Huawei Certification

HCDP-IESN

Implementing Enterprise Switching Networks
Lab Guide

Huawei Technologies Co.,Ltd

Huawei Certification

HCDP-IESN Implementing Enterprise Switching

Lab Guide

Edition 1.6

Huawei Certification System

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Legend:
- ┄┄► Proposed Advanced relationship
- ──► Necessary advanced relationship

	Routing & Switching	WLAN	Wireless Transmission	Security	UC&C		VC	Cloud	Storage	ICT Convergence Design
Associate		HCNA-WLAN	HCNA-LTE	HCNA-Transmission	HCNA-Security	HCNA-UC	HCNA-CC	HCNA-VC	HCNA-Cloud	HCNA-Storage	HCNA-Design
Professional	HCNP-R&S (HCDP)	HCNP-Carrier (HCDP-Carrier)	HCNP-WLAN	HCNP-LTE	HCNP-Transmission	HCNP-Security	HCNP-UC	HCNP-CC	HCNP-VC	HCNP-Cloud	HCNP-Storage	HCNP-Design
Expert	HCIE-R&S	HCIE-Carrier	HCIE-WLAN	HCIE-LTE	HCIE-Transmission	HCIE-Security	HCIE-UC	HCIE-CC	HCIE-VC	HCIE-Cloud	HCIE-Storage	HCIE-Design
Architect	HCAr										

HCNA(HCDA)
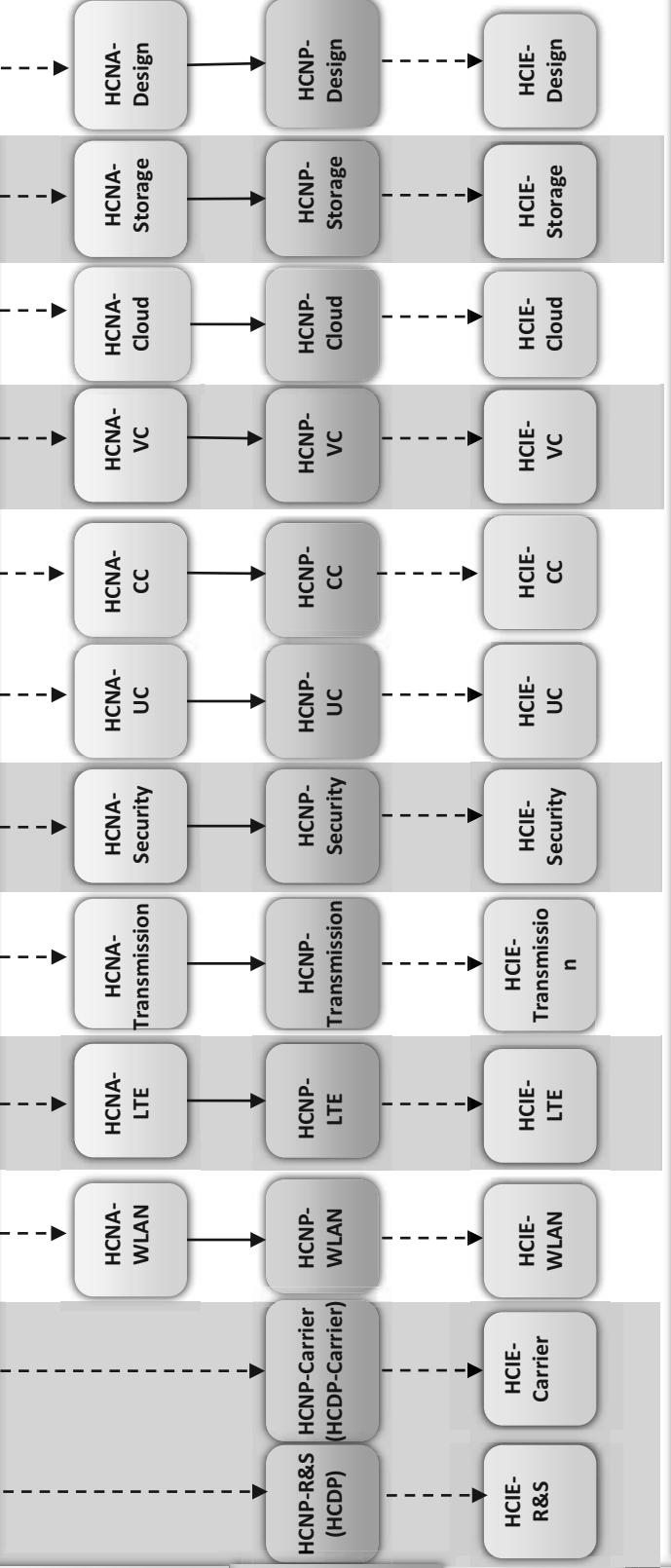
Referenced icon

| Router | L3 Switch | L2 Switch | Firewall | Net cloud |
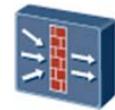
Ethernet line

Serial line

Lab environment specification

The Lab environment is suggested below:

Identifier	Device	OS version
R1	AR 2220	Version 5.90 (V200R001C01SPC300)
R2	AR 2220	Version 5.90 (V200R001C01SPC300)
R3	AR 2220	Version 5.90 (V200R001C01SPC300)
R4	AR 1220	Version 5.90 (V200R001C01SPC300)
R5	AR 1220	Version 5.90 (V200R001C01SPC300)
S1	S5700-28C-EI-24S	Version 5.70 (V100R006C00SPC800)
S2	S5700-28C-EI-24S	Version 5.70 (V100R006C00SPC800)
S3	S3700-28TP-EI-AC	Version 5.70 (V100R006C00SPC800)
S4	S3700-28TP-EI-AC	Version 5.70 (V100R006C00SPC800)
FW1	USG2160	Version 5.30 (V300R001C00SPC700)
FW2	USG2160	Version 5.30 (V300R001C00SPC700)

CONTENTS

Chapter 1 Implementing VLAN features

Lab 1-1 VLAN Configuration

Learning Objectives

The objectives of this lab are to learn and understand how to perform the following operations:

- Configure VLANs.
- Configure Eth-trunks.
- Use hybrid interfaces.

Topology
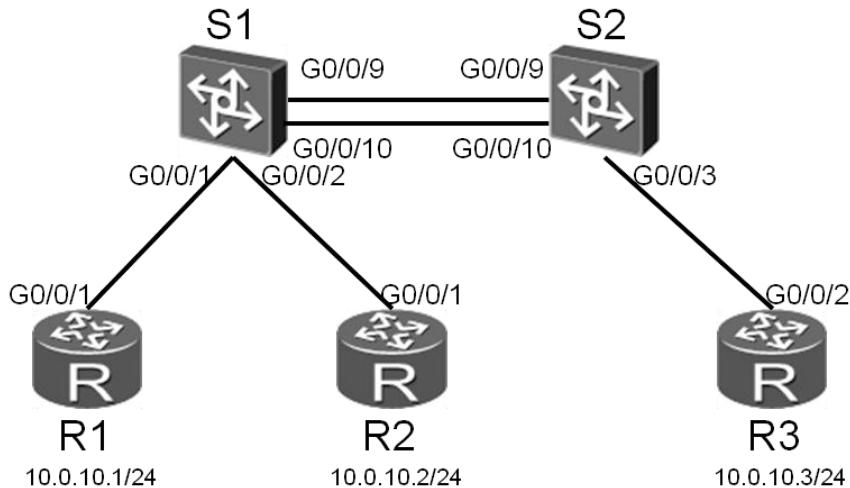
Figure 1-1 VLAN configuration

Scenario

Assume that you are a network administrator of a company. The company uses an Ethernet that has two switches. In the preceding figure, R1 and R2 represent computers on the network and R3 is a server. To optimize the network, the transmission speed and reliability must be improved for the links between S1 and S2. Two VLANs are configured to isolate broadcast domains.

R2 and R3 are in the same VLAN. R1 needs to communicate with R3.

Tasks

Step 1 **Perform basic configurations and IP addressing.**

Configure IP addresses and subnet masks for all routers.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.10.1 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface GigabitEthernet 0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.10.2 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]ip address 10.0.10.3 24
```

Configure names for the two switches,shutdown some unused interfaces.

```
<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1
[S1]interface GigabitEthernet 0/0/13
[S1-GigabitEthernet0/0/13]shutdown
[S1-GigabitEthernet0/0/13]interface GigabitEthernet 0/0/14
[S1-GigabitEthernet0/0/14]shutdown

<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
```

Step 2 **Configure link aggregation with Eth-trunk.**

The Eth-trunk technology bundles two or more links into a single link to increase the bandwidth and improve reliability. Add the G0/0/9 and G0/0/10 interfaces of S1 and S2 to an Eth-trunk.

Create an Eth-trunk.

```
[S1]interface Eth-Trunk 1
[S1-Eth-Trunk1]

[S2]interface Eth-Trunk 1
[S2-Eth-Trunk1]
```

Configure the Eth-trunk to work in static Link Aggregation Control Protocol (LACP) mode.

```
[S1-Eth-Trunk1]bpdu enable
[S1-Eth-Trunk1]mode lacp-static

[S2-Eth-Trunk1]bpdu enable
[S2-Eth-Trunk1]mode lacp-static
```

Add the G0/0/9 and G0/0/10 interfaces of S1 and S2 to the Eth-trunk.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]eth-trunk 1
[S1-GigabitEthernet0/0/9]quit
[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]eth-trunk 1

[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]eth-trunk 1
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]eth-trunk 1
```

Run the **display eth-trunk** command to view the configuration result.

```
[S1]display eth-trunk 1

Eth-Trunk1's state information is:
Local:
LAG ID: 1              WorkingMode: STATIC
```

```
Preempt Delay: Disabled    Hash arithmetic: According to SA-XOR-DA
System Priority: 32768     System ID: 4c1f-cc45-aace
Least Active-linknumber: 1  Max Active-linknumber: 8
Operate status: up       Number Of Up Port In Trunk: 2
-------------------------------------------------------------------------
ActorPortName        Status   PortType PortPri PortNo PortKey PortState Weight
GigabitEthernet0/0/9  Selected 1GE      32768   9      305    10100010 1
GigabitEthernet0/0/10 Selected 1GE      32768   10     305    10100010 1

Partner:
-------------------------------------------------------------------------
ActorPortName        SysPri   SystemID  PortPri PortNo  PortKey  PortState
GigabitEthernet0/0/9  32768    4c1f-cc45-aace 32768   9      305     10100010
GigabitEthernet0/0/10 32768    4c1f-cc45-aace 32768   10     305     10100010
```

The preceding information shows that the Eth-trunk link works in static LACP mode and the maximum number of active interfaces is 8. In addition, the G0/0/9 and G0/0/10 interfaces are active.

Change the maximum number of active interfaces.

```
[S1-Eth-Trunk1]max active-linknumber 1


[S2-Eth-Trunk1]max active-linknumber 1
```

View the configurations of the Eth-trunk link.

```
[S1]display eth-trunk 1
Eth-Trunk1's state information is:
Local:
LAG ID: 1                WorkingMode: STATIC
Preempt Delay: Disabled    Hash arithmetic: According to SA-XOR-DA
System Priority: 32768     System ID: 4c1f-cc45-aace
Least Active-linknumber: 1  Max Active-linknumber: 1
Operate status: up         Number Of Up Port In Trunk: 1
-------------------------------------------------------------------------
ActorPortName        Status   PortType PortPri PortNo PortKey PortState Weight
GigabitEthernet0/0/9  Selected 1GE      32768   9      305    10111100 1
GigabitEthernet0/0/10 Unselect 1GE      32768   10     305    10100000 1

Partner:
-------------------------------------------------------------------------
ActorPortName        SysPri   SystemID  PortPri PortNo  PortKey  PortState
```

```
GigabitEthernet0/0/9   32768  4c1f-cc45-aacc  32768  9    305      10111100
GigabitEthernet0/0/10  32768  4c1f-cc45-aacc  32768  10   305      10100000
```

The preceding information shows that the G0/0/10 interface changes to the Unselect state. In this way, one link in the Eth-trunk link group transmits data and the other is a backup, improving network reliability.

Disable the G0/0/9 interface of S1 to verify the link backup function.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]shutdown
```

View the information about the Eth-trunk link.

```
[S1]display eth-trunk 1
Eth-Trunk1's state information is:
Local:
LAG ID: 1              WorkingMode: STATIC
Preempt Delay: Disabled   Hash arithmetic: According to SA-XOR-DA
System Priority: 32768    System ID: 4c1f-cc45-aace
Least Active-linknumber: 1  Max Active-linknumber: 1
Operate status: up        Number Of Up Port In Trunk: 1
------------------------------------------------------------------------
ActorPortName        Status   PortType PortPri PortNo PortKey PortState Weight
GigabitEthernet0/0/9   Unselect 1GE     32768   9     305     10100010  1
GigabitEthernet0/0/10  Selected 1GE     32768   10    305     10111100  1

Partner:
------------------------------------------------------------------------
ActorPortName        SysPri    SystemID  PortPri PortNo  PortKey   PortState
GigabitEthernet0/0/9   0       0000-0000-0000  0    0     0         10100011
GigabitEthernet0/0/10  32768   4c1f-cc45-aacc  32768  10   305       10111100
```

The preceding information shows that the G0/0/9 interface in the Eth-trunk link changes to the Unselect state, and G0/0/10 changes from the Unselect state to the Selected state to transmit data. This proves the link backup function.

Step 3 **Configure VLANs.**

Create two VLANs on S1 and S2 to isolate R1 from R2 and R3. Configure the Eth-trunk link between S1 and S2 to work in Trunk mode so that the routers in the two VLANs can communicate with each other.

Create VLAN 10 and VLAN 20 on S1 and S2.

```
[S1]vlan batch 10 20


[S2]vlan batch 10 20
```

Configure the G0/0/1 and G0/0/2 interfaces of S1 to work in Access mode, and add the two interfaces to VLAN 10.

```
[S1]interface GigabitEthernet 0/0/1
[S1-GigabitEthernet0/0/1]port link-type access
[S1-GigabitEthernet0/0/1]port default vlan 10
[S1]interface GigabitEthernet 0/0/2
[S1-GigabitEthernet0/0/2]port link-type access
[S1-GigabitEthernet0/0/2]port default vlan 20
```

Configure the G0/0/3 interface of S2 to work in Access mode, and add this interface to VLAN 20.

```
[S2]interface GigabitEthernet 0/0/3
[S2-GigabitEthernet0/0/3]port link-type access
[S2-GigabitEthernet0/0/3]port default vlan 20
```

Configure the Eth-trunk link between S1 and S2 to work in Trunk mode. By default, the trunk interface allows only packets from VLAN 1 to pass through. Therefore, configure the trunk interface to allow packets from VLAN 10 and VLAN 20 to pass through.

```
[S1]interface Eth-Trunk 1
[S1-Eth-Trunk1]port link-type trunk
[S1-Eth-Trunk1]port trunk allow-pass vlan 10 20

[S2]inter Eth-Trunk 1
[S2-Eth-Trunk1]port link-type trunk
[S2-Eth-Trunk1]port trunk allow-pass vlan 10 20
```

Run the **display port vlan** command to view the status of the trunk interface.

```
[S2]display port vlan

Port               Link Type   PVID  Trunk VLAN List
-----------------------------------------------------------------------
Eth-Trunk1          trunk       1    1 10 20
GigabitEthernet0/0/1   hybrid      1    -
```

```
GigabitEthernet0/0/2     hybrid      1    -
GigabitEthernet0/0/3     access      20    -

GigabitEthernet0/0/4     hybrid      1    -
GigabitEthernet0/0/5     hybrid      1    -
GigabitEthernet0/0/6     hybrid      1    -
GigabitEthernet0/0/7     hybrid      1    -
GigabitEthernet0/0/8     hybrid      1    -
GigabitEthernet0/0/9     hybrid      0    -
GigabitEthernet0/0/10    hybrid      0    -
GigabitEthernet0/0/11    hybrid      1    -
GigabitEthernet0/0/12    hybrid      1    -
GigabitEthernet0/0/13    hybrid      1    -
GigabitEthernet0/0/14    hybrid      1    -
GigabitEthernet0/0/15    hybrid      1    -
GigabitEthernet0/0/16    hybrid      1    -
GigabitEthernet0/0/17    hybrid      1    -
GigabitEthernet0/0/18    hybrid      1    -
GigabitEthernet0/0/19    hybrid      1    -
GigabitEthernet0/0/20    hybrid      1    -
GigabitEthernet0/0/21    hybrid      1    -
GigabitEthernet0/0/22    hybrid      1    -
GigabitEthernet0/0/23    hybrid      1    -
GigabitEthernet0/0/24    hybrid      1    -
Eth-Trunk1               trunk       1    1 10 20
```

The preceding information shows that the Eth-trunk interface works in Trunk mode and allows VLAN 10 to communicate with VLAN 20.

Run the **ping** command to test whether the routes from R2 to R1 and R3 are reachable.

```
[R2]ping -c 1 10.0.10.1
  PING 10.0.10.1: 56  data bytes, press CTRL_C to break
    Request time out


  --- 10.0.10.1 ping statistics ---
    1 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss


[R2]ping -c 1 10.0.10.3
  PING 10.0.10.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.3: bytes=56 Sequence=1 ttl=255 time=3 ms
```

```
 --- 10.0.10.3 ping statistics ---
  1 packet(s) transmitted
  1 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 3/3/3 ms
```

The preceding information shows that computers in different VLANs on two switches that are interconnected cannot communicate with each other,computers in the same VLAN can;but computers in different VLANs on two switches that are interconnected over trunk can communicate with each other.

Step 4 **Configure hybrid interfaces.**

The hybrid interface allows R1 to communicate with R3 in Layer 2 mode. Compare the hybrid interface with the trunk interface to learn the configurations and features of the hybrid interface.

Configuration 1: The link between S1 and S2 works in Trunk mode.

Configure the G0/0/1 interface of S1 to work in Hybrid mode, and add this interface to VLAN 10. Configure the function of removing VLAN tags of packets from VLAN 20.

```
[S1]interface GigabitEthernet 0/0/1
[S1-GigabitEthernet0/0/1]port default vlan 1
[S1-GigabitEthernet0/0/1]port link-type hybrid
[S1-GigabitEthernet0/0/1]port hybrid pvid vlan 10
[S1-GigabitEthernet0/0/1]port hybrid tagged vlan 10
[S1-GigabitEthernet0/0/1]port hybrid untagged vlan  20
```

Configure the G0/0/3 interface of S2 to work in Hybrid mode, and add this interface to VLAN 20. Enable the G0/0/3 interface to forward packets from VLAN 10 in untagged mode.

