneling ingress t1 then service-vlan 100
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t1
XorPlus# commit
```

```
XorPlus# set vlans dot1q-tunneling ingress t2 from one-tag customer-vlan-list 20
XorPlus# set vlans dot1q-tunneling ingress t2 then service-vlan 200
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t2
XorPlus# commit

XorPlus# set vlans dot1q-tunneling ingress t3 from one-tag customer-vlan-list 30
XorPlus# set vlans dot1q-tunneling ingress t3 then service-vlan 300
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t3
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show interface gigabit-ethernet ge-1/1/1 dot1q-tunneling
Dot1q Tunneling Mode: none, Ether Type: 0x8100
    Ingress: t1
        Untagged-type Enabled: true
        One-tagged-type Customer Vlan:
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 100
        New Customer Vlan: 10
    Ingress: t2
        Untagged-type Enabled: false
        One-tagged-type Customer Vlan: 20
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 200
        New Customer Vlan: 0
    Ingress: t3
        Untagged-type Enabled: false
        One-tagged-type Customer Vlan: 30
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 300
        New Customer Vlan: 0
XorPlus#
```

(3) Configuring Q-in-Q tunneling egress pop service VLANs

Selective Q-in-Q tunneling allows you to delete different customer VLAN tags, based on different service VLAN tags.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 100
[edit]

XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling mode
internal
```

```
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t1 from customer-vlan 10
XorPlus# set vlans dot1q-tunneling egress t1 from service-vlan 100
XorPlus# set vlans dot1q-tunneling egress t1 then action none
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t1
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t2 from customer-vlan 20
XorPlus# set vlans dot1q-tunneling egress t2 from service-vlan 200
XorPlus# set vlans dot1q-tunneling egress t2 then action one
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t2
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t3 from customer-vlan 30
XorPlus# set vlans dot1q-tunneling egress t3 from service-vlan 300
XorPlus# set vlans dot1q-tunneling egress t3 then action one
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t3
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show interface gigabit-ethernet ge-1/1/1 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
    Egress: t1
        Service Vlan: 100
        Customer Vlan: 10
        Action: Strip both tags
    Egress: t2
        Service Vlan: 200
        Customer Vlan: 20
        Action: Retain the customer vlan tag
    Egress: t3
        Service Vlan: 300
        Customer Vlan: 30
        Action: Retain the customer vlan tag
XorPlus#
```

Q-in-Q Configuration Example

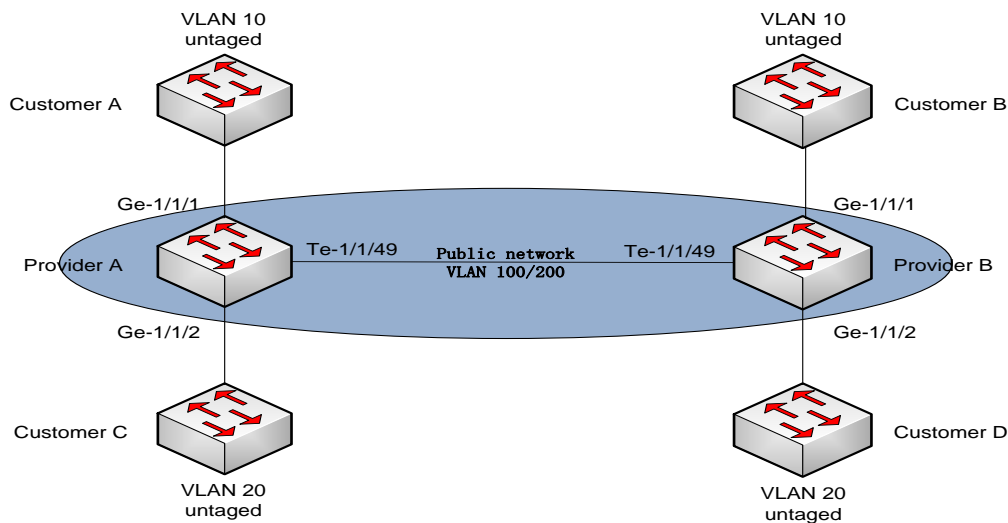The configuration of Q-in-Q is shown in Fig. 4-2.

Figure 4-2. Q-in-Q configuration.

(1) Configuration on Provider A

- Configure VLAN 100 as the default VLAN of GigabitEthernet ge-1/1/1, and enable the Q-in-Q tunneling internal mode on GigabitEthernet ge-1/1/1.

- Configure the untagged frames received by the port with the customer VLAN tag 30 and service VLAN Tag 100.

- Configure the customer VLAN tag 10 frames received by the port with the service VLAN Tag 100.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 100
[edit]

XorPlus# set vlans dot1q-tunneling ingress t1 from untag enabled true
XorPlus# set vlans dot1q-tunneling ingress t1 then customer-vlan 30
XorPlus# set vlans dot1q-tunneling ingress t1 then service-vlan 100
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t1
XorPlus# commit

XorPlus# set vlans dot1q-tunneling ingress t2 from one-tag customer-vlan-list 10
XorPlus# set vlans dot1q-tunneling ingress t2 then service-vlan 100
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t2
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t3 from customer-vlan 10
XorPlus# set vlans dot1q-tunneling egress t3 from service-vlan 100
XorPlus# set vlans dot1q-tunneling egress t3 then action one
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t3
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t4 from customer-vlan 30
XorPlus# set vlans dot1q-tunneling egress t4 from service-vlan 100
```

```
XorPlus# set vlans dot1q-tunneling egress t4 then action none
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t4
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling mode
internal
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show interface gigabit-ethernet ge-1/1/1 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
    Ingress: t1
        Untagged-type Enabled: true
        One-tagged-type Customer Vlan:
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 100
        New Customer Vlan: 30
    Ingress: t2
        Untagged-type Enabled: false
        One-tagged-type Customer Vlan: 10
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 100
        New Customer Vlan: 0
    Egress: t3
        Service Vlan: 100
        Customer Vlan: 10
        Action: Retain the customer vlan tag
    Egress: t4
        Service Vlan: 100
        Customer Vlan: 30
        Action: Strip both tags
XorPlus#
```

- Configure VLAN 200 as the default VLAN of GigabitEthernet ge-1/1/2, and enable the Q-in-Q tunneling internal mode on GigabitEthernet ge-1/1/2.

- Configure the untagged frames received by the port with the customer VLAN tag 30 and service VLAN Tag 200.

- Configure the customer VLAN tag 20 frames received by the port with the service VLAN Tag 200.

```
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 200
[edit]

XorPlus# set vlans dot1q-tunneling ingress t5 from untag enabled true
XorPlus# set vlans dot1q-tunneling ingress t5 then customer-vlan 30
XorPlus# set vlans dot1q-tunneling ingress t5 then service-vlan 200
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
ingress t5
XorPlus# commit

XorPlus# set vlans dot1q-tunneling ingress t6 from one-tag customer-vlan-list 20
XorPlus# set vlans dot1q-tunneling ingress t6 then service-vlan 200
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
ingress t6
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t7 from customer-vlan 20
```

```
XorPlus# set vlans dot1q-tunneling egress t7 from service-vlan 200
XorPlus# set vlans dot1q-tunneling egress t7 then action one
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
egress t7
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t8 from customer-vlan 30
XorPlus# set vlans dot1q-tunneling egress t8 from service-vlan 200
XorPlus# set vlans dot1q-tunneling egress t8 then action none
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
egress t8
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling mode
internal

XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show interface gigabit-ethernet ge-1/1/2 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
    Ingress: t5
        Untagged-type Enabled: true
        One-tagged-type Customer Vlan:
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 200
        New Customer Vlan: 30
    Ingress: t6
        Untagged-type Enabled: false
        One-tagged-type Customer Vlan: 20
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 200
        New Customer Vlan: 0
    Egress: t7
        Service Vlan: 200
        Customer Vlan: 20
        Action: Retain the customer vlan tag
    Egress: t8
        Service Vlan: 200
        Customer Vlan: 30
        Action: Strip both tags
XorPlus#
```

Configure VLAN 100/200 as the trunk port of GigabitEthernet te-1/1/49, and enable the Q-in-Q tunneling internal mode.

```
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching dot1q-tunneling mode
internal
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show interface gigabit-ethernet te-1/1/49 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
XorPlus#
```

(2) Configuration on Provider B
- Configure VLAN 100 as the default VLAN of GigabitEthernet ge-1/1/1, and enable the Q-in-Q tunneling internal mode on GigabitEthernet ge-1/1/1.

- Configure the untagged frames received by the port with the customer VLAN tag 30 and service VLAN Tag 100.

- Configure the customer VLAN tag 10 frames received by the port with the service VLAN Tag 100.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 100
[edit]

XorPlus# set vlans dot1q-tunneling ingress t1 from untag enabled true
XorPlus# set vlans dot1q-tunneling ingress t1 then customer-vlan 30
XorPlus# set vlans dot1q-tunneling ingress t1 then service-vlan 100
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t1
XorPlus# commit

XorPlus# set vlans dot1q-tunneling ingress t2 from one-tag customer-vlan-list 10
XorPlus# set vlans dot1q-tunneling ingress t2 then service-vlan 100
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
ingress t2
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t3 from customer-vlan 10
XorPlus# set vlans dot1q-tunneling egress t3 from service-vlan 100
XorPlus# set vlans dot1q-tunneling egress t3 then action one
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t3
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t4 from customer-vlan 30
XorPlus# set vlans dot1q-tunneling egress t4 from service-vlan 100
XorPlus# set vlans dot1q-tunneling egress t4 then action none
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling
egress t4
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching dot1q-tunneling mode
internal

XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show interface gigabit-ethernet ge-1/1/1 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
    Ingress: t1
        Untagged-type Enabled: true
        One-tagged-type Customer Vlan:
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 100
        New Customer Vlan: 30
    Ingress: t2
        Untagged-type Enabled: false
        One-tagged-type Customer Vlan: 10
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 100
```

```
        New Customer Vlan: 0
    Egress: t3
        Service Vlan: 100
        Customer Vlan: 10
        Action: Retain the customer vlan tag
    Egress: t4
        Service Vlan: 100
        Customer Vlan: 30
        Action: Strip both tags
XorPlus#
```

● Configure VLAN 200 as the default VLAN of GigabitEthernet ge-1/1/2, and enable the Q-in-Q tunneling internal mode on GigabitEthernet 1/1/2.

● Configure the untagged frames received by the port with the customer VLAN tag 30 and service VLAN Tag 200.

● Configure the customer VLAN tag 20 frames received by the port with the service VLAN Tag 200.

```
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 200
[edit]

XorPlus# set vlans dot1q-tunneling ingress t5 from untag enabled true
XorPlus# set vlans dot1q-tunneling ingress t5 then customer-vlan 30
XorPlus# set vlans dot1q-tunneling ingress t5 then service-vlan 200
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
ingress t5
XorPlus# commit

XorPlus# set vlans dot1q-tunneling ingress t6 from one-tag customer-vlan-list 20
XorPlus# set vlans dot1q-tunneling ingress t6 then service-vlan 200
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
ingress t6
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t7 from customer-vlan 20
XorPlus# set vlans dot1q-tunneling egress t7 from service-vlan 200
XorPlus# set vlans dot1q-tunneling egress t7 then action one
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
egress t7
XorPlus# commit

XorPlus# set vlans dot1q-tunneling egress t8 from customer-vlan 30
XorPlus# set vlans dot1q-tunneling egress t8 from service-vlan 200
XorPlus# set vlans dot1q-tunneling egress t8 then action none
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling
egress t8
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching dot1q-tunneling mode
internal

XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show interface gigabit-ethernet ge-1/1/2 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
    Ingress: t5
        Untagged-type Enabled: true
```

```
        One-tagged-type Customer Vlan:
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 200
        New Customer Vlan: 30
    Ingress: t6
        Untagged-type Enabled: false
        One-tagged-type Customer Vlan: 20
        Double-tagged-type Service Vlan: 0
        New Service Vlan: 200
        New Customer Vlan: 0
    Egress: t7
        Service Vlan: 200
        Customer Vlan: 20
        Action: Retain the customer vlan tag
    Egress: t8
        Service Vlan: 200
        Customer Vlan: 30
        Action: Strip both tags
XorPlus#
```

Configure VLAN 100/200 as the trunk port of GigabitEthernet te-1/1/49, and enable the Q-in-Q tunneling internal mode.

```
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching dot1q-tunneling mode
internal
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show interface gigabit-ethernet te-1/1/49 dot1q-tunneling
Dot1q Tunneling Mode: internal, Ether Type: 0x8100
XorPlus#
```

MSTP Configuration

802.1D, 802.1w, and 802.1s are spanning tree protocols that can avoid the loop in Layer 2. You can configure the parameters of MSTP, including bridge-priority, forward-delay, max-age, and hello-time interval.

(1) Enabling spanning tree mode in MSTP

```
XorPlus# set protocols spanning-tree force-version 3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring basic global parameters of MSTP
When configuring global parameters, make sure to set the forward delay as greater than MaxAge/2 + 1, or the commit will fail.

```
XorPlus# set protocols spanning-tree mstp bridge-priority 4096
[edit]
```

```
XorPlus# set protocols spanning-tree mstp forward-delay 20
[edit]
XorPlus# set protocols spanning-tree mstp hello-time 2
[edit]
XorPlus# set protocols spanning-tree mstp max-age 20
[edit]
XorPlus# set protocols spanning-tree mstp max-hops 8
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name test1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show spanning-tree mstp bridge
Bridge Spanning Tree Parameters
  Enabled Protocol: MSTP
  Root ID: 4096.08:9e:01:39:1a:fe
  External Root Path Cost: 0
  CIST Regional Root ID: 4096.08:9e:01:39:1a:fe
  Root Port:
  CIST Internal Root Path Cost: 0
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 20
  Remaining Hops: 8
  Bridge Configuration Name: test1
  Bridge Configuration Digest: ac36177f50283cd4b83821d8ab26de62
  Number of Topology Changes: 13
  Time Since Last Topology Change: 0 days 00:00:31
Local Parameters
  Bridge ID:  4096.08:9e:01:39:1a:fe
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 20
  Remaining Hops: 8
XorPlus#
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 1
[edit]
XorPlus# set protocols spanning-tree mstp msti 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 300
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 400
[edit]
```

```
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show spanning-tree mstp bridge
Bridge Spanning Tree Parameters
  Enabled Protocol: MSTP
  Root ID: 4096.08:9e:01:39:1a:fe
  External Root Path Cost: 0
  CIST Regional Root ID: 4096.08:9e:01:39:1a:fe
  Root Port:
  CIST Internal Root Path Cost: 0
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 20
  Remaining Hops: 8
  Bridge Configuration Name: test1
  Bridge Configuration Digest: 8b5d98ca042bad0d7fa5f18744f4755d
  Msti 1 Member VLANs:
      100, 200,
  Msti 2 Member VLANs:
      300, 400,
  Number of Topology Changes: 14
  Time Since Last Topology Change: 0 days 00:02:49
Local Parameters
  Bridge ID:  4096.08:9e:01:39:1a:fe
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 20
  Remaining Hops: 8
XorPlus#
```

(3) Configuring MSTP interface parameters

```
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 external-path-cost 30000
[edit]
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 internal-path-cost 10000
[edit]
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 edge true
[edit]
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 mode point-to-point
[edit]
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 port-priority 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show spanning-tree mstp interface
Spanning Tree Interface Parameters for Instance 0
Interface   Port ID    Designated   Designated Bridge       Ext Port   Int Port   State
Role
                       Port ID      ID                      Cost       Cost
----------  ---------  ----------   ----------------------  ---------  ---------  ----------  ---
---
ge-1/1/1    96.1       96.1         8192.08:9e:01:39:1a:fe  30000      10000      FORWARDING
EDGE
```

(4) Configuring the BPDU Filter
The BPDU filter prevents the bridge from using BPDUs for STP calculations. The switch will then ignore
any BPDUs that it receives.

```
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 bpdu-filter true
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Configuring BPDU root guard

If a switch port receives a higher bridge-priority BPDU, it will ignore the BPDU and keep the current root-bridge as the root-bridge.

```
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 root-guard true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(6) Configuring BPDU TCN-guard

When a port is configured with TCN-guard, the port does not process and propagate any topological change-related information received on the configured port.

```
XorPlus# set protocols spanning-tree mstp interface ge-1/1/1 tcn-guard true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(7) Disabling/enabling MSTP

If you disable MSTP, the port will stay in forwarding status and cease to send BPDUs.

```
XorPlus# set protocols spanning-tree enable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#

XorPlus# run show spanning-tree mstp interface
Spanning Tree Interface Parameters for Instance 0
Interface  Port ID  Designated Designated Bridge      Ext Port  Int Port  State       Role
                    Port ID    ID                      Cost      Cost
---------  -------  ---------- ----------------------- --------  --------  ----------  ---------
----
ge-1/1/1   96.1     96.1       8192.08:9e:01:39:1a:fe  30000     10000     FORWARDING  MSTP
DISABLED
ge-1/1/2   128.2    128.2      8192.08:9e:01:39:1a:fe  20000     20000     FORWARDING  MSTP
DISABLED
ge-1/1/13  128.13   128.13     8192.08:9e:01:39:1a:fe  20000     20000     FORWARDING  MSTP
DISABLED

XorPlus# set protocols spanning-tree enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus#
XorPlus# run show spanning-tree mstp interface
Spanning Tree Interface Parameters for Instance 0
```

Interface	Port ID	Designated Port ID	Designated Bridge ID	Ext Port Cost	Int Port Cost	State	Role
ge-1/1/1	96.1	96.1	8192.08:9e:01:39:1a:fe	30000	10000	FORWARDING	EDGE
ge-1/1/2	128.2	128.2	8192.08:9e:01:39:1a:fe	20000	20000	FORWARDING	EDGE
ge-1/1/13	128.13	128.13	8192.08:9e:01:39:1a:fe	20000	20000	FORWARDING	DESIGNATED

PVST Configuration

802.1D, 802.1w, and 802.1s are spanning tree protocols that can avoid the loop in Layer 2. You can configure the parameters of PVST, including bridge-priority, forward-delay, max-age, and hello-time interval.

(1) Enabling spanning tree mode in PVST

```
XorPlus# set protocols spanning-tree force-version 4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring basic VLAN parameters of PVST
When configuring basic VLAN parameters, set the forward delay as greater than MaxAge/2 + 1, or the commit will fail.

```
XorPlus# set protocols spanning-tree pvst vlan 2 bridge-priority 4096
[edit]
XorPlus# set protocols spanning-tree pvst vlan 2 forward-delay 20
[edit]
XorPlus# set protocols spanning-tree pvst vlan 2 hello-time 4
[edit]
XorPlus# set protocols spanning-tree pvst vlan 2 max-age 30
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show spanning-tree pvst bridge vlan 2
PVST Bridge Parameters for VLAN 2
  Root Bridge: 4098.08:9e:01:61:65:71
  Root Cost: 0
  Root Port:
  Hello Time: 4
  Max Age: 30
  Forward Delay: 20
  Time Since Last Topology Change: 0 days 00:02:55
Local Parameters
  Bridge ID:  4098.08:9e:01:61:65:71
  Hello Time: 4
  Maximum Age: 30
  Forward Delay: 20
```

(3) Configuring PVST interface parameters

```
XorPlus# set protocols spanning-tree pvst vlan 2 interface ge-1/1/1 path-cost 555555
[edit]
XorPlus# set protocols spanning-tree pvst vlan 2 interface ge-1/1/1 port-priority 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show spanning-tree pvst interface vlan 2
Rapid PVST+ Spanning Tree Interface Status for VLAN 2
Interface    Port ID    Designated  Designated Bridge      Port Cost  State       Role
                        Port ID     ID
----------   ---------  ----------  ---------------------  ---------  ----------  --------------
-
ge-1/1/1     192.1      192.1        4098.08:9e:01:61:65:71  555555     FORWARDING  EDGE
```

(4) Configuring the interface mode
You can configure the interface mode as point-to-point or shared.

```
XorPlus# set protocols spanning-tree pvst interface ge-1/1/1 mode point-to-point
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree pvst interface ge-1/1/1 mode shared
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Disabling/enabling PVST on one VLAN
You can disable or enable the spanning tree protocol PVST on a single designated VLAN.

```
XorPlus# set protocols spanning-tree pvst vlan 2 enable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show spanning-tree pvst bridge vlan 2
PVST Bridge Parameters for VLAN 2
  Root Bridge: 32769.08:9e:01:61:65:71
  Root Cost: 0
  Root Port:
  Hello Time: 2
  Max Age: 20
  Forward Delay: 15
  Time Since Last Topology Change: 15804 days 23:00:11
Local Parameters
  Bridge ID:  32769.08:9e:01:61:65:71
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 15
XorPlus# set protocols spanning-tree pvst vlan 2 enable true
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show spanning-tree pvst bridge vlan 2
PVST Bridge Parameters for VLAN 2
  Root Bridge: 4098.08:9e:01:61:65:71
  Root Cost: 0
  Root Port:
  Hello Time: 4
  Max Age: 30
  Forward Delay: 20
  Time Since Last Topology Change: 0 days 00:00:21
Local Parameters
  Bridge ID:  4098.08:9e:01:61:65:71
  Hello Time: 4
  Maximum Age: 30
  Forward Delay: 20
XorPlus#
```

(6) Disabling/enabling PVST

You cannot disable the spanning tree protocol PVST with just the **enable false** command. To disable PVST, *first* configure the spanning tree mode in MSTP/RSTP/STP, then disable the spanning tree. After the spanning tree is disabled, the port will stay in "forwarding" status and cease to send BPDUs.

```
XorPlus# set protocols spanning-tree enable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit Failed
102 Command failed Cannot disable spanning tree under PVST mode[edit]
XorPlus#
XorPlus# exit discard
XorPlus> configure
Entering configuration mode.
There are no other users in configuration mode.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree force-version 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree enable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#

XorPlus# set protocols spanning-tree force-version 4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus#
XorPlus# run show spanning-tree
Bridge Spanning Tree Parameters
  Enabled Protocol: PVST
  Root ID: 32769.08:9e:01:61:65:71
  Root Path Cost: 0
  Designated Bridge ID: 32769.08:9e:01:61:65:71
  Root Port:
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 15
  Number of Topology Changes: 1
  Time Since Last Topology Change: 0 days 00:00:09
Local Parameters
  Bridge ID:  32769.08:9e:01:61:65:71
  Hello Time: 2
  Maximum Age: 20
  Forward Delay: 15
```

MSTP Configuration Example

- We provide two examples of MSTP configuration. In our first example, VLAN 100 is mapped to MSTI-1, and VLAN 200 is mapped to MSTI-2. The entire topology belongs to only one MSTP domain, named **region1**. Switch A is the root of the network.

- In order to achieve load balancing, VLAN 100 should be in MSTI-1 (Fig. 4-4), and VLAN 200 should be in MSTI-2 (Fig. 4-5).
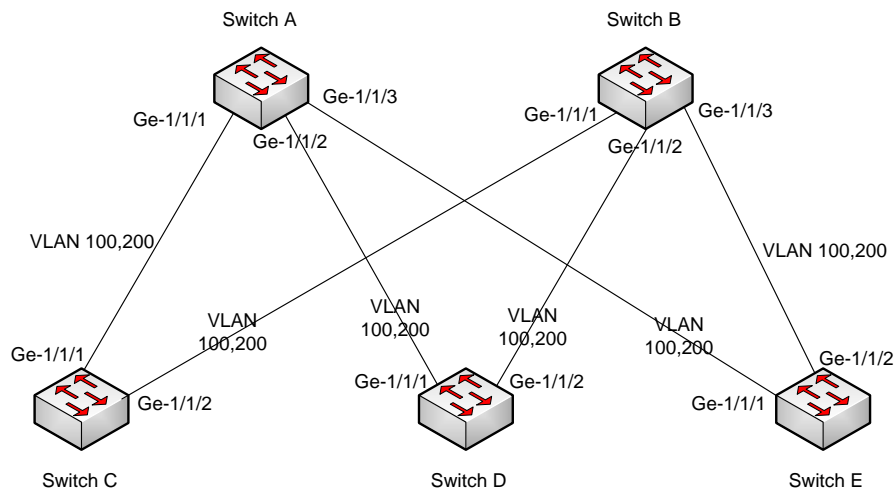

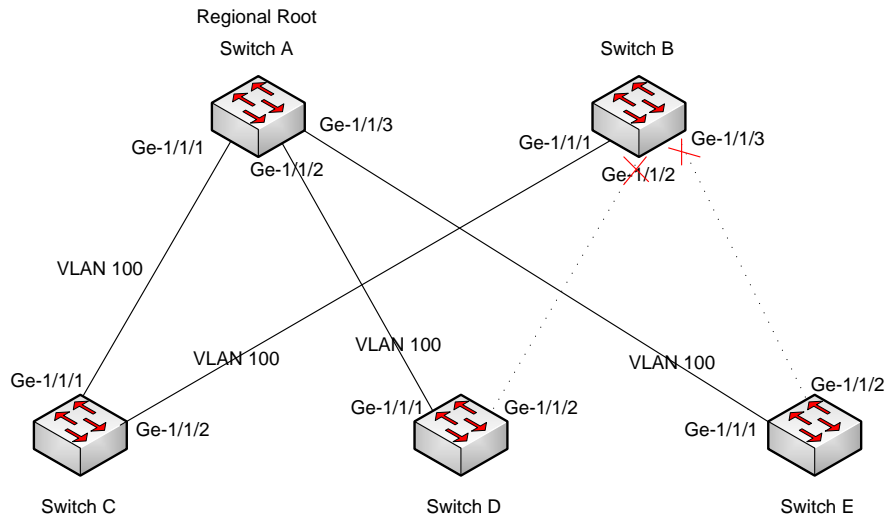**Figure 4-3. MSTP configuration.**
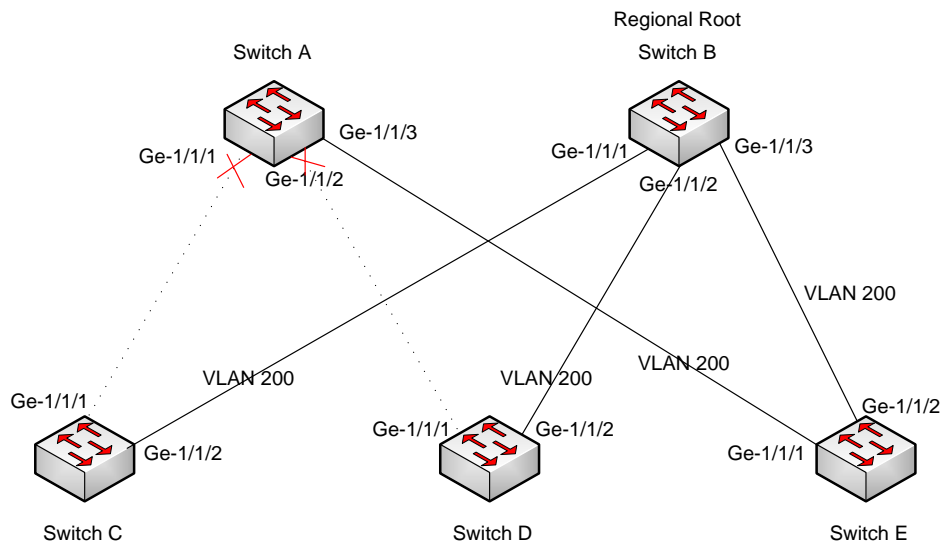
Figure 4-4. MSTI-1 topology for VLAN 100.

Figure 4-5. MSTI-2 topology for VLAN 200.

(1) Configuring Switch A

For Switch A, configure ge-1/1/1~ge-1/1/3 as trunk ports, and as members of VLAN 100 and VLAN 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
```

```
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch A is the root of the network and the regional root of MSTI-1, configure it as the higher priority.

```
XorPlus# set protocols spanning-tree mstp bridge-priority 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B
Configure ge-1/1/1~ge-1/1/3 as trunk ports, and as members of VLAN 100 and VLAN 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch B is the regional root of MSTI-2, and that ge-1/1/2 and ge-1/1/3 are in blocking status in MSTI-1, you should configure a higher MSTI-2 priority, and a large value for internal-path-cost in MSTI-1.

```
XorPlus# set protocols spanning-tree mstp msti 2 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/2 cost 10000000
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/3 cost 10000000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C
Configure ge-1/1/1~ge-1/1/2 as trunk ports, and as members of VLAN 100 and VLAN 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

- To set ge-1/1/1 and ge-1/1/2 in forwarding status in MSTI-1, configure a lower value for internal-path-cost.

- To set ge-1/1/1 in blocking status in MSTI-2, configure a higher value for internal-path-cost.

```
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/1 cost 1000
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/2 cost 1000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 interface ge-1/1/1 cost 100000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D
Configure ge-1/1/1~ge-1/1/2 as trunk ports, and as members of VLAN 100 and VLAN 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
```

```
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To set ge-1/1/1 in blocking status in MSTI-2 and ge-1/1/2 in blocking status in MSTI-1, configure a large value for internal-path-cost.

```
XorPlus# set protocols spanning-tree mstp msti 2 interface ge-1/1/1 cost 10000000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/2 cost 10000000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Configuring Switch E

Configure ge-1/1/1~ge-1/1/2 as trunk ports, and as members of VLAN 100 and VLAN 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

```
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

● To set ge-1/1/1 and ge-1/1/2 in forwarding status in MSTI-2, configure a lower value for internal-path-cost.

● To set ge-1/1/2 in blocking status in MSTI-1, configure a large value for internal-path-cost.

```
XorPlus# set protocols spanning-tree mstp msti 2 interface ge-1/1/1 cost 1000
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 interface ge-1/1/2 cost 1000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/2 cost 10000000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

● In our second example, there are two regions. In region 1, VLAN 100 is mapped to MSTI-1, VLAN 200 is mapped to MSTI-2, and VLAN 300 is mapped to MSTI-3. In region 2, VLAN 200 is mapped to MSTI-2, and VLAN 400 is mapped to MSTI-4. Switch A is the root of the entire network.

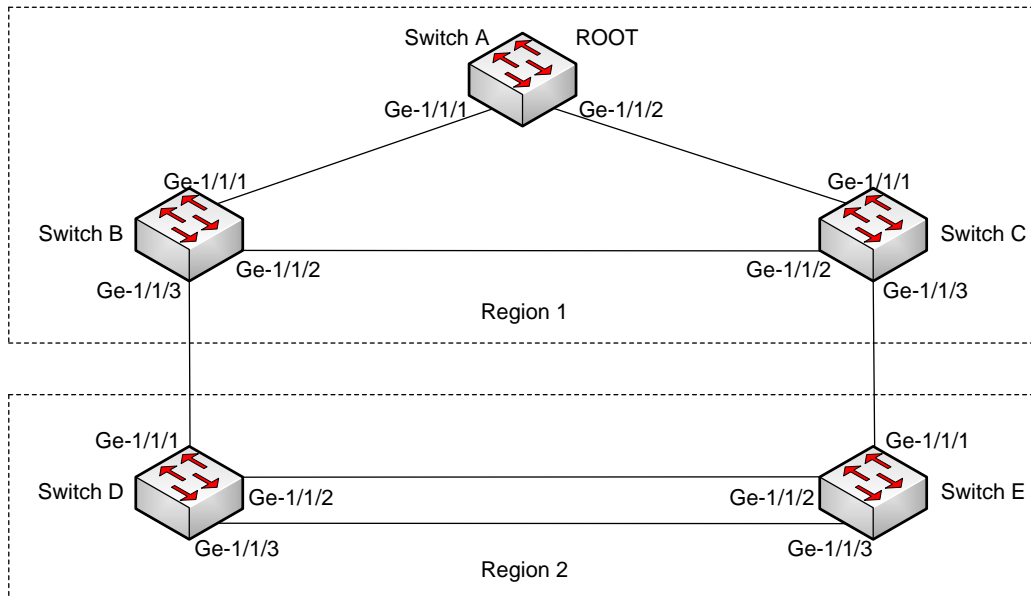● The topologies of the VLANs are presented in Fig. 4-6 through 4-10.
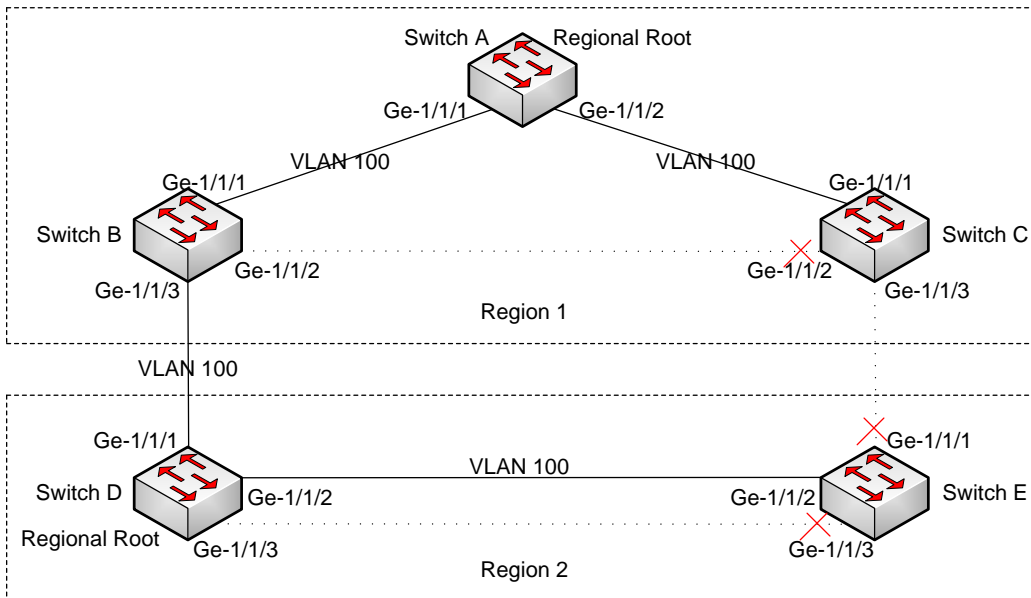
Figure 4-6. MSTP configuration.
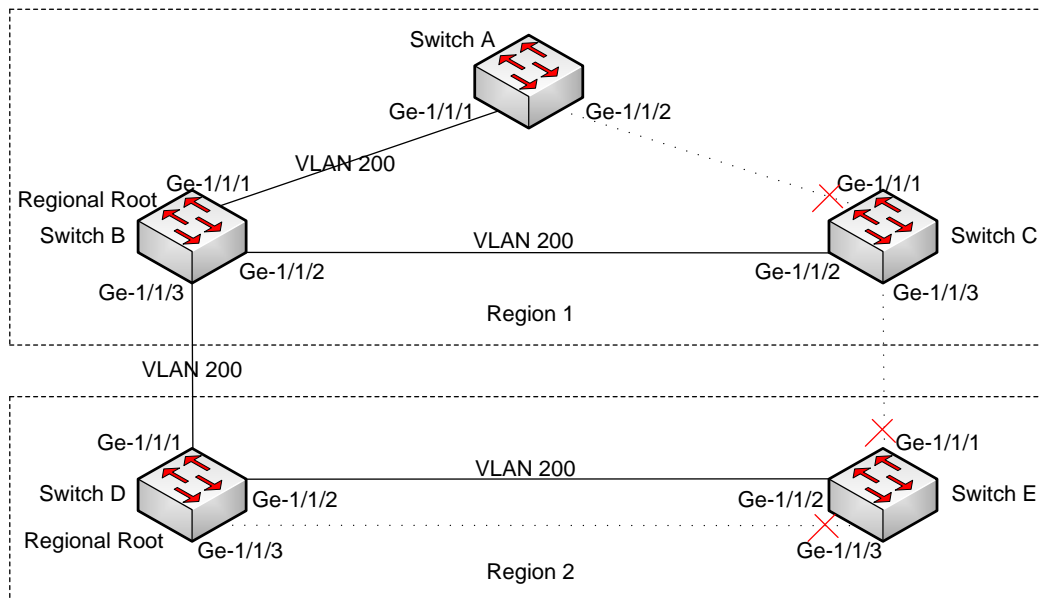

Figure 4-7. Topology for VLAN 100.

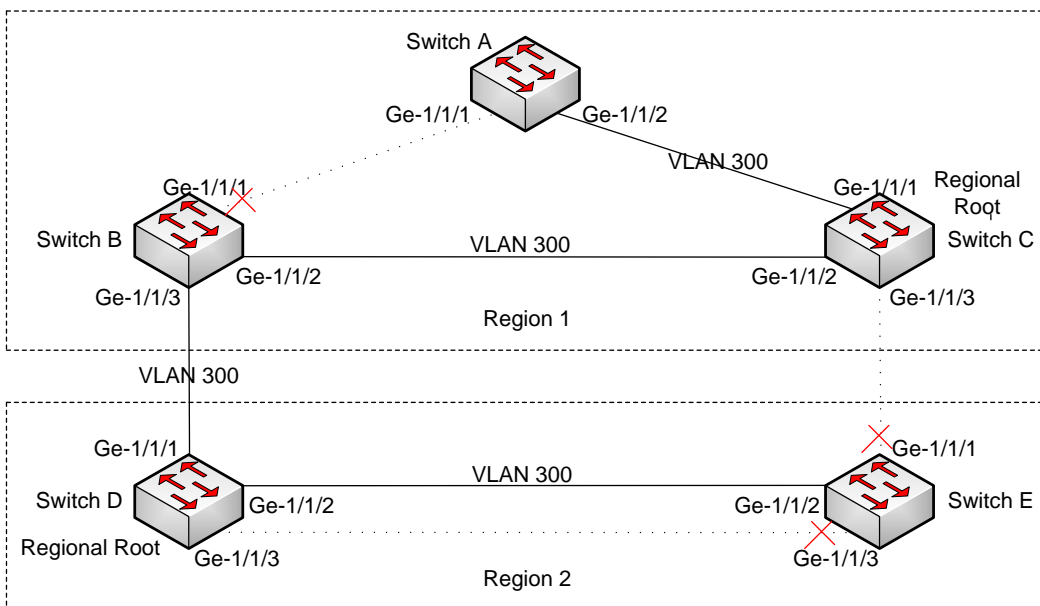**Figure 4-8. Topology for VLAN 200.**

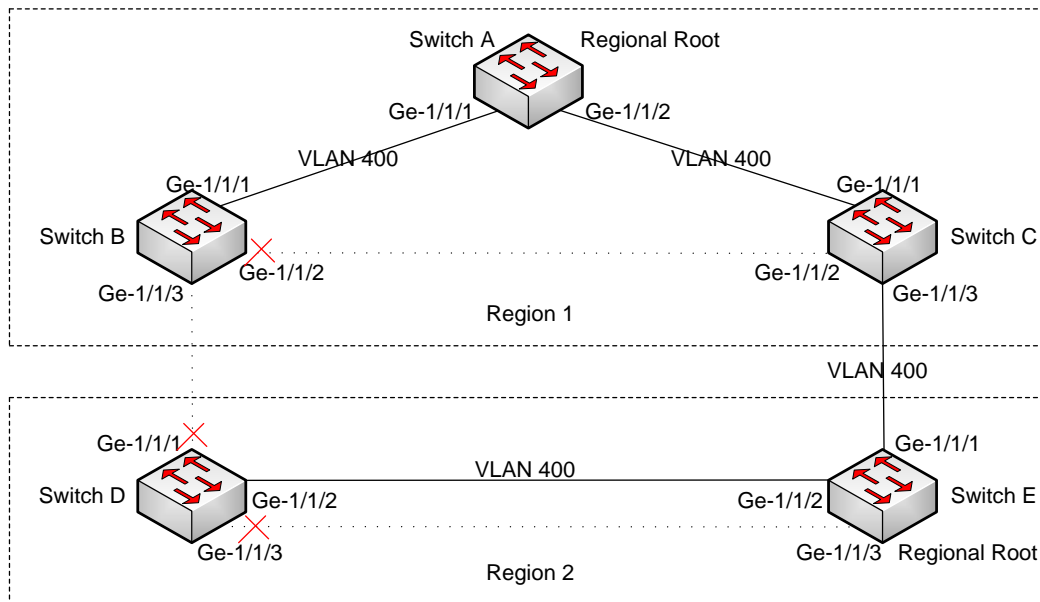**Figure 4-9. Topology for VLAN 300.**

Figure 4-10. Topology for VLAN 400.

(1) Configuring Switch A

For Switch A, configure ge-1/1/1~ge-1/1/2 as trunk ports, and as members of VLAN 100, VLAN 200, VLAN 300, and VLAN 400.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 400
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
```

```
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp msti 3 vlan 300
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch A is the root of the network and the regional root of MSTI-1, configure it as the higher priority.

```
XorPlus# set protocols spanning-tree mstp bridge-priority 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B
Configure ge-1/1/1~ge-1/1/3 as trunk ports, and as members of VLAN 100, VLAN 200, VLAN 300, and VLAN 400.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 400
[edit]
```

```
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 400
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp msti 3 vlan 300
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch B is the regional root of MSTI-2, and that ge-1/1/1 is in blocking status in MSTI-3, configure a higher MSTI-2 priority, and a large value for internal-path-cost in MSTI-3.

```
XorPlus# set protocols mstp msti 2 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols mstp msti 3 interface ge-1/1/1 cost 10000000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure ge-1/1/1~ge-1/1/3 as trunk ports, and as members of VLAN 100, VLAN 200, VLAN 300, and VLAN 400.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
```

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 400
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 1 vlan 100
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp msti 3 vlan 300
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch C is the regional root of MSTI-3, ge-1/1/1 is in blocking status in MSTI-2, and that ge-1/1/2 is in blocking status in MSTI-1, you should configure a higher MSTI-3 priority, and large values for internal-path-costs of ge-1/1/1 in MSTI-2 and ge-1/1/2 in MSTI-1.

```
XorPlus# set protocols spanning-tree mstp msti 3 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 2 interface ge-1/1/1 cost 10000000
[edit]
XorPlus# set protocols spanning-tree mstp msti 1 interface ge-1/1/2 cost 10000000
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D

Configure ge-1/1/1~ge-1/1/3 as trunk ports, and as members of VLAN 100, VLAN 200, VLAN 300, and VLAN 400.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 400
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp msti 4 vlan 400
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch D is the regional root of MSTI-2 and the root of CIST, configure a higher MSTI-2 priority and bridge priority.

```
XorPlus# set protocols spanning-tree mstp bridge-priority 16384
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols spanning-tree mstp msti 2 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Configuring Switch E
Configure ge-1/1/1~ge-1/1/3 as trunk ports, and as members of VLAN 100, VLAN 200, VLAN 300, and VLAN 400.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 400
[edit]
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree mstp msti 2 vlan 200
[edit]
XorPlus# set protocols spanning-tree mstp msti 4 vlan 400
[edit]
XorPlus# set protocols spanning-tree mstp configuration-name region2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch E is the regional root of MSTI-4, configure a higher MSTI-4 priority.

```
XorPlus# set protocols spanning-tree mstp msti 4 bridge-priority 4096
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

PVST Configuration Example

In the following topology, we provide an example of PVST configuration. Switches A and B are in the aggregation layer, and switches C and D are in the access layer. Configure switch A as the root bridge of VLAN 100 and VLAN 200, switch B as the root bridge of VLAN 300, and switch C as the root bridge of VLAN 400.
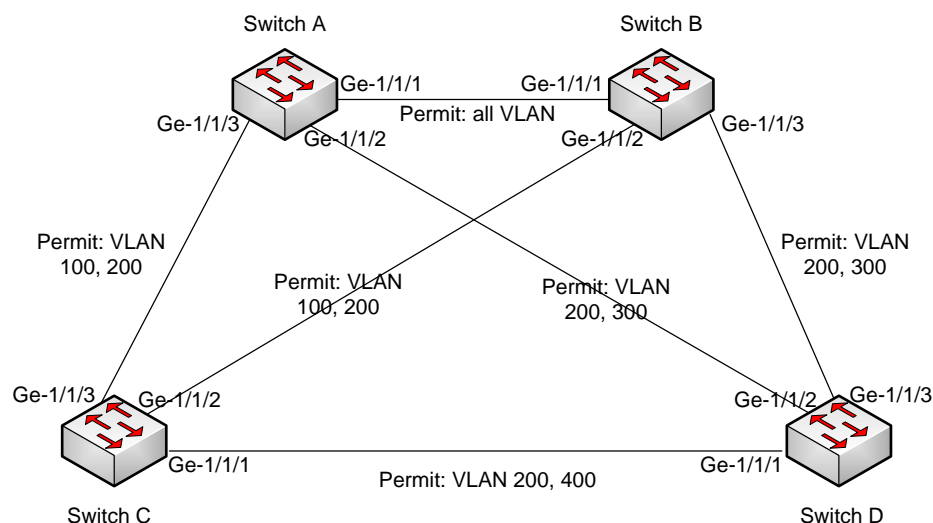

Figure 4-11. PVST configuration.

(1) Configuring Switch A

For Switch A, configure ge-1/1/1~ge-1/1/3 as trunk ports, and ge-1/1/1 as a member of VLANs 100, 200, 300, and 400; ge-1/1/2 as a member of VLANs 200 and 300; and ge-1/1/3 as a member of VLANs 100 and 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree force-version 4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch A is the root bridge of VLANs 100 and 200, configure VLANs 100 and 200 as the higher priority.

```
XorPlus# set protocols spanning-tree pvst vlan 100 bridge-priority 0
[edit]
XorPlus# set protocols spanning-tree pvst vlan 200 bridge-priority 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B
Configure ge-1/1/1~ge-1/1/3 as trunk ports, and ge-1/1/1 as a member of VLANs 100, 200, 300, and 400; ge-1/1/2 as a member of VLANs 100 and 200; and ge-1/1/3 as a member of VLANs 200 and 300.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
```

```
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 300
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree force-version 4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch B is the root bridge of VLAN 300, configure VLAN 300 as the higher priority.