```
[S2]interface GigabitEthernet 0/0/3
[S2-GigabitEthernet0/0/3]port default vlan 1
[S2-GigabitEthernet0/0/3]port link-type hybrid
[S2-GigabitEthernet0/0/3]port hybrid pvid vlan 20
[S2-GigabitEthernet0/0/3]port hybrid untagged vlan 10
```

Run the **display vlan** and **display port vlan** commands to view interface status.

```
[S1]display vlan 20

----------------------------------------------------------------------------
U: Up;         D: Down;         TG: Tagged;         UT: Untagged;
MP: Vlan-mapping;               ST: Vlan-stacking;
#: ProtocolTransparent-vlan;    *: Management-vlan;
----------------------------------------------------------------------------
VID  Type   Ports
----------------------------------------------------------------------------
20   common UT:GE0/0/1(U)      GE0/0/2(U)
            TG:Eth-Trunk1(U)
VID  Status Property    MAC-LRN Statistics Description
----------------------------------------------------------------------------
20   enable default     enable  disable   VLAN 0020


[S1]display port vlan

Port                Link Type  PVID  Trunk VLAN List
----------------------------------------------------------------------------
Eth-Trunk1          trunk      1     1 10 20
GigabitEthernet0/0/1  hybrid   10    10
GigabitEthernet0/0/2  access   20    -
GigabitEthernet0/0/3  hybrid    1    -
GigabitEthernet0/0/4  hybrid    1    -
GigabitEthernet0/0/5  hybrid    1    -
GigabitEthernet0/0/6  hybrid    1    -
GigabitEthernet0/0/7  hybrid    1    -
GigabitEthernet0/0/8  hybrid    1    -
GigabitEthernet0/0/9  hybrid    0    -
GigabitEthernet0/0/10 hybrid    0    -
GigabitEthernet0/0/11 hybrid    1    -
GigabitEthernet0/0/12 hybrid    1    -
GigabitEthernet0/0/13 hybrid    1    -
GigabitEthernet0/0/14 hybrid    1    -
GigabitEthernet0/0/15 hybrid    1    -
GigabitEthernet0/0/16 hybrid    1    -
GigabitEthernet0/0/17 hybrid    1    -
GigabitEthernet0/0/18 hybrid    1    -
GigabitEthernet0/0/19 hybrid    1    -
GigabitEthernet0/0/20 hybrid    1    -
GigabitEthernet0/0/21 hybrid    1    -
GigabitEthernet0/0/22 hybrid    1    -
GigabitEthernet0/0/23 hybrid    1    -
GigabitEthernet0/0/24 hybrid    1    -
```

```
[S2]display vlan 10

------------------------------------------------------------------------------
U: Up;          D: Down;          TG: Tagged;          UT: Untagged;
MP: Vlan-mapping;                 ST: Vlan-stacking;
#: ProtocolTransparent-vlan;    *: Management-vlan;
------------------------------------------------------------------------------
VID  Type    Ports
------------------------------------------------------------------------------
10   common  UT:GE0/0/3(U)
             TG:Eth-Trunk1(U)
VID  Status  Property     MAC-LRN Statistics Description
------------------------------------------------------------------------------
10   enable  default      enable  disable    VLAN 0010

[S2]display port vlan
Port               Link Type   PVID  Trunk VLAN List
------------------------------------------------------------------------------
Eth-Trunk1             trunk     1     1 10 20
GigabitEthernet0/0/1   hybrid    1     -
GigabitEthernet0/0/2   hybrid    1     -
GigabitEthernet0/0/3   hybrid    20    20
GigabitEthernet0/0/4   hybrid    1     -
GigabitEthernet0/0/5   hybrid    1     -
GigabitEthernet0/0/6   hybrid    1     -
GigabitEthernet0/0/7   hybrid    1     -
GigabitEthernet0/0/8   hybrid    1     -
GigabitEthernet0/0/9   hybrid    0     -
GigabitEthernet0/0/10  hybrid    0     -
GigabitEthernet0/0/11  hybrid    1     -
GigabitEthernet0/0/12  hybrid    1     -
GigabitEthernet0/0/13  hybrid    1     -
GigabitEthernet0/0/14  hybrid    1     -
GigabitEthernet0/0/15  hybrid    1     -
GigabitEthernet0/0/16  hybrid    1     -
GigabitEthernet0/0/17  hybrid    1     -
GigabitEthernet0/0/18  hybrid    1     -
GigabitEthernet0/0/19  hybrid    1     -
GigabitEthernet0/0/20  hybrid    1     -
GigabitEthernet0/0/21  hybrid    1     -
GigabitEthernet0/0/22  hybrid    1     -
GigabitEthernet0/0/23  hybrid    1     -
```

```
GigabitEthernet0/0/24   hybrid      1    -
```

The preceding information shows that the G0/0/1 interface of S1 forwards packets from VLAN 20 in untagged mode. The port VLAN ID (PVID) of G0/0/1 belongs to VLAN 10. The G0/0/3 interface of S2 forwards packets from VLAN 10 in untagged mode. The PVID of G0/0/3 belongs to VLAN 20.

Run the **ping** command to test whether the routes from R1 to R2 and R3 are reachable.

```
[R1]ping -c 1 10.0.10.2
  PING 10.0.10.2: 56  data bytes, press CTRL_C to break
    Request time out

  --- 10.0.10.2 ping statistics ---
    1 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss

[R1]ping -c 1 10.0.10.3
  PING 10.0.10.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.3: bytes=56 Sequence=1 ttl=255 time=13 ms

  --- 10.0.10.3 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 13/13/13 ms
```

Configuration 2: The link between S1 and S2 works in Hybrid mode.

Configure the Eth-trunk interfaces on S1 and S2 to work in Hybrid mode. Run **Untagged VLAN 10** on the Eth-trunk interface of S1 and **Untagged VLAN 20** on the Eth-trunk interface of S2.

```
[S1]interface Eth-Trunk 1
[S1-Eth-Trunk1]undo port trunk allow-pass vlan 10 20
[S1-Eth-Trunk1]port link-type hybrid
[S1-Eth-Trunk1]port hybrid untagged vlan 10

[S2]interface Eth-Trunk 1
[S2-Eth-Trunk1]undo port trunk allow-pass vlan 10 20
[S2-Eth-Trunk1]port link-type hybrid
```

```
[S2-Eth-Trunk1]port hybrid untagged vlan 20
```

View the configurations of the Eth-trunk 1 interface.

```
[S1]display port vlan

Port              Link Type   PVID  Trunk VLAN List
--------------------------------------------------------------------------
Eth-Trunk1        hybrid      1     -
GigabitEthernet0/0/1   hybrid    10   -
GigabitEthernet0/0/2   access    20   -
GigabitEthernet0/0/3   hybrid    1    -
GigabitEthernet0/0/4   hybrid    1    -
GigabitEthernet0/0/5   hybrid    1    -
GigabitEthernet0/0/6   hybrid    1    -
GigabitEthernet0/0/7   hybrid    1    -
GigabitEthernet0/0/8   hybrid    1    -
GigabitEthernet0/0/9   hybrid    0    -
GigabitEthernet0/0/10  hybrid    0    -
GigabitEthernet0/0/11  hybrid    1    -
GigabitEthernet0/0/12  hybrid    1    -
GigabitEthernet0/0/13  hybrid    1    -
GigabitEthernet0/0/14  hybrid    1    -
GigabitEthernet0/0/15  hybrid    1    -
GigabitEthernet0/0/16  hybrid    1    -
GigabitEthernet0/0/17  hybrid    1    -
GigabitEthernet0/0/18  hybrid    1    -
GigabitEthernet0/0/19  hybrid    1    -
GigabitEthernet0/0/20  hybrid    1    -
GigabitEthernet0/0/21  hybrid    1    -
GigabitEthernet0/0/22  hybrid    1    -
GigabitEthernet0/0/23  hybrid    1    -
GigabitEthernet0/0/24  hybrid    1    -


[S1]display vlan 10

--------------------------------------------------------------------------
U: Up;        D: Down;        TG: Tagged;        UT: Untagged;
MP: Vlan-mapping;            ST: Vlan-stacking;
#: ProtocolTransparent-vlan;   *: Management-vlan;
--------------------------------------------------------------------------
VID Type    Ports
--------------------------------------------------------------------------
10   common  UT:GE0/0/1(U)      Eth-Trunk1(U)
```

```
VID  Status  Property     MAC-LRN  Statistics  Description
-------------------------------------------------------------------------
10   enable  default      enable   disable     VLAN 0010
```

The preceding information shows that the Eth-trunk 1 interface of S1 works in Hybrid mode and forwards packets from VLAN 10 in untagged mode. The Eth-trunk 1 interface of S2 works in Hybrid mode and forwards packets from VLAN 20 in untagged mode.

Run the **ping** command to test whether the routes from R1 to R2 and R3 are reachable.

```
[R1]ping -c 1 10.0.10.2
  PING 10.0.10.2: 56  data bytes, press CTRL_C to break
    Request time out

  --- 10.0.10.2 ping statistics ---
    1 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss

[R1]ping -c 1 10.0.10.3

  PING 10.0.10.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.3: bytes=56 Sequence=1 ttl=255 time=4 ms

  --- 10.0.10.3 ping statistics ---
    1 packet(s) transmitted
    0 packet(s) received
    0% packet loss
```

R1 can communicate with R3.

Additional Exercises: Analyzing and Verifying

In step 4, figure out the differences in data transmission when the Eth-trunk interfaces on S1 and S2 work in Trunk mode and Hybrid mode.

Final Configurations

```
[S1]display current-configuration
#
!Software Version V100R005C01SPC100
 sysname S1
```

```
#
 vlan batch 10 20
#
 stp mode rstp
 stp enable
#
 undo http server enable
#
interface Eth-Trunk1
 port hybrid untagged vlan 10
 mode lacp-static
 max active-linknumber 1
 bpdu enable
#
interface GigabitEthernet0/0/1
 port hybrid pvid vlan 10
 port hybrid tagged vlan 10
#
interface GigabitEthernet0/0/2
 port link-type access
 port default vlan 20
#
interface GigabitEthernet0/0/3
 shutdown
#
interface GigabitEthernet0/0/4
 shutdown
#
interface GigabitEthernet0/0/9
 shutdown
 eth-trunk 1
#
interface GigabitEthernet0/0/10
 eth-trunk 1
#
interface GigabitEthernet0/0/13
 shutdown
#
interface GigabitEthernet0/0/14
 shutdown
#
interface GigabitEthernet0/0/21
 shutdown
```

```
#
interface GigabitEthernet0/0/22
 shutdown
#
interface GigabitEthernet0/0/23
 shutdown
#
Return
```

[S2]**display current-configuration**
```
#
!Software Version V100R005C01SPC100
 sysname S2
#
 vlan batch 10 20
#
 stp mode rstp
 stp enable
#
interface Eth-Trunk1
 port hybrid untagged vlan 20
 mode lacp-static
 max active-linknumber 1
 bpdu enable
#
interface GigabitEthernet0/0/1
 shutdown
#
interface GigabitEthernet0/0/2
 shutdown
#
interface GigabitEthernet0/0/3
 port hybrid pvid vlan 20
 port hybrid tagged vlan 20
#
interface GigabitEthernet0/0/4
 shutdown
#
interface GigabitEthernet0/0/5
 shutdown
#
interface GigabitEthernet0/0/9
 eth-trunk 1
```

```
#
interface GigabitEthernet0/0/10
 eth-trunk 1
#
interface GigabitEthernet0/0/11
 shutdown
#
interface GigabitEthernet0/0/12
 shutdown
#
interface GigabitEthernet0/0/13
 shutdown
#
interface GigabitEthernet0/0/23
 shutdown
#
interface GigabitEthernet0/0/24
 shutdown
#
return
```

Lab 1-2 MUX VLAN Configuration and GVRP Configuration (Optional)

Learning Objectives

The objectives of this lab are to learn and understand how to perform the following operations:

- Configure GARP VLAN Registration Protocol (GVRP).
- Configure multiplexer (MUX) VLANs.
- Configure voice VLANs in automatic mode.

Topology
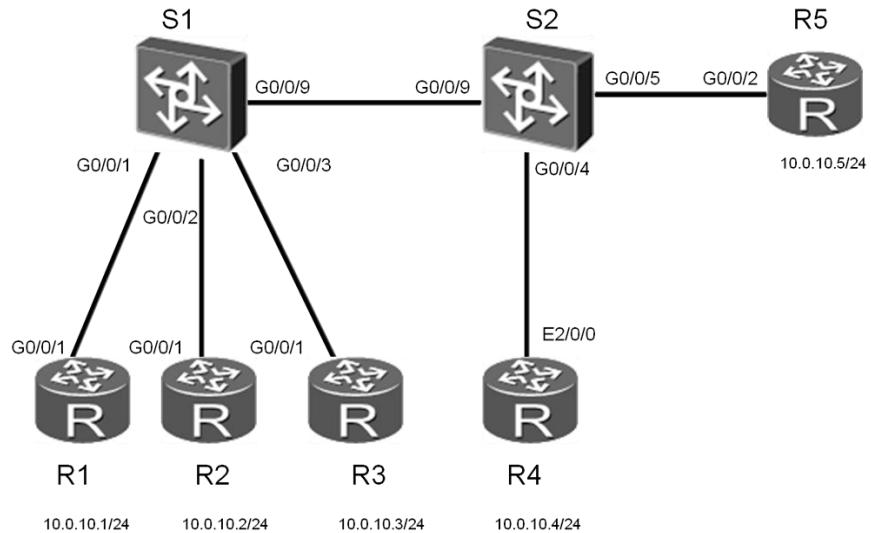
Figure 1-2 MUX VLAN configuration and GVRP configuration

Scenario

Assume that you are a network administrator of a company. The company uses an Ethernet that has two switches. In the preceding figure, the routers represent computers on the network. To optimize the network, broadcast domains must be isolated from each other. R1 and R2 are in the same VLAN, and R3 and R4 are in the same VLAN. As required by the company, all

computers can access R4, but R3 and R4 cannot communicate with each other, with neither R1 nor R2. Voice devices will be used on the G0/0/24 interface of S2. Therefore, plan a voice VLAN and related configurations in advance.

Tasks

Step 1 **Perform basic configurations and IP addressing.**

Configure IP addresses and subnet masks for all routers.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface g0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.10.1 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface g0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.10.2 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface g0/0/1
[R3-GigabitEthernet0/0/1]ip address 10.0.10.3 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R4
[R4]interface g0/0/2
[R4-GigabitEthernet0/0/2]ip address 10.0.10.4 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R5
[R5]interface g0/0/2
[R5-GigabitEthernet0/0/2]ip address 10.0.10.5 24

<Quidway>system-view
```

```
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1
[S1]

<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
[S2]
```

Test whether the routes from R1 to R2, R3, R4, and R5 are reachable.

```
[R1]ping -c 1 10.0.10.2
  PING 10.0.10.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.2: bytes=56 Sequence=1 ttl=255 time=14 ms

  --- 10.0.10.2 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 14/14/14 ms

[R1]ping -c 1 10.0.10.3
  PING 10.0.10.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.3: bytes=56 Sequence=1 ttl=255 time=5 ms

  --- 10.0.10.3 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 5/5/5 ms

[R1]ping -c 1 10.0.10.4
  PING 10.0.10.4: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.4: bytes=56 Sequence=1 ttl=255 time=15 ms

  --- 10.0.10.4 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 15/15/15 ms

[R1]ping -c 1 10.0.10.5
  PING 10.0.10.5: 56  data bytes, press CTRL_C to break
```

```
   Reply from 10.0.10.5: bytes=56 Sequence=1 ttl=255 time=6 ms


  --- 10.0.10.5 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 6/6/6 ms
```

Step 2 **Configure GVRP.**

GVRP transmits VLAN information across the network, improving the VLAN configuration efficiency. Configure the G0/0/9 interface of S2 to work in Fixed mode and that of S1 to work in Normal mode so that S1 can learn the VLAN configurations on S2.