```
XorPlus# set protocols spanning-tree pvst vlan 300 bridge-priority 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C
Configure ge-1/1/1~ge-1/1/3 as trunk ports, and ge-1/1/1 as a member of VLANs 200 and 400, ge-1/1/2 as a member of VLANs 100 and 200, and ge-1/1/3 as a member of VLANs 100 and 200.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree force-version 4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

To make sure that Switch C is the root bridge of VLAN 400, configure VLAN 400 as the higher priority.

```
XorPlus# set protocols spanning-tree pvst vlan 400 bridge-priority 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D

Configure ge-1/1/1~ge-1/1/3 as trunk ports, and ge-1/1/1 as a member of VLANs 200 and 400, ge-1/1/2 as a member of VLANs 200 and 300, and ge-1/1/3 as a member of VLANs 200 and 300.

```
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# set vlans vlan-id 300
[edit]
XorPlus# set vlans vlan-id 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching vlan members 400
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching vlan members 300
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 200
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching vlan members 300
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols spanning-tree force-version 4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Buffer Management Configuration

- The switch provides the buffer for burst traffic to avoid dropping packets. You can configure "cell" and "packet" to control buffer management.

- In general, you do not need to configure parameters for "cell" and "packet," because the switch contains their default parameters.

- You can configure the switch to be in burst mode for burst traffic, which will dynamically allocate the "cell" and "packet" for each port and queue.

(1) Configuring burst mode for a specified port

```
XorPlus# set interface ethernet-switching-options buffer burst-mode enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring "cell" and "packet" for a specified port

```
XorPlus# set interface ethernet-switching-options buffer cell queue 1 guaranteed-ratio 10
[edit]
XorPlus# set interface ethernet-switching-options buffer cell queue 1 shared-ratio 30
[edit]
XorPlus# set interface ethernet-switching-options buffer cell shared-ratio 50
[edit]
XorPlus# set interface ethernet-switching-options buffer cell total-shared-ratio 80
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface ethernet-switching-options buffer packet queue 1 guaranteed-ratio 10
[edit]
XorPlus# set interface ethernet-switching-options buffer packet queue 1 shared-ratio 40
[edit]
XorPlus# set interface ethernet-switching-options buffer packet shared-ratio 60
[edit]
XorPlus# set interface ethernet-switching-options buffer packet total-shared-ratio 80
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

BPDU Tunneling Configuration

As a Layer 2 tunneling technology, BPDU tunneling enables Layer 2 protocol packets from geographically dispersed customer networks to be transparently transmitted over specific tunnels across a service provider network.

(1) Configuring BPDU tunneling for STP on an interface

```
XorPlus# set interface gigabit-ethernet ge-1/1/37 family ethernet-switching bpdu-tunneling
protocol stp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring destination multicast MAC address for BPDU packets

```
XorPlus# set interface bpdu-tunneling destination-mac 01:0E:00:00:00:01
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

BPDU Tunneling Configuration Example

In the following topology, we provide an example of configuring BPDU tunneling.

Figure 4-12. BPDU Tunneling Configuration.

(1) Configuration on Provider A

Configure VLAN 100 as the default VLAN of GigabitEthernet ge-1/1/1, and enable BPDU tunneling on GigabitEthernet ge-1/1/1.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching bpdu-tunneling
protocol stp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure VLAN 200 as the default VLAN of GigabitEthernet ge-1/1/2, and enable BPDU tunneling on GigabitEthernet ge-1/1/2.

```
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching bpdu-tunneling
protocol stp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus#
```

Configure VLAN 200 as the default VLAN of GigabitEthernet te-1/1/49.

```
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

Configure the destination multicast MAC address for BPDUs as 01:0E:00:00:00:1.

```
XorPlus# set interface bpdu-tunneling destination-mac 01:0E:00:00:00:01
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuration on Provider B

Configure VLAN 100 as the default VLAN of GigabitEthernet ge-1/1/1, and enable BPDU tunneling on GigabitEthernet ge-1/1/1.

```
XorPlus# set vlans vlan-id 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 100
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching bpdu-tunneling
protocol stp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure VLAN 200 as the default VLAN of GigabitEthernet ge-1/1/2, and enable BPDU tunneling on GigabitEthernet ge-1/1/2.

```
XorPlus# set vlans vlan-id 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 200
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching bpdu-tunneling
protocol stp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure VLAN 200 as the default VLAN of GigabitEthernet te-1/1/49.

```
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching vlan members 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

Configure the destination multicast MAC address for BPDUs as 01:0E:00:00:00:1.

```
XorPlus# set interface bpdu-tunneling destination-mac 01:0E:00:00:00:01
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring Flex Links

(1) Configuring a Flex Links interface and active interface preemption delay
You can configure two physical ports or two LAGs as Flex Links, or one physical port and one LAG as Flex Links.

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 backup-port interface ae1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 backup-port delay 10
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface aggregate-ethernet ae2 backup-port interface ae3
[edit]
XorPlus# co
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

(2) Configuring the preemption mode

By default, the preemption mode is "forced," and the active interface is preferred. Beyond that, you can configure the "bandwidth" or "off" mode. The "bandwidth" mode calls for a higher bandwidth interface, and the "off" mode turns off preemption.

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 backup-port mode bandwidth
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Showing Flex Links on all interfaces

You can check the state of your Flex Links interfaces:

```
XorPlus# run show interface flexlink
Active Interface     Backup Interface    Mode        Delay(seconds)
-----------------    -----------------   ---------   --------------
ge-1/1/1(up)         ge-1/1/2(standby)   bandwidth   10
XorPlus#
```

Configuring IPv6 RA Guard

(1) Configuring the IPv6 RA guard policy

You can configure the RA guard policy with these steps: hop-limit, managed-config-flag, other-config-flag, prefix, source-ipv6-addr, and source-mac-addr.

```
XorPlus# set protocols neighbour ra-guard 1 hop-limit 1
[edit]
XorPlus# set protocols neighbour ra-guard 1 managed-config-flag false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols neighbour ra-guard 2 prefix 2001:1:1:1::/64
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols neighbour ra-guard 3 source-mac-addr 22:22:22:22:22:22
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring "trusted-port"

You can apply the RA guard to physical interfaces, LAGs, or VLANs; no more than one RA guard can be applied to one interface. The RAs will be forwarded only if all conditions are matched, but if "trusted-port" has been configured for the RA guard, then RAs will be forwarded on the trusted port regardless.

```
XorPlus# set protocols neighbour ra-guard term 1 interface ge-1/1/1
[edit]
XorPlus# set protocols neighbour ra-guard term 1 interface ae1
[edit]
```

```
XorPlus# set protocols neighbour ra-guard term 1 vlan-id 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols neighbour ra-guard trusted-port ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols neighbour ra-guard term 2 vlan-id 3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

When the switch receives an ingress RA message, it will attempt to match the message via the RA guard. If the ingress port has the RA guard applied but is not a trusted port, the applied VLAN ID will be matched first. If the RA tag is matched with the VLAN ID, the RA guard will continue matching conditions to determine whether to forward or drop the RA message. If the RA tag is *not* matched with the VLAN ID, the applied interface will be matched (followed by the subsequent conditions).

(3) Displaying RA guards

```
XorPlus# run show raguard
Raguard: 1
    cur hop limit        : 1..10
    managed configuration : Unset
    other configuration  : Set
    source mac address   :
                           22:22:22:22:22:22
    source ipv6 address  :
                           fe80::/64
    prefix               :
                           2001:1:1:1::/64
    interface     : ge-1/1/1, ae1
    vlan          : 2
    packet dropped: 0
    packet total  : 0

Raguard: 2
    vlan          : 3
    packet dropped: 0
    packet total  : 0

trusted port:
    ge-1/1/1
XorPlus#
```

Chapter 5. Layer 3 Routing Configuration

This chapter describes the configuration steps of Layer 3 routing, including static routing, RIPv2, OSPFv2, VRRP, and ECMP.

Layer 3 VLAN Interface Configuration

- The Layer 3 interface is a VLAN interface. You should create a VLAN and a VLAN interface before configuring the Layer 3 interface.

- You can configure the IP address and prefix length for the VLAN interface.

- When all the member ports in the VLAN are link-down, the VLAN interface will be link-down. The VLAN interface will be link-up when at least one of the member ports are link-up.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 192.168.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 192.168.2.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show vlan-interface
vlan-2      Hwaddr C8:0A:A9:9E:14:9F, Vlan:2, State:DOWN
            Inet addr: 192.168.1.1/24
                    fe80::ca0a:a9ff:fe9e:149f/64
            Traffic statistics:
              IPv4 Input Packets............................0
              IPv4 Forwarding Packets.......................0
              IPv6 Input Packets............................0
              IPv6 Forwarding Packets.......................0

vlan-3      Hwaddr C8:0A:A9:9E:14:9F, Vlan:3, State:UP
            Inet addr: 192.168.2.1/24
                    fe80::ca0a:a9ff:fe9e:149f/64
            Traffic statistics:
              IPv4 Input Packets............................0
              IPv4 Forwarding Packets.......................0
              IPv6 Input Packets............................0
              IPv6 Forwarding Packets.......................0
```

```
XorPlus#
```

ARP Configuration

(1) Configuring ARP aging time
In the default setting, the ARP aging time is 1200 seconds.

```
XorPlus# set protocols arp aging-time 600
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring a static ARP entry

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlan-interface interface vlan-2 address 192.168.1.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols arp interface vlan-2 address 192.168.1.1 mac-address 22:22:22:22:22:22
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Static Routing Configuration

- In L2/L3, all routing entries will be configured to the ASIC switching chip if the outgoing VLAN-interface is link-up, and the outgoing physical port is learning.

- Traffic that can be routed will have a route entry in the RIB and the ARP of the next hop; the outgoing interface should be link-up. The traffic will then be soft-routed (i.e., routed by the switch's CPU).

- When the switch learns the MAC address of the next hop, the switch will forward the traffic with the ASIC chip.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 192.168.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-2 address 192.168.2.1 prefix-length 24
[edit]
XorPlus# set protocols static route 10.10.1.0/24 next-hop 192.168.2.5
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show route table ipv4 unicast final
10.10.1.0/24       [static(1)/1]
                   > to 192.168.2.5 via vlan-3/vlan-3
192.168.1.0/24     [connected(0)/0]
                   > via vlan-2/vlan-2
192.168.2.0/24     [connected(0)/0]
                   > via vlan-3/vlan-3
XorPlus#
XorPlus# run show route forward-route ipv4 all
Destination        NetMask            NextHopMac         Port
--------------     ---------------    -----------------  ---------
10.10.1.0          255.255.255.0      00:1E:68:37:EF:7D  ge-1/1/2
192.168.1.0        255.255.255.0      C8:0A:A9:04:49:28  connected
192.168.2.0        255.255.255.0      C8:0A:A9:04:49:28  connected
```

With the **show route forward-route ipv4 all** command, all the route entries in the ASIC chip will be displayed. Following the **show route table ipv4 unicast final** command, all routes in the RIB of the kernel will be displayed.

Static Routing Configuration Example

- An example of configuration with static routing is shown in Fig. 5-1.

- Host A and Host B should be able to communicate with each other.

- Host A and Host B should be able to communicate with the gateway (e.g., access Internet).
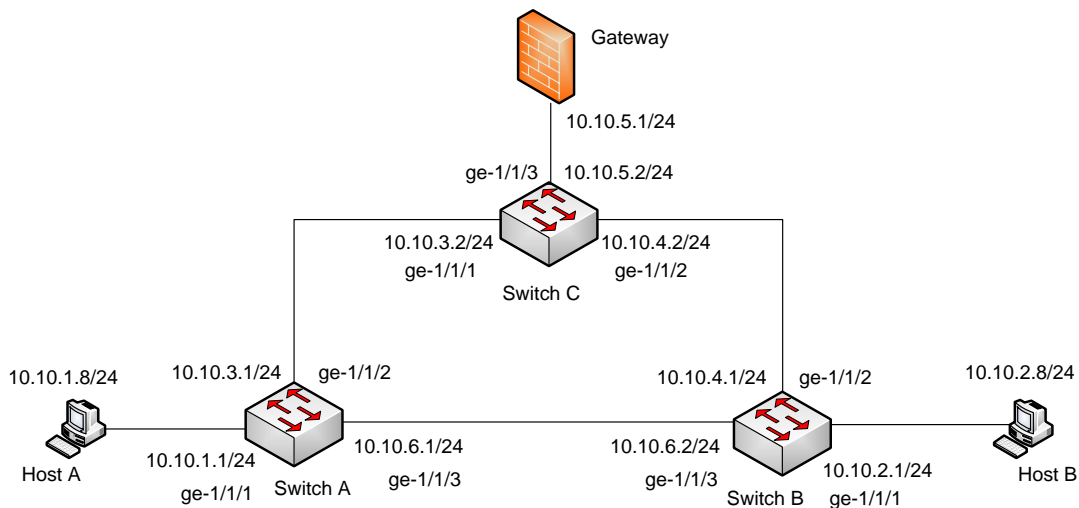
Figure 5-1. Static routing configuration.

(1) Configuring Switch A

For Switch A, you should configure 3 VLAN interfaces for networks 10.10.1.1/24, 10.10.3.1/24, and 10.10.6.1/24. You should also configure a static route to 10.10.2.0/24, and a default route.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set vlans vlan-id 4
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 4
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlans vlan-id 4 l3-interface vlan-4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-2 address 10.10.3.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-4 vif vlan-2 address 10.10.6.1 prefix-length 24
[edit]
XorPlus# set protocols static route 10.10.2.0/24 next-hop 10.10.6.2
[edit]
XorPlus# set protocols static route 0.0.0.0/0 next-hop 10.10.3.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

```
XorPlus#
```

You can verify the route entry in the RIB as follows:

```
XorPlus# run show route table ipv4 unicast final
0.0.0.0/0         [static(1)/1]
                  > to 10.10.3.2 via vlan-3/vlan-3
10.10.2.0/24      [static(1)/1]
                  > to 10.10.6.2 via vlan-4/vlan-4
10.10.1.0/24      [connected(0)/0]
                  > via vlan-2/vlan-2
10.10.3.0/24      [connected(0)/0]
                  > via vlan-3/vlan-3
10.10.6.0/24      [connected(0)/0]
                  > via vlan-4/vlan-4
XorPlus#
```

(2) Configuring Switch B

Configure 3 VLAN interfaces for networks 10.10.2.1/24, 10.10.4.1/24, and 10.10.6.2/24. Then configure a static route to 10.10.1.0/24, and a default route.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set vlans vlan-id 4
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 4
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlans vlan-id 4 l3-interface vlan-4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.2.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-2 address 10.10.4.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-4 vif vlan-2 address 10.10.6.1 prefix-length 24
[edit]
XorPlus# set protocols static route 10.10.1.0/24 next-hop 10.10.6.1
[edit]
XorPlus# set protocols static route 0.0.0.0/0 next-hop 10.10.4.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You can verify the route entry in the RIB:

```
XorPlus# run show route table ipv4 unicast final
0.0.0.0/0         [static(1)/1]
                  > to 10.10.4.2 via vlan-3/vlan-3
```

```
10.10.1.0/24        [static(1)/1]
                    > to 10.10.6.1 via vlan-4/vlan-4
10.10.2.0/24        [connected(0)/0]
                    > via vlan-2/vlan-2
10.10.4.0/24        [connected(0)/0]
                    > via vlan-3/vlan-3
10.10.6.0/24        [connected(0)/0]
                    > via vlan-4/vlan-4
XorPlus#
```

(3) Configuring Switch C

Configure 3 VLAN interfaces for networks 10.10.3.2/24, 10.10.4.2/24, and 10.10.5.2/24. Then configure a static route to 10.10.1.0/24, and a default route.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set vlans vlan-id 4
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 4
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlans vlan-id 4 l3-interface vlan-4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.3.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.4.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-4 vif vlan-4 address 10.10.5.2 prefix-length 24
[edit]
XorPlus# set protocols static route 10.10.1.0/24 next-hop 10.10.3.1
[edit]
XorPlus# set protocols static route 10.10.2.0/24 next-hop 10.10.4.1
[edit]
XorPlus# set protocols static route 10.10.6.0/24 next-hop 10.10.3.1
[edit]
XorPlus# set protocols static route 0.0.0.0/0 next-hop 10.10.5.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You can verify the route entry in the RIB:

```
XorPlus# run show route table ipv4 unicast final
0.0.0.0/0           [static(1)/1]
                    > to 10.10.5.1 via vlan-4/vlan-4
10.10.1.0/24        [static(1)/1]
                    > to 10.10.3.1 via vlan-2/vlan-2
10.10.2.0/24        [static(1)/1]
```

```
                          > to 10.10.4.1 via vlan-3/vlan-3
10.10.6.0/24        [static(1)/1]
                          > to 10.10.3.1 via vlan-2/vlan-2
10.10.3.0/24        [connected(0)/0]
                          > via vlan-2/vlan-2
10.10.4.0/24        [connected(0)/0]
                          > via vlan-3/vlan-3
10.10.5.0/24        [connected(0)/0]
                          > via vlan-4/vlan-4
XorPlus#
```

RIPv2 Routing Protocol Configuration

- In L2/L3, RIPv2 is supported.

- A policy statement is used to specify which route entry will be distributed. For example, you can distribute the static route or the connected route to a neighbor. You can also specify the distributed route metric.

- You can configure the RIPv2 interface parameters (accept-default-route, advertise-default-route, deletion-delay, request-interval, update-interval).

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 192.168.1.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 192.168.2.1 prefix-length 24
[edit]
XorPlus# set protocols static route 9.9.9.0/24 next-hop 192.168.2.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set policy policy-statement connected-to-rip term export from protocol connected
[edit]
XorPlus# set policy policy-statement connected-to-rip term export then metric 0
[edit]
XorPlus# set policy policy-statement static-to-rip term export from protocol static
[edit]
XorPlus# set policy policy-statement static-to-rip term export then metric 1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols rip interface vlan-2 vif vlan-2 address 192.168.1.1
```

```
[edit]
XorPlus# set protocols rip export "connected-to-rip,static-to-rip"
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You can verify the RIP configuration:

```
XorPlus# run show rip status all

* RIP on vlan-2 vlan-2 192.168.1.1
  Status: enabled
XorPlus#
XorPlus# run show rip statistics all

* RIP on vlan-2 vlan-2 192.168.1.1
  Status: enabled

  Counter                            Value
  ------------------------------ ----------------
  Requests Sent                         7
  Updates Sent                          6
  Triggered Updates Sent                1
  Non-RIP Updates Sent                  0
  Total Packets Received                0
  Request Packets Received              0
  Update Packets Received               0
  Bad Packets Received                  0
  Authentication Failures               0
  Bad Routes Received                   0
  Non-RIP Requests Received             0
```

RIPv2 Routing Configuration Example

- An example of configurating RIPv2 is shown in Fig. 5-2.

- Host A and Host B should be able to communicate with each other with an RIP route.

- Host A and Host B should be able to communicate with the gateway (e.g., access Internet) with RIP.
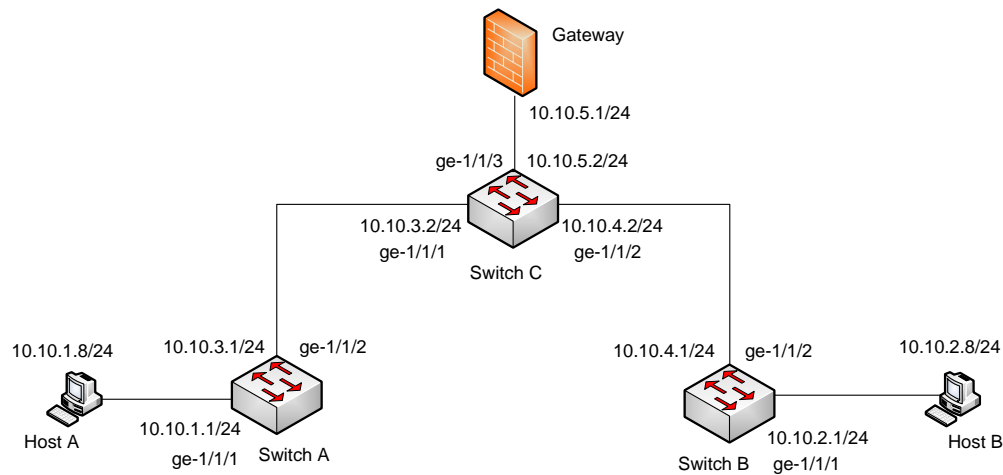
Layer 3 Routing Configuration

Figure 5-2. RIPv2 routing configuration.

(1) Configuring Switch A

For Switch A, configure 2 VLAN interfaces for networks 10.10.1.1/24 and 10.10.3.1/24. You should also configure an RIP interface in network 10.10.3.1/24. Switch A should accept the default route, which is advertised by Switch C.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
 [edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.3.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set policy policy-statement connected-to-rip term export from protocol connected
[edit]
XorPlus# set policy policy-statement connected-to-rip term export then metric 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols rip interface vlan-3 address 10.10.3.1
[edit]
XorPlus# set protocols rip export "connected-to-rip"
[edit]
XorPlus# set protocols rip interface vlan-3 vif vlan-3 address 10.10.3.1 accept-default-route
true
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B

Configure 2 VLAN interfaces for networks 10.10.1.1/24 and 10.10.3.1/24. Then configure an RIP interface in network 10.10.3.1/24. Switch B should accept the default route, which is advertised by Switch C.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
 [edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.2.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-2 address 10.10.4.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set policy policy-statement connected-to-rip term export from protocol connected
[edit]
XorPlus# set policy policy-statement connected-to-rip term export then metric 0
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols rip interface vlan-3 vif vlan-3 address 10.10.4.1
[edit]
XorPlus# set protocols rip export "connected-to-rip"
[edit]
XorPlus# set protocols rip interface vlan-3 vif vlan-3 address 10.10.4.1 accept-default-route
true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure 3 VLAN interfaces for networks 10.10.3.2/24, 10.10.4.2/24, and 10.10.5.2/24. You should also configure a default route and 2 RIP interfaces.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set vlans vlan-id 4
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 4
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlans vlan-id 4 l3-interface vlan-4
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.3.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.4.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-4 vif vlan-4 address 10.10.5.2 prefix-length 24
[edit]
XorPlus# set protocols static route 0.0.0.0/0 next-hop 10.10.5.1
[edit]
XorPlus# set protocols rip interface vlan-2 vif vlan-2 address 10.10.3.2
[edit]
XorPlus# set protocols rip interface vlan-2 vif vlan-2 address 10.10.3.2 advertise-default-route
true
[edit]
XorPlus# set protocols rip interface vlan-3 vif vlan-3 address 10.10.4.2
[edit]
XorPlus# set protocols rip interface vlan-3 vif vlan-3 address 10.10.4.2 advertise-default-route
true
[edit]
XorPlus# set protocols rip export "connected-to-rip"
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Verifying the RIP Configuration
You can verify the RIP configuration of the switches as shown below. (In our example, we verify the RIP peer and the RIP route table in Switch A.)

```
XorPlus# run show rip peer
Address          Interface        State    Hello Rx    Hello Tx    Last Hello
---------------  ---------------  ------   ----------  ----------  ----------
10.10.3.2        vlan-3/vlan-3    Up       0           0           00:41:44
XorPlus#
XorPlus# run show route table ipv4 unicast rip
0.0.0.0/0          [rip(120)/1]
                   > to 10.10.3.2 via vlan-3/vlan-3
10.10.2.0/24       [rip(120)/1]
                   > to 10.10.3.2 via vlan-3/vlan-3
10.10.4.0/24       [rip(120)/1]
                   > to 10.10.3.2 via vlan-3/vlan-3
```

OSPF Routing Protocol Configuration

- In L2/L3, OSPFv2 is supported.

- XorPlus supports normal areas, stub areas, and not-so-stubby areas (NSSAs) in OSPF.

(1) Configuring the router ID

The router ID should be configured first when you configure OSPF.

The router ID is a string similar to the IP address, and should be unique in the OSPF domain. You should not change the router ID after completing the configuration.

```
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

(2) Configuring an OSPF area and area-type

Area 0.0.0.0 is the backbone area of OSPF; each OSPF domain should have the area 0.0.0.0. Area types include normal, stub, and NSSA.

```
XorPlus# set protocols ospf4 area 0.0.0.0 area-type normal
[edit]
XorPlus# set protocols ospf4 area 1.1.1.1 area-type stub
[edit]
XorPlus# set protocols ospf4 area 2.2.2.2 area-type nssa
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring OSPF interfaces

After configuring an OSPF area, configure OSPF interfaces in the area. These interfaces will transmit and receive LSAs to calculate the route.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.60.10 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.61.10 prefix-length 24
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.60.10
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-3 vif vlan-3 address 10.10.61.10
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show ospf4 interface
Interface  State    Area            DR ID           BDR ID          Nbrs
---------  -------- --------------- --------------- --------------- ----
vlan-2     DR       0.0.0.0         1.1.1.1         0.0.0.0         0
```

```
vlan-3      DR          0.0.0.0            1.1.1.1           0.0.0.0           0
```

(4) Configuring additional OSPF interface parameters

You can also configure additional OSPF interface parameters (hello interval, interface-cost, static neighbor, priority, retransmit-interval, router-dead-interval, transmit-delay).

```
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.60.10 hello-
interval 5
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.60.10
interface-cost 8
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.60.10
transmit-delay 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show ospf4 interface detail
Interface vlan-2/vlan-2, State DR, Area 0.0.0.0
DR ID 1.1.1.1, BDR ID  0.0.0.0, Nbrs 0
Network Type BROADCAST, Address 10.10.60.10, Mask 255.255.255.0, Cost 8
DR addr 10.10.60.10, BDR addr 0.0.0.0, Priority 128
Hello 10, Dead 40, ReXmit 5, NORMAL
```

OSPF Routing Basic Configuration Example

- Fig.5-3 presents an example of configuring OSPF routing. Switch A and Switch B are located in the backbone area, 0.0.0.0. There are two non-backbone areas, 1.1.1.1 and 2.2.2.2.

- Switch D will obtain the routes of networks 10.10.1.0/24, 10.10.3.0/24, and 10.10.9.0/24, through the LSAs sent from its neighbors. Switch C will obtain the routes of networks 10.10.1.0/24, 10.10.2.0/24, and 10.10.8.0/24, according to LSAs sent from its neighbors.
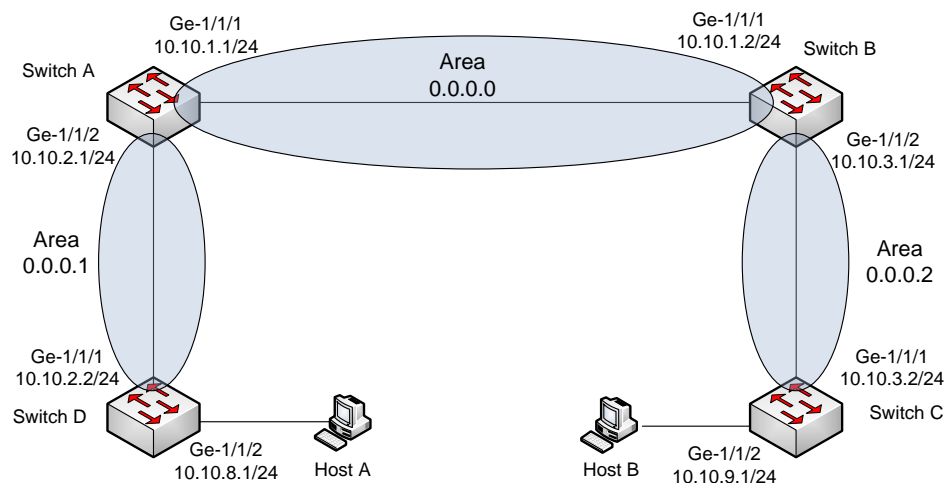

Figure 5-3. OSPF basic routing configuration.

L2/L3 Configuration Guide

(1) Configuring Switch A

For switch A, configure 2 VLAN interfaces for networks 10.10.1.1/24 and 10.10.2.1/24. You should also configure area 0.0.0.0, which includes network 10.10.1.1/24, and area 0.0.0.1, which includes network 10.10.2.1/24.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.2.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.1 interface vlan-3 vif vlan-3 address 10.10.2.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B

Configure 2 VLAN interfaces for networks 10.10.1.2/24 and 10.10.3.1/24. Then configure area 0.0.0.0, which includes network 10.10.1.2/24, and area 0.0.0.3, which includes network 10.10.3.1/24.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.3.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
```

```
[edit]
XorPlus# set protocols ospf4 router-id 2.2.2.2
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.1.2
[edit]
XorPlus# set protocols ospf4 area 0.0.0.2 interface vlan-3 vif vlan-3 address 10.10.3.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C
Configure just one OSPF interface, in area 0.0.0.2.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.3.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.9.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols ospf4 router-id 3.3.3.3
[edit]
XorPlus# set protocols ospf4 area 0.0.0.2 interface vlan-2 vif vlan-2 address 10.10.3.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D
Configure just one OSPF interface, in area 0.0.0.1.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.2.2 prefix-length 24
[edit]
```

```
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.8.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols ospf4 router-id 4.4.4.4
[edit]
XorPlus# set protocols ospf4 area 0.0.0.1 interface vlan-2 vif vlan-2 address 10.10.2.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Verifying the OSPF configuration
You can verify the OSPF configuration of a switch by checking its OSPF neighbor.

Below, switch A has two OSPF neighbor interfaces, 10.10.1.2 and 10.10.2.2.

```
XorPlus# run show ospf4 neighbor
Address          Interface              State    Router ID        Pri   Dead
---------------  ---------------------  -------- ---------------  ----- ----
10.10.1.2        vlan-2/vlan-2          Full     2.2.2.2          1     32
10.10.2.2        vlan-3/vlan-3          Full     4.4.4.4          1     32
```

Then check the OSPF database as shown below:

```
XorPlus# run show ospf4 database
  OSPF link state database, Area 0.0.0.0
Type     ID               Adv Rtr          Seq         Age   Opt Cksum   Len
-------  ---------------  ---------------  ----------  ----  --- ------  ---
Router   *1.1.1.1         1.1.1.1          0x8000025a  394   0x2 0xf2bb  48
Network  *10.10.1.1       1.1.1.1          0x80000180  394   0x2 0xc0b9  32
Network  *10.10.2.1       1.1.1.1          0x80000180  394   0x2 0xc0b9  32
Router   2.2.2.2          2.2.2.2          0x8000023e  339   0x2 0x3024  36
Network  10.10.3.1        2.2.2.2          0x80000180  394   0x2 0xc0b9  32
Router   3.3.3.3          3.3.3.3          0x8000023e  339   0x2 0x3024  36
Network  10.10.9.1        3.3.3.3          0x80000180  394   0x2 0xc0b9  32
Router   4.4.4.4          4.4.4.4          0x8000023e  339   0x2 0x3024  36
Network  10.10.8.1        4.4.4.4          0x80000180  394   0x2 0xc0b9  32

   OSPF link state database, Area 0.0.0.2
Type     ID               Adv Rtr          Seq         Age   Opt Cksum   Len
-------  ---------------  ---------------  ----------  ----  --- ------  ---
Router   *1.1.1.1         1.1.1.1          0x8000025a  394   0x2 0xf2bb  48
Network  *10.10.1.1       1.1.1.1          0x80000180  394   0x2 0xc0b9  32
Network  *10.10.2.1       1.1.1.1          0x80000180  394   0x2 0xc0b9  32
Router   2.2.2.2          2.2.2.2          0x8000023e  339   0x2 0x3024  36
Network  10.10.3.1        2.2.2.2          0x80000180  394   0x2 0xc0b9  32
Router   3.3.3.3          3.3.3.3          0x8000023e  339   0x2 0x3024  36
Network  10.10.9.1        3.3.3.3          0x80000180  394   0x2 0xc0b9  32
Router   4.4.4.4          4.4.4.4          0x8000023e  339   0x2 0x3024  36
Network  10.10.8.1        4.4.4.4          0x80000180  394   0x2 0xc0b9  32
```

Finally, you can check the OSPF route in the RIB of switch A.

```
XorPlus#
XorPlus# run show route table ipv4 unicast osfp

10.10.3.0/24       [ospf(110)/2]
                   > to 10.10.1.2 via vlan-2/vlan-2
```

OSPF Configuration Example: NSSA/Stub/Normal

● The configurations of an OSPF NSSA and a stub area are shown in Fig. 5-4.

● Switch D will obtain the routes of networks 10.10.1.0/24, 10.10.3.0/24, and 10.10.9.0/24, according to the LSAs received from its neighbors. Switch C will obtain the routes of networks 10.10.1.0/24, 10.10.2.0/24, and 10.10.8.0/24, according to the LSAs received from its neighbors.

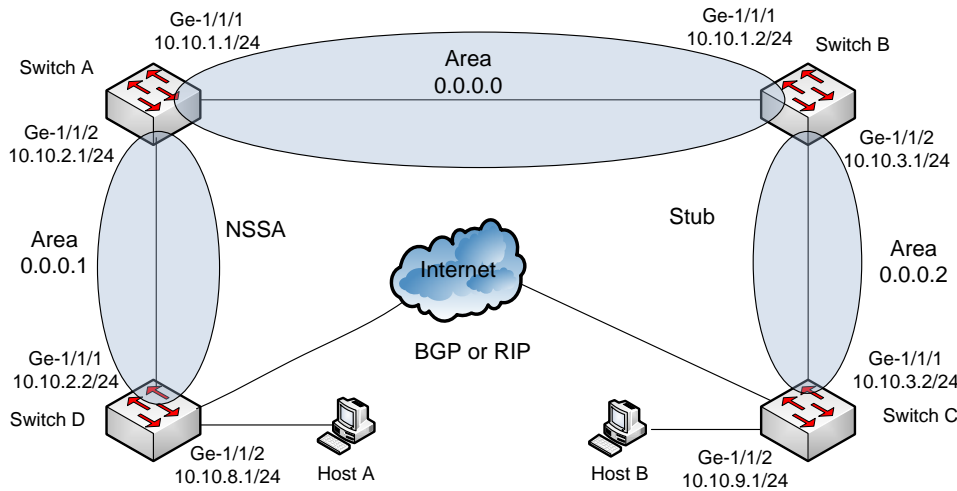● The figure below does not include RIP or BGP configurations.

Figure 5-4. OSPF NSSA, stub area configurations.

(1) Configuring Switch A

For switch A, configure 2 VLAN interfaces for networks 10.10.1.1/24 and 10.10.2.1/24. You should also configure area 0.0.0.0, which includes network 10.10.1.1/24, and area 0.0.0.1, which includes network 10.10.2.1/24.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.2.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

```
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.1 interface vlan-3 vif vlan-3 address 10.10.2.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.1 area-type nssa
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B

Configure 2 VLAN interfaces for networks 10.10.1.2/24 and 10.10.3.1/24. Then configure area 0.0.0.0, which includes network 10.10.1.2/24, and stub area 0.0.0.3, which includes network 10.10.3.1/24.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.3.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols ospf4 router-id 2.2.2.2
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-2 vif vlan-2 address 10.10.1.2
[edit]
XorPlus# set protocols ospf4 area 0.0.0.2 interface vlan-3 vif vlan-3 address 10.10.3.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.2 area-type stub
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure just one OSPF interface, in area 0.0.0.2.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
```

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.3.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.9.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols ospf4 router-id 3.3.3.3
[edit]
XorPlus# set protocols ospf4 area 0.0.0.2 interface vlan-2 vif vlan-2 address 10.10.3.2
[edit]
XorPlus# set protocols ospf4 area 0.0.0.2 area-type stub
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D

Configure just one OSPF interface, in area 0.0.0.1. Switch D should import the RIP or BGP route from the RIB, and distribute it to other areas.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.2.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.8.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set policy policy-statement rip-ospf term rip from protocol rip
[edit]
XorPlus# set policy policy-statement rip-ospf term rip then external-type 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols ospf4 router-id 4.4.4.4
[edit]
XorPlus# set protocols ospf4 area 0.0.0.1 interface vlan-2 vif vlan-2 address 10.10.2.2
[edit]
XorPlus# set protocols ospf4 area 0.0.0.1 area-type nssa
[edit]
XorPlus# set protocols ospf4 export rip-ospf
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

OSPF Stub Area/NSSA Summary

By default, external routes and inter-area routes will be injected into stub areas or NSSAs. You can utilize the **summaries disable true** parameter to prevent external or inter-area routes from being injected into stub areas or NSSAs. You can also use **set protocols ospf4 area <area-id> default-lsa disable false** to create a default route entry.
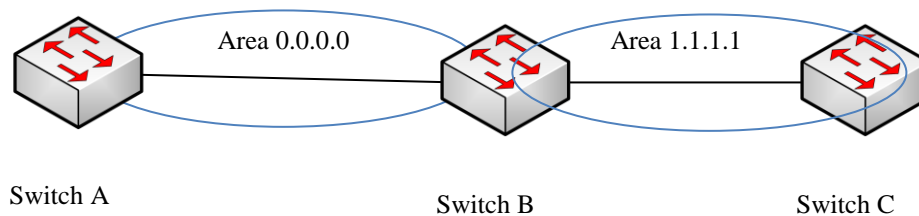

Figure 5-5. OSPF Stub area/NSSA summary: area 1.1.1.1 should be a stub area or an NSSA.

(1) Configuring Switch A

```
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.2 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-500 vif vlan-500 address 192.168.1.2
[edit]
XorPlus# commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

OSPF Virtual Link Configuration Guide

- The single backbone area (area 0.0.0.0) cannot be disconnected, or certain areas of the Autonomous System will become unreachable. To establish and maintain connectivity of the backbone, virtual links can be configured through non-backbone areas. Virtual links serve to connect physically separate components of the backbone.

- The two endpoints of a virtual link are Area Border Routers (ARBs). The virtual link must be configured in both routers. The configuration information in each router consists of the other virtual endpoint (the other ARB), and the non-backbone area that the two routers have in common (called the transit area). Virtual links cannot be configured through stub areas.

- Enable OSPF on Switchs A, B, C, and D at the beginning. There is no route entry from the backbone area (0.0.0.0) to area 2.2.2.2.
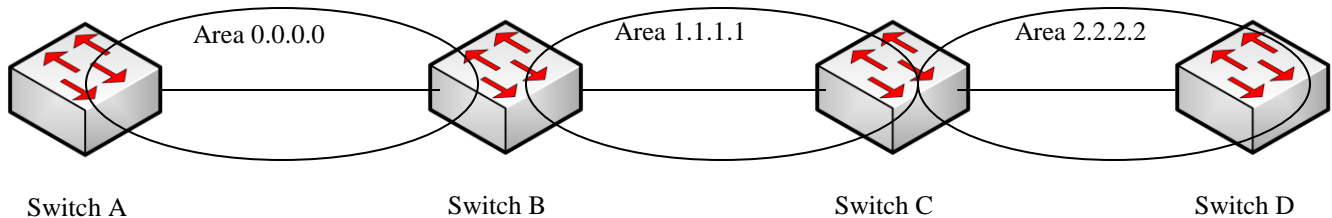
Figure 5-7. Virtual link configuration.

(1) Configuring Switch A

```
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.2 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/47 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-500 vif vlan-500 address 192.168.1.2
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(2) Configuring Switch B

```
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.250 prefix-length
30
[edit]
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.1 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/48 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 router-id 4.4.4.4
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-500 vif vlan-500 address 192.168.1.1
[edit]
XorPlus# set protocols ospf4 area 1.1.1.1 interface vlan-400 vif vlan-400 address 172.25.150.250
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(3) Configuring Switch C

```
XorPlus# set vlans vlan-id 300 l3-interface vlan-300
[edit]
XorPlus# set vlan-interface interface vlan-300 vif vlan-300 address 172.25.150.246 prefix-length
30
[edit]
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.249 prefix-length
30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 300
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/51 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 router-id 3.3.3.3
[edit]
XorPlus# set protocols ospf4 area 2.2.2.2 interface vlan-300 vif vlan-300 address 172.25.150.246
[edit]
XorPlus# set protocols ospf4 area 1.1.1.1 interface vlan-400 vif vlan-400 address 172.25.150.249
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(4) Configuring Switch D

```
XorPlus# set vlans vlan-id 300 l3-interface vlan-300
[edit]
XorPlus# set vlan-interface interface vlan-300 vif vlan-300 address 172.25.150.245 prefix-length
30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 300
[edit]
XorPlus# set protocols ospf4 router-id 2.2.2.2
[edit]
XorPlus# set protocols ospf4 area 2.2.2.2 interface vlan-300 vif vlan-300 address 172.25.150.245
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

Enable virtual links on the Area Border Routers (Switch B and Switch C). After this step, there will be a route entry from the backbone area, 0.0.0.0, to area 2.2.2.2.

(1) Configuring Switch B

```
XorPlus# set protocols ospf6 area 0.0.0.0 virtual-link 3.3.3.3 transmit-area 1.1.1.1
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

L2/L3 Configuration Guide

(2) Configuring Switch C

```
XorPlus# set protocols ospf6 area 0.0.0.0 virtual-link 4.4.4.4 transmit-area 1.1.1.1
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(3) Checking an IPv6 OSPF

```
# Check ipv6 ospf neighbor on Switch B
XorPlus# run show ospf4 neighbor
Address          Interface            State     Router ID        Pri    Dead
--------------   --------------------   --------   --------------   -----  ----
192.168.1.2      vlan-500/vlan-500    Full      1.1.1.1          128    34
172.25.150.249   vlan-400/vlan-400    Full      3.3.3.3          128    36
172.25.150.249   vlink/3.3.3.3        Init      3.3.3.3          0      0
```

(2) Configuring Switch B

```
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.1 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set protocols ospf4 router-id 4.4.4.4
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-100 vif vlan-500 address 192.168.1.1
[edit]
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.250 prefix-length
30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-400 vif vlan-400 address 172.25.150.250
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(3) Configuring Switch C

```
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.249 prefix-length
30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 router-id 3.3.3.3
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-400 vif vlan-400 address 172.25.150.249
[edit]
XorPlus#commit
```

```
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(4) Configuring area 1.1.1.1 as a stub area or NSSA

```
XorPlus# set protocols ospf4 area 1.1.1.1 area-type  <normal  |   stub  | nssa>
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
# Check route table on  DUT3,there will be route entry to backbone area 192.168.1.0/30
XorPlus# run show route forward-route ipv4 all
Destination       NetMask          NextHopMac          Port
---------------   ---------------  -----------------   ---------
172.25.150.248    255.255.255.252  08:9E:01:62:D5:61   connected
192.168.1.0       255.255.255. 252  60:EB:69:9B:BE:31   te-1/1/51
Total route count:2
```

(5) Disabling the summary function on ABR (DUT2 area 1.1.1.1)

```
XorPlus#  set protocols ospf4 area 1.1.1.1 summaries disable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
# Check route table on  DUT3,the route entry to backone area was lost
XorPlus# run show route forward-route ipv4 all
Destination       NetMask          NextHopMac          Port
---------------   ---------------  -----------------   ---------
172.25.150.248    255.255.255.252  08:9E:01:62:D5:61   connected
Total route count:1
# Enabel default-lsa function on ABR(DUT2)
XorPlus# run show route forward-route ipv4 all
Destination       NetMask          NextHopMac          Port
---------------   ---------------  -----------------   ---------
172.25.150.248    255.255.255.252  08:9E:01:62:D5:61   connected
0.0.0.0              0.0.0.0                  60:EB:69:9B:BE:31   te-1/1/51
Total route count:2
```

OSPF Area Range Configuration Guide

- OSPF should aggregate the route entries from the backbone area into a non-backbone area, or from a non-backbone area into the backbone area. Route aggregation works only on the ABR.

- You can use the "advertise disable" parameter to restrain ABR route aggregation. The ABR will generate route aggregation by default after you configure **area-range**, and the packet is routed to the best (the longest or most specific) match.
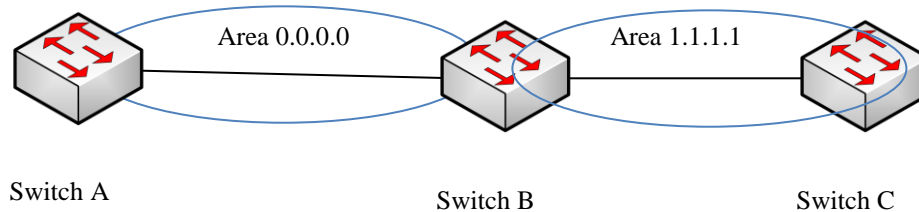
Figure 5-6. OSPF area range configuration.

(1) Configuring Switch A

```
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.2 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-500 vif vlan-500 address 192.168.1.2
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(2) Configuring Switch B

```
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.1 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set protocols ospf4 router-id 4.4.4.4
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-100 vif vlan-500 address 192.168.1.1
[edit]
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.250 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-400 vif vlan-400 address 172.25.150.250
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(3) Configuring Switch C

```
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.249 prefix-length
30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 router-id 3.3.3.3
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-400 vif vlan-400 address 172.25.150.249
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(4) Checking the route table on Switch C

There will be a 30-bit route entry, 192.168.1.0/30.

```
XorPlus# run show route forward-route ipv4 all
Destination       NetMask           NextHopMac         Port
---------------   ---------------   -----------------  ---------
172.25.150.248    255.255.255.252   08:9E:01:62:D5:61  connected
192.168.1.0       255.255.255. 252   60:EB:69:9B:BE:31  te-1/1/51
Total route count:2
```

(5) Configuring area-range on ABR (DUT2)

```
XorPlus# set protocols ospf4 area 0.0.0.0 area-range 192.168.1.0/24 advertise true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(6) Checking the route table on DUT3

The route entry 192.168.1.0/30 will be replaced by 192.168.1.0/24.