Configure the G0/0/9 interfaces of S1 and S2 to work in Trunk mode and allow the access from all VLANs.

```
[S1]interface g0/0/9
[S1-GigabitEthernet0/0/9]port link-type trunk
[S1-GigabitEthernet0/0/9]port trunk allow-pass vlan all

[S2]interface g0/0/9
[S2-GigabitEthernet0/0/9]port link-type trunk
[S2-GigabitEthernet0/0/9]port trunk allow-pass vlan all
```

Enable GVRP on S1 and S2.

```
[S1]gvrp

[S2]gvrp
```

Run the **display gvrp status** command to view GVRP status information.

```
[S1]display gvrp status
 GVRP is enabled

[S2]display gvrp status
 GVRP is enabled
```

Configure the G0/0/9 interface of S1 to work in Normal mode.

```
[S1]interface g0/0/9
[S1-GigabitEthernet0/0/9]gvrp
```

```
[S1-GigabitEthernet0/0/9]gvrp registration normal
[S1-GigabitEthernet0/0/9]bpdu enable
```

Configure the G0/0/9 interface of S2 to work in Fixed mode.

```
[S2]interface g0/0/9
[S2-GigabitEthernet0/0/9]gvrp
[S2-GigabitEthernet0/0/9]gvrp registration fixed
[S2-GigabitEthernet0/0/9]bpdu enable
```

Run the **display gvrp statistics** command to view GVRP statistics.

```
[S1]display gvrp statistics

 GVRP statistics on port GigabitEthernet0/0/9
   GVRP status                    : Enabled
   GVRP registrations failed      : 0
   GVRP last PDU origin                  : 4c1f-cc45-aacc
   GVRP registration type         : Normal
```

Run the **display vlan** command to view VLAN information about S1 in the current state.

```
[S1]display vlan
The total number of vlans is : 1
--------------------------------------------------------------------------
U: Up;        D: Down;        TG: Tagged;        UT: Untagged;
MP: Vlan-mapping;             ST: Vlan-stacking;
#: ProtocolTransparent-vlan;   *: Management-vlan;
--------------------------------------------------------------------------

VID  Type    Ports
--------------------------------------------------------------------------
1    common  UT:GE0/0/1(U)     GE0/0/2(U)      GE0/0/3(U)      GE0/0/4(U)
             GE0/0/5(U)      GE0/0/6(D)      GE0/0/7(D)      GE0/0/8(D)
             GE0/0/9(U)      GE0/0/10(D)     GE0/0/11(D)     GE0/0/12(D)
             GE0/0/13(D)     GE0/0/14(D)     GE0/0/15(D)     GE0/0/16(D)
             GE0/0/17(D)     GE0/0/18(D)     GE0/0/19(D)     GE0/0/20(D)
             GE0/0/21(D)     GE0/0/22(D)     GE0/0/23(D)     GE0/0/24(D)


VID  Status  Property    MAC-LRN Statistics Description
--------------------------------------------------------------------------
1    enable  default     enable  disable    VLAN 0001
```

Create VLAN 10, VLAN 20, and VLAN 100 on S2.

```
[S2]vlan batch 10 20 100
Info: This operation may take a few seconds. Please wait for a moment...done.
```

View VLAN information about S1 again.

```
[S1]display vlan
The total number of vlans is : 4
--------------------------------------------------------------------------
U: Up;         D: Down;         TG: Tagged;         UT: Untagged;
MP: Vlan-mapping;            ST: Vlan-stacking;
#: ProtocolTransparent-vlan;   *: Management-vlan;
--------------------------------------------------------------------------
VID Type    Ports
--------------------------------------------------------------------------
1   common  UT:GE0/0/1(U)     GE0/0/2(U)     GE0/0/3(U)     GE0/0/4(U)
                GE0/0/5(U)     GE0/0/6(D)     GE0/0/7(D)     GE0/0/8(D)
                GE0/0/9(U)     GE0/0/10(D)    GE0/0/11(D)    GE0/0/12(D)
                GE0/0/13(D)    GE0/0/14(D)    GE0/0/15(D)    GE0/0/16(D)
                GE0/0/17(D)    GE0/0/18(D)    GE0/0/19(D)    GE0/0/20(D)
                GE0/0/21(D)    GE0/0/22(D)    GE0/0/23(D)    GE0/0/24(D)
10  dynamic TG:GE0/0/9(U)
20  dynamic TG:GE0/0/9(U)
100 dynamic TG:GE0/0/9(U)


VID Status  Property    MAC-LRN Statistics Description
--------------------------------------------------------------------------
1   enable  default     enable  disable    VLAN 0001
10  enable  default     enable  disable    VLAN 0010
20  enable  default     enable  disable    VLAN 0020
100 enable  default     enable  disable    VLAN 0100
```

The preceding information shows that S1 learns the VLAN information about S2.

Create VLAN 30 on S1 and observe the changes of the VLAN information about S1 and S2.

```
[S1]vlan 30
[S1-vlan30]quit
[S1]display vlan
The total number of vlans is : 5
--------------------------------------------------------------------------
U: Up;         D: Down;         TG: Tagged;         UT: Untagged;
MP: Vlan-mapping;            ST: Vlan-stacking;
```

```
#: ProtocolTransparent-vlan;    *: Management-vlan;
--------------------------------------------------------------------------


VID  Type    Ports
--------------------------------------------------------------------------
1    common  UT:GE0/0/1(U)     GE0/0/2(U)      GE0/0/3(U)      GE0/0/4(U)
                GE0/0/5(U)      GE0/0/6(D)      GE0/0/7(D)      GE0/0/8(D)
                GE0/0/9(U)      GE0/0/10(D)     GE0/0/11(D)     GE0/0/12(D)
                GE0/0/13(D)     GE0/0/14(D)     GE0/0/15(D)     GE0/0/16(D)
                GE0/0/17(D)     GE0/0/18(D)     GE0/0/19(D)     GE0/0/20(D)
                GE0/0/21(D)     GE0/0/22(D)     GE0/0/23(D)     GE0/0/24(D)
10   dynamic TG:GE0/0/9(U)
20   dynamic TG:GE0/0/9(U)
30   common  TG:GE0/0/9(U)
100  dynamic TG:GE0/0/9(U)


VID  Status  Property    MAC-LRN Statistics Description
--------------------------------------------------------------------------
1    enable  default     enable  disable    VLAN 0001
10   enable  default     enable  disable    VLAN 0010
20   enable  default     enable  disable    VLAN 0020
30   enable  default     enable  disable    VLAN 0030
100  enable  default     enable  disable    VLAN 0100


[S2]display vlan
The total number of vlans is : 4
--------------------------------------------------------------------------
U: Up;        D: Down;        TG: Tagged;        UT: Untagged;
MP: Vlan-mapping;             ST: Vlan-stacking;
#: ProtocolTransparent-vlan;    *: Management-vlan;
--------------------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------------------
1    common  UT:GE0/0/1(U)     GE0/0/2(U)      GE0/0/3(U)      GE0/0/4(U)
                GE0/0/5(U)      GE0/0/6(D)      GE0/0/7(D)      GE0/0/8(D)
                GE0/0/9(U)      GE0/0/10(D)     GE0/0/11(D)     GE0/0/12(D)
                GE0/0/13(D)     GE0/0/14(D)     GE0/0/15(D)     GE0/0/16(D)
                GE0/0/17(D)     GE0/0/18(D)     GE0/0/19(D)     GE0/0/20(D)
                GE0/0/21(D)     GE0/0/22(D)     GE0/0/23(D)     GE0/0/24(D)
10   common  TG:GE0/0/9(U)
20   common  TG:GE0/0/9(U)
100  common  TG:GE0/0/9(U)
```

```
VID Status Property     MAC-LRN Statistics Description
-----------------------------------------------------------------------
1   enable default     enable disable    VLAN 0001
10  enable default     enable disable    VLAN 0010
20  enable default     enable disable    VLAN 0020
100 enable default      enable disable    VLAN 0100
```

The preceding information shows that S2 does not learn the VLAN information about S1.

Step 3 **Configure MUX VLANs.**

After devices on the same network segment are added to different VLANs, Layer 2 communication is isolated, that is, routers in different VLANs cannot communicate with each other. However, the MUX VLAN can allow these routers to communicate with a specified VLAN. In addition, the MUX VLAN can restrict devices in the same VLAN from communicating with each other.

Configure VLAN 100 as the primary VLAN of the MUX VLAN, and VLAN 10 and VLAN 20 as the secondary VLANs.

Configure the types of the interfaces on the computers that connect to the switches to ensure that: all computers can communicate with R4; R3 and R4 cannot communicate with each other or with routers in other VLANs.

Configure VLAN 100 as a secondary VLAN and add related configurations.

```
[S1]vlan 10
[S1-vlan10]quit
[S1]vlan 20
[S1-vlan20]quit
[S1]vlan 100
[S1-vlan100]mux-vlan
[S1-vlan100]subordinate group 10
[S1-vlan100]subordinate separate 20

[S2]vlan 100
[S2-vlan100]mux-vlan
[S2-vlan100]subordinate group 10
[S2-vlan100]subordinate separate 20
```

Add the G0/0/5 interface on R5 that connects to S2 to VLAN 100 and enable the MUX VLAN function.

```
[S2]interface GigabitEthernet 0/0/5
[S2-GigabitEthernet0/0/5]port link-type access
[S2-GigabitEthernet0/0/5]port default vlan 100
[S2-GigabitEthernet0/0/5]port mux-vlan enable
```

Add the G0/0/1 interface on R1 that connects to S1 and the G0/0/2 interface on R2 that connects to S1 to VLAN 10 and enable the MUX VLAN function.

```
[S1]interface GigabitEthernet 0/0/1
[S1-GigabitEthernet0/0/1]port link-type access
[S1-GigabitEthernet0/0/1]port default vlan 10
[S1-GigabitEthernet0/0/1]port mux-vlan enable
[S1-GigabitEthernet0/0/1]interface GigabitEthernet 0/0/2
[S1-GigabitEthernet0/0/2]port link-type access
[S1-GigabitEthernet0/0/2]port default vlan 10
[S1-GigabitEthernet0/0/2]port mux-vlan enable
```

Add the G0/0/3 interface on R3 that connects to S1 and the G0/0/4 interface on R4 that connects to S2 to VLAN 20 and enable the MUX VLAN function.

```
[S1]interface GigabitEthernet 0/0/3
[S1-GigabitEthernet0/0/3]port link-type access
[S1-GigabitEthernet0/0/3]port default vlan 20
[S1-GigabitEthernet0/0/3]port mux-vlan enable


[S2]interface GigabitEthernet 0/0/4
[S2-GigabitEthernet0/0/4]port link-type access
[S2-GigabitEthernet0/0/4]port default vlan 20
[S2-GigabitEthernet0/0/4]port mux-vlan enable
```

Run the **display mux-vlan** command to view information about all MUX VLANs.

```
[S1]display mux-vlan
Principal Subordinate Type        Interface
--------------------------------------------------------------------------
100      -         principal
100      20        separate   GigabitEthernet0/0/3
100      10        group      GigabitEthernet0/0/1 GigabitEthernet0/0/2


[S2]display mux-vlan
Principal Subordinate Type        Interface
--------------------------------------------------------------------------
```

```
100      -          principal    GigabitEthernet0/0/5
100      20         separate     GigabitEthernet0/0/4
100      10         group
----------------------------------------------------------------------------
```

Run the **ping** command to test whether the routes from R1 to R2, R3, R4, and R5 are reachable.

```
[R1]ping -c 1 10.0.10.2
  PING 10.0.10.2: 56  data bytes, press CTRL_C to break
   Reply from 10.0.10.2: bytes=56 Sequence=1 ttl=255 time=3 ms

  --- 10.0.10.2 ping statistics ---
   1 packet(s) transmitted
   1 packet(s) received
   0.00% packet loss
   round-trip min/avg/max = 3/3/3 ms


[R1]ping -c 1 10.0.10.3
  PING 10.0.10.3: 56  data bytes, press CTRL_C to break
   Request time out

  --- 10.0.10.3 ping statistics ---
   1 packet(s) transmitted
   0 packet(s) received
   100.00% packet loss


[R1]ping -c 1 10.0.10.4
  PING 10.0.10.4: 56  data bytes, press CTRL_C to break
   Request time out

  --- 10.0.10.4 ping statistics ---
   1 packet(s) transmitted
   0 packet(s) received
   100.00% packet loss


[R1]ping -c 1 10.0.10.5
  PING 10.0.10.5: 56  data bytes, press CTRL_C to break
   Reply from 10.0.10.5: bytes=56 Sequence=1 ttl=255 time=3 ms

  --- 10.0.10.5 ping statistics ---
   1 packet(s) transmitted
   1 packet(s) received
```

```
    0.00% packet loss
    round-trip min/avg/max = 3/3/3 ms
```

Run the **ping** command to test whether the routes from R3 to R2, R4, and R5 are reachable.

```
[R3]ping -c 1 10.0.10.2
  PING 10.0.10.2: 56  data bytes, press CTRL_C to break
    Request time out

  --- 10.0.10.2 ping statistics ---
    1 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss

[R3]ping -c 1 10.0.10.4
  PING 10.0.10.4: 56  data bytes, press CTRL_C to break
    Request time out

  --- 10.0.10.4 ping statistics ---
    1 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss

[R3]ping -c 1 10.0.10.5
  PING 10.0.10.5: 56  data bytes, press CTRL_C to break
    Reply from 10.0.10.5: bytes=56 Sequence=1 ttl=255 time=3 ms

  --- 10.0.10.5 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 3/3/3 ms
```

The preceding information shows that: R1 and R2 in VLAN 10 can communicate with each other, as well as with R5; R3 and R4 in VLAN 10 can communicate only with R5.

Step 4 **Configure voice VLANs.**

To meet service development requirements, voice VLANs are configured on S2 and related configuration is completed on the G0/0/24 interface.

Create VLAN 30 and VLAN 200 on S2. VLAN 200 functions as a voice VLAN.

```
[S2]vlan batch 30 200
Info: This operation may take a few seconds. Please wait for a moment...done.
```

Configure the interface type and default VLAN for the G0/0/24 interface of S2. Assume that the voice device belongs to VLAN 30.

```
[S2]interface GigabitEthernet 0/0/24
[S2-GigabitEthernet0/0/24]port hybrid pvid vlan 30
[S2-GigabitEthernet0/0/24]port hybrid untagged vlan 30
```

Configure an OUI address on S2. Assume that the media access control (MAC) address of the voice device is 0011-2200-0000 and the subnet mask is ffff-ff00-0000.

```
[S2]voice-vlan mac-address 0011-2200-0000 mask ffff-ff00-0000
```

Enable the voice VLAN function and configure an automatic voice VLAN on the G0/0/24 interface of S2.

```
[S2]interface GigabitEthernet 0/0/24
[S2-GigabitEthernet0/0/24]voice-vlan 200 enable
[S2-GigabitEthernet0/0/24]voice-vlan mode auto
[S2-GigabitEthernet0/0/24]voice-vlan security enable
```

Run the **display voice-vlan oui** command to view the OUI address of the voice VLAN.

```
[S2]display voice-vlan oui
-------------------------------------------------
OuiAddress     Mask          Description
-------------------------------------------------
0011-2200-0000  ffff-ff00-0000
```

Run the **display voice-vlan 200 status** command to view the configurations of the voice VLAN.

```
[S2]display voice-vlan 200 status
Voice VLAN Configurations:
----------------------------------------------------------
Voice VLAN ID        : 200
Voice VLAN status     : Enable
Voice VLAN aging time   : 1440(minutes)
```

```
Voice VLAN 8021p remark  : 6
Voice VLAN dscp remark   : 46
---------------------------------------------------------
Port Information:
---------------------------------------------------------
Port                 Add-Mode  Security-Mode  Legacy
---------------------------------------------------------
GigabitEthernet0/0/24  Auto      Security       Disable
```

Additional Exercises: Analyzing and Verifying

Figure out whether computers in different MUX VLANs can communicate with each other.

Final Configurations

```
[S1]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S1
#
 vlan batch 10 20 30 100
#
 gvrp
#
vlan 100
 mux-vlan
 subordinate separate 20
 subordinate group 10
#
interface GigabitEthernet0/0/1
 port link-type access
 port default vlan 10
 port mux-vlan enable
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/2
 port link-type access
 port default vlan 10
 port mux-vlan enable
```

```
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/3
 port link-type access
 port default vlan 20
 port mux-vlan enable
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/9
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
 undo ntdp enable
 undo ndp enable
 gvrp
#
interface GigabitEthernet0/0/10
 shutdown
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
Return

[S2]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S2
#
 voice-vlan mac-address 0011-2200-0000 mask ffff-ff00-0000
#
 vlan batch 10 20 30 100 200
#
 gvrp
#
vlan 100
 mux-vlan
 subordinate separate 20
 subordinate group 10
#
```

```
interface GigabitEthernet0/0/4
 port link-type access
 port default vlan 20
 port mux-vlan enable
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/5
 port link-type access
 port default vlan 100
 port mux-vlan enable
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/9
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
 undo ntdp enable
 undo ndp enable
 gvrp
 gvrp registration fixed
#
interface GigabitEthernet0/0/10
 shutdown
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/24
voice-vlan 200 enable
 port hybrid pvid vlan 30
 port hybrid untagged vlan 30
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
Return
```

Lab 1-3 Inter-VLAN Communication

Learning Objectives

The objectives of this lab are to learn and understand how to perform the following operations:

- Configure multi-arm routing.
- Configure single-arm routing.
- Configure inter-VLAN communication.
- Configure VLAN aggregation.

Topology
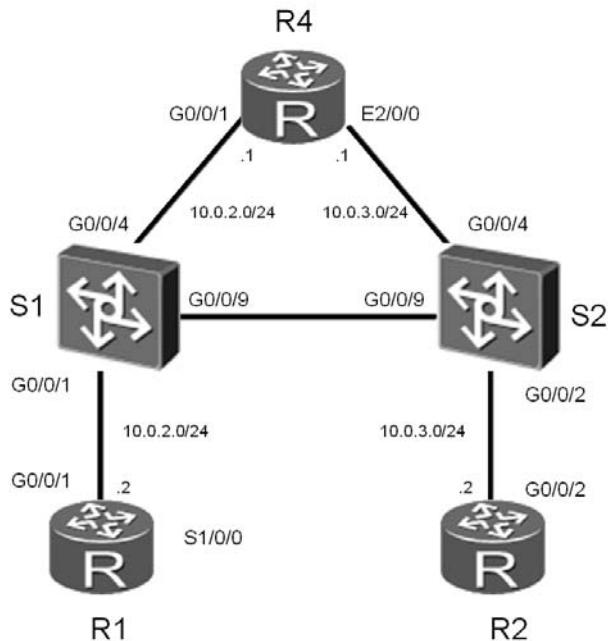
Figure 1-3 Inter-VLAN communication

Scenario

Assume that you are a network administrator of a company. The company uses an Ethernet that has two switches and one router. In the preceding figure, R1 and R2 represent two computers in different departments and are added to two VLANs. As required by the company, R1 needs to communicate with R2.

Multi-arm routing is used first and later replaced with single-arm routing to reduce the costs.

Then multi-layer switching is used because traffic is mostly transmitted between VLANs as the network architecture changes. Finally the VLAN aggregation technology is used to facilitate network management.

Tasks

Step 1 **Perform basic configurations and IP addressing.**

Disable G0/0/9 of S1 to avoid affecting the experiment.

Configure IP addresses and subnet masks for all routers.

```
<huawei>system-view
Enter system view, return user view with Ctrl+Z.
[huawei]sysname R1
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.2.2 24


<huawei>system-view
Enter system view, return user view with Ctrl+Z.
[huawei]sysname R2
[R2]interface GigabitEthernet 0/0/2
[R2-GigabitEthernet0/0/2]ip address 10.0.3.2 24


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/10]undo shutdown


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/10]undo shutdown


<huawei>system-view
Enter system view, return user view with Ctrl+Z.
[huawei]sysname R4
[R4]interface GigabitEthernet 0/0/1
```

```
[R4-GigabitEthernet0/0/1]ip address 10.0.2.1 24
[R4-GigabitEthernet0/0/1]interface GigabitEthernet 0/0/2
[R4-GigabitEthernet0/0/2]ip address 10.0.3.1 24
```

Run the **ping** command to test whether the route from R1 to the G0/0/1 interface of R4 is reachable.

```
[R1]ping -c 1 10.0.2.1
  PING 10.0.2.1: 56  data bytes, press CTRL_C to break
    Reply from 10.0.2.1: bytes=56 Sequence=1 ttl=255 time=4 ms


  --- 10.0.2.1 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 4/4/4 ms
```

Run the **ping** command to test whether the route from R2 to the G0/0/2 interface of R4 is reachable.

```
[R2]ping -c 1 10.0.3.1
  PING 10.0.3.1: 56  data bytes, press CTRL_C to break
    Reply from 10.0.3.1: bytes=56 Sequence=1 ttl=255 time=3 ms


  --- 10.0.3.1 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 3/3/3 ms
```

Step 2 **Configure multi-arm routing.**

R1 and R2 are in different VLANs.

The gateway of R1 uses the IP address of the G0/0/1 interface of R4, and that of R2 uses the IP address of the G0/0/2 interface of R4.

Multiple interfaces of R4 support communication between VLANs. This is multi-arm routing.

Create VLAN 2 and VLAN 3 on S1 and S2.

```
[S1]vlan batch 2 3
Info: This operation may take a few seconds. Please wait for a moment...done.
```

```
[S2]vlan batch 2 3
Info: This operation may take a few seconds. Please wait for a moment...done.
```

Add R1 and the G0/0/1 interface of R4 to VLAN 2, and R2 and the G0/0/2 interface of R4 to VLAN 3.

```
[S1]interface GigabitEthernet 0/0/1
[S1-GigabitEthernet0/0/1]port link-type access
[S1-GigabitEthernet0/0/1]port default vlan 2
[S1-GigabitEthernet0/0/1]inter g0/0/4
[S1-GigabitEthernet0/0/4]port link-type access
[S1-GigabitEthernet0/0/4]port default vlan 2


[S2]interface GigabitEthernet 0/0/2
[S2-GigabitEthernet0/0/2]port link-type access
[S2-GigabitEthernet0/0/2]port default vlan 3
[S2-GigabitEthernet0/0/2]inter g0/0/4
[S2-GigabitEthernet0/0/4]port link-type access
[S2-GigabitEthernet0/0/4]port default vlan 3
```

Configure a gateway on R1 and R2. The gateway of R1 uses the IP address of the G0/0/1 interface of R4, and that of R2 uses the IP address of the G0/0/2 interface of R4.

```
[R1]ip route-static 0.0.0.0 0 10.0.2.1


[R2]ip route-static 0.0.0.0 0 10.0.3.1
```

Run the **display vlan** command to check the configurations.

```
[S1]display vlan 2
--------------------------------------------------------------------------
U: Up;         D: Down;         TG: Tagged;         UT: Untagged;
MP: Vlan-mapping;               ST: Vlan-stacking;
#: ProtocolTransparent-vlan;   *: Management-vlan;
--------------------------------------------------------------------------
VID Type   Ports
--------------------------------------------------------------------------
2   common  UT:GE0/0/1(U)      GE0/0/4(U)
VID Status  Property    MAC-LRN Statistics Description
--------------------------------------------------------------------------
2   enable  default     enable  disable    VLAN 0002


[S2]display vlan 3
```

```
--------------------------------------------------------------------------
U: Up;        D: Down;        TG: Tagged;        UT: Untagged;
MP: Vlan-mapping;             ST: Vlan-stacking;
#: ProtocolTransparent-vlan;   *: Management-vlan;
--------------------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------------------
3    common  UT:GE0/0/2(U)      GE0/0/4(U)
VID  Status  Property    MAC-LRN Statistics Description
--------------------------------------------------------------------------
3    enable default     enable disable   VLAN 0003
```

Test whether the route from R1 to R2 is reachable.

```
[R1]ping -c 1 10.0.3.2
  PING 10.0.3.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.3.2: bytes=56 Sequence=1 ttl=254 time=3 ms

  --- 10.0.3.2 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 3/3/3 ms

[R2]ping -c 1 10.0.2.2
  PING 10.0.2.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.2.2: bytes=56 Sequence=1 ttl=254 time=3 ms

  --- 10.0.2.2 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 3/3/3 ms
```

Step 3 **Configure single-arm routing.**

Create two subinterfaces on a physical interface of R4. Inter-VLAN communication is implemented on relevant subinterfaces.

This is single-alarm routing.

Disable the G0/0/4 interface of S2.

```
[S2]interface GigabitEthernet 0/0/4
```

```
[S2-GigabitEthernet0/0/4]shutdown
```

Add the G0/0/9 interfaces of S1 and S2 to VLAN 3.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]undo shutdown
[S2-GigabitEthernet0/0/9]port link-type access
[S2-GigabitEthernet0/0/9]port default vlan 3


[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]undo shutdown
[S1-GigabitEthernet0/0/9]port link-type access
[S1-GigabitEthernet0/0/9]port default vlan 3
```

Configure the G0/0/4 interface of S1 to work in Trunk mode and allow the access from VLAN 2 and VLAN 3.

```
[S1]interface GigabitEthernet 0/0/4
[S1-GigabitEthernet0/0/4]port default vlan 1
[S1-GigabitEthernet0/0/4]port link-type trunk
[S1-GigabitEthernet0/0/4]port trunk allow-pass vlan 2 3
```

Create two subinterfaces for the G0/0/1 interface of R4. Configure IP addresses for the two subinterfaces and configure them as Dot1q termination Ethernet subinterfaces.

```
[R4]interface GigabitEthernet 0/0/1.2
[R4-GigabitEthernet0/0/1.2]control-vid 20 dot1q-termination
[R4-GigabitEthernet0/0/1.2]dot1q termination vid 2
[R4-GigabitEthernet0/0/1.2]arp broadcast enable
[R4-GigabitEthernet0/0/1.2]ip address 10.0.20.1 24
[R4-GigabitEthernet0/0/1.2]interface GigabitEthernet 0/0/1.3
[R4-GigabitEthernet0/0/1.3]control-vid 30 dot1q-termination
[R4-GigabitEthernet0/0/1.3]dot1q termination vid 3
[R4-GigabitEthernet0/0/1.3]arp broadcast enable
[R4-GigabitEthernet0/0/1.3]ip address 10.0.30.1 24
```

Run the **display ip interface brief** command to view subinterface configurations on R4.

```
[R4]display ip interface brief
*down: administratively down
(l): loopback
(s): spoofing

The number of interface that is UP in Physical is 6
```

```
The number of interface that is DOWN in Physical is 4
The number of interface that is UP in Protocol is 3
The number of interface that is DOWN in Protocol is 7


Interface                    IP Address/Mask    Physical  Protocol
Cellular0/0/0                unassigned         down      down
Cellular0/0/1                unassigned         down      down
Ethernet2/0/0                unassigned         down      down
Ethernet2/0/1                10.0.3.1/24        down      down
GigabitEthernet0/0/0          unassigned         up        down
GigabitEthernet0/0/1          10.0.2.1/24        up        up
GigabitEthernet0/0/1.2        10.0.20.1/24       up        down
GigabitEthernet0/0/1.3        10.0.30.1/24       up        down
NULL0                        unassigned         up       up(s)
Serial1/0/0                   unassigned         up        up
```

Change the IP addresses and gateways of R1 and R2.

```
[R1]inter GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.20.2 24
[R1-GigabitEthernet0/0/1]quit
[R1]undo ip route-static 0.0.0.0 0 10.0.2.1
[R1]ip route-static 0.0.0.0 0 10.0.20.1


[R2]interface GigabitEthernet 0/0/2
[R2-GigabitEthernet0/0/2]ip address 10.0.30.2 24
[R2-GigabitEthernet0/0/2]quit
[R2]undo ip route-static 0.0.0.0 0 10.0.3.1
[R2]ip route-static 0.0.0.0 0 10.0.30.1
```

Test whether the route from R1 to R2 is reachable.

```
[R1]ping -c 1 10.0.30.2
  PING 10.0.30.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.30.2: bytes=56 Sequence=1 ttl=254 time=3 ms

  --- 10.0.30.2 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 3/3/3 ms
```

The preceding information shows that computers in VLAN 2 and VLAN 3 can communicate with each other.

Compared with the multi-arm scheme, this scheme reduces the costs in purchasing router interfaces.

In single-arm routing, all data is transmitted over a single interface. When the number of VLANs increases, the bandwidth of this link may be insufficient. Moreover, this link is likely to cause a single-point failure and then the entire network fails.

Step 4 **Configure Layer 3 switching.**

In Layer 3 switching, no router is required and each VLAN has a VLANIF interface for communicating with other VLANs.

Disable the G0/0/4 interface of S1.

```
[S1]interface GigabitEthernet 0/0/4
[S1-GigabitEthernet0/0/4]shutdown
```

Configure the G0/0/9 interfaces of S1 and S2 to work in Trunk mode and allow the access from VLAN 2 and VLAN 3.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]port default vlan 1
[S1-GigabitEthernet0/0/9]port link-type trunk
[S1-GigabitEthernet0/0/9]port trunk allow-pass vlan 2 3

[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]port default vlan 1
[S2-GigabitEthernet0/0/9]port link-type trunk
[S2-GigabitEthernet0/0/9]port trunk allow-pass vlan 2 3
```

Create the VLANIF 2 and VLANIF 3 interfaces on S1 and configure IP addresses for the interfaces.

```
[S1]interface Vlanif 2
[S1-Vlanif2]ip address 10.0.20.1 24
[S1]interface Vlanif 3
[S1-Vlanif3]ip address 10.0.30.1 24
```

Test whether the route from R1 to R2 is reachable.

```
[R1]ping -c 1 10.0.30.2
  PING 10.0.30.2: 56  data bytes, press CTRL_C to break
```

```
   Reply from 10.0.30.2: bytes=56 Sequence=1 ttl=254 time=2 ms


 --- 10.0.30.2 ping statistics ---
  1 packet(s) transmitted
  1 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 2/2/2 ms
```

The preceding information shows that Layer 3 communication between computers in VLAN 2 and those in VLAN 3 is implemented using the two VLANIF interfaces of S1.

Layer 3 switching delivers higher scalability than single-arm routing and can withstand the addition of VLANs.

Layer 3 switching can effectively serve a network where most traffic is generated by inter-VLAN communication.

Step 5 **Configure VLAN aggregation.**

Similar to Layer 3 switching, VLAN aggregation implements inter-VLAN communication on a switch. In VLAN aggregation, all VLANs are on the same network segment to reduce the number of required IP network segments and unify gateway configuration.

Create VLAN 10, VLAN 20, and VLAN 100 on S1 and S2.

```
[S1]vlan batch 10 20 100
Info: This operation may take a few seconds. Please wait for a moment...done.


[S2]vlan batch 10 20 100
Info: This operation may take a few seconds. Please wait for a moment...done.
```

Configure the G0/0/9 interfaces of S1 and S2 to allow the access from VLAN 10 and VLAN 20.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]port trunk allow-pass vlan 10 20


[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]port trunk allow-pass vlan 10 20
```

Add the G0/0/1 interface of S1 to VLAN 10 and the G0/0/2 interface of S2

to VLAN 20.

```
[S1]interface GigabitEthernet 0/0/1
[S1-GigabitEthernet0/0/1]port default vlan 10


[S2]interface GigabitEthernet 0/0/2
[S2-GigabitEthernet0/0/1]port default vlan 20
```

Configure VLAN 100 as a Super-VLAN, and add VLAN 10 and VLAN 20 to the Super-VLAN. Then VLAN 10 and VLAN 20 are Sub-VLANs of this Super-VLAN.

```
[S1]vlan 100
[S1-vlan100]aggregate-vlan
[S1-vlan100]access-vlan 10 20
```

Configure a VLANIF interface for VLAN 100 and enable the ARP proxy function.

```
[S1]interface Vlanif 100
[S1-Vlanif100]ip address 10.0.100.1 24
[S1-Vlanif100]arp-proxy inter-sub-vlan-proxy enable
```

Change the IP addresses of R1 and R2 to ensure that they are on the same network segment as the VLANIF 100 interface. Configure the IP address of the VLANIF 100 interface as the gateway IP address.

```
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.100.2 24
[R1-GigabitEthernet0/0/1]quit
[R1]ip route-static 0.0.0.0 0 10.0.100.1


[R2]interface GigabitEthernet 0/0/2
[R2-GigabitEthernet0/0/2]ip address 10.0.100.3 24
[R2-GigabitEthernet0/0/2]quit
[R2]ip route-static 0.0.0.0 0 10.0.100.1
```

Test whether the routes from R1 and R2 to the VLANIF 100 interface of S1 are reachable.

```
[R1]ping -c 1 10.0.100.1
  PING 10.0.100.1: 56  data bytes, press CTRL_C to break
    Reply from 10.0.100.1: bytes=56 Sequence=1 ttl=254 time=3 ms

  --- 10.0.100.1 ping statistics ---
```

```
   1 packet(s) transmitted
   1 packet(s) received
   0.00% packet loss
   round-trip min/avg/max = 3/3/3 ms


[R1]ping -c 1 10.0.100.3
  PING 10.0.100.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.100.3: bytes=56 Sequence=1 ttl=254 time=2 ms


  --- 10.0.100.3 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 2/2/2 ms


[R2]pin -c 1 10.0.100.1
  PING 10.0.100.1: 56  data bytes, press CTRL_C to break
    Reply from 10.0.100.1: bytes=56 Sequence=1 ttl=254 time=3 ms


  --- 10.0.100.1 ping statistics ---
    1 packet(s) transmitted
    1 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 3/3/3 ms
```

The preceding information shows that R1 and R2 can communicate with the VLANIF 100 interface of S1. Compared with Layer 3 switching, VLAN aggregation allows different VLANs to use the same gateway for communication. This reduces the number of required IP addresses and improves management efficiency. However, computers on the same network segment communicate with each other over the same VLANIF interface, this challenges the robustness of the interface.

Additional Exercises: Analyzing and Verifying

Figure out the features, strong points, drawbacks, and application scenarios of multi-arm routing, single-arm routing, inter-VLAN communication, and VLAN aggregation.

Final Configurations

```
[S1]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S1
#
 vlan batch 2 to 3 10 20 100
#
vlan 100
 aggregate-vlan
 access-vlan 10 20
#
interface Vlanif2
 ip address 10.0.20.1 255.255.255.0
#
interface Vlanif3
 ip address 10.0.30.1 255.255.255.0
#
interface Vlanif100
 ip address 10.0.100.1 255.255.255.0
 arp-proxy inter-sub-vlan-proxy enable
#
interface GigabitEthernet0/0/1
 port link-type access
 port default vlan 10
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/4
 shutdown
port link-type trunk
 port trunk allow-pass vlan 2 to 3
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/9
 port link-type trunk
 port trunk allow-pass vlan 2 to 3 10 20
 undo ntdp enable
```

```
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/10
 shutdown
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
Return
```

[S2]display current-configuration

```
#
!Software Version V100R006C00SPC800
 sysname S2
#
 vlan batch 2 to 3 10 20 100
#
interface GigabitEthernet0/0/2
 port link-type access
 port default vlan 20
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/4
 shutdown
 port link-type access
 port default vlan 3
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface GigabitEthernet0/0/9
 port link-type trunk
 port trunk allow-pass vlan 2 to 3 10 20
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
return
```

[R4]display current-configuration

```
[V200R001C00SPC500]
#
 sysname R4
#
interface GigabitEthernet0/0/1
 ip address 10.0.2.1 255.255.255.0
#
interface GigabitEthernet0/0/1.2
 control-vid 20 dot1q-termination
 dot1q termination vid 2
 ip address 10.0.20.1 255.255.255.0
 arp broadcast enable
#
interface GigabitEthernet0/0/1.3
 control-vid 30 dot1q-termination
 dot1q termination vid 3
 ip address 10.0.30.1 255.255.255.0
 arp broadcast enable
#
interface GigabitEthernet0/0/0
ip address 10.0.3.1 255.255.255.0
#
Return
```

Lab 1-4 SEP and Smart Link

Learning Objectives

The objectives of this lab are to learn and understand how to perform the following operations:

- Configure SEP.
- Configure Smart Link.
- Configure hybrid networking of SEP and Smart Link.

Topology
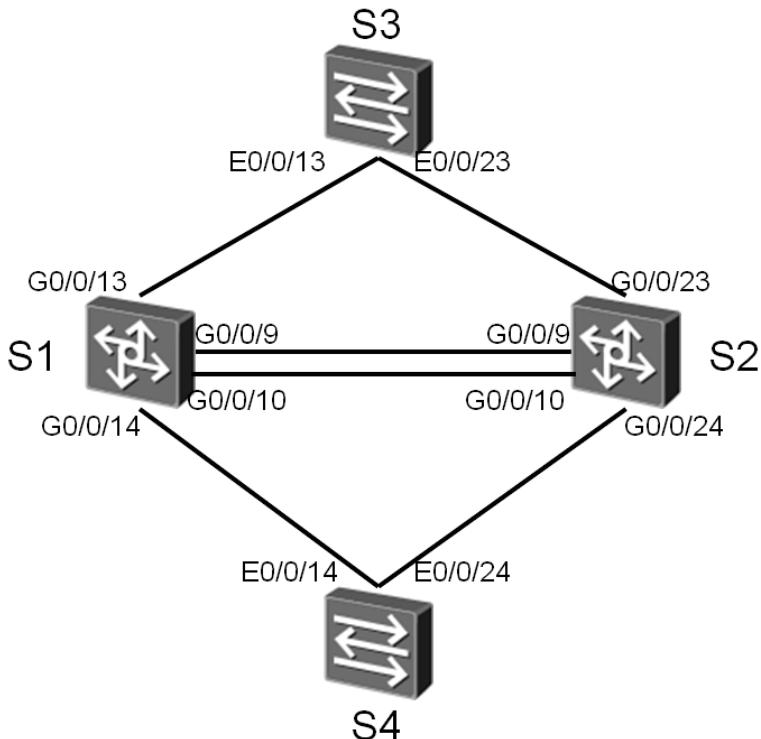
Figure 1-4 SEP configuration

Scenario

Assume that you are a network administrator of a company. The company

uses an Ethernet that has four switches. S1, S2, and S3 comprise the core network. The backup design is used to improve the robustness of the network. That is, SEP is used for loop protection. Configure two upstream links on the access layer switch (S4). The Smart Link technology provides master and slave links for a network, ensuring network reliability.

Tasks

Step 1 **Perform basic configurations.**

Configure names for all devices and disable the E0/0/1 interface of S4 to avoid affecting the experiment.