```
XorPlus# run show route forward-route ipv4 all
Destination       NetMask           NextHopMac         Port
---------------   ---------------   -----------------  ---------
172.25.150.248    255.255.255.252   08:9E:01:62:D5:61  connected
192.168.1.0       255.255.255. 0     60:EB:69:9B:BE:31  te-1/1/51
Total route count:2
```

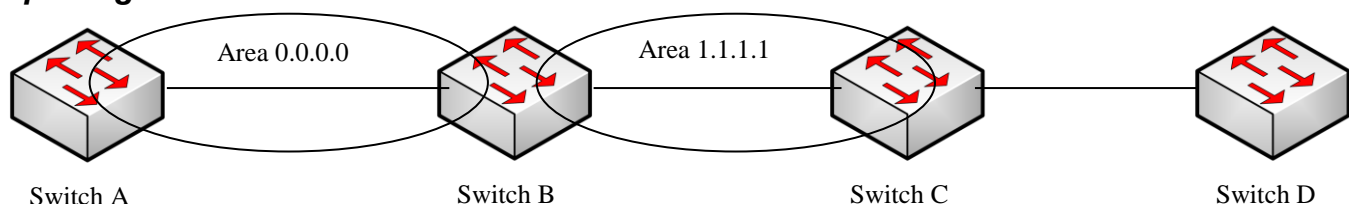## Importing an External Route into an OSPF Area

Figure 5-8. Importing an external route into an OSPF area.

(1) Configuring Switch A

```
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.2 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/47 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-500 vif vlan-500 address 192.168.1.2
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(2) Configuring Switch B

```
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.250 prefix-length
30
[edit]
XorPlus# set vlans vlan-id 500 l3-interface vlan-500
[edit]
XorPlus# set vlan-interface interface vlan-500 vif vlan-500 address 192.168.1.1 prefix-length 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/48 family ethernet-switching native-vlan-id 500
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 router-id 4.4.4.4
[edit]
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan-500 vif vlan-500 address 192.168.1.1
[edit]
XorPlus# set protocols ospf4 area 1.1.1.1 interface vlan-400 vif vlan-400 address 172.25.150.250
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(3) Configuring Switch C

```
XorPlus# set vlans vlan-id 300 l3-interface vlan-300
[edit]
XorPlus# set vlan-interface interface vlan-300 vif vlan-300 address 172.25.150.246 prefix-length
30
[edit]
XorPlus# set vlans vlan-id 400 l3-interface vlan-400
[edit]
XorPlus# set vlan-interface interface vlan-400 vif vlan-400 address 172.25.150.249 prefix-length
30
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 family ethernet-switching native-vlan-id 300
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/51 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# set protocols ospf4 router-id 3.3.3.3
[edit]
```

```
XorPlus# set protocols ospf4 area 2.2.2.2 interface vlan-300 vif vlan-300 address 172.25.150.246
[edit]
XorPlus# set protocols ospf4 area 1.1.1.1 interface vlan-400 vif vlan-400 address 172.25.150.249
[edit]
XorPlus#commit
[edit]
Waiting for merging configuration.
Commit OK.
Save Done.
[edit]
XorPlus#
```

(4) Configuring an external route import policy on Switch C

```
# Configure external static route.
XorPlus# set protocols static route 192.168.6.0/24 next-hop 172.25.150.245
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
# Configure policy to import external route
XorPlus# set policy policy-statement static term 1 from protocol static
[edit]
XorPlus# set policy policy-statement static then accept
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
# Using policy on ospf
XorPlus#  set protocols ospf4 export static
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
# Check route table on Switch A , there will be route entry 192.168.6.0/24
XorPlus# run show route forward-route ipv4 all
Destination       NetMask            NextHopMac          Port
--------------    ---------------    -----------------   ---------
192.168.1.0       255.255.255.252    C8:0A:A9:AE:0A:66   connected
172.25.150.248    255.255.255.252    60:EB:69:9B:BE:31   te-1/1/47
192.168.6.0        255.255.255.0      60:EB:69:9B:BE:31  te-1/1/47
Total route count:3
```

BGP Configuration Guide

(1) Configuring a BGP router ID

The router ID should be configured first when you configure BGP. The router ID is a string similar to the IP address, and is the identifier of a BGP router in an AS. You should not change the router ID after completing the configuration.

By default, the BGP router ID is not configured.

```
XorPlus# set protocols bgp bgp-id 1.1.1.1
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring BGP local AS

The local AS (autonomous system) should be configured first when you configure BGP.

The AS_Path attribute records all the AS's that a route passes through from the source to the destination, following the order of vectors.

```
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring external BGP peering

If the AS number of the specified peer is different from the local AS number during the configuration of BGP peers, an EBGP peer is configured.

To establish point-to-point connections between peer autonomous systems, configure a BGP session on each interface of a point-to-point link. Generally, such sessions are made at network exit points with neighboring hosts outside the AS.

```
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 next-hop-self true [edit]
XorPlus# set protocols bgp peer 192.168.49.1 local-ip  192.168.49.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring internal BGP peering

If the AS number of the specified peer is the same as the local AS number during the configuration of BGP peers, an IBGP peer is configured.

```
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 next-hop-self true [edit]
XorPlus# set protocols bgp peer 192.168.49.1 local-ip  192.168.49.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Configuring the BGP Local Preference

Internal BGP (IBGP) sessions use a metric called the local preference, which is carried in IBGP update packets in the path attribute LOCAL_PREF. When an autonomous system (AS) has multiple routes to another AS, the local preference indicates the degree of preference for one route over the other routes. Expectedly, the route with the highest local preference value is preferred.

```
XorPlus# set policy policy-statement send-network term t1 from network4 172.168.200.0/24
[edit]
XorPlus# set policy policy-statement send-network term t1 from protocol bgp
[edit]
XorPlus# set policy policy-statement send-network term t1 then localpref 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 export send-network
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(6) Configuring BGP MED

The multi-exit discriminator (MED) helps determine the optimal route for the incoming traffic of an AS, and is similar to the metric used in IGP. When a BGP device obtains multiple routes to the same destination address but with different next hops from EBGP peers, the BGP device selects the route with the smallest MED value as the optimal route.

```
XorPlus# set policy policy-statement send-network term t1 from network4 172.168.200.0/24
[edit]
XorPlus# set policy policy-statement send-network term t1 from protocol bgp
[edit]
XorPlus# set policy policy-statement send-network term t1 then med 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 export send-network
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(7) Configuring BGP next hop

● When an Autonomous System Boundary Router (ASBR) forwards the route learned from an EBGP peer to an IBGP peer, the ASBR, by default, does not change the next hop of the route. When the IBGP peer receives this route, it finds the next hop unreachable, sets the route to inactive, and does not use this route to guide traffic forwarding.

● To enable the IBGP peer to use this route to guide traffic forwarding, configure the ASBR to set its IP address as the next hop of the route when the ASBR forwards this route to the IBGP peer. After the

IBGP peer receives this route from the ASBR, it finds the next hop of the route reachable, sets the route to active, and uses this route to guide traffic forwarding.

- When a BGP route changes, BGP needs to iterate the indirect next hop of the route again. If no restriction is imposed on the iterated route, BGP may iterate the next hop to an incorrect forwarding path, causing traffic loss. Configure routing policy-based route iteration to prevent traffic loss.

```
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 next-hop-self true [edit]
XorPlus# set protocols bgp peer 192.168.49.1 local-ip  192.168.49.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(8) Configuring BGP route reflectors
- To ensure the connectivity between IBGP peers within an AS, you need to establish full mesh connections between the IBGP peers. When there are many IBGP peers, it is costly to establish a fully meshed network. A route reflector (RR) can solve this problem.

- A cluster ID can help prevent routing loops between multiple RRs within a cluster, and between clusters. When a cluster has multiple RRs, the same cluster ID must be configured for all RRs within the cluster.

- If full-mesh IBGP connections are established between clients of multiple RRs, route reflection between clients is not required and wastes bandwidth resources. In this case, prohibit route reflection between clients to reduce the network burden.

- Within an AS, an RR transmits routing information and forwards traffic. When an RR connects to a large number of clients and non-clients, many CPU resources are consumed if the RR transmits routing information and forwards traffic simultaneously. This also reduces route transmission efficiency. To improve route transmission efficiency, prohibit BGP from adding preferred routes to IP routing tables on the RR, enabling the RR to only transmit routing information.

```
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 next-hop-self true [edit]
XorPlus# set protocols bgp peer 192.168.49.1 local-ip  192.168.49.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols bgp route-reflector cluster-id 16.16.16.16
[edit]
XorPlus# set protocols bgp route-reflector disable false
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 client true
[edit]
XorPlus# commit
Waiting for merging configuration.
```

```
Commit OK.
Save done.
[edit]
XorPlus#
```

(9) Configuring BGP confederations

A confederation divides an AS into sub-AS's, which establish EBGP connections. Within each sub-AS, IBGP peers establish full mesh connections or have an RR configured. On a large BGP network, configuring a confederation can reduce the number of IBGP connections, simplify routing policy management, and improve route advertisement efficiency.

```
XorPlus# set protocols bgp local-as 65533
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 as 65533
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 local-ip  192.168.49.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols bgp confederation identifier 2000
[edit]
XorPlus# set protocols bgp confederation disable false
[edit]
XorPlus# set protocols bgp peer 192.168.49.1 confederation-member true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(10) Configuring the BGP connect timer

Hold timers can be configured for all peers. The proper maximum interval at which Keepalive messages are sent is one third the hold time.

```
XorPlus# set protocols bgp peer 192.168.49.1 holdtime 30
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(11) Configuring MD5 authentication for TCP connections

Configure Message Digest 5 (MD5) authentication on a TCP connection between two BGP peers. The two peers must have the same configured password to establish TCP connections.

```
XorPlus# set protocols bgp peer 192.168.11.10 md5-password pica8
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(12) Configuring EBGP fast-external-fallover

This feature allows BGP to immediately respond to a fault on an interface, and delete the direct EBGP sessions on the interface without waiting for the hold timer to expire. It implements rapid BGP network convergence.

By default, EBGP fast-external-fallover is disabled.

```
XorPlus# set protocols bgp fast-external-fallover disable false
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(13) Configuring BGP route summarization

BGP supports automatic route summarization and manual route summarization. Manual route summarization takes precedence over automatic route summarization.

Configure automatic route summarization as follows:

```
XorPlus# set protocols bgp auto-summary true
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

bgp auto-summary true summarizes the routes exported by BGP.

To configure manual route summarization:

```
XorPlus# set protocols bgp aggregate network4 192.168.1.0/24 suppress-detail true
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(14) Configuring BGP to advertise default routes to peers

The BGP device can be configured to send only a default route, with the local address as the next hop address, to its peer, regardless of whether there are default routes in the local routing table.

```
XorPlus# set protocols bgp peer 192.168.11.10 default-route-advertise
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(15) Configuring BGP to remove private AS numbers

Private autonomous system (AS) numbers that range from 64512 to 65535 are used to conserve globally unique AS numbers. BGP can remove private AS numbers from updates to a peer.

```
XorPlus# set protocols bgp peer 192.168.11.10 public-as-only
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus#
```

(16) Configuring BGP AS loop

Repeated local AS numbers are allowed in routes. In the default setting, however, repeated local AS numbers are not allowed.

```
XorPlus# set protocols bgp peer 192.168.11.10 allow-as-loop true
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(17) Configuring BGP load balancing

If multiple paths to a destination exist, you can configure load balancing over such paths to improve link utilization.

Enable BGP load balancing:

```
XorPlus# set protocols bgp multipath disable false
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

BGP will not load balance across multiple paths by default. This is acceptable if you are multihomed to a single AS, but what if you are multihomed to different AS path? In that case, you cannot load balance across theoretically equal paths. Enter the **BGP multipath path-relax** command:

```
XorPlus# set protocols bgp multipath path-relax true
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

BGP Basic Configuration Example

- As shown in Fig. 5-9, BGP runs between switches. An EBGP connection is established between Switch A and Switch B, and IBGP full mesh connections are established between Switch B, Switch C, and Switch D.

- Configure IBGP connections between Switch B, Switch C, and Switch D.

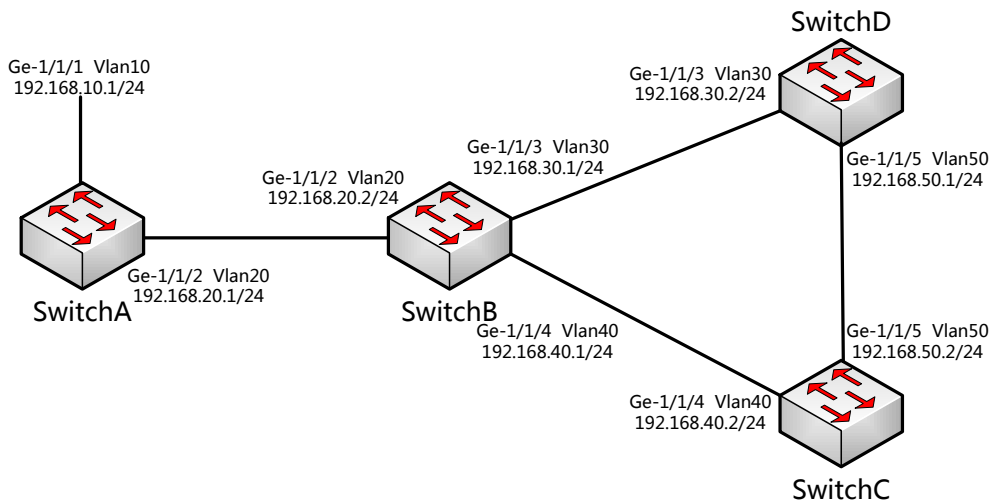- Configure an EBGP connection between Switch A and Switch B.

SwitchD

Ge-1/1/1 Vlan10
192.168.10.1/24

Ge-1/1/3 Vlan30
192.168.30.2/24

Ge-1/1/3 Vlan30
192.168.30.1/24

Ge-1/1/5 Vlan50
192.168.50.1/24

Ge-1/1/2 Vlan20
192.168.20.2/24

Ge-1/1/2 Vlan20
192.168.20.1/24

SwitchA

SwitchB

Ge-1/1/4 Vlan40
192.168.40.1/24

Ge-1/1/5 Vlan50
192.168.50.2/24

Ge-1/1/4 Vlan40
192.168.40.2/24

SwitchC

Figure 5-9. BGP configuration.

(1) Configuring Switch A

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 10 l3-interface 10
[edit]
XorPlus# set vlans vlan-id 20 l3-interface 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 10
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 10 vif 10 address 192.168.10.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 20 vif 20 address 192.168.20.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 1.1.1.1
[edit]
```

```
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 local-ip 192.168.20.1
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 20 l3-interface 20
[edit]
XorPlus# set vlans vlan-id 30 l3-interface 30
[edit]
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 20 vif 20 address 192.168.20.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 30 vif 30 address 192.168.30.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 40 vif 40 address 192.168.40.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure EBGP and IBGP connections.

```
XorPlus# set protocols bgp bgp-id 2.2.2.2
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 as 100
[edit]
```

```
XorPlus# set protocols bgp peer 192.168.20.1 local-ip 192.168.20.2
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 local-ip 192.168.30.1
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 local-ip 192.168.40.1
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 40 vif 40 address 192.168.40.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 50 vif 50 address 192.168.50.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an IBGP connection.

```
XorPlus# set protocols bgp bgp-id 3.3.3.3
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 as 200
```

```
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 local-ip 192.168.40.2
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 local-ip 192.168.50.2
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 30 l3-interface 30
[edit]
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 30 vif 40 address 192.168.30.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 50 vif 50 address 192.168.50.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an IBGP connection.

```
XorPlus# set protocols bgp bgp-id 4.4.4.4
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 local-ip 192.168.30.2
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 next-hop-self true
[edit]
```

```
XorPlus# set protocols bgp peer 192.168.50.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 local-ip 192.168.50.1
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Viewing BGP peer statuses on Switch B

```
XorPlus# run show bgp peers detail
Peer 2: local 192.168.10.2/179 remote 192.168.10.1/179
  Peer ID: 1.1.1.1
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds

Peer 2: local 192.168.30.1/179 remote 192.168.30.2/179
  Peer ID: 4.4.4.4
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds

Peer 3: local 192.168.40.1/179 remote 192.168.40.2/179
  Peer ID: 3.3.3.3
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds
XorPlus#
```

(6) Configuring Switch A to advertise route 192.168.10.0/24

```
XorPlus# set policy policy-statement direct-to-bgp term t1 from protocol connected
[edit]
XorPlus# set policy policy-statement direct-to-bgp term t1 from network4 192.168.10.0/24
[edit]
XorPlus# set policy policy-statement direct-to-bgp term t1 then accept
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols bgp export direct-to-bgp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

View the BGP routing table of Switch B:

```
XorPlus# run show bgp routes
Status Codes: * valid route, > best route
Origin Codes: i IGP, e EGP, ? incomplete


   Prefix              Nexthop              Peer            AS Path
   ------              -------              ----            -------
*> 192.168.10.0/24     192.168.20.1         1.1.1.1         100 ?
XorPlus#
```

View the BGP routing table of Switch C:

```
XorPlus# run show bgp routes
Status Codes: * valid route, > best route
Origin Codes: i IGP, e EGP, ? incomplete


   Prefix              Nexthop              Peer            AS Path
   ------              -------              ----            -------
*  192.168.10.0/24     192.168.20.1         2.2.2.2         100 ?
XorPlus#
```

The preceding command output display that the route to destination 192.168.10.0/24 becomes invalid because the next hop address of this route is unreachable.

(7) Configuring Switch B to advertise a connected route

```
XorPlus# set policy policy-statement direct-to-bgp term t1 from protocol connected
[edit]
XorPlus# set policy policy-statement direct-to-bgp term t1 then accept
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set protocols bgp export direct-to-bgp
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

View the BGP routing table of Switch C:

```
XorPlus# run show bgp routes
Status Codes: * valid route, > best route
Origin Codes: i IGP, e EGP, ? incomplete


   Prefix            Nexthop              Peer         AS Path
   ------            -------              ----         -------
*  192.168.10.0/24   192.168.20.1         2.2.2.2      100 ?
*> 192.168.20.0/24   192.168.40.1         2.2.2.2      ?
*> 192.168.30.0/24   192.168.40.1         2.2.2.2      ?
XorPlus#
```

Then **ping** 192.168.10.1 on Switch C:

```
XorPlus# run ping 192.168.10.1
PING 192.168.10.1 (192.168.10.1) 56(84) bytes of data.
64 bytes from 192.168.10.1: icmp_req=1 ttl=63 time=4.68 ms
64 bytes from 192.168.10.1: icmp_req=2 ttl=63 time=4.46 ms
64 bytes from 192.168.10.1: icmp_req=3 ttl=63 time=5.35 ms
64 bytes from 192.168.10.1: icmp_req=4 ttl=63 time=4.52 ms
64 bytes from 192.168.10.1: icmp_req=5 ttl=63 time=4.51 ms

--- 192.168.10.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4017ms
rtt min/avg/max/mdev = 4.460/4.709/5.358/0.338 ms
XorPlus#
```

BGP Route Reflector Configuration Example

- The IBGP network should be formed without interrupting full mesh BGP connections between Switch B, Switch C, and Switch D, and call for simplified device configuration and management.

- Configure Switch B, Switch C, and Switch D to have IBGP connections. Between Switch A and Switch B should be an EBGP connection.

- Configure Switch C as a route reflector with clients Switch B and Switch D.
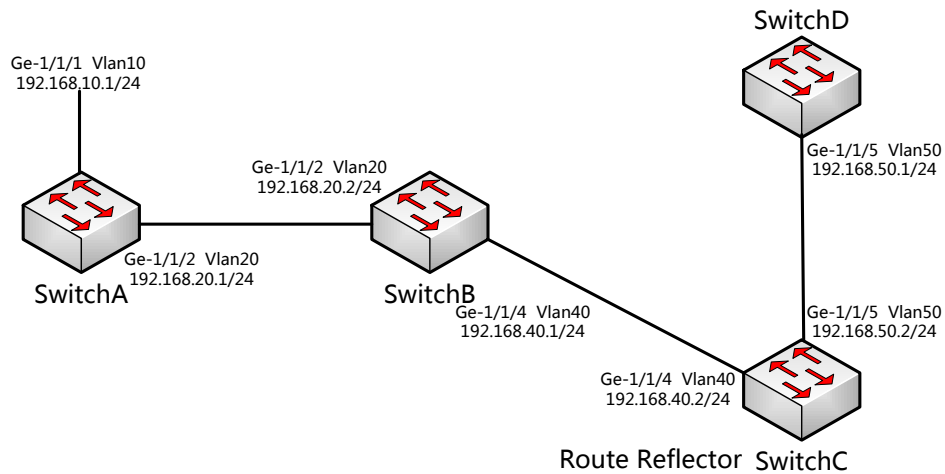
Figure 5-10. BGP route reflector.

(1) Configuring Switch A
Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 10 l3-interface 10
[edit]
XorPlus# set vlans vlan-id 20 l3-interface 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 10
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 10 vif 10 address 192.168.10.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 20 vif 20 address 192.168.20.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 1.1.1.1
[edit]
XorPlus# set protocols bgp local-as 100
```

```
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 local-ip 192.168.20.1
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 20 l3-interface 20
[edit]
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 20 vif 20 address 192.168.20.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 40 vif 40 address 192.168.40.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure EBGP and IBGP connections.

```
XorPlus# set policy policy-statement p2 term t1 from protocol bgp
[edit]
XorPlus#
XorPlus# set policy policy-statement p2 term t1 from network4 192.168.10.0/24
[edit]
XorPlus# set policy policy-statement p2 term t1 then nexthop4 192.168.40.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

```
XorPlus# set protocols bgp bgp-id 2.2.2.2
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 local-ip 192.168.20.2
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 local-ip 192.168.40.1
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 next-hop-self true
XorPlus# set protocols bgp export p2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 40 vif 40 address 192.168.40.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 50 vif 50 address 192.168.50.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an IBGP connection.

```
XorPlus# set protocols bgp bgp-id 3.3.3.3
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
```

```
XorPlus# set protocols bgp peer 192.168.40.1 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 local-ip 192.168.40.2
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 local-ip 192.168.50.2
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure IBGP connections for the route reflector clients.

```
XorPlus# set protocols bgp route-reflector cluster-id 3.3.3.3
[edit]
XorPlus# set protocols bgp route-reflector disable false
[edit]
XorPlus#
XorPlus# set protocols bgp peer 192.168.40.1 client true
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 client true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D
Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 30 l3-interface 30
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 30 vif 30 address 192.168.30.2 prefix-length 24
XorPlus# set vlan-interface interface 50 vif 50 address 192.168.50.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
```

```
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an IBGP connection.

```
XorPlus# set protocols bgp bgp-id 4.4.4.4
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 local-ip 192.168.30.2
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 local-ip 192.168.50.1
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Verifying configurations
View the BGP routing table of Switch B:

```
XorPlus# run show bgp routes
Status Codes: * valid route, > best route
Origin Codes: i IGP, e EGP, ? incomplete

   Prefix                Nexthop                 Peer            AS Path
   ------                -------                 ----            -------
*> 192.168.10.0/24       192.168.20.1            1.1.1.1         200 ?
XorPlus#
```

View the BGP routing table of Switch D:

```
XorPlus# run show bgp routes detail
192.168.10.0/24
        From peer: 3.3.3.3
        Route: Not Used
        Origin: INCOMPLETE
        AS Path: 200
        Nexthop: 192.168.40.1
        Multiple Exit Discriminator: 0
        Local Preference: 100
        Originator ID: 2.2.2.2
        Cluster List: 3.3.3.3
```

BGP Confederation Configuration Example

- Configure a BGP confederation on each switch in AS 200 to divide AS 200 into two sub-AS's: AS 65010 and AS 65011. To reduce the number of IBGP connections, three switches in AS 65010 establish full mesh IBGP connections.

- Configure BGP confederation members Switch A, Switch B, Switch C, and Switch D. Between Switch A and Switch D is an EBGP connection within AS 200.