```
<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1
[S1]


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
[S2]


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S3
[S3]


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S4
[S4]interface Ethernet 0/0/1
[S4-Ethernet0/0/1]shutdown
```

Step 2 **Configure SEP.**

Redundant connections are created between S1, S2, and S3 to improve the robustness of the network. Two network loops exist.

The G0/0/9 and G0/0/10 interfaces of S1 and S2 form a closed loop. The

G0/0/13 interface of S1, G0/0/13 and G0/0/23 of S3, and G0/0/23 of S2 form an open loop. SEP is used to provide redundancy protection for the two network loops.

Create a SEP network segment, configure a control VLAN, and specify protection instances.

```
[S1]sep segment 1
[S1-sep-segment1]control-vlan 10
[S1-sep-segment1]protected-instance all
[S1-sep-segment1]quit
[S1]sep segment 2
[S1-sep-segment2]control-vlan 20
[S1-sep-segment2]protected-instance all

[S2]sep segment 1
[S2-sep-segment1]control-vlan 10
[S2-sep-segment1]protected-instance all
[S2-sep-segment1]quit
[S2]sep segment 2
[S2-sep-segment2]control-vlan 20
[S2-sep-segment2]protected-instance all

[S3]sep segment 2
[S3-sep-segment2]control-vlan 20
[S3-sep-segment2]protected-instance all

[S4]sep segment 2
[S4-sep-segment2]control-vlan 20
[S4-sep-segment2]protected-instance all
```

Add interfaces to the SEP network segment and configure roles for the interfaces.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]stp disable
[S1-GigabitEthernet0/0/9]sep segment 1 edge primary
[S1-GigabitEthernet0/0/9]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]stp disable
[S1-GigabitEthernet0/0/10]sep segment 1 edge secondary
[S1-GigabitEthernet0/0/10]interface GigabitEthernet 0/0/13
[S1-GigabitEthernet0/0/13]stp disable
[S1-GigabitEthernet0/0/13]sep segment 2 edge primary
```

```
[S2]interface GigabitEthernet 0/0/23
[S2-GigabitEthernet0/0/23]stp disable
[S2-GigabitEthernet0/0/23]sep segment 2 edge secondary
[S2-GigabitEthernet0/0/23]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]stp disable
[S2-GigabitEthernet0/0/9]sep segment 1
[S2-GigabitEthernet0/0/9]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]stp disable
[S2-GigabitEthernet0/0/10]sep segment 1

[S3]interface Ethernet 0/0/13
[S3-Ethernet0/0/13]stp disable
[S3-Ethernet0/0/13]sep segment 2
[S3-Ethernet0/0/13]interface ethernet 0/0/23
[S3-Ethernet0/0/23]stp disable
[S3-Ethernet0/0/23]sep segment 2
```

Configure the blocking and preemption modes.

```
[S1]sep segment 1
[S1-sep-segment1]block port optimal
[S1-sep-segment1]quit
[S1]sep segment 2
[S1-sep-segment2]block port
[S1-sep-segment2]block port optimal

[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]sep segment 1 priority 128

[S3]inter Ethernet 0/0/23
[S3-Ethernet0/0/23]sep segment 2 priority 128

[S1]sep segment 1
[S1-sep-segment1]preempt delay 30
[S1-sep-segment1]quit
[S1]sep segment 2
[S1-sep-segment2]preempt delay 30
```

Enable the function of advertising topology changes.

```
[S1]sep segment 2
[S1-sep-segment2]tc-notify segment 1

[S2]sep segment 2
```

```
[S2-sep-segment2]tc-notify segment 1
```

Run the **display sep topology** command to view SEP information.

```
[S1]display sep topology
SEP segment 1
-----------------------------------------------------------------
System Name         Port Name      Port Role      Port Status
-----------------------------------------------------------------
S1                  GE0/0/9        primary        forwarding
S2                  GE0/0/9        common         forwarding
S2                  GE0/0/10       common         discarding
S1                  GE0/0/10       secondary      forwarding


SEP segment 2
-----------------------------------------------------------------
System Name         Port Name      Port Role      Port Status
-----------------------------------------------------------------
S1                  GE0/0/13       primary        forwarding
S3                  Eth0/0/13      common         forwarding
S3                  Eth0/0/23      common         forwarding
S2                  GE0/0/23       secondary      discarding
```

Disable the G0/0/9 interface of S2 to check the running of SEP.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]shutdown
[S2-GigabitEthernet0/0/9]quit
[S2]display sep topology
SEP segment 1
SEP detects a segment failure that may be caused by an incomplete topology
-----------------------------------------------------------------
System Name         Port Name      Port Role      Port Status
-----------------------------------------------------------------
S1                  GE0/0/9        secondary      discarding
S1                  GE0/0/10       secondary      forwarding
S2                  GE0/0/10       common         forwarding
S2                  GE0/0/9        common         discarding


SEP segment 2
-----------------------------------------------------------------
System Name         Port Name      Port Role      Port Status
-----------------------------------------------------------------
S1                  GE0/0/13       primary        forwarding
```

```
S3              Eth0/0/13       common        forwarding
S3              Eth0/0/23       common        forwarding
S2              GE0/0/23        secondary     discarding
```

Enable the G0/0/9 interface of S2 and disable the E0/0/13 interface of S3 to check the running of SEP.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]undo shutdown

[S3]interface Ethernet 0/0/13
[S3-Ethernet0/0/13]shutdown
[S3]display sep topology
SEP segment 2
SEP detects a segment failure that may be caused by an incomplete topology
-----------------------------------------------------------------
System Name       Port Name     Port Role     Port Status
-----------------------------------------------------------------
S2                GE0/0/23      secondary     forwarding
S3                Eth0/0/23     common        forwarding
S3                Eth0/0/13     common        discarding
```

Enable the E0/0/13 interface of S3to check the running of SEP.

```
[S3]interface Ethernet 0/0/13
[S3-Ethernet0/0/13]undo shutdown

[S1]display sep topology
SEP segment 1
-----------------------------------------------------------------
System Name       Port Name     Port Role     Port Status
-----------------------------------------------------------------
S1                GE0/0/9       primary       forwarding
S2                GE0/0/9       common        forwarding
S2                GE0/0/10      common        discarding
S1                GE0/0/10      secondary     forwarding

SEP segment 2
-----------------------------------------------------------------
System Name       Port Name     Port Role     Port Status
-----------------------------------------------------------------
S1                GE0/0/13      primary       forwarding
S3                Eth0/0/13     common        forwarding
S3                Eth0/0/23     common        discarding
```

```
S2                GE0/0/23        secondary      forwarding
```

The preceding information shows that SEP changes the network topology when a fault occurs. After the fault is rectified, SEP blocks the specified interface.

Step 3 **Configure Smart Link.**

The Smart Link technology provides redundant upstream connections for users. The Smart Link technology sets the E0/0/14 interface of S4 as the master interface and the E0/0/24 interface as the slave interface. When the master interface is faulty, S4 switches to the slave interface quickly, ensuring service continuity for users.

Configure a control VLAN on S4 and add the interfaces to the control VLAN.

```
[S4]vlan 100
[S4-vlan100]quit
[S4]interface Ethernet 0/0/14
[S4-Ethernet0/0/14]port link-type trunk
[S4-Ethernet0/0/14]port trunk allow-pass vlan 100
[S4-Ethernet0/0/14]interface ethe0/0/24
[S4-Ethernet0/0/24]port link-type trunk
[S4-Ethernet0/0/24]port trunk allow-pass vlan 100
```

Configure a control VLAN on S1 and S2. Add the G0/0/14 interfaces of S1 and S2 to this VLAN.

```
[S1]vlan 100
[S1-vlan100]quit
[S1]interface GigabitEthernet 0/0/14
[S1-GigabitEthernet0/0/14]port link-type trunk
[S1-GigabitEthernet0/0/14]port trunk allow-pass vlan 100

[S2]vlan 100
[S2-vlan100]quit
[S2]interface GigabitEthernet 0/0/24
[S2-GigabitEthernet0/0/24]port link-type trunk
[S2-GigabitEthernet0/0/24]port trunk allow-pass vlan 100
```

Disable Spanning Tree Protocol (STP) for the E0/0/14 and E0/0/24 interfaces of S4.

```
[S4]interface Ethernet 0/0/14
[S4-Ethernet0/0/14]stp disable
[S4-Ethernet0/0/14]interface ethe0/0/24
[S4-Ethernet0/0/24]stp disable
```

Add the E0/0/14 and E0/0/24 interfaces of S4 to the Smart Link group, E0/0/14 as the master interface and E0/0/24 as the slave interface.

```
[S4]smart-link group 1
[S4-smlk-group1]port Ethernet 0/0/14 master
[S4-smlk-group1]port Ethernet 0/0/24 slave
```

Enable the switchover function on S4 and set the switchover time.

```
[S4]smart-link group 1
[S4-smlk-group1]restore enable
[S4-smlk-group1]timer wtr 30
```

Enable the function of sending Flush packets on S4, and the function of receiving Flush packets on S1 and S2.

```
[S4]smart-link group 1
[S4-smlk-group1]flush send control-vlan 100 password simple huawei

[S1]interface GigabitEthernet 0/0/14
[S1-GigabitEthernet0/0/14]smart-link flush receive control-vlan 100 password
simple huawei

[S2]interface GigabitEthernet 0/0/24
[S2-GigabitEthernet0/0/24]smart-link flush receive control-vlan 100 password
simple huawei
```

Enable the Smart Link function on S4.

```
[S4]smart-link group 1
[S4-smlk-group1]smart-link enable
```

Run the **display smart-link group** command to view the information about the Smart Link group on S4.

```
[S4]display smart-link group 1
Smart Link group 1 information :
  Smart Link group was enabled
  Wtr-time is: 30 sec.
  There is no Load-Balance
```

```
There is no protected-vlan reference-instance
DeviceID: 5489-98ec-f012  Control-vlan ID: 100
   Member           Role   State   Flush Count Last-Flush-Time
 ------------------------------------------------------------------
 Ethernet0/0/14        Master Active   1       2008/01/05 03:11:18
UTC-05:13
 Ethernet0/0/24        Slave  Inactive 0       0000/00/00 00:00:00
UTC+00:00
```

Disable the E0/0/14 interface of S4 to verify the Smart Link function.

```
[S4]interface Ethernet 0/0/14
[S4-Ethernet0/0/14]shutdown
[S4]display smart-link group 1
Smart Link group 1 information :
 Smart Link group was enabled
 Wtr-time is: 30 sec.
 There is no Load-Balance
 There is no protected-vlan reference-instance
 DeviceID: 5489-98ec-f012  Control-vlan ID: 100
   Member           Role   State   Flush Count Last-Flush-Time
 ------------------------------------------------------------------

 Ethernet0/0/14        Master Inactive 1       2008/01/05 03:11:18 UTC-05:13
 Ethernet0/0/24        Slave  Active   1       2008/01/05 03:14:57 UTC-05:13
```

The preceding information shows that the Smart Link function enables S4 to switch over to the slave interface when the master interface is faulty.

Step 4 **Configure hybrid networking of SEP and Smart Link.**

When Smart Link is configured on the lower-layer network, SEP must learn the conditions of the lower-layer network to meet network changes. Enable SEP and Smart Link on the network.

On S1 and S2, enable the function of processing Smart Link Flush packets.

```
[S1]sep segment 1
[S1-sep-segment1]deal smart-link-flush

[S2]sep segment 1
[S2-sep-segment1]deal smart-link-flush
```

Additional Exercises: Analyzing and Verifying

Compare SEP and STP, and figure out their respective strong points and drawbacks.

Final Configurations

```
[S1]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S1
#
 vlan batch 10 20 100
#
sep segment 1
 control-vlan 10
 block port optimal
 preempt delay 30
 protected-instance 0 to 48
 deal smart-link-flush
sep segment 2
 control-vlan 20
 block port optimal
 preempt delay 30
 tc-notify segment 1
 protected-instance 0 to 48
#
interface GigabitEthernet0/0/9
 port hybrid tagged vlan 10
 stp disable
 sep segment 1 edge primary
#
interface GigabitEthernet0/0/10
 port hybrid tagged vlan 10
 stp disable
 sep segment 1 edge secondary
#
interface GigabitEthernet0/0/13
 port hybrid tagged vlan 20
 stp disable
 sep segment 2 edge primary
#
```

```
interface GigabitEthernet0/0/14
 port link-type trunk
 port trunk allow-pass vlan 100
 smart-link flush receive control-vlan 100 password simple huawei
#
Return


[S2]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S2
#
 vlan batch 10 20 100
#
sep segment 1
 control-vlan 10
 protected-instance 0 to 48
 deal smart-link-flush
sep segment 2
 control-vlan 20
 tc-notify segment 1
 protected-instance 0 to 48
#
interface GigabitEthernet0/0/9
 port hybrid tagged vlan 10
 stp disable
 sep segment 1
#
interface GigabitEthernet0/0/10
 port hybrid tagged vlan 10
 stp disable
 sep segment 1
 sep segment 1 priority 128
#
interface GigabitEthernet0/0/23
 port hybrid tagged vlan 20
 stp disable
 sep segment 2 edge secondary
#
interface GigabitEthernet0/0/24
 port link-type trunk
 port trunk allow-pass vlan 100
 smart-link flush receive control-vlan 100 password simple huawei
```

```
#
return

[S3]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S3
#
 vlan batch 20
#
sep segment 2
 control-vlan 20
 protected-instance 0 to 48
#
#
interface Ethernet0/0/13
 port hybrid tagged vlan 20
 stp disable
 sep segment 2
#
interface Ethernet0/0/23
 port hybrid tagged vlan 20
 stp disable
 sep segment 2
 sep segment 2 priority 128
#
Return

[S4]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S4
#
 vlan batch 20 100
#
sep segment 2
 control-vlan 20
 protected-instance 0 to 48
#
interface Ethernet0/0/1
 shutdown
#
interface Ethernet0/0/14
```

```
 shutdown
 port link-type trunk
 port trunk allow-pass vlan 100
 stp disable
#
interface Ethernet0/0/24
 port link-type trunk
 port trunk allow-pass vlan 100
 stp disable
#
smart-link group 1
 restore enable
 smart-link enable
 port Ethernet0/0/14 master
 port Ethernet0/0/24 slave
 timer wtr 30
 flush send control-vlan 100 password simple huawei
#
Return
```

Chapter 2 STP and SEP

Lab 2-1 STP, RSTP, and MSTP Configuration

Learning Objectives

The objectives of this lab are to learn and understand how to perform the following operations:

- Learn the differences among Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP).
- Modify bridge priorities to control root bridge election.
- Modify interface priorities to control root interface and designated interface election.
- Configure RSTP and conduct compatibility configuration between STP and RSTP.
- Configure MSTP to implement load balancing among VLANs.

Topology
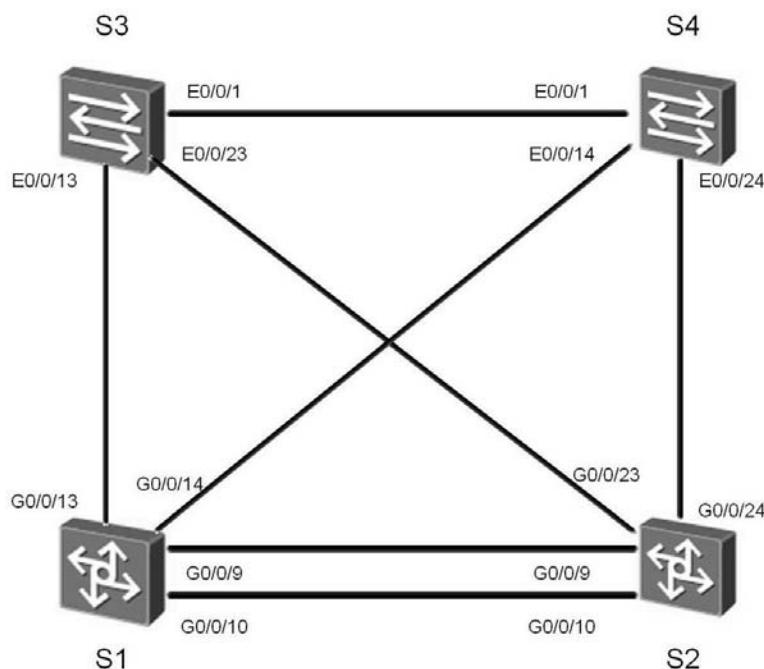
Figure 2-1 STP, RSTP, and MSTP topology

Scenario

Assume that you are a network administrator of a company. The company uses a backup network. STP is used to avoid loops. By default ,STP convergence takes a long period of time. You can use RSTP to speed up network convergence. By default, all VLANs share a spanning tree. If you want to load balancing among VLANs,you can use MSTP.

Tasks

Step 1 Configure STP and verify the configuration.

If the device default spanning tree is not turned on, use the following command to open. Configuration using the STP:

```
<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1
[S1]stp enable
[S1]stp mode stp


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
[S2]stp enable
[S2]stp mode stp


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S3
[S3]stp enable
[S3]stp mode stp


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S4
[S4]stp enable
[S4]stp mode stp
```

View STP status information.

```
[S1]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :32768.4c1f-cc45-aadc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :32768.4c1f-cc45-aac1 / 20000
CIST RegRoot/IRPC  :32768.4c1f-cc45-aadc / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
TC or TCN received :36
TC count per hello :2
STP Converge Mode  :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:0m:1s
……output omit……

[S2]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :32768.4c1f-cc45-aac1
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :32768.4c1f-cc45-aac1 / 0
CIST RegRoot/IRPC  :32768.4c1f-cc45-aac1 / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
TC or TCN received :20
TC count per hello :0
STP Converge Mode  :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:1m:4s
……output omit……

[S1]display stp brief
 MSTID  Port              Role  STP State    Protection
   0   GigabitEthernet0/0/9    ROOT  FORWARDING    NONE
   0   GigabitEthernet0/0/10   ALTE  DISCARDING    NONE
   0   GigabitEthernet0/0/13   DESI  FORWARDING    NONE
   0   GigabitEthernet0/0/14   DESI  FORWARDING    NONE

[S2]display stp brief
 MSTID  Port              Role  STP State    Protection
   0   GigabitEthernet0/0/9    DESI  FORWARDING    NONE
   0   GigabitEthernet0/0/10   DESI  FORWARDING    NONE
```

```
    0    GigabitEthernet0/0/23      DESI  FORWARDING      NONE
    0    GigabitEthernet0/0/24      DESI  FORWARDING      NONE
```

S2 is the root bridge and all interfaces are designated interfaces.

The actual results of the experiment may be different due to the uncertainty of the MAC addresses of switches.

Step 2 **Control root bridge election.**

Configure S1 as the primary root bridge and S2 as the secondary root bridge.

```
[S1]stp root primary

[S2]stp root secondary
```

View STP configuration information.

```
[S1]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :0    .4c1f-cc45-aadc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :0    .4c1f-cc45-aadc / 0
CIST RegRoot/IRPC  :0    .4c1f-cc45-aadc / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
CIST Root Type     :Primary root
TC or TCN received :67
TC count per hello :0
STP Converge Mode  :Normal
Share region-configuration :Enabled
Time since last TC :0 days 0h:0m:15s
……output omit……

[S2]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :4096 .4c1f-cc45-aac1
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :0    .4c1f-cc45-aadc / 20000
CIST RegRoot/IRPC  :4096 .4c1f-cc45-aac1 / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
```

```
CIST Root Type      :Secondary root
TC or TCN received :26
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:0m:1s
……output omit……
```

Configure S1 as the primary root bridge and S2 as the secondary root bridge.

The smaller the priority value, the higher the priority. Change the priority value to 8129 for S1 and to 4096 for S2.

```
[S1]undo stp root
[S1]stp priority 8192

[S2]undo stp root
[S2]stp priority 4096
```

View STP information.

```
[S1]display stp

-------[CIST Global Info][Mode STP]-------
CIST Bridge        :8192 .4c1f-cc45-aadc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :4096 .4c1f-cc45-aac1 / 20000
CIST RegRoot/IRPC  :8192 .4c1f-cc45-aadc / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
TC or TCN received :79
TC count per hello :1
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:0m:0s
……output omit……

[S2]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :4096 .4c1f-cc45-aac1
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :4096 .4c1f-cc45-aac1 / 0
CIST RegRoot/IRPC  :4096 .4c1f-cc45-aac1 / 0
CIST RootPortId    :0.0
```

```
BPDU-Protection    :Disabled
TC or TCN received :88
TC count per hello :0
STP Converge Mode  :Normal
Share region-configuration :Enabled
Time since last TC :0 days 0h:0m:9s
······output omit······
```

S2 becomes the root bridge as it has a higher priority than S1.

Step 3 **Control root interface election.**

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                   Role  STP State     Protection
   0    GigabitEthernet0/0/9    ROOT  FORWARDING      NONE
   0    GigabitEthernet0/0/10   ALTE  DISCARDING      NONE
   0    GigabitEthernet0/0/13   DESI  FORWARDING      NONE
   0    GigabitEthernet0/0/14   DESI  FORWARDING      NONE
```

The GigabitEthernet 0/0/9 interface of S1 is the root interface.

The default priority is 128. The lower the priority value, the larger the priority.

S1 interconnects with S2 over the G0/0/9 and G0/0/10 interfaces.

Set the priority to 32 for the G0/0/9 interface of S2 and to 16 for the G0/0/10 interface.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]stp port priority 32
[S2-GigabitEthernet0/0/9]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]stp port priority 16
```

Note: The priorities of the interfaces of S2, instead of S1, are changed.

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                   Role  STP State     Protection
   0    GigabitEthernet0/0/9    ALTE  DISCARDING      NONE
   0    GigabitEthernet0/0/10   ROOT  FORWARDING      NONE
   0    GigabitEthernet0/0/13   DESI  FORWARDING      NONE
```

```
    0   GigabitEthernet0/0/14      DESI  FORWARDING     NONE
```

The GigabitEthernet 0/0/10 interface of S1 becomes the root interface.

Step 4 **Control designated port election.**

View status information about the direct interfaces of S3 and S4.

```
[S3]display stp interface Ethernet 0/0/1
----[CIST][Port1(Ethernet0/0/1)][DISCARDING]----
 Port Protocol      :Enabled
 Port Role          :Alternate Port
 Port Priority      :128
 Port Cost(Dot1T )  :Config=auto / Active=199999
 Designated Bridge/Port  :32768.5489-98ec-f00a / 128.1
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type :Config=auto / Active=dot1s
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0
 TC or TCN send     :17
 TC or TCN received :52
 BPDU Sent          :172
        TCN: 0, Config: 172, RST: 0, MST: 0
 BPDU Received      :206
        TCN: 0, Config: 206, RST: 0, MST: 0


[S4]display stp interface Ethernet 0/0/1

----[CIST][Port1(Ethernet0/0/1)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Designated Port
 Port Priority      :128
 Port Cost(Dot1T )  :Config=auto / Active=199999
 Designated Bridge/Port  :32768.5489-98ec-f00a / 128.1
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type :Config=auto / Active=dot1s
```

```
PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 20
TC or TCN send     :37
TC or TCN received :17
BPDU Sent          :181
       TCN: 0, Config: 181, RST: 0, MST: 0
BPDU Received      :172
       TCN: 0, Config: 172, RST: 0, MST: 0
```

The Ethernet 0/0/1 interface of S3 is an alternate interface and that of S4 is a designated interface. Change the path cost to 2000000 for the E0/0/24 interface of S4.

```
[S4-Ethernet0/0/24]stp cost 2000000
```

View role information about interfaces.

```
[S3]display stp interface Ethernet 0/0/1
----[CIST][Port1(Ethernet0/0/1)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Designated Port
 Port Priority      :128
 Port Cost(Dot1T )  :Config=auto / Active=199999
 Designated Bridge/Port   :32768.5489-98ec-f022 / 128.1
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type :Config=auto / Active=dot1s
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 20
 TC or TCN send     :52
 TC or TCN received :52
 BPDU Sent          :284
        TCN: 0, Config: 284, RST: 0, MST: 0
 BPDU Received      :380
        TCN: 0, Config: 380, RST: 0, MST: 0

[S4]display stp interface Ethernet 0/0/1
----[CIST][Port1(Ethernet0/0/1)][DISCARDING]----
 Port Protocol      :Enabled
 Port Role          :Alternate Port
 Port Priority      :128
 Port Cost(Dot1T )  :Config=auto / Active=199999
```

```
Designated Bridge/Port  :4096.4c1f-cc45-aac1 / 128.30
Port Edged          :Config=default / Active=disabled
Point-to-point      :Config=auto / Active=true
Transit Limit       :147 packets/hello-time
Protection Type     :None
Port STP Mode       :STP
Port Protocol Type  :Config=auto / Active=dot1s
PortTimes           :Hello 2s MaxAge 20s FwDly 15s RemHop 0
TC or TCN send      :7
TC or TCN received  :162
BPDU Sent           :8
        TCN: 7, Config: 1, RST: 0, MST: 0
BPDU Received       :1891
        TCN: 0, Config: 1891, RST: 0, MST: 0
```

The Ethernet 0/0/1 interface of S3 becomes a designated interface and that of S4 becomes an alternate interface.

Step 5 **Configure RSTP and verify the configuration.**

Configure IP addresses for the VLANIF interfaces of S1 and S2. Test whether the route from S1 to S2 is reachable.

```
[S1]interface Vlanif 1
[S1-Vlanif1]ip address 10.0.1.1 24

[S2]interface Vlanif 1
[S2-Vlanif1]ip address 10.0.1.2 24

[S1]ping 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=255 time=9 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=254 time=1 ms

  --- 10.0.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 1/2/9 ms
```

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                    Role  STP State    Protection
   0    GigabitEthernet0/0/9     ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/13    DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/14    DESI  FORWARDING    NONE
```

The GigabitEthernet 0/0/10 interface of S1 is the root interface. Run the **ping** command to test whether the route from S1 to S2 is reachable for 20 times.

Note: Disable the GigabitEthernet 0/0/10 interface of S2 immediately after running the **ping** command on S1.

```
 [S1]ping -c 20 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=254 time=1 ms
Dec 21 2011 16:20:44-05:13 S1 %%01IFNET/4/IF_STATE(l)[5]:Interface
GigabitEthernet0/0/10 has turned into DOWN state.
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out
    Reply from 10.0.1.2: bytes=56 Sequence=18 ttl=255 time=15 ms
    Reply from 10.0.1.2: bytes=56 Sequence=19 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=20 ttl=254 time=1 ms

  --- 10.0.1.2 ping statistics ---
    20 packet(s) transmitted
```

```
  5 packet(s) received
  75.00% packet loss
  round-trip min/avg/max = 1/3/15 ms
```

```
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]shutdown
```

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                     Role  STP State    Protection
   0    GigabitEthernet0/0/9     ROOT  FORWARDING     NONE
   0    GigabitEthernet0/0/13    DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/14    DESI  FORWARDING     NONE
```

The GigabitEthernet 0/0/9 interface of S1 becomes the root interface and enters the FORWARDING state. There are 15 expired packets and the network convergence takes 30 seconds.

Enable the GigabitEthernet 0/0/10 interface of S2.

```
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]undo shutdown
```

Configure RSTP.

```
[S1]stp mode rstp

[S2]stp mode rstp

[S3]stp mode rstp

[S4]stp mode rstp
```

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID    Port                    Role  STP State    Protection
   0    GigabitEthernet0/0/9      ALTE  DISCARDING     NONE
   0    GigabitEthernet0/0/10     ROOT  FORWARDING     NONE
   0    GigabitEthernet0/0/13     DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/14     DESI  FORWARDING     NONE
```

The GigabitEthernet 0/0/10 interface of S1 becomes the root interface. Run the **ping** command to test whether the route from S1 to S2 is reachable

for 20 times.

Note: Disable the GigabitEthernet 0/0/10 interface of S2 immediately after running the **ping** command on S1.

```
[S1]ping -c 20 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=254 time=1 ms
Dec 21 2011 16:37:10-05:13 S1 %%01IFNET/4/IF_STATE(l)[7]:Interface
GigabitEthernet0/0/10 has turned into DOWN state.
    Request time out
    Reply from 10.0.1.2: bytes=56 Sequence=7 ttl=255 time=10 ms
    Reply from 10.0.1.2: bytes=56 Sequence=8 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=9 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=10 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=11 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=12 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=13 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=14 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=15 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=16 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=17 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=18 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=19 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=20 ttl=254 time=1 ms

  --- 10.0.1.2 ping statistics ---
    20 packet(s) transmitted
    19 packet(s) received
    5.00% packet loss
round-trip min/avg/max = 1/1/10 ms

[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]shutdown
```

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                 Role  STP State    Protection
   0   GigabitEthernet0/0/9     ROOT  FORWARDING     NONE
```

```
   0    GigabitEthernet0/0/13      DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/14      DESI  FORWARDING     NONE
```

The GigabitEthernet 0/0/9 interface of S1 becomes the root interface and enters the FORWARDING state. There is one expired packet and the network convergence takes 2 seconds.

Enable the GigabitEthernet 0/0/10 interface of S2.

```
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]undo shutdown
```

Step 6 **Perform compatibility configuration between RSTP and STP.**

Enable STP on S1 and retain other configurations.

```
[S1]stp mode stp
```

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                    Role  STP State    Protection
   0    GigabitEthernet0/0/9     ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/13    DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/14    DESI  FORWARDING    NONE
```

The GigabitEthernet 0/0/10 interface of S1 is the root interface. Run the **ping** command to test whether the route from S1 to S2 is reachable for 20 times.

Note: Disable the GigabitEthernet 0/0/10 interface of S2 immediately after running the **ping** command on S1.

```
 [S1]ping -c 20 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=254 time=1 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=254 time=1 ms
Dec 21 2011 16:20:44-05:13 S1 %%01IFNET/4/IF_STATE(l)[5]:Interface
GigabitEthernet0/0/10 has turned into DOWN state.
    Request time out
    Request time out
```

```
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Request time out
   Reply from 10.0.1.2: bytes=56 Sequence=18 ttl=255 time=15 ms
   Reply from 10.0.1.2: bytes=56 Sequence=19 ttl=254 time=1 ms
   Reply from 10.0.1.2: bytes=56 Sequence=20 ttl=254 time=1 ms

 --- 10.0.1.2 ping statistics ---
   20 packet(s) transmitted
   5 packet(s) received
   75.00% packet loss
   round-trip min/avg/max = 1/3/15 ms


[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]shutdown
```

View role information about interfaces of S1.

```
[S1]display stp brief
 MSTID  Port                   Role  STP State    Protection
   0   GigabitEthernet0/0/9    ROOT  FORWARDING     NONE
   0   GigabitEthernet0/0/13   DESI  FORWARDING     NONE
   0   GigabitEthernet0/0/14   DESI  FORWARDING     NONE
```

The GigabitEthernet 0/0/9 interface of S1 becomes the root interface and enters the FORWARDING state. There are 15 expired packets and the network convergence takes 30 seconds.

RSTP is compatible with STP but it still uses the convergence mechanism of STP.

Enable the GigabitEthernet 0/0/10 interface of S2.

```
[S2]interface GigabitEthernet 0/0/10
```

```
[S2-GigabitEthernet0/0/10]undo shutdown
```

Step 7 Configure MSTP and verify the configuration.

Create VLANs 2 to 20 and add interfaces to relevant VLANs.

```
[S1]vlan batch 2 to 20
Info: This operation may take a few seconds. Please wait for a moment...done.
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]port link-type trunk
[S1-GigabitEthernet0/0/9]port trunk allow-pass vlan 1 TO 20
[S1-GigabitEthernet0/0/9]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]port link-type trunk
[S1-GigabitEthernet0/0/10]port trunk allow-pass vlan 1 TO 20
[S1-GigabitEthernet0/0/10]interface GigabitEthernet 0/0/13
[S1-GigabitEthernet0/0/13]port link-type trunk
[S1-GigabitEthernet0/0/13]port trunk allow-pass vlan 1 TO 20
[S1-GigabitEthernet0/0/13]interface GigabitEthernet 0/0/14
[S1-GigabitEthernet0/0/14]port link-type trunk
[S1-GigabitEthernet0/0/14]port trunk allow-pass vlan 1 TO 20

[S2]vlan batch 1 to 20
Info: This operation may take a few seconds. Please wait for a moment...done.
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]port link-type trunk
[S2-GigabitEthernet0/0/9]port trunk allow-pass vlan 1 TO 20
[S2-GigabitEthernet0/0/9]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]port link-type trunk
[S2-GigabitEthernet0/0/10]port trunk allow-pass vlan 1 TO 20
[S2-GigabitEthernet0/0/10]interface GigabitEthernet 0/0/23
[S2-GigabitEthernet0/0/23]port link-type trunk
[S2-GigabitEthernet0/0/23]port trunk allow-pass vlan 1 TO 20
[S2-GigabitEthernet0/0/23]interface GigabitEthernet 0/0/24
[S2-GigabitEthernet0/0/24]port link-type trunk
[S2-GigabitEthernet0/0/24]port trunk allow-pass vlan 1 TO 20

[S3]vlan batch 1 to 20
Info: This operation may take a few seconds. Please wait for a moment...done.
[S3]interface Ethernet0/0/1
[S3-Ethernet0/0/1]port link-type trunk
[S3-Ethernet0/0/1]port trunk allow-pass vlan 1 TO 20
[S3-Ethernet0/0/1]interface Ethernet0/0/13
```

```
[S3-Ethernet0/0/13]port link-type trunk
[S3-Ethernet0/0/13]port trunk allow-pass vlan 1 TO 20
[S3-Ethernet0/0/13]interface Ethernet0/0/23
[S3-Ethernet0/0/23]port link-type trunk
[S3-Ethernet0/0/23]port trunk allow-pass vlan 1 TO 20


[S4]vlan batch 1 to 20
Info: This operation may take a few seconds. Please wait for a moment...done.
[S4]interface Ethernet0/0/1
[S4-Ethernet0/0/1]port link-type trunk
[S4-Ethernet0/0/1]port trunk allow-pass vlan 1 TO 20
[S4-Ethernet0/0/1]interface Ethernet0/0/14
[S4-Ethernet0/0/14]port link-type trunk
[S4-Ethernet0/0/14]port trunk allow-pass vlan 1 TO 20
[S4-Ethernet0/0/14]interface Ethernet0/0/24
[S4-Ethernet0/0/24]port link-type trunk
[S4-Ethernet0/0/24]port trunk allow-pass vlan 1 TO 20
```

Configure MSTP.

Configure VLANs 110 to belong to instance 1 and VLANs 1120 to belong to instance 2.

```
[S1]stp mode mstp
[S1]stp region-configuration
[S1-mst-region]region-name RG1
[S1-mst-region]instance 1 vlan 1 TO 10
[S1-mst-region]instance 2 vlan 11 to 20
[S1-mst-region]active region-configuration
Info: This operation may take a few seconds. Please wait for a moment....done.


[S2]stp mode mstp
[S2]stp region-configuration
[S2-mst-region]region-name RG1
[S2-mst-region]instance 1 vlan 1 TO 10
[S2-mst-region]instance 2 vlan 11 to 20
[S2-mst-region]active region-configuration
Info: This operation may take a few seconds. Please wait for a moment....done.


[S3]STP mode mstp
Info: This operation may take a few seconds. Please wait for a moment.....done.
[S3]stp region-configuration
[S3-mst-region]region-name RG1
[S3-mst-region]instance 1 vlan 1 to 10
```

```
[S3-mst-region]instance 2 vlan 11 to 20


[S4]STP mode mstp
Info: This operation may take a few seconds. Please wait for a moment.....done.
[S4]stp region-configuration
[S4-mst-region]region-name RG1
[S4-mst-region]instance 1 vlan 1 to 10
[S4-mst-region]instance 2 vlan 11 to 20
```

View the mapping between MSTP instances and VLANs.

```
[S1]display stp region-configuration
 Oper configuration
   Format selector   :0
   Region name       :RG1
   Revision level    :0
   Instance   VLANs Mapped
      0      21 to 4094
      1       1 to 10
      2      11 to 20
```

Set the priority of S1 to 4096 in instance 1 and to 8192 in instance 2.