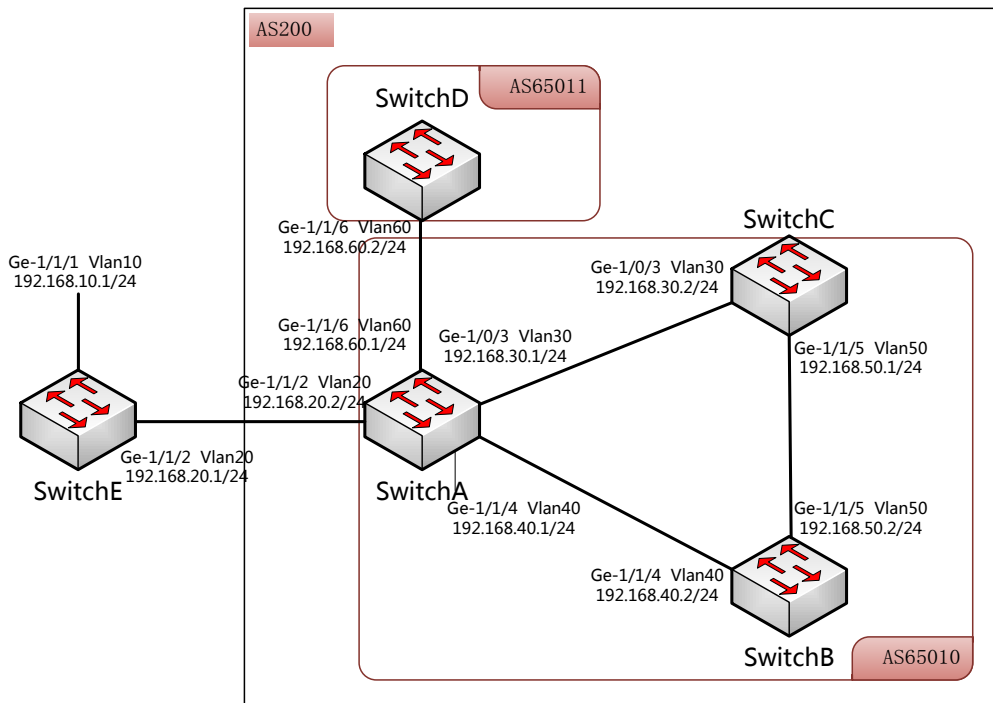- Configure Switch A to connect without AS 200 to Switch E.

Figure 5-11. BGP confederation configuration.

(1) Configuring Switch A

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 20 l3-interface 20
[edit]
XorPlus# set vlans vlan-id 30 l3-interface 30
[edit]
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# set vlans vlan-id 60 l3-interface 60
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/6 family ethernet-switching native-vlan-id 60
[edit]
```

```
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 20 vif 20 address 192.168.20.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 30 vif 30 address 192.168.30.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 40 vif 40 address 192.168.40.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 60 vif 60 address 192.168.60.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure EBGP and IBGP connections within confederation AS 200.

```
XorPlus# set protocols bgp bgp-id 2.2.2.2
[edit]
XorPlus# set protocols bgp local-as 65010
[edit]
XorPlus# protocols bgp confederation identifier 200
[edit]
XorPlus# protocols bgp confederation disable false
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 as 65010
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 local-ip 192.168.30.1
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 confederation-member true
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 as 65010
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 local-ip 192.168.40.1
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 confederation-member true
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 as 65011
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 local-ip 192.168.60.1
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 confederation-member true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection without confederation AS 200.

```
XorPlus# set protocols bgp peer 192.168.20.2 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 local-ip 192.168.20.2
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 40 vif 40 address 192.168.40.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 50 vif 50 address 192.168.50.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an IBGP connection within confederation AS 200.

```
XorPlus# set protocols bgp bgp-id 3.3.3.3
[edit]
XorPlus# set protocols bgp local-as 65010
[edit]
XorPlus# protocols bgp confederation identifier 200
[edit]
XorPlus# protocols bgp confederation disable false
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 as 65010
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 local-ip 192.168.40.2
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 next-hop-self true
```

```
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 confederation-member true
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 as 65010
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 local-ip 192.168.50.2
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 confederation-member true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 30 l3-interface 30
[edit]
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 30 vif 40 address 192.168.30.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 50 vif 50 address 192.168.50.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an IBGP connection within confederation AS 200.

```
XorPlus# set protocols bgp bgp-id 4.4.4.4
[edit]
XorPlus# set protocols bgp local-as 65010
[edit]
XorPlus# protocols bgp confederation identifier 200
[edit]
XorPlus# protocols bgp confederation disable false
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 as 65010
[edit]
```

```
XorPlus# set protocols bgp peer 192.168.30.1 local-ip 192.168.30.2
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 confederation-member true
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 as 65010
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 local-ip 192.168.50.1
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 next-hop-self true
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 confederation-member true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 60 l3-interface 60
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/6 family ethernet-switching native-vlan-id 60
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 60 vif 60 address 192.168.60.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection within confederation AS 200.

```
XorPlus# set protocols bgp bgp-id 5.5.5.5
[edit]
XorPlus# set protocols bgp local-as 65011
[edit]
XorPlus# protocols bgp confederation identifier 200
[edit]
XorPlus# protocols bgp confederation disable false
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 as 65010
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 local-ip 192.168.60.1
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 next-hop-self true
```

```
[edit]
XorPlus# set protocols bgp peer 192.168.60.2 confederation-member true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Configuring Switch E

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 10 l3-interface 10
[edit]
XorPlus# set vlans vlan-id 20 l3-interface 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 10
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface 10 vif 10 address 192.168.10.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface 20 vif 20 address 192.168.20.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 1.1.1.1
[edit]
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 local-ip 192.168.20.1
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 next-hop-self true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(6) Verifying the configuration
View the BGP routing table of Switch B:

```
XorPlus#  run show bgp routes detail
192.168.10.0/24
        From peer: 2.2.2.2
        Route: Not Used
        Origin: INCOMPLETE
        AS Path: 100
        Nexthop: 192.168.20.1
        Multiple Exit Discriminator: 0
        Local Preference: 100
```

View the BGP routing table of Switch D:

```
XorPlus# run show bgp routes detail
192.168.10.0/24
        From peer: 15.15.15.15
        Route: Not Used
        Origin: INCOMPLETE
        AS Path: (65010) 100
        Nexthop: 192.168.30.2
        Local Preference: 100
```

BGP Load Balancing Configuration Example

● Configure load balancing on Switch A.

● Configure EBGP connections between Switch B and Switch A, and between Switch B and Switch D.

● Configure EBGP connections between Switch C and Switch A, and between Switch C and Switch D.
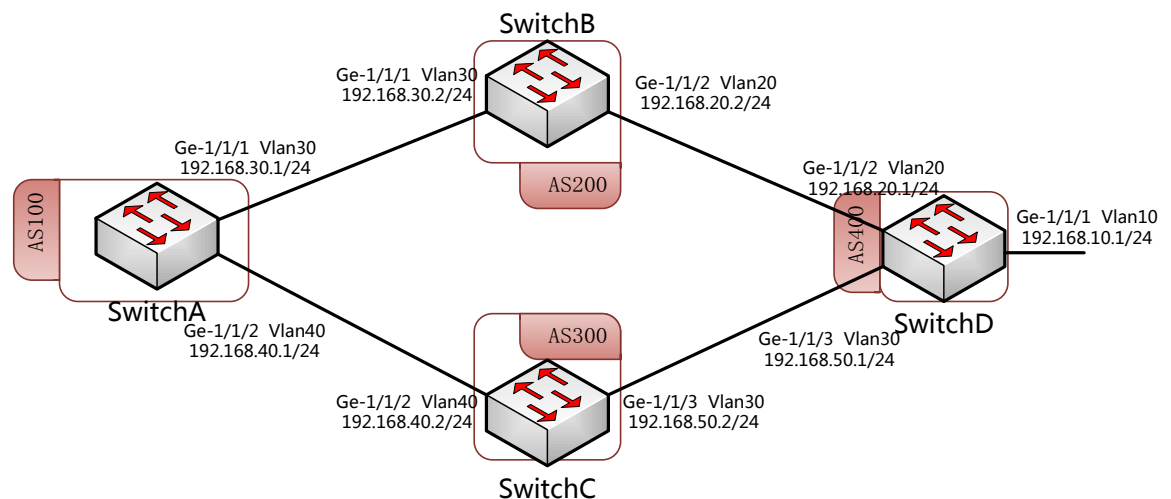

Figure 5-12. BGP load balancing.

(1) Configuring Switch A
Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 30 l3-interface vlan30
[edit]
```

```
XorPlus# set vlans vlan-id 40 l3-interface vlan40
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface vlan30 vif vlan30 address 192.168.30.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan40 vif vlan40 address 192.168.40.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 1.1.1.1
[edit]
XorPlus# set protocols bgp local-as 100
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 local-ip 192.168.30.1
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 as 300
[edit]
XorPlus# set protocols bgp peer 192.168.40.2 local-ip 192.168.30.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring Switch B
Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 20 l3-interface vlan20
[edit]
XorPlus# set vlans vlan-id 30 l3-interface vlan30
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 30
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface vlan20 vif vlan20 address 192.168.20.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan30 vif vlan30 address 192.168.30.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 2.2.2.2
[edit]
XorPlus# set protocols bgp local-as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 as 400
[edit]
XorPlus# set protocols bgp peer 192.168.20.1 local-ip 192.168.20.2
[edit]
XorPlus# set protocols bgp peer 192.168.30.1 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.30.2 local-ip 192.168.30.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring Switch C

Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 40 l3-interface 40
[edit]
XorPlus# set vlans vlan-id 50 l3-interface 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 40
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface vlan40 vif vlan40 address 192.168.40.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan50 vif vlan50 address 192.168.50.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 3.3.3.3
[edit]
XorPlus# set protocols bgp local-as 300
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 as 100
[edit]
XorPlus# set protocols bgp peer 192.168.40.1 local-ip 192.168.40.2
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 as 400
[edit]
XorPlus# set protocols bgp peer 192.168.50.1 local-ip 192.168.50.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring Switch D
Configure the VLAN that each interface belongs to.

```
XorPlus# set vlans vlan-id 10 l3-interface vlan10
[edit]
XorPlus# set vlans vlan-id 20 l3-interface vlan20
[edit]
XorPlus# set vlans vlan-id 50 l3-interface vlan50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 10
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 20
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 50
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure the VLAN interfaces and assign them IP addresses.

```
XorPlus# set vlan-interface interface vlan10 vif vlan10 address 192.168.10.1 prefix-length 24
```

```
[edit]
XorPlus# set vlan-interface interface vlan20 vif vlan20 address 192.168.20.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan50 vif vlan50 address 192.168.50.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure an EBGP connection.

```
XorPlus# set protocols bgp bgp-id 4.4.4.4
[edit]
XorPlus# set protocols bgp local-as 400
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 as 200
[edit]
XorPlus# set protocols bgp peer 192.168.20.2 local-ip 192.168.20.1
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 as 300
[edit]
XorPlus# set protocols bgp peer 192.168.50.2 local-ip 192.168.50.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Viewing BGP peer statuses on Switch B

```
XorPlus# run show bgp peers detail
Peer 2: local 192.168.20.2/179 remote 192.168.20.1/39912
  Peer ID: 1.1.1.1
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds

Peer 2: local 192.168.30.2/16808 remote 192.168.30.1/179
  Peer ID: 4.4.4.4
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
```

```
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds
```

(6) Viewing BGP peer statuses on Switch C

```
XorPlus# run show bgp peers detail
Peer 2: local 192.168.40.2/179 remote 192.168.40.1/38815
  Peer ID: 1.1.1.1
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds

Peer 2: local 192.168.50.2/49923 remote 192.168.50.1/179
  Peer ID: 4.4.4.4
  Peer State: ESTABLISHED
  Admin State: START
  Negotiated BGP Version: 4
  Peer AS Number: 100
  Updates Received: 20,  Updates Sent: 2
  Messages Received: 634,  Messages Sent: 611
  Time since last received update: 1685 seconds
  Number of transitions to ESTABLISHED: 1
  Time since last entering ESTABLISHED state: 15995 seconds
  Retry Interval: 120 seconds
  Hold Time: 90 seconds,  Keep Alive Time: 30 seconds
  Configured Hold Time: 90 seconds,  Configured Keep Alive Time: 30 seconds
  Minimum AS Origination Interval: 0 seconds
  Minimum Route Advertisement Interval: 0 seconds
```

(7) Configuring Switch D to advertise route 192.168.10.0/24
Configure Switch A to enable BGP multipath:

```
XorPlus# set protocols bgp multipath disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configure Switch D to advertise route 192.168.10.0/24:

```
XorPlus# set policy policy-statement direct-to-bgp term t1 from protocol connected
[edit]
XorPlus# set policy policy-statement direct-to-bgp term t1 from network4 192.168.10.0/24
[edit]
XorPlus# set policy policy-statement direct-to-bgp term t1 then accept
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

```
XorPlus#
XorPlus# set protocols bgp export direct-to-bgp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

View the BGP routing table of Switch A:

```
XorPlus#  run show bgp routes
Status Codes: * valid route, > best route
Origin Codes: i IGP, e EGP, ? incomplete

   Prefix              Nexthop              Peer          AS Path
   ------              -------              ----          -------
*> 192.168.10.0/24     192.168.30.2         2.2.2.2       200 400 ?
*  192.168.10.0/24     192.168.40.2         3.3.3.3       200 400 ?
XorPlus#
```

As expected, Switch A is not load balancing because it does not view the paths as "equal," but as different AS paths.

(8) Configuring BGP multipath path-relax on Switch A

```
XorPlus# set protocols bgp multipath path-relax true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

View the BGP routing table and IP routing table of Switch A:

```
XorPlus#  run show bgp routes
Status Codes: * valid route, > best route
Origin Codes: i IGP, e EGP, ? incomplete

   Prefix              Nexthop              Peer          AS Path
   ------              -------              ----          -------
*> 192.168.10.0/24     192.168.30.2         2.2.2.2       200 400 ?
*> 192.168.10.0/24     192.168.40.2         3.3.3.3       200 400 ?
XorPlus#

XorPlus# run show route table ipv4 unicast ebgp
192.168.10.0/24    [ebgp(20)/0]
                   > to 192.168.30.2 via vlan30/vlan30
192.168.10.0/24    [ebgp(20)/0]
                   > to 192.168.40.2 via vlan40/vlan40
XorPlus#
XorPlus#
```

Configuring ECMP (Equal-Cost Multipath Routing)

- In L2/L3, ECMP is supported. The maximum ECMP outgoing port group is 4*128. If you configure each ECMP route to have up to 4 equal-cost paths, for example, then the maximum ECMP outgoing port group support is 128. If you configure each ECMP route to have up to 16 equal-cost paths, the maximum ECMP outgoing port group support is 32. Several different ECMP routes can share the same outgoing port group.

- After configuring the ECMP equal-cost path maximum, save the configuration file and reboot the switch to make it available.

(1) Configuring the equal-cost path maximum

```
XorPlus# set interface ecmp_path_max 8
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
ECMP max path changes, please save running-config to startup and reset the box!
[edit]
XorPlus#
XorPlus# save running-to-startup
Save done.
[edit]
XorPlus#
XorPlus# run request system reboot
The system is going down NOW!
Sending SIGTERM to all processes
Sending SIGKILL to all processes
Requesting system reboot
Restarting system.
rstcr compatible register does not exist!
uses the mpc8541's gpio to do a reset.
U-Boot 1.3.0 (Sep  8 2010 - 17:20:00)
CPU:   8541, Version: 1.1, (0x80720011)
Core:  E500, Version: 2.0, (0x80200020)
Clock Configuration:
       CPU: 825 MHz, CCB: 330 MHz,
       DDR: 165 MHz, LBC:  41 MHz
L1:    D-cache 32 kB enabled
       I-cache 32 kB enabled
I2C:   ready
DRAM:  Initializing
```

(2) Configuring static ECMP routing

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set vlans vlan-id 4
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/5 family ethernet-switching native-vlan-id 4
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlans vlan-id 4 l3-interface vlan-4
[edit]
XorPlus# set vlan-interface interface vlan-2 address 10.10.60.10 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 address 10.10.61.10 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-4 address 10.10.62.10 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus# set protocols static route 10.10.51.0/24 next-hop 10.10.61.20
[edit]
XorPlus# set protocols static route 10.10.51.0/24 qualified-next-hop 10.10.62.20 metric 1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You can check the static ECMP route for 10.10.51.0/24 in the RIB.

```
XorPlus# run show route table ipv4 unicast final
10.10.51.0/24      [static(1)/1]
                   > to 10.10.61.20 via vlan-3/vlan-3
10.10.51.0/24      [static(1)/1]
                   > to 10.10.62.20 via vlan-4/vlan-4
10.10.60.0/24      [connected(0)/0]
                   > via vlan-2/vlan-2
10.10.61.0/24      [connected(0)/0]
                   > via vlan-3/vlan-3
10.10.62.0/24      [connected(0)/0]
                   > via vlan-4/vlan-4
```

(3) Configuring ECMP hash fields

In the default setting, all fields are hashed by "ip-source," "port-destination," "port-source," and "vlan." You can enable additional fields as shown below:

```
XorPlus# set interface ecmp hash-mapping field ingress-interface disable false
[edit]
XorPlus# set interface ecmp hash-mapping field ip-destination disable false
[edit]
XorPlus# set interface ecmp hash-mapping field ip-protocol disable false
[edit]
XorPlus# set interface ecmp hash-mapping field ip-source disable false
[edit]
XorPlus# set interface ecmp hash-mapping field port-destination disable false
[edit]
XorPlus# set interface ecmp hash-mapping field port-source disable false
[edit]
XorPlus# set interface ecmp hash-mapping field vlan disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Configuring VRRP (Virtual Router Redundancy Protocol)

In L2/L3, VRRP is supported, for both preempt and non-preempt parameters.

(1) Configuring VRRP

In the configuration below, a virtual router with IP 192.168.1.5/24 has been created. You can configure VRRP preemption and the VRRP priority.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
```

```
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 192.168.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 192.168.2.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols vrrp interface vlan-2 vrid 1
[edit]
XorPlus# set protocols vrrp interface vlan-2 vif vlan-2 vrid 1 ip 192.168.1.5 prefix-length 24
[edit]
XorPlus# set protocols vrrp interface vlan-2 vif vlan-2 vrid 1 preempt true
[edit]
XorPlus# set protocols vrrp interface vlan-2 vif vlan-2 vrid 1 priority 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You can check the VRRP configuration.

```
XorPlus# run show vrrp vlan-2
Interface       vlan-2
Vif             vlan-2
VRID            1
State           master
Master IP       192.168.1.1
XorPlus#
```

IPv6 Neighbor Configuration

(1) Configuring the IPv6 neighbor aging time
You can configure the IPv6 neighbor aging time. The neighbor will be removed after the timer has expired.

```
XorPlus# set protocols neighbour aging-time 480
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring a static IPv6 neighbor
You can configure a static IPv6 neighbor in a specified interface.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set protocols neighbour interface vlan-2 vif vlan-2 address 2001::01 mac-address
22:22:22:22:22:22
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show ipv6-neighbors static
aging-time(seconds): 480
Address                                    HW Address          Interface
------------------------------------       -----------------   ---------
2001::1                                    22:22:22:22:22:22   vlan-2
XorPlus#
```

(3) Configuring IPv6 router advertisement
You can manually enable router advertisement messages.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlan-interface interface vlan1 router-advertisement disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

IPv6 Static Routing Configuration

- In L2/L3, IPv6 static routing is supported. The IPv6 for OSPFv3 and RIPng will be supported soon.

- In P-3290 and P-3780, you should configure the link-local IPv6 address, otherwise all the IPv6 interfaces will share the same link-local address. This problem will be fixed in a future version.

(1) Configuring a static route for IPv6
You can configure the link-local address and global address for a VLAN interface.

```
XorPlus# set vlans vlan-id 2
[edit]
XorPlus# set vlans vlan-id 3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/4 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 2001:db8:3c4d:5:60:ff:73:87
prefix-length 64
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address fe80::ca0a:a9ff:fe04:4931 prefix-
length 64
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 2001:db8:3c4d:6:0:ff:73:87
prefix-length 64
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address fe80::ca0a:a9ff:4:4932 prefix-
length 64
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
```

```
Save done.
[edit]
XorPlus# set protocols static route 2001:db8:3c4d:7::/64 next-hop 2001:db8:3c4d:5:60:d6ff:73:89
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

Then verify the IPv6 static route in the RIB:

```
XorPlus# run show route table ipv6 unicast final
2001:db8:3c4d:5::/64[connected(0)/0]
                    > via vlan-2/vlan-2
2001:db8:3c4d:6::/64[connected(0)/0]
                    > via vlan-3/vlan-3
fe80::/64           [connected(0)/0]
                    > via vlan-3/vlan-3
fe80::/64           [connected(0)/0]
                    > via vlan-2/vlan-2
```

OSPFv3 Routing Protocol Configuration

In XorPlus, OSPFv3 is supported.

(1) Configuring the router ID

```
XorPlus# set protocols ospf6 instance-id 1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

(2) Configuring an OSPF area and area-type
Area 0.0.0.0 is the backbone area of OSPF; each OSPF domain should have the area 0.0.0.0. Area types includes normal, stub, and NSSA.

```
XorPlus# set protocols ospf6 area 0.0.0.0 area-type normal
[edit]
XorPlus# set protocols ospf6 area 1.1.1.1 area-type stub
[edit]
XorPlus# set protocols ospf6 area 2.2.2.2 area-type nssa
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring OSPF interfaces

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 2001::15 prefix-length 64
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 2002::15 prefix-length 64
```

```
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set protocols ospf6 area 0.0.0.0 interface vlan-2 vif vlan-2 address 2001::15
[edit]
XorPlus# set protocols ospf6 area 0.0.0.0 interface vlan-3 vif vlan-3 address 2002::15
[edit]
XorPlus# set protocols ospf6 instance-id 1
[edit]
XorPlus# set protocols ospf6 router-id 1.1.1.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show ospf6 interface
Interface  State     Area             DR ID            BDR ID           Nbrs
---------  --------  ---------------  ---------------  ---------------  ----
vlan-2     Down      0.0.0.0          0.0.0.0          0.0.0.0          0
vlan-3     Down      0.0.0.0          0.0.0.0          0.0.0.0          0
```

(4) Configuring additional OSPF interface parameters
You can also configure additional OSPF interface parameters (hello-interval, interface-cost, static neighbor, priority, retransmit-interval, router-dead-interval, and transmit-delay).

```
XorPlus# set protocols ospf6 area 0.0.0.0 interface vlan-2 vif vlan-2 hello-interval 10
[edit]
XorPlus# set protocols ospf6 area 0.0.0.0 interface vlan-2 vif vlan-2 interface-cost 8
[edit]
XorPlus# set protocols ospf6 area 0.0.0.0 interface vlan-2 vif vlan-2 transmit-delay 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

ACL and Filter Configuration

- In L2/L3, ACLs support destination-address-ipv4, destination-address-ipv6, destination-mac-address, destination-port, ether-type, ip, protocol, source-address-ipv4, source-address-ipv6, source-mac-address, source-port, and vlan-id.