Set the priority of S2 to 4096 in instance 2 and to 8192 in instance 1.

```
[S1]stp instance 1 priority 4096
[S1]stp instance 2 priority 8192


[S2]stp instance 2 priority 4096
[S2]stp instance 1 priority 8192
```

View status information about instance 1 and instance 2.

```
[S1]display stp instance 1
-------[MSTI 1 Global Info]-------
MSTI Bridge ID      :4096.4c1f-cc45-aadc
MSTI RegRoot/IRPC   :4096.4c1f-cc45-aadc / 0
MSTI RootPortId     :0.0
Master Bridge       :4096.4c1f-cc45-aac1
Cost to Master      :20000
TC received         :20
TC count per hello  :0
······output omit······


[S2]display stp instance 2
```

```
-------[MSTI 2 Global Info]-------
MSTI Bridge ID      :4096.4c1f-cc45-aac1
MSTI RegRoot/IRPC   :4096.4c1f-cc45-aac1 / 0
MSTI RootPortId     :0.0
Master Bridge       :4096.4c1f-cc45-aac1
Cost to Master      :0
TC received         :16
TC count per hello  :0
······output omit······
```

S1 is the root bridge of instance 1, and S2 is the root bridge of instance 2.

View the role information about interfaces in instance 1.

```
[S1]display stp instance 1 brief
 MSTID  Port                    Role  STP State    Protection
  1     GigabitEthernet0/0/9     DESI  FORWARDING      NONE
  1     GigabitEthernet0/0/10    DESI  FORWARDING      NONE
  1     GigabitEthernet0/0/13    DESI  FORWARDING      NONE
  1     GigabitEthernet0/0/14    DESI  FORWARDING      NONE


[S2]display stp instance 1 brief
 MSTID  Port                    Role  STP State    Protection
  1     GigabitEthernet0/0/9     ROOT  FORWARDING      NONE
  1     GigabitEthernet0/0/10    ALTE  DISCARDING      NONE
  1     GigabitEthernet0/0/23    DESI  FORWARDING      NONE
  1     GigabitEthernet0/0/24    DESI  FORWARDING      NONE


[S3]display stp instance 1 brief
 MSTID  Port                    Role  STP State    Protection
  1     Ethernet0/0/1            ALTE  DISCARDING      NONE
  1     Ethernet0/0/13           ROOT  FORWARDING      NONE
  1     Ethernet0/0/23           ALTE  DISCARDING      NONE


[S4]display stp instance 1 brief
 MSTID  Port                    Role  STP State    Protection
  1     Ethernet0/0/1            DESI  FORWARDING      NONE
  1     Ethernet0/0/14           ROOT  FORWARDING      NONE
  1     Ethernet0/0/24           ALTE  DISCARDING      NONE
```

In instance 1, S1 is the root bridge. Users in VLAN 1 to VLAN 10 of S3 communicate with users in VLAN 1 to VLAN 10 of S1, S2, and S4 over the Ethernet 0/0/13 interface.

View the role information about interfaces in instance 2.

```
[S1]display stp instance 2 brief
 MSTID  Port                    Role  STP State    Protection
   2   GigabitEthernet0/0/9     ROOT  FORWARDING     NONE
   2   GigabitEthernet0/0/10    ALTE  DISCARDING     NONE
   2   GigabitEthernet0/0/13    DESI  FORWARDING     NONE

[S2]display stp instance 2 brief
 MSTID  Port                    Role  STP State    Protection
   2   GigabitEthernet0/0/9     DESI  FORWARDING     NONE
   2   GigabitEthernet0/0/10    DESI  FORWARDING     NONE
   2   GigabitEthernet0/0/23    DESI  FORWARDING     NONE
   2   GigabitEthernet0/0/24    DESI  FORWARDING     NONE

[S3]display stp instance 2 brief
 MSTID  Port                    Role  STP State    Protection
   2   Ethernet0/0/1            ALTE  DISCARDING     NONE
   2   Ethernet0/0/13           ALTE  DISCARDING     NONE
   2   Ethernet0/0/23           ROOT  FORWARDING     NONE

[S4]display stp instance 2 brief
 MSTID  Port                    Role  STP State    Protection
   2   Ethernet0/0/1            DESI  FORWARDING     NONE
   2   Ethernet0/0/14           DESI  FORWARDING     NONE
   2   Ethernet0/0/24           ROOT  FORWARDING     NONE
```

In instance 2, S2 is the root bridge. Users in VLAN 11 to VLAN 20 of S3 communicate with users in VLAN 11 to VLAN 20 of S1, S2, and S4 over the Ethernet 0/0/23 interface.

Additional Exercises: Analyzing and Verifying

Figure out how MSTP balances data transmission load among VLANs in different areas.

Figure out the reasons why RSTP can forward data quickly.

Final Configurations

```
[S1]display current-configuration
#
!Software Version V100R006C00SPC800
```

```
 sysname S1
#
vlan batch 2 to 20
#
 stp instance 0 priority 8192
 stp instance 1 priority 4096
stp instance 2 priority 8192
#
 stp region-configuration
  region-name RG1
  instance 1 vlan 1 to 10
  instance 2 vlan 11 to 20
  active region-configuration
#
interface Vlanif1
 ip address 10.0.1.1 255.255.255.0
#
interface GigabitEthernet0/0/9
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
interface GigabitEthernet0/0/10
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
interface GigabitEthernet0/0/13
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
Return

[S2]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S2
#
 vlan batch 2 to 20
#
stp instance 1 priority 8192
 stp instance 2 priority 4096
 stp instance 0 root secondary
#
 stp region-configuration
```

```
 region-name RG1
 instance 1 vlan 1 to 10
 instance 2 vlan 11 to 20
 active region-configuration
#
interface Vlanif1
 ip address 10.0.1.2 255.255.255.0
#
interface GigabitEthernet0/0/9
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
 stp instance 0 port priority 32
#
interface GigabitEthernet0/0/10
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
 stp instance 0 port priority 16
#
interface GigabitEthernet0/0/23
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
interface GigabitEthernet0/0/24
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
Return


[S3]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S3
#
vlan batch 2 to 20
#
stp region-configuration
  region-name RG1
  instance 1 vlan 1 to 10
  instance 2 vlan 11 to 20
  active region-configuration
#
interface Ethernet0/0/1
 port link-type trunk
```

```
 port trunk allow-pass vlan 2 to 20
#
interface Ethernet0/0/13
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
interface Ethernet0/0/23
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
Return

[S4]display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S4
#
 vlan batch 2 to 20
#
 stp region-configuration
  region-name RG1
  instance 1 vlan 1 to 10
  instance 2 vlan 11 to 20
  active region-configuration
#
interface Ethernet0/0/1
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
interface Ethernet0/0/14
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
#
interface Ethernet0/0/23
#
interface Ethernet0/0/24
 port link-type trunk
 port trunk allow-pass vlan 2 to 20
 stp instance 0 cost 2000000
#
Return
```

Lab 2-2 Compatibility Between Multi-Region MSTP and STP (Optional)

Learning Objectives

The objectives of this lab are to learn and understand how to perform the following operations:

- Configure multi-instance Multiple Spanning Tree Protocol (MSTP) and multi-region MSTP.
- Configure MSTP and Spanning Tree Protocol (STP) to be compatible.
- Configure MSTP edge interface protection, designated interface protection, loop protection, and TC-BPDU protection.

Topology
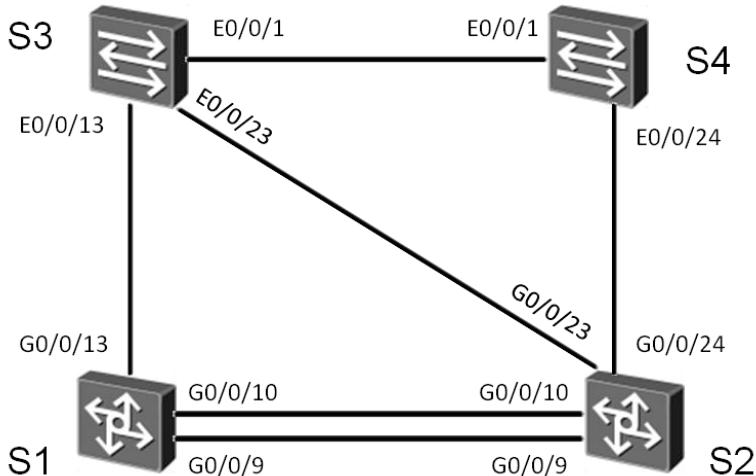
Figure 2-2 Compatibility between multi-region MSTP and STP

Scenario

Assume that you are a network administrator of a company. In the Layer 2 networking architecture, MSTP is deployed to:

Avoid sub-optimal routes.

Resolve the problem that some virtual local area network (VLAN) paths

are unreachable if a single spanning tree instance is used.

Implement load balancing.

Interoperate with traditional spanning trees.

Tasks

Step 1 **Perform basic configurations.**

Disable unused interfaces before carrying out the experiment.

```
<S1>system-view
Enter system view, return user view with Ctrl+Z.
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]shutdown

<S3>system-view
Enter system view, return user view with Ctrl+Z.
[S3]interface Ethernet 0/0/23
[S3-Ethernet0/0/23]shutdown

<S4>system-view
Enter system view, return user view with Ctrl+Z.
[S4]interface Ethernet 0/0/14
[S4-Ethernet0/0/14]shutdown
```

Create VLANs 3, 4, 5, 6, 7, and 8 on all switches.

```
[S1]vlan batch 3 to 8

[S2]vlan batch 3 to 8

[S3]vlan batch 3 to 8

[S4]vlan batch 3 to 8
```

View information about the created VLANs.

```
[S1]display vlan
* : management-vlan
--------------------
The total number of vlans is : 7
VLAN ID Type      Status  MAC Learning Broadcast/Multicast/Unicast Property
```

```
-------------------------------------------------------------------------
1      common     enable  enable     forward   forward   forward default
3      common     enable  enable     forward   forward   forward default
4      common     enable  enable     forward   forward   forward default
5      common     enable  enable     forward   forward   forward default
6      common     enable  enable     forward   forward   forward default
7      common     enable  enable     forward   forward   forward default
8      common     enable  enable     forward   forward   forward default
```

[S2]**display vlan**
```
* : management-vlan
--------------------
The total number of vlans is : 7
VLAN ID Type      Status   MAC Learning Broadcast/Multicast/Unicast Property
-------------------------------------------------------------------------
1      common     enable  enable     forward   forward   forward default
3      common     enable  enable     forward   forward   forward default
4      common     enable  enable     forward   forward   forward default
5      common     enable  enable     forward   forward   forward default
6      common     enable  enable     forward   forward   forward default
7      common     enable  enable     forward   forward   forward default
8      common     enable  enable     forward   forward   forward default
```

[S3]**display vlan**
```
* : management-vlan
--------------------
The total number of vlans is : 7
VLAN ID Type      Status   MAC Learning Broadcast/Multicast/Unicast Property
-------------------------------------------------------------------------
1      common     enable  enable     forward   forward   forward default
3      common     enable  enable     forward   forward   forward default
4      common     enable  enable     forward   forward   forward default
5      common     enable  enable     forward   forward   forward default
6      common     enable  enable     forward   forward   forward default
7      common     enable  enable     forward   forward   forward default
8      common     enable  enable     forward   forward   forward default
```

[S4]**display vlan**
```
* : management-vlan
--------------------
The total number of vlans is : 7
VLAN ID Type      Status   MAC Learning Broadcast/Multicast/Unicast Property
-------------------------------------------------------------------------
```

1	common	enable	enable	forward	forward	forward default
3	common	enable	enable	forward	forward	forward default
4	common	enable	enable	forward	forward	forward default
5	common	enable	enable	forward	forward	forward default
6	common	enable	enable	forward	forward	forward default
7	common	enable	enable	forward	forward	forward default
8	common	enable	enable	forward	forward	forward default

Set the type to Trunk for the links between switches. Enable the links to receive bridge protocol data unit (BDPU) packets and to allow the access from all VLANs. Note: The direct link between S2 and S3 remains unchanged.

```
[S1]interface GigabitEthernet 0/0/13
[S1-GigabitEthernet0/0/13]port link-type trunk
[S1-GigabitEthernet0/0/13]port trunk allow-pass vlan all
[S1-GigabitEthernet0/0/13]bpdu enable
[S1-GigabitEthernet0/0/13]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]port link-type trunk
[S1-GigabitEthernet0/0/10]port trunk allow-pass vlan all
[S1-GigabitEthernet0/0/10]bpdu enable

[S2]interface GigabitEthernet 0/0/24
[S2-GigabitEthernet0/0/24]port link-type trunk
[S2-GigabitEthernet0/0/24]port trunk allow-pass vlan all
[S2-GigabitEthernet0/0/24]bpdu enable
[S2-GigabitEthernet0/0/24]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]port link-type trunk
[S2-GigabitEthernet0/0/10]port trunk allow-pass vlan all
[S2-GigabitEthernet0/0/10]bpdu enable

[S3]interface  Ethernet0/0/1
[S3-Ethernet0/0/1]port link-type trunk
[S3-Ethernet0/0/1]port trunk allow-pass vlan all
[S3-Ethernet0/0/1]bpdu enable
[S3-Ethernet0/0/1]interface Ethernet0/0/13
[S3-Ethernet0/0/13]port link-type trunk
[S3-Ethernet0/0/13]port trunk allow-pass vlan all
[S3-Ethernet0/0/13]bpdu enable

[S4]interface  Ethernet0/0/1
[S4-Ethernet0/0/1]port link-type trunk
[S4-Ethernet0/0/1]port trunk allow-pass vlan all
[S4-Ethernet0/0/1]bpdu enable
```

```
[S4-Ethernet0/0/1]interface Ethernet0/0/24
[S4-Ethernet0/0/24]port link-type trunk
[S4-Ethernet0/0/24]port trunk allow-pass vlan all
[S4-Ethernet0/0/24]bpdu enable
```

Step 2 **Configure multi-instance MSTP.**

Enable MSTP in the system view.

```
[S1]stp enable
[S1]stp mode mstp

[S2]stp enable
[S2]stp mode mstp

[S3]stp enable
[S3]stp mode mstp

[S4]stp enable
[S4]stp mode mstp
```

Configure all switches to belong to RG1 and set the revision level to 1. Create instance 1 and map it to VLANs 3, 4 and 5. Create instance 2 and map it to VLANs 6, 7, and 8. Then activate the region configurations.

```
[S1]stp region-configuration
[S1-mst-region]region-name RG1
[S1-mst-region]revision-level 1
[S1-mst-region]instance 1 vlan 3 4 5
[S1-mst-region]instance 2 vlan 6 7 8
[S1-mst-region]active region-configuration

[S2]stp  region-configuration
[S2-mst-region]region-name RG1
[S2-mst-region]revision-level 1
[S2-mst-region]instance 1 vlan 3 4 5
[S2-mst-region]instance 2 vlan 6 7 8
[S2-mst-region]active region-configuration

[S3]stp  region-configuration
[S3-mst-region]region-name RG1
[S3-mst-region]revision-level 1
```

```
[S3-mst-region]instance 1 vlan 3 4 5
[S3-mst-region]instance 2 vlan 6 7 8
[S3-mst-region]active region-configuration

[S4]stp  region-configuration
[S4-mst-region]region-name RG1
[S4-mst-region]revision-level 1
[S4-mst-region]instance 1 vlan 3 4 5
[S4-mst-region]instance 2 vlan 6 7 8
[S4-mst-region]active region-configuration
```

View MSTP information.

[S1]**display stp brief**

```
MSTID  Port                    Role  STP State   Protection
  0    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
  0    GigabitEthernet0/0/13   DESI  FORWARDING    NONE
  1    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
  1    GigabitEthernet0/0/13   DESI  FORWARDING    NONE
  2    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
  2    GigabitEthernet0/0/13   DESI  FORWARDING    NONE
```

[S2]**display stp brief**

```
MSTID  Port                    Role  STP State   Protection
  0    GigabitEthernet0/0/10   ROOT  FORWARDING    NONE
  0    GigabitEthernet0/0/24   DESI  FORWARDING    NONE
  1    GigabitEthernet0/0/10   ROOT  FORWARDING    NONE
  1    GigabitEthernet0/0/24   DESI  FORWARDING    NONE
  2    GigabitEthernet0/0/10   ROOT  FORWARDING    NONE
  2    GigabitEthernet0/0/24   DESI  FORWARDING    NONE
```

[S3]**display stp brief**

```
MSTID  Port                Role  STP State   Protection
  0    Ethernet0/0/1       DESI  FORWARDING    NONE
  0    Ethernet0/0/13      ROOT  FORWARDING    NONE
  1    Ethernet0/0/1       DESI  FORWARDING    NONE
  1    Ethernet0/0/13      ROOT  FORWARDING    NONE
  2    Ethernet0/0/1       DESI  FORWARDING    NONE
  2    Ethernet0/0/13      ROOT  FORWARDING    NONE
```

[S4]**display stp brief**

```
MSTID  Port                Role  STP State   Protection
  0    Ethernet0/0/1       ROOT  FORWARDING    NONE
```

```
0    Ethernet0/0/24            ALTE  DISCARDING    NONE
1    Ethernet0/0/1             ROOT  FORWARDING    NONE
1    Ethernet0/0/24            ALTE  DISCARDING    NONE
2    Ethernet0/0/1             ROOT  FORWARDING    NONE
2    Ethernet0/0/24            ALTE  DISCARDING    NONE
```

S1 is the root switch and the E0/0/24 interface of S4 is the alternate interface for all MSTP processes.

In instance 2, set the priority to 0 for S2, to 4096 for S1, and to 8192 for S4 so that S2 becomes the root switch in instance 2.

```
[S2]stp instance 2 priority 0


[S1]stp instance 2 priority 4096


[S4]stp instance 2 priority 8192
```

View MSTP information.

```
[S1]display stp brief
MSTID  Port                    Role  STP State    Protection
  0    GigabitEthernet0/0/10    DESI  FORWARDING    NONE
  0    GigabitEthernet0/0/13    DESI  FORWARDING    NONE
  1    GigabitEthernet0/0/10    DESI  FORWARDING    NONE
  1    GigabitEthernet0/0/13    DESI  FORWARDING    NONE
  2    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
  2    GigabitEthernet0/0/13    DESI  FORWARDING    NONE


[S2]display stp brief
MSTID  Port                    Role  STP State    Protection
  0    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
  0    GigabitEthernet0/0/24    DESI  FORWARDING    NONE
  1    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
  1    GigabitEthernet0/0/24    DESI  FORWARDING    NONE
  2    GigabitEthernet0/0/10    DESI  FORWARDING    NONE
  2    GigabitEthernet0/0/24    DESI  FORWARDING    NONE


[S3]display stp brief
MSTID  Port                    Role  STP State    Protection
  0    Ethernet0/0/1            DESI  FORWARDING    NONE
  0    Ethernet0/0/13           ROOT  FORWARDING    NONE
  1    Ethernet0/0/1            DESI  FORWARDING    NONE
  1    Ethernet0/0/13           ROOT  FORWARDING    NONE
```

```
   2    Ethernet0/0/1              ALTE  DISCARDING    NONE
   2    Ethernet0/0/13            ROOT  FORWARDING    NONE


[S4]display stp brief
 MSTID  Port                      Role  STP State   Protection
   0    Ethernet0/0/1             ALTE  DISCARDING    NONE
   0    Ethernet0/0/24            ROOT  FORWARDING    NONE
   1    Ethernet0/0/1             ALTE  DISCARDING    NONE
   1    Ethernet0/0/24            ROOT  FORWARDING    NONE
   2    Ethernet0/0/1             DESI  FORWARDING    NONE
   2    Ethernet0/0/24            ROOT  FORWARDING    NONE
```

S2 becomes the root switch in instance 2 and the E0/0/1 interface of S3 becomes the alternate interface. The status of switches does not change in instance 1. This proves that MSTP instances calculate spanning tree instances independently.

Step 3 **Configure multi-region MSTP.**

Delete the MSTP region and priority configurations made in step 2 for all switches.

```
[S1]undo stp region-configuration
[S1]undo stp instance 2 priority


[S2]undo stp region-configuration
[S2]undo stp instance 2 priority


[S3]undo stp region-configuration


[S4]undo stp region-configuration
[S4]undo stp instance 2 priority
```

Configure S1 and S3 to belong to RG1 and set the revision level to 1.

Create instance 1 and map it to VLANs 3, 4, and 5.

Create instance 2 and map it to VLANs 6, 7, and 8.

```
[S1]stp region-configuration
[S1-mst-region]region-name RG1
[S1-mst-region]revision-level 1
[S1-mst-region]instance 1 vlan 3 4 5
```

```
[S1-mst-region]instance 2 vlan 6 7 8
[S1-mst-region]active region-configuration


[S3]stp region-configuration
[S3-mst-region]region-name RG1
[S3-mst-region]revision-level 1
[S3-mst-region]instance 1 vlan 3 4 5
[S3-mst-region]instance 2 vlan 6 7 8
[S3-mst-region]active region-configuration
```

Configure S2 and S4 to belong to RG2 and set the revision level to 2.

Create instance 1 and map it to VLANs 3, 4, and 5.

Create instance 2 and map it to VLANs 6, 7, and 8. Then activate the region configurations.

```
[S2]stp region-configuration
[S2-mst-region]region-name RG2
[S2-mst-region]revision-level 2
[S2-mst-region]instance 1 vlan 3 4 5
[S2-mst-region]instance 2 vlan 6 7 8
[S2-mst-region]active region-configuration


[S4]stp region-configuration
[S4-mst-region]region-name RG2
[S4-mst-region]revision-level 2
[S4-mst-region]instance 1 vlan 3 4 5
[S4-mst-region]instance 2 vlan 6 7 8
[S4-mst-region]active region-configuration
```

View MSTP information.

```
[S1]display stp brief
 MSTID  Port                Role  STP State    Protection
   0    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/13   DESI  FORWARDING    NONE
   1    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
   1    GigabitEthernet0/0/13   DESI  FORWARDING    NONE
   2    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
   2    GigabitEthernet0/0/13   DESI  FORWARDING    NONE


[S2]display stp brief
 MSTID  Port                Role  STP State    Protection
```

```
   0    GigabitEthernet0/0/10        ROOT  FORWARDING       NONE
   0    GigabitEthernet0/0/24        DESI  FORWARDING       NONE
   1    GigabitEthernet0/0/10        MAST  FORWARDING       NONE
   1    GigabitEthernet0/0/24        DESI  FORWARDING       NONE
   2    GigabitEthernet0/0/10        MAST  FORWARDING       NONE
```

```
[S3]display stp brief
 MSTID  Port                    Role  STP State    Protection
   0    Ethernet0/0/1           DESI  FORWARDING      NONE
   0    Ethernet0/0/13          ROOT  FORWARDING      NONE
   1    Ethernet0/0/1           DESI  FORWARDING      NONE
   1    Ethernet0/0/13          ROOT  FORWARDING      NONE
   2    Ethernet0/0/1           DESI  FORWARDING      NONE
   2    Ethernet0/0/13          ROOT  FORWARDING      NONE
```

```
[S4]display stp brief
 MSTID  Port                    Role  STP State    Protection
   0    Ethernet0/0/1           ALTE  DISCARDING      NONE
   0    Ethernet0/0/24          ROOT  FORWARDING      NONE
   1    Ethernet0/0/1           ALTE  DISCARDING      NONE
   1    Ethernet0/0/24          ROOT  FORWARDING      NONE
   2    Ethernet0/0/1           ALTE  DISCARDING      NONE
   2    Ethernet0/0/24          ROOT  FORWARDING      NONE
```

S1 is the root switch and the E0/0/1 interface of S4 is the alternate interface.

Set the priority to 0 for S3 in instance 0 so that S3 is the Common and Internal Spanning Tree (CIST) root, and to 0 in instance 1 so that S3 is the regional root in instance 1. Set the priority to 0 for S4 in instance 1 so that S4 is the regional root in instance 1.

```
[S3]stp instance 0 priority 0
[S3]stp instance 1 priority 0

[S4]stp instance 1 priority 0
```

View MSTP information.

```
[S1]display stp brief
 MSTID  Port                     Role  STP State    Protection
   0    GigabitEthernet0/0/10    DESI  FORWARDING      NONE
   0    GigabitEthernet0/0/13    ROOT  FORWARDING      NONE
   1    GigabitEthernet0/0/10    DESI  FORWARDING      NONE
```

```
   1    GigabitEthernet0/0/13      ROOT  FORWARDING      NONE
   2    GigabitEthernet0/0/10      DESI  FORWARDING      NONE
   2    GigabitEthernet0/0/13      DESI  FORWARDING      NONE


[S2]display stp brief
 MSTID  Port                  Role  STP State   Protection
   0    GigabitEthernet0/0/10      ROOT  FORWARDING      NONE
   0    GigabitEthernet0/0/24      DESI  FORWARDING      NONE
   1    GigabitEthernet0/0/10      MAST  FORWARDING      NONE
   1    GigabitEthernet0/0/24      ROOT  FORWARDING      NONE
   2    GigabitEthernet0/0/10      MAST  FORWARDING      NONE
   2    GigabitEthernet0/0/24      DESI  FORWARDING      NONE


[S3]display stp brief
 MSTID  Port                  Role  STP State   Protection
   0    Ethernet0/0/1              DESI  FORWARDING      NONE
   0    Ethernet0/0/13             DESI  FORWARDING      NONE
   1    Ethernet0/0/1              DESI  FORWARDING      NONE
   1    Ethernet0/0/13             DESI  FORWARDING      NONE
   2    Ethernet0/0/1              DESI  FORWARDING      NONE
   2    Ethernet0/0/13             ROOT  FORWARDING      NONE


[S4]display stp brief
 MSTID  Port                  Role  STP State   Protection
   0    Ethernet0/0/1              ALTE  DISCARDING      NONE
   0    Ethernet0/0/24             ROOT  FORWARDING      NONE
   1    Ethernet0/0/1              ALTE  DISCARDING      NONE
   1    Ethernet0/0/24             DESI  FORWARDING      NONE
   2    Ethernet0/0/1              ALTE  DISCARDING      NONE
   2    Ethernet0/0/24             ROOT  FORWARDING      NONE
```

Delete the MSTP configurations from S2 and S4. Configure S2 and S4 to belong to RG2 and set the revision level to 2. Create instance 1 and map it to VLANs 6, 7, and 8. Create instance 2 and map it to VLANs 3, 4 and 5. Then activate the region configurations.

```
[S2]undo stp region-configuration

[S3]undo stp instance 0 priority
[S3]undo stp instance 1 priority

[S4]undo stp region-configuration
```

```
[S4]undo stp instance 1 priority

[S2]stp region-configuration
[S2-mst-region]region-name RG2
[S2-mst-region]revision-level 2
[S2-mst-region]instance 1 vlan 6 7 8
[S2-mst-region]instance 2 vlan 3 4 5
[S2-mst-region]active region-configuration

[S4]stp region-configuration
[S4-mst-region]region-name RG2
[S4-mst-region]revision-level 2
[S4-mst-region]instance 1 vlan 6 7 8
[S4-mst-region]instance 2 vlan 3 4 5
[S4-mst-region]active region-configuration
```

View MSTP information.

[S1]**display stp brief**

```
MSTID  Port                  Role  STP State   Protection
   0   GigabitEthernet0/0/10   DESI  FORWARDING    NONE
   0   GigabitEthernet0/0/13   DESI  FORWARDING    NONE
   1   GigabitEthernet0/0/10   DESI  FORWARDING    NONE
   1   GigabitEthernet0/0/13   DESI  FORWARDING    NONE
   2   GigabitEthernet0/0/10   DESI  FORWARDING    NONE
   2   GigabitEthernet0/0/13   DESI  FORWARDING    NONE
```

[S2]**display stp brief**

```
MSTID  Port                  Role  STP State   Protection
   0   GigabitEthernet0/0/10   ROOT  FORWARDING    NONE
   0   GigabitEthernet0/0/24   DESI  FORWARDING    NONE
   1   GigabitEthernet0/0/10   MAST  FORWARDING    NONE
   1   GigabitEthernet0/0/24   DESI  FORWARDING    NONE
   2   GigabitEthernet0/0/10   MAST  FORWARDING    NONE
   2   GigabitEthernet0/0/24   DESI  FORWARDING    NONE
```

[S3]**display stp brief**

```
MSTID  Port             Role  STP State   Protection
   0   Ethernet0/0/1     DESI  FORWARDING    NONE
   0   Ethernet0/0/13    ROOT  FORWARDING    NONE
   1   Ethernet0/0/1     DESI  FORWARDING    NONE
   1   Ethernet0/0/13    ROOT  FORWARDING    NONE
   2   Ethernet0/0/1     DESI  FORWARDING    NONE
```

```
    2    Ethernet0/0/13           ROOT  FORWARDING    NONE


[S4]display stp brief
MSTID  Port                   Role  STP State    Protection
    0    Ethernet0/0/1           ALTE  DISCARDING    NONE
    0    Ethernet0/0/24          ROOT  FORWARDING    NONE
    1    Ethernet0/0/1           ALTE  DISCARDING    NONE
    1    Ethernet0/0/24          ROOT  FORWARDING    NONE
    2    Ethernet0/0/1           ALTE  DISCARDING    NONE
```

Except instance 0, the MSTP instances in other regions calculate spanning trees independently, regardless of whether the instances contain or map the same VLAN. That is, the spanning tree processes in the same region run independent of each other.

Step 4 Configure MSTP and STP to be compatible.

Configure S1, S2, and S3 to belong to the same MSTP region. Enable STP on S4.

Delete the MSTP configurations from S2 and then create RG1 on S2. Create instance 1 and map it to VLANs 3, 4, and 5. Create instance 2 and map it to VLANs 6, 7, and 8. Then activate the region configurations.

```
[S2]undo stp region-configuration
[S2]stp region-configuration
[S2-mst-region]region-name RG1
[S2-mst-region]revision-level 1
[S2-mst-region]instance 1 vlan 3 4 5
[S2-mst-region]instance 2 vlan  6 7 8
[S2-mst-region]active region-configuration
```

Enable the S0/0/23 interfaces of S2 and S3.

Configure the direct link between S2 and S3 to work in Trunk mode, receive bridge protocol data unit (BPDU) packets, and allow the access from all VLANs.

```
[S2]int GigabitEthernet 0/0/23
[S2-GigabitEthernet0/0/23]undo shutdown
[S2-GigabitEthernet0/0/23]port link-type trunk
[S2-GigabitEthernet0/0/23]port trunk all vlan all
[S2-GigabitEthernet0/0/23]bpdu enable
```

```
[S3]int Ethernet0/0/23
[S3-Ethernet0/0/23]undo shutdown
[S3-Ethernet0/0/23]port link-type trunk
[S3-Ethernet0/0/23]port trunk allow-pass vlan all
[S3-Ethernet0/0/23]bpdu enable
```

Delete the MSTP configurations from S4 and enable STP on S4.

```
[S4]undo stp region-configuration
[S4]stp mode stp
```

View STP information.

```
[S1]display stp brief
 MSTID  Port                  Role  STP State    Protection
   0    GigabitEthernet0/0/10  DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/13  DESI  FORWARDING     NONE
   1    GigabitEthernet0/0/10  DESI  FORWARDING     NONE
   1    GigabitEthernet0/0/13  DESI  FORWARDING     NONE
   2    GigabitEthernet0/0/10  DESI  FORWARDING     NONE
   2    GigabitEthernet0/0/13  DESI  FORWARDING     NONE


[S2]display stp brief
 MSTID  Port                  Role  STP State    Protection
   0    GigabitEthernet0/0/10  ROOT  FORWARDING     NONE
   0    GigabitEthernet0/0/23  DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/24  DESI  FORWARDING     NONE
   1    GigabitEthernet0/0/10  ROOT  FORWARDING     NONE
   1    GigabitEthernet0/0/23  DESI  FORWARDING     NONE
   1    GigabitEthernet0/0/24  DESI  FORWARDING     NONE
   2    GigabitEthernet0/0/10  ROOT  FORWARDING     NONE
   2    GigabitEthernet0/0/23  DESI  FORWARDING     NONE
   2    GigabitEthernet0/0/24  DESI  FORWARDING     NONE


[S3]display stp brief
 MSTID  Port             Role  STP State    Protection
   0    Ethernet0/0/1     DESI  FORWARDING     NONE
   0    Ethernet0/0/13    ROOT  FORWARDING     NONE
   0    Ethernet0/0/23    ALTE  DISCARDING     NONE
   1    Ethernet0/0/1     DESI  FORWARDING     NONE
   1    Ethernet0/0/13    ROOT  FORWARDING     NONE
   1    Ethernet0/0/23    ALTE  DISCARDING     NONE
   2    Ethernet0/0/1     DESI  FORWARDING     NONE
   2    Ethernet0/0/13    ROOT  FORWARDING     NONE
```

```
   2    Ethernet0/0/23            ALTE  DISCARDING    NONE


[S4]display stp brief
MSTID  Port                   Role  STP State    Protection
   0    Ethernet0/0/1            ROOT  FORWARDING    NONE
   0    Ethernet0/0/24           ALTE  DISCARDING    NONE
```

STP-enabled S4 and instance 0 in MSTP-enabled S1, S2, and S3 calculate the CIST together. S1 is the CIST root.

Set the priority to 4096 for S4 so that it becomes the CIST root.

```
[S4]stp priority 4096
```

View STP information.

```
[S1]display stp brief
MSTID  Port                   Role  STP State    Protection
   0    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/13    DESI  FORWARDING    NONE
   1    GigabitEthernet0/0/10    DESI  FORWARDING    NONE
   1    GigabitEthernet0/0/13    DESI  FORWARDING    NONE
   2    GigabitEthernet0/0/10    DESI  FORWARDING    NONE
   2    GigabitEthernet0/0/13    DESI  FORWARDING    NONE


[S2]display stp brief
MSTID  Port                   Role  STP State    Protection
   0    GigabitEthernet0/0/10    DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/23    DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/24    ROOT  FORWARDING    NONE
   1    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
   1    GigabitEthernet0/0/23    DESI  FORWARDING    NONE
   1    GigabitEthernet0/0/24    MAST  FORWARDING    NONE
   2    GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
   2    GigabitEthernet0/0/23    DESI  FORWARDING    NONE
   2    GigabitEthernet0/0/24    MAST  FORWARDING    NONE


[S3]display stp brief
MSTID  Port                   Role  STP State    Protection
   0    Ethernet0/0/1            ALTE  DISCARDING    NONE
   0    Ethernet0/0/13           ALTE  DISCARDING    NONE
   0    Ethernet0/0/23           ROOT  FORWARDING    NONE
   1    Ethernet0/0/1            ALTE  DISCARDING    NONE
```

```
   1    Ethernet0/0/13           ROOT  FORWARDING     NONE

   1    Ethernet0/0/23           ALTE  DISCARDING     NONE

   2    Ethernet0/0/1            ALTE  DISCARDING     NONE

   2    Ethernet0/0/13           ROOT  FORWARDING     NONE

   2    Ethernet0/0/23           ALTE  DISCARDING     NONE


[S4]display stp brief
MSTID  Port                     Role  STP State    Protection
   0    Ethernet0/0/1            DESI  FORWARDING     NONE
   0    Ethernet0/0/24           DESI  FORWARDING     NONE
```

S4 becomes the CIST root and all interfaces on S4 become designated interfaces.

Step 5 **Configure designated interface protection.**

Configure designated interface protection for the E0/0/1 and E0/0/24 interfaces of S4.

```
[S4]int Ethernet0/0/1
[S4-Ethernet0/0/1]stp root-protection
[S4-Ethernet0/0/1]int Ethernet0/0/24
[S4-Ethernet0/0/24]stp root-protection
```

View STP information about S4.

```
[S4]display stp brief
MSTID  Port                     Role  STP State    Protection
   0    Ethernet0/0/1            DESI  FORWARDING     ROOT
   0    Ethernet0/0/24           DESI  DISCARDING     ROOT
```

Set the priority to 0 for S2 in instance 0 to simulate preemption of the CIST root.

```
[S2]stp instance 0 priority 0
```

View STP information about S2 and S4.

```
[S2]display stp brief
MSTID  Port                     Role  STP State    Protection
   0    GigabitEthernet0/0/10    DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/23    DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/24    DESI  LEARNING       NONE
   1    GigabitEthernet0/0/10    ROOT  FORWARDING     NONE
```

```
  1   GigabitEthernet0/0/23     DESI  LEARNING      NONE
  1   GigabitEthernet0/0/24     DESI  LEARNING      NONE
  2   GigabitEthernet0/0/10     ROOT  FORWARDING    NONE