- TCP flags are also supported. These ACLs can be applied to physical ports, LAG ports, and VLAN interfaces. One ACL can be applied to multiple ports (the properties of the ports can be same or different), but only one port can be matched to one ACL.

(1) Configuring ACLs

```
XorPlus# set firewall filter bad-net sequence bad-1 from source-address-ipv4 1.1.1.0/24
[edit]
XorPlus# set firewall filter bad-net sequence bad-1 then action discard
[edit]
XorPlus# set firewall filter bad-net sequence bad-2 from source-address-ipv4 1.1.2.0/24
[edit]
XorPlus# set firewall filter bad-net sequence bad-2 then action discard
[edit]
XorPlus# commit
```

```
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set firewall filter bad-net input interface ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set firewall filter bad-net input interface ae1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

When the switch receives a packet in ingress and egress, it will attempt to match ACLs by sequence number, with smaller values representing higher priorities. If the matched ACL's action is "forward" or "discard," the switch will forward or discard the packet and will not match the remaining ACLs. If there is no matching ACL, the packet will be dropped.

(2) Configuring ACLs in VLANs
Every member port in the VLAN interface will be applied with the ACLs configured in the VLAN interface.

```
XorPlus# set firewall filter bad-net sequence bad-1 from source-address-ipv4 1.1.1.0/24
[edit]
XorPlus# set firewall filter bad-net sequence bad-1 then action discard
[edit]
XorPlus# set firewall filter bad-net sequence bad-2 from source-address-ipv4 1.1.2.0/24
[edit]
XorPlus# set firewall filter bad-net sequence bad-2 then action discard
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set firewall filter bad-net input vlan-interface vlan-2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring ACL discard TCP ACK
You can configure ACL TCP flags (ACK/FIN/PSH/RST/SYN/URG/TCP-ESTABLISHED/TCP-INITIAL) to specify what action (forward/discard) to perform on which packets (true/false).

```
XorPlus# set firewall filter bad-net sequence bad-1 then action discard
[edit]
XorPlus# set firewall filter bad-net sequence bad-1 from protocol tcp flags ack true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
```

```
[edit]
XorPlus# set firewall filter bad-net output interface ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring ACL logging for match statistics

```
XorPlus# set firewall filter bad-net sequence bad-1 then action discard
[edit]
XorPlus# set firewall filter bad-net sequence bad-1 from destination-address-ipv4
192.168.100.0/24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set firewall filter bad-net input interface ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set firewall filter bad-net sequence bad-1 log interval 10
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run syslog monitor on
XorPlus#
```

Chapter 6. Multicast Configuration

This chapter describes IGMP, PIM-SM, and IGMP Snooping configurations.

IGMP Snooping Configuration

In L2/L3, IGMPv2 Snooping and IGMPv2 Snooping Querier are both supported.

(1) IGMP snooping basic configuration
In the default setting, the switch disables IGMP snooping. You should globally enable IGMP per VLAN.

```
XorPlus# set protocols igmp-snooping enable true
[edit]
XorPlus# set protocols igmp-snooping vlan-id 1 enable true
[edit]
XorPlus# set protocols igmp-snooping vlan-id 1 mrouter interface ge-1/1/3
[edit]
XorPlus# set protocols igmp-snooping vlan-id 1 querier other-querier-timer 1
[edit]
XorPlus# set protocols igmp-snooping vlan-id 1 static group 238.255.0.1 interface ge-1/1/2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show igmp-snooping vlan 1
Vlan 1:
-------------------------------------------
IGMP snooping                 : Enabled
IGMPv2 fast leave             : Disabled
IGMP querier state            : Disabled
IGMP querier source ip address : 0.0.0.0
IGMP other querier timer      : 1
IGMP querier version          : 2

XorPlus#
```

(2) IGMP snooping querier
For multicast traffic in Layer 2, enable an IGMP snooping querier in the VLAN.

```
XorPlus# set protocols igmp-snooping vlan-id 1 querier enable true
[edit]
XorPlus# set protocols igmp-snooping vlan-id 1 querier address 10.10.1.1
[edit]
XorPlus# set protocols igmp-snooping vlan-id 1 querier version 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show igmp-snooping querier
Vlan      IP Address          IGMP Version
--------  ------------------  ------------
1         10.10.1.1           v2

XorPlus#
```

IGMP Configuration

In XorPlus, IGMPv1/v2/v3 is supported.

(1) Configuring an IGMP interface

Enable the multicast interface before enabling the IGMP interface.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlan-interface interface vlan2 vif vlan2 address 10.10.60.10 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan3 vif vlan3 address 10.10.61.10 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set multicast-interface interface vlan2 vif vlan2 disable false
[edit]
XorPlus# set multicast-interface interface vlan3 vif vlan2 disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols igmp interface vlan2 vif vlan2
[edit]
XorPlus# set protocols igmp interface vlan3 vif vlan3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show igmp interface
Interface    State    Querier          Timeout    Version    Groups
------------ -------- ---------------- ---------- --------- --------
vlan2        UP       10.10.60.10      None       2          2
vlan3        UP       10.10.61.10      None       2          2
XorPlus#
```

(2) Configuring IGMP parameters for the IGMP interface

```
XorPlus# set protocols igmp interface vlan2 vif vlan2 query-interval 4
[edit]
XorPlus# set protocols igmp interface vlan2 vif vlan2 query-last-member-interval 3
[edit]
XorPlus# set protocols igmp interface vlan2 vif vlan2 query-response-interval 100
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(3) Configuring an IGMPv3 interface

You can configure IGMPv3 in a specified interface.

```
XorPlus# set protocols igmp interface vlan3 vif vlan3 version 3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
XorPlus# run show igmp interface
Interface    State    Querier         Timeout   Version   Groups
------------ -------- --------------- --------- --------- --------
vlan2        UP       10.10.60.10     None      2         2
vlan3        UP       10.10.61.10     None      3         2
```

(4) Joining and leaving a group; displaying group information

If you send an IGMPv2 report to VLAN 2, and an IGMPv3 report to VLAN 3, for example, you can display the group information of the switch. You should not have to worry about 224.0.0.2, 224.0.0.22, etc., which are used for the system (e.g. OSPF, RIP).

```
XorPlus# run show igmp group
Interface    Group           Source          LastReported Timeout V State
------------ --------------- --------------- ------------ ------- - -----
vlan2        224.0.0.2       0.0.0.0         10.10.60.10  92      2 E
vlan2        224.0.0.22      0.0.0.0         10.10.60.10  101     2 E
vlan2        238.255.0.1     0.0.0.0         10.10.60.100 61      2 E
vlan3        224.0.0.2       0.0.0.0         10.10.61.10  205     3 E
vlan3        224.0.0.22      0.0.0.0         10.10.61.10  205     3 E
vlan3        238.255.0.2     0.0.0.0         10.10.61.100 0       3 I
vlan3        238.255.0.2     20.20.20.20     10.10.61.100 257     3 F
```

If you send a leaving message for the above group, the specified group will be removed.

```
XorPlus# run show igmp group
Interface    Group           Source          LastReported Timeout V State
------------ --------------- --------------- ------------ ------- - -----
vlan2        224.0.0.2       0.0.0.0         10.10.60.10  88      2 E
vlan2        224.0.0.22      0.0.0.0         10.10.60.10  105     2 E
vlan3        224.0.0.2       0.0.0.0         10.10.61.10  227     3 E
vlan3        224.0.0.22      0.0.0.0         10.10.61.10  227     3 E
XorPlus#
```

PIM-SM Configuration

In L2/L3, PIM-SM is supported.

(1) PIM-SM basic configuration

● Before configuring a PIM-SM interface, you should enable a multicast interface.

● You can then configure a candidate-RP and a candidate-BSR. For configuring the candidate-BSR, "scope-zone" denotes the zone of the multicast group, which is included in the multicast domain.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.60.10 prefix-length 24
[edit]
```

```
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.61.10 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set multicast-interface interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set multicast-interface interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set multicast-interface interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols igmp interface vlan-3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols pimsm4 interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set protocols pimsm4 interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set protocols pimsm4 interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols pimsm4 bootstrap cand-bsr scope-zone 224.0.0.0/4 cand-bsr-by-vif-name
vlan-3
[edit]
XorPlus# set protocols pimsm4 bootstrap cand-rp group-prefix 237.0.0.0/8 cand-rp-by-vif-name
vlan-2
[edit]
XorPlus# set protocols pimsm4 bootstrap cand-rp group-prefix 231.0.0.0/8 cand-rp-by-vif-name
vlan-3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Static RP configuration
You can also configure static RP instead of BSR or dynamic RP.

```
XorPlus# set protocols pimsm4 static-rps rp 10.10.60.10 group-prefix 238.0.0.0/8 rp-priority 10
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

L2/L3 Configuration Guide

PIM-SM Configuration Example

- In the following topology, Switch B is the C-BSR and C-RP. Host A is a receiver for multicast traffic, and Host B is a multicast source that will send the multicast traffic.

- You'll need to configure ge-1/1/2 as an IGMP interface in switch A for Host A.

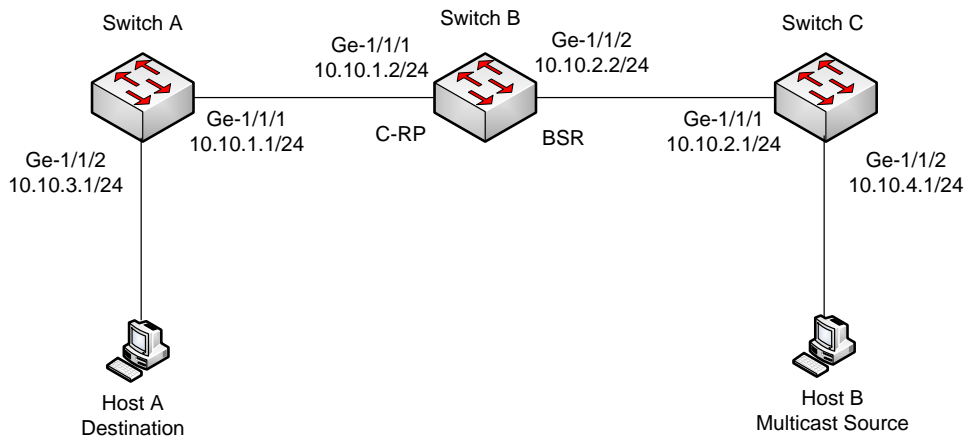- In this example, the static route in the RIB will be used by PIM-SM.

Figure 6-1. PIM-SM multicast routing configuration.

(1) Configuring Switch A

For switch A, configure ge-1/1/2 as an IGMP interface, and ge-1/1/1 as a PIM-SM interface.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.3.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set multicast-interface interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set multicast-interface interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set multicast-interface interface register_vif disable false
[edit]
XorPlus# set protocols igmp interface vlan-3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
```

```
[edit]
XorPlus# set protocols pimsm4 interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set protocols pimsm4 interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set protocols pimsm4 interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#set protocols static route 10.10.2.0/24 next-hop 10.10.1.2
[edit]
XorPlus#set protocols static route 10.10.4.0/24 next-hop 10.10.1.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show pim interface
Interface    State     Mode     V   PIMstate   Priority   DRaddr            Neighbors
----------   --------   ------   -   --------   --------   ---------------   ---------
vlan-2       UP         Sparse   2   DR         1          10.10.1.1         0
vlan-3       UP         Sparse   2   DR         1          10.10.3.1         0
register_vif UP         Sparse   2   DR         1          10.10.1.1         0
XorPlus#
XorPlus# run show igmp interface
Interface    State      Querier          Timeout   Version   Groups
-----------  --------   ---------------  --------   --------   --------
vlan-2       DISABLED 10.10.1.1          None      2          0
vlan-3       UP         10.10.3.1        None      2          3
```

(2) Configuring Switch B

Configure 2 PIM-SM interfaces, ge-1/1/1 and ge-1/1/2. You will also need to configure a candidate BSR and a candidate RP.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.1.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.2.2 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set multicast-interface interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set multicast-interface interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set multicast-interface interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols pimsm4 interface vlan-2 vif vlan-2 disable false
```

```
[edit]
XorPlus# set protocols pimsm4 interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set protocols pimsm4 interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols pimsm4 bootstrap cand-bsr scope-zone 224.0.0.0/4 cand-bsr-by-vif-name
vlan-3
[edit]
XorPlus# set protocols pimsm4 bootstrap cand-rp group-prefix 238.0.0.0/8 cand-rp-by-vif-name
vlan-2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#set protocols static route 10.10.3.0/24 next-hop 10.10.1.1
[edit]
XorPlus#set protocols static route 10.10.4.0/24 next-hop 10.10.2.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show pim bootstrap
Active zones:
BSR              Pri LocalAddress    Pri State            Timeout SZTimeout
10.10.2.2          1 10.10.2.2         1 Elected               19        -1
Expiring zones:
BSR              Pri LocalAddress    Pri State            Timeout SZTimeout
XorPlus#
XorPlus# run show pim rps
RP             Type      Pri   Holdtime    Timeout    ActiveGroups    GroupPrefix
-------------  -------   ---   --------    -------    ------------    ----------------
10.10.1.2      bootstrap 192   150         -1         0               238.0.0.0/8
XorPlus#
```

(3) Configuring Switch C

Configure 2 PIM-SM interfaces, ge-1/1/1 and ge-1/1/2. You will also need to configure a candidate BSR and a candidate RP.

```
XorPlus# set vlans vlan-id 2 l3-interface vlan-2
[edit]
XorPlus# set vlans vlan-id 3 l3-interface vlan-3
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 family ethernet-switching native-vlan-id 2
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 family ethernet-switching native-vlan-id 3
[edit]
XorPlus# set vlan-interface interface vlan-2 vif vlan-2 address 10.10.2.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan-3 vif vlan-3 address 10.10.4.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set multicast-interface interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set multicast-interface interface vlan-3 vif vlan-3 disable false
```

```
[edit]
XorPlus# set multicast-interface interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols pimsm4 interface vlan-2 vif vlan-2 disable false
[edit]
XorPlus# set protocols pimsm4 interface vlan-3 vif vlan-3 disable false
[edit]
XorPlus# set protocols pimsm4 interface register_vif disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set protocols static route 10.10.1.0/24 next-hop 10.10.2.2
[edit]
XorPlus# set protocols static route 10.10.3.0/24 next-hop 10.10.2.2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# run show pim interface
Interface    State     Mode    V   PIMstate   Priority   DRaddr           Neighbors
----------   --------   ------  -   --------   --------   ---------------  ---------
vlan-2       UP        Sparse  2   DR         1          10.10.2.1        0
vlan-3       UP        Sparse  2   DR         1          10.10.4.1        0
register_vif UP        Sparse  2   DR         1          10.10.2.1        0
XorPlus#
```

Chapter 7. QoS Configuration

This chapter describes Layer 2 and Layer 3 QoS configurations.

Configuring QoS

- In L2/L3, 802.1p, DSCP, and COS QoS are supported.

- You should first create forwarding classes, which determine the queue number of the specified traffic type.

- Define your QoS classifiers (by specifying the associated forwarding class) and include the trust-mode. Map the code-point in the forwarding class.

- Finally, apply each classifier to its specified ports.

(1) Configuring priority queuing

```
XorPlus# set class-of-service forwarding-class best-effort local-priority 3
[edit]
XorPlus# set class-of-service forwarding-class rt-traffic local-priority 0
[edit]
XorPlus# set class-of-service forwarding-class normal-traffic local-priority 2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring classifiers with IEEE 802.1/DSCP/COS QoS

```
XorPlus# set class-of-service classifier c1 trust-mode ieee-802.1
[edit]
XorPlus# set class-of-service classifier c1 forwarding-class best-effort code-point 3
[edit]
XorPlus# set class-of-service classifier c2 trust-mode dscp
[edit]
XorPlus# set class-of-service classifier c2 forwarding-class rt-traffic code-point 10
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

(3) Applying classifiers to specified ports

```
XorPlus# set class-of-service interface ge-1/1/1 classifier c1
[edit]
XorPlus# set class-of-service interface ge-1/1/2 classifier c2
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

XorPlus

Chapter 8. OpenFlow Configuration

This chapter describes the configuration of OpenFlow. Since PicOS 2.0, the switch can mix data traffic between the OpenFlow and L2/L3 networks. We call this enhancement "crossflow" mode.

OpenFlow Introduction

- In L2/L3, OpenFlow v1.0, OF v1.1, OF v1.2, and OF v1.3 are all supported. You can configure any supported version in the CLI.

- All ports in the switch are either legacy or crossflow ports. In a crossflow port, you can enable or disable **local-control**, regarding local processing of protocol packets.

- You can configure specified ports in crossflow mode, and enable/disable the local control in a crossflow port. If you enable local control in a crossflow port, the protocol packet (containing the BPDU, LLDP, and OSPF PDU) will be processed in the local protocol stack. In the mean time, the MAC learning and flood domain will also be enabled in this crossflow port. Without local control, the protocol packet, MAC learning, and flood domain will not be enabled in crossflow mode.

- There are two distinct modes within crossflow mode, L2/L3 mode and TCAM mode. If you enable L2/L3 mode, all flows will be installed in the routing table and the FDB table in the hardware. If you enable TCAM mode, all flows will be installed in the TCAM table.

- In L2/L3 mode, only two special flows will be accepted by the hardware, and all other flows will be rejected by the switch:

    Flow type 1 (stored in FDB table)
    Match fields: Destination MAC address, VLAN-ID
    Actions: output port (only one)

    Flow type 2 (stored in routing table)
    Match fields: Dst-MAC, Dst-IP/Net, VLAN-ID, ether-type
    Actions: Modify src-MAC, Modify Dst-MAC, Modify VLAN-ID, output port (only one)

- In TCAM mode, all types of flows will be accepted and installed in the TCAM table.

- Crossflow port modes can be summarized as follows:

    TCAM mode and local-control-off:
    The port is totally controlled by controller
    All broadcast turned off & auto learning turned off
    Packet forwarded by looking up the TCAM

    L2/L3 mode and local-control-off:
    The port is totally controlled by controller
    All broadcast turned off & auto learning turned off
    Packet forwarded by looking up the FDB and routing table

    TCAM mode and local-control-on:

The port is controlled by local protocol stack engine
All broadcast turned on & auto learning turned on
User or controller can add flows in the TCAM to control traffic

L2/L3 mode local-control-on:
The port is controlled by local protocol stack engine
All broadcast turned on & auto learning turned on
User or controller can add flows in the FDB and routing table to control traffic
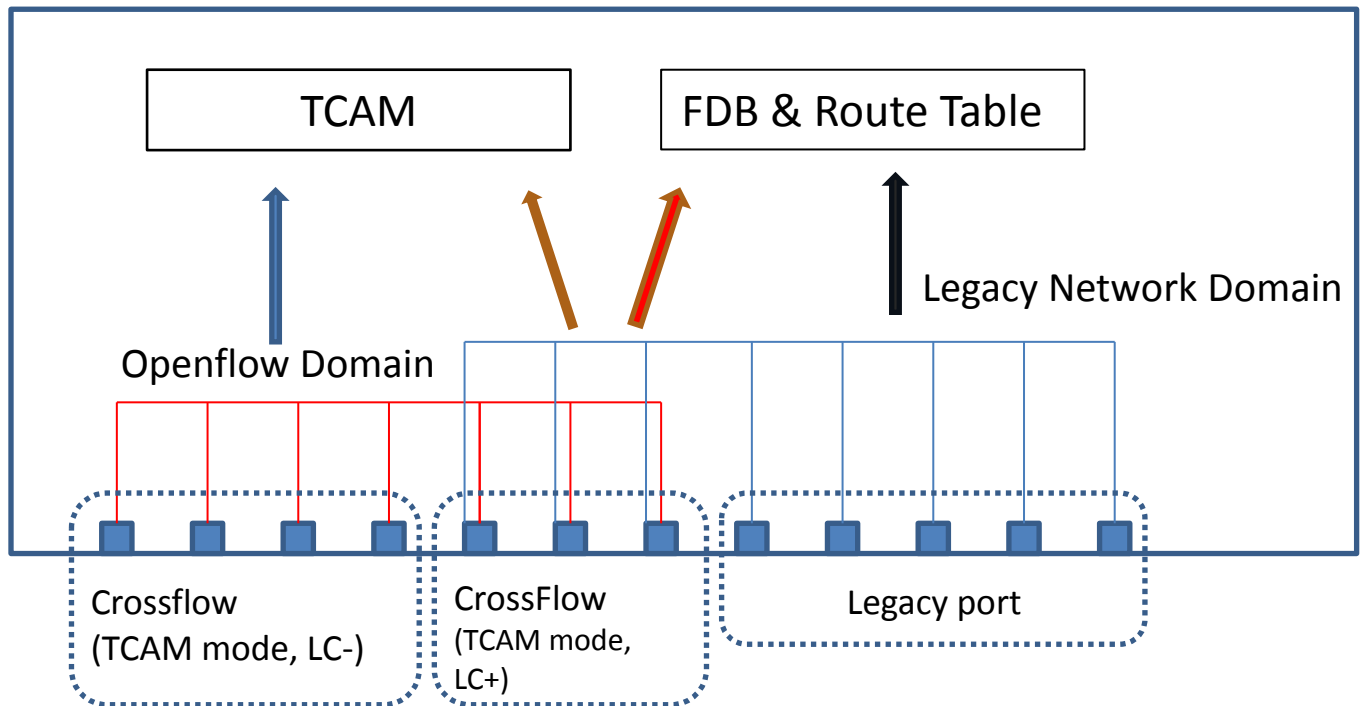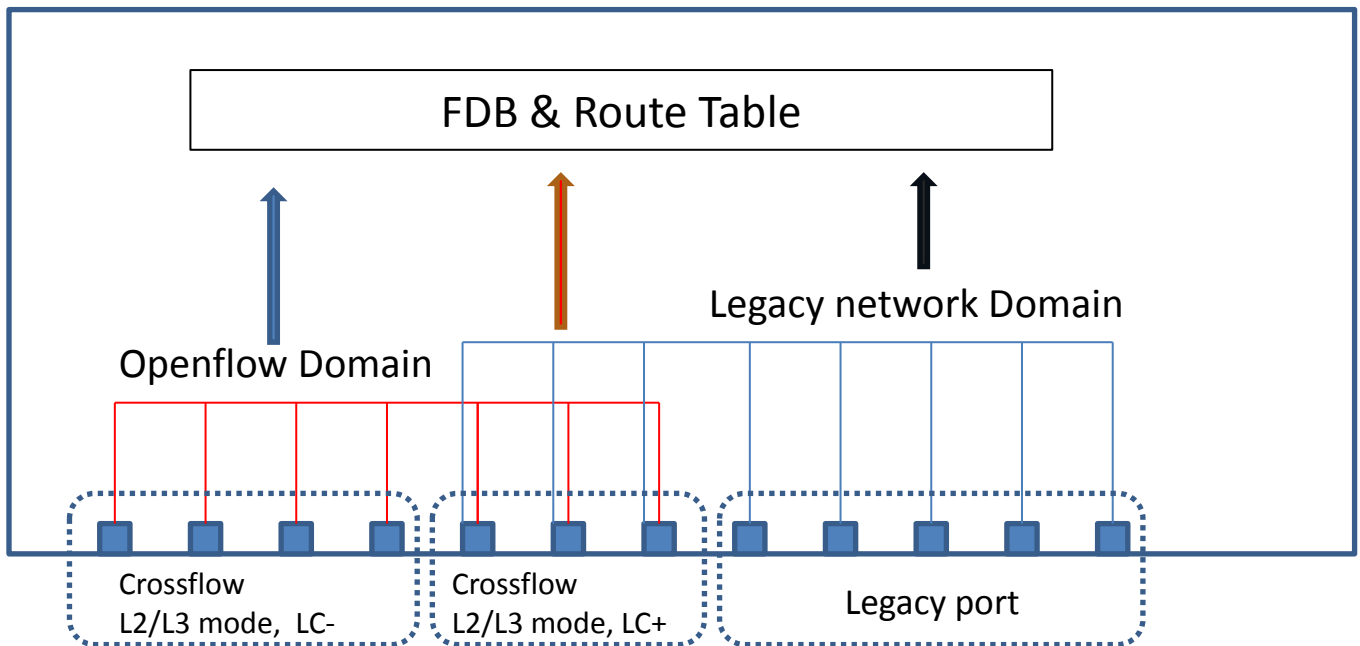

Figure 8-1. TCAM mode crossflow ports.

Figure 8-2. L2/L3 mode crossflow ports.

- In TCAM mode and L2/L3 mode, traffic can be forwarded between the OpenFlow domain and the Legacy network domain (e.g., you can send traffic from a crossflow port to a legacy port, as shown in the following figures).
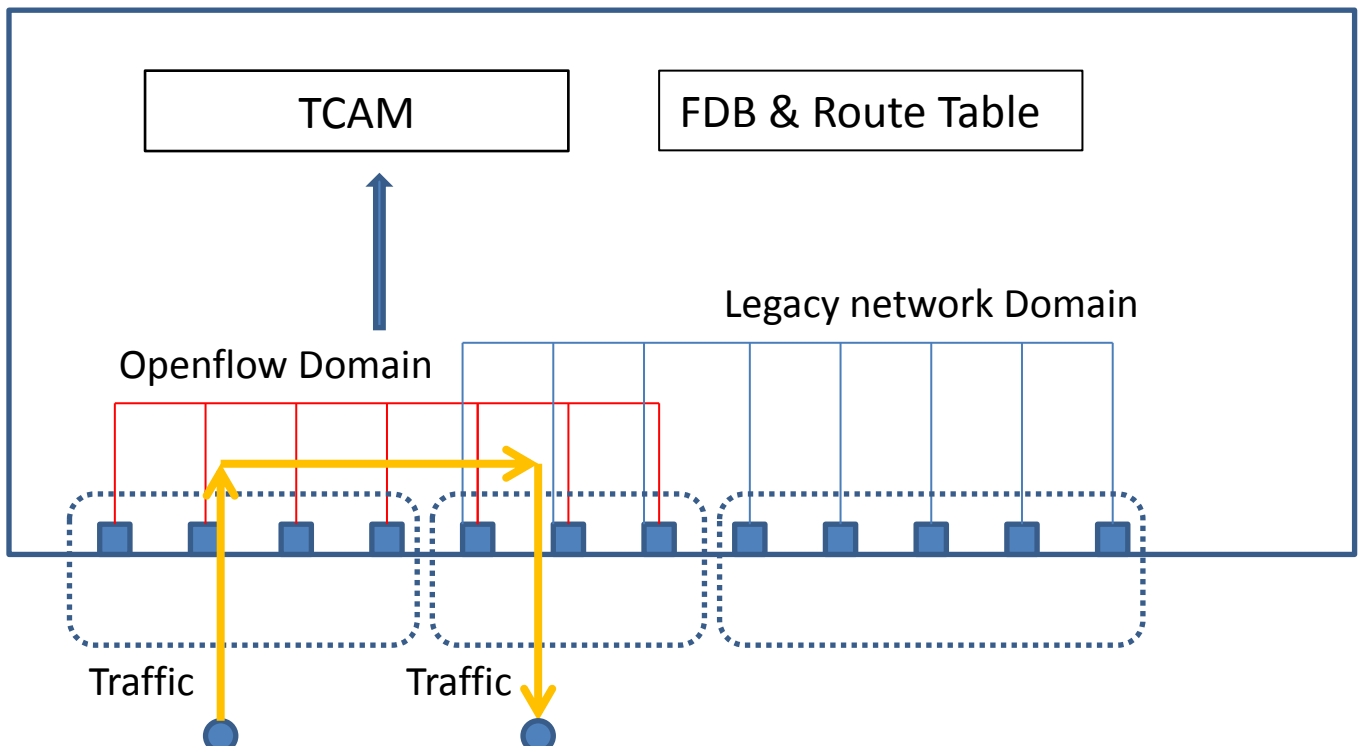

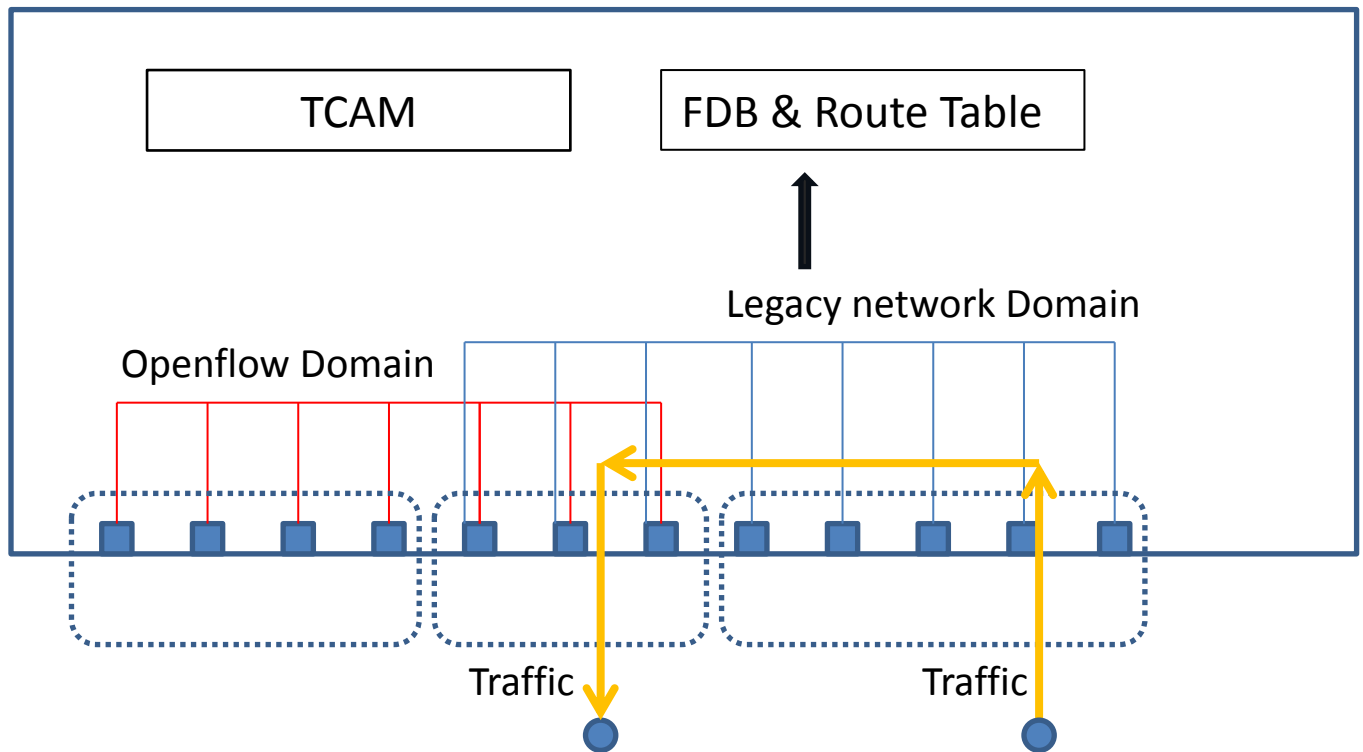**Figure 8-3. TCAM mode traffic between crossflow ports.**

Figure 8-4. L2/L3 mode traffic between crossflow port and legacy port.

OpenFlow Basic Configuration

You can enable OpenFlow and configure a specified port as a crossflow port.

(1) Allocating resources to OpenFlow

The OpenFlow module needs resources in the ASIC to install flows. For example, you can allocate a specified TCAM entry and L3 routing table entry for OpenFlow, as shown below. Allocate the resources before enabling OpenFlow, or the configuration will not be successful.

```
XorPlus# set interface max-acl-rule-limit ingress 400
[edit]
XorPlus# set interface max-route-limit 6000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Enabling OpenFlow

```
XorPlus# set open-flow
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

```
XorPlus#
```

(3) Configuring a specified port as a crossflow port

With OpenFlow globally enabled, you can configure a specified port as a crossflow port. You can then manually disable **local-control**, which is enabled in the default setting.

```
XorPlus# set interface gigabit-ethernet ge-1/1/1 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 crossflow local-control false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(4) Configuring your switch's OpenFlow version

By default, the switch enables OpenFlow v1.2, and also supports OpenFlow v1.0, OpenFlow v 1.1., and OpenFlow v1.3. Your switch can negotiate with the controller and these four OpenFlow versions.

```
XorPlus# set open-flow allowed-versions openflow-v1.3 disable false
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(5) Configuring static flow match fields

You can create a static flow with the following matched fields: arp-source-address, arp-target-address, destination-port, ethernet-destination-address, ethernet-destination-mask, ethernet-source-address, ethernet-type, icmp-code, icmp-type, ingress-port, ip-destination-address, ip-protocol, ip-source-address, ip-tos, ipv6-destination-address, ipv6-source-address, mpls-label, nd-source-address, nd-target-address, nd-target-ip, source-port, vlan-id, and vlan-priority.

```
XorPlus# set open-flow flow f1 match-field ethernet-destination-address 22:22:22:22:22:22
[edit]
XorPlus# set open-flow flow f1 match-field vlan-id 100
[edit]
XorPlus# set open-flow flow f1 match-field ip-destination-address 192.168.1.0/24
[edit]
XorPlus# set open-flow flow f1 match-field ethernet-type 2048
[edit]
XorPlus# set open-flow flow f1 action output interface ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show open-flow flow-table
OFPST_FLOW reply (OF1.2) (xid=0x2):
 cookie=0x0, duration=30.624s, table=0, n_packets=0, n_bytes=0,
ip,dl_vlan=100,dl_dst=22:22:22:22:22:22,nw_dst=192.168.1.0/24 actions=output:1
XorPlus#
```

(6) Configuring output actions of static flow

You can add "output" actions for a flow with "interface," "virtual-interface," and "controller," and specify one physical port as the output port (e.g. ge-1/1/1, ge-1/1/2).

You can also add "virtual-interface" as the output port (e.g. "all," "drop"), and configure "controller" as the output port of a flow.

```
XorPlus# set open-flow flow f1 match-field ethernet-destination-address 22:22:22:22:22:22
[edit]
XorPlus# set open-flow flow f1 match-field vlan-id 100
[edit]
XorPlus# set open-flow flow f1 action output interface ge-1/1/1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(7) Configuring modification actions of static flow

You can add "modify" actions for a flow with "ethernet-destination-address," "ethernet-source-address," "mpls," "vlan-id," and "vlan-priority."

```
XorPlus# set open-flow flow f1 match-field ethernet-destination-address 22:22:22:22:22:22
[edit]
XorPlus# set open-flow flow f1 match-field vlan-id 100
[edit]
XorPlus# set open-flow flow f1 action modify ethernet-destination-address 22:22:22:33:33:33
[edit]
XorPlus# set open-flow flow f1 action modify vlan-id 200
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show open-flow flow-table
OFPST_FLOW reply (OF1.2) (xid=0x2):
 cookie=0x0, duration=11.032s, table=0, n_packets=0, n_bytes=0,
dl_vlan=100,dl_dst=22:22:22:22:22:22 actions=mod_vlan_vid:200,mod_dl_dst:22:22:22:33:33:33
XorPlus#
```

(8) Configuring ECMP static flow in L2/L3 mode

In L2/L3 mode, you can add a ECMP static flow, which is stored in the routing table. Traffic that is matched with the flow will be forwarded with ECMP.

```
XorPlus# set vlans vlan-id 100 l3-interface vlan100
[edit]
XorPlus# set vlans vlan-id 200 l3-interface vlan200
[edit]
XorPlus# set vlans vlan-id 300 l3-interface vlan300
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/1 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/2 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/3 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/4 family ethernet-switching port-mode trunk
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/1 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/2 family ethernet-switching vlan members 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/3 family ethernet-switching vlan members 200
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/4 family ethernet-switching vlan members 300
```

```
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan100 vif vlan100 address 1.1.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan200 vif vlan200 address 2.2.2.2 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan300 vif vlan300 address 3.3.3.3 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/1 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/2 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/3 crossflow enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set open-flow flow f1 match-field ethernet-destination-address 08:9e:01:39:1a:fe
[edit]
XorPlus# set open-flow flow f1 match-field ip-destination-address 4.4.4.0/24
[edit]
XorPlus# set open-flow flow f1 match-field vlan-id 100
[edit]
XorPlus# set open-flow flow f1 match-field ethernet-type 2048
[edit]
XorPlus# set open-flow flow f1 action ecmp output-interface te-1/1/2 vlan-id 200
[edit]
XorPlus# set open-flow flow f1 action ecmp output-interface te-1/1/2 src-mac 08:9e:01:39:1a:fe
[edit]
XorPlus# set open-flow flow f1 action ecmp output-interface te-1/1/2 next-hop 08:9e:01:39:1a:11
[edit]
XorPlus# set open-flow flow f1 action ecmp output-interface te-1/1/3 vlan-id 300
[edit]
XorPlus# set open-flow flow f1 action ecmp output-interface te-1/1/3 src-mac 08:9e:01:39:1a:fe
[edit]
XorPlus# set open-flow flow f1 action ecmp output-interface te-1/1/3 next-hop 08:9e:01:39:1a:22
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# run show open-flow flow-table layer-3
FlowID    Destination      NetMask          NextHopMac         Output
------    --------------   --------------   -----------------  ---------
1         4.4.4.0          255.255.255.0    08:9e:01:39:1a:11  te-1/1/2
1         4.4.4.0          255.255.255.0    08:9e:01:39:1a:22  te-1/1/3
XorPlus#
```

(9) Configuring the local port of the OpenFlow bridge
You can connect to the switch by the inband port, which has the local port IP address.

```
XorPlus# set open-flow local-port address 192.168.1.1
[edit]
XorPlus# set open-flow local-port netmask 255.255.255.0
[edit]
```

```
XorPlus#
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(10) Configuring the switch's working mode

You can configure the switch to work in TCAM mode or L2/L3 mode. In TCAM mode, all flows will be installed in the TCAM table. In L2/L3 mode, all flows will be installed in the routing and FDB tables.

```
XorPlus# set open-flow working-mode tcam-mode
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(11) Configuring your OpenFlow controller

You can configure multiple controllers for the OpenFlow bridge (only one of them will be the active controller).

```
XorPlus# set open-flow controller contr-serv address 192.168.1.100
[edit]
XorPlus# set open-flow controller contr-serv port 6633
[edit]
XorPlus# set open-flow controller contr-serv protocol tcp
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
```

Crossflow Configuration Example

In the following topology, we build a server network in a data center. The following requirements should be met:

- Servers should not be able to communicate with each other, which means traffic from a server can only be forwarded in the upstream direction.

- The network should be scalable, and the configuration of the switch should be simple (e.g., isolating the traffic between servers by ACLs or VLANs is too complex of a configuration).

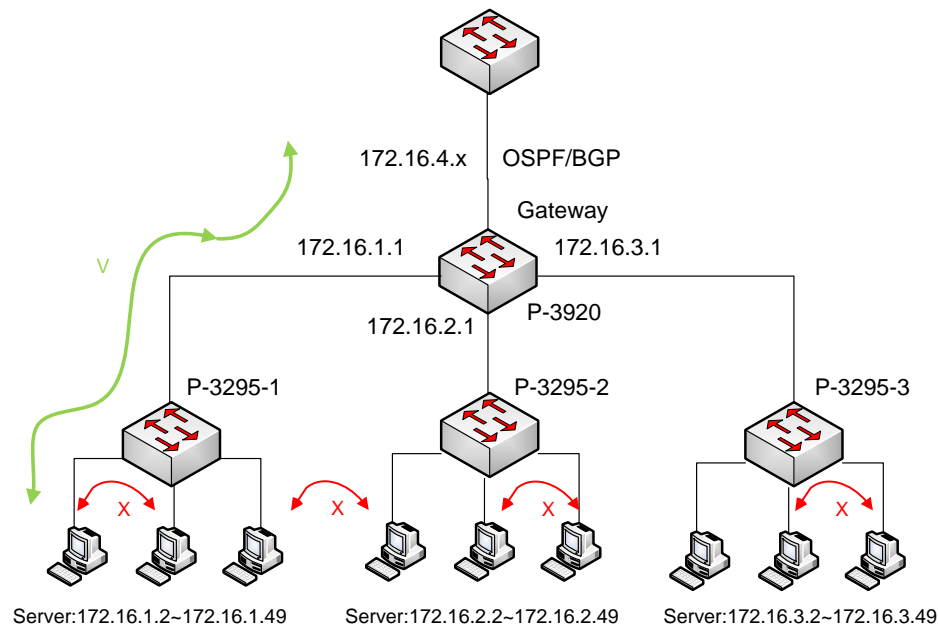You can configure a ToR switch manually or by a controller—it's up to you.

Figure 8-5. Crossflow network.

(1) Configuring the P3295-1 switch

For P3295-1, configure ports ge-1/1/1~ge-1/1/48 in crossflow mode. Create 48 flows that will make traffic from the servers be forwarded only upstream, and be sure to configure flows that will forward the downstream traffic to the corresponding server.

```
XorPlus# set interface max-acl-rule-limit ingress 400
[edit]
XorPlus# set interface max-route-limit 6000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet ge-1/1/1 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/1 crossflow local-control false
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/2 crossflow local-control false
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet ge-1/1/3 crossflow local-control false
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/49 crossflow enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

You should also configure the flows to forward packets correctly:

```
XorPlus# set open-flow working-mode tcam-mode
[edit]
XorPlus# set open-flow flow server-1-upstream match-field ingress-port ge-1/1/1
[edit]
XorPlus# set open-flow flow server-1-upstream action output interface te-1/1/49
[edit]
XorPlus# set open-flow flow server-1-downstream match-field ingress-port te-1/1/49
[edit]
XorPlus# set open-flow flow server-1-downstream match-field ip-destination-address 172.16.1.2/32
[edit]
XorPlus# set open-flow flow server-1-downstream action output interface ge-1/1/1
[edit]
XorPlus# set open-flow flow server-2-upstream match-field ingress-port ge-1/1/2
[edit]
XorPlus# set open-flow flow server-2-upstream action output interface te-1/1/49
[edit]
XorPlus# set open-flow flow server-2-downstream match-field ingress-port te-1/1/49
[edit]
XorPlus# set open-flow flow server-2-downstream match-field ip-destination-address 172.16.1.3/32
[edit]
XorPlus# set open-flow flow server-2-downstream action output interface ge-1/1/2
[edit]
XorPlus# set open-flow flow server-3-upstream match-field ingress-port ge-1/1/3
[edit]
XorPlus# set open-flow flow server-3-upstream action output interface te-1/1/49
[edit]
XorPlus# set open-flow flow server-3-downstream match-field ingress-port te-1/1/49
[edit]
XorPlus# set open-flow flow server-3-downstream match-field ip-destination-address 172.16.1.4/32
[edit]
XorPlus# set open-flow flow server-3-downstream action output interface ge-1/1/3
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

If you do not wish to manually configure the above flows with the CLI, you can configure a controller to perform those tasks:

```
XorPlus# set open-flow controller user-contr address 172.16.100.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
```

(2) Configuring P3295-2 and P3295-3 switches

You can configure P3295-2 and P3295-3 using the instructions for configuring P3295-1.

(3) Configuring the P3920 switch

For P3920, configure ports te-1/1/1~te-1/1/48 as a Layer 3 interfaces and enable the OSPF interface in qe-1/1/49. The interface qe-1/1/49 will join the OSPF network to the outside.

```
XorPlus# set vlans vlan-id 100 l3-interface vlan100
[edit]
XorPlus# set vlans vlan-id 200 l3-interface vlan200
[edit]
XorPlus# set vlans vlan-id 300 l3-interface vlan300
[edit]
```

```
XorPlus# set vlans vlan-id 400 l3-interface vlan400
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/1 family ethernet-switching native-vlan-id 100
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/2 family ethernet-switching native-vlan-id 200
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/3 family ethernet-switching native-vlan-id 300
[edit]
XorPlus# set interface gigabit-ethernet qe-1/1/49 family ethernet-switching native-vlan-id 400
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set vlan-interface interface vlan100 vif vlan100 address 172.16.1.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan200 vif vlan200 address 172.16.2.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan300 vif vlan300 address 172.16.3.1 prefix-length 24
[edit]
XorPlus# set vlan-interface interface vlan400 vif vlan400 address 172.16.4.1 prefix-length 24
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set interface max-acl-rule-limit ingress 400
[edit]
XorPlus# set interface max-route-limit 6000
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus#
XorPlus# set interface gigabit-ethernet te-1/1/1 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/2 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet te-1/1/3 crossflow enable true
[edit]
XorPlus# set interface gigabit-ethernet qe-1/1/49 crossflow enable true
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
[edit]
XorPlus# set open-flow working-mode tcam-mode
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
XorPlus# set open-flow flow net-1-upstream match-field ingress-port te-1/1/1
[edit]
XorPlus# set open-flow flow net-1-upstream action output interface qe-1/1/49
[edit]
XorPlus# set open-flow flow net-1-upstream action modify ethernet-destination-address
22:22:22:22:22:22
[edit]
XorPlus# set open-flow flow net-2-upstream match-field ingress-port te-1/1/2
[edit]
XorPlus# set open-flow flow net-2-upstream action output interface qe-1/1/49
[edit]
```

```
XorPlus# set open-flow flow net-2-upstream action modify ethernet-destination-address
22:22:22:22:22:22
[edit]
XorPlus# set open-flow flow net-3-upstream match-field ingress-port te-1/1/3
[edit]
XorPlus# set open-flow flow net-3-upstream action output interface qe-1/1/49
[edit]
XorPlus# set open-flow flow net-3-upstream action modify ethernet-destination-address
22:22:22:22:22:22
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
XorPlus#
```

Be sure to configure the OSPF interface to work with the OSPF Layer 3 network.

```
XorPlus# set protocols ospf4 area 0.0.0.0 interface vlan400 vif vlan400 address 172.16.4.1
[edit]
XorPlus# set protocols ospf4 router-id 1.1.1.1
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
XorPlus# set policy policy-statement static-to-ospf term t1 from protocol connected
[edit]
XorPlus# set protocols ospf4 export static-to-ospf
[edit]
XorPlus# commit
Waiting for merging configuration.
Commit OK.
Save done.
XorPlus#
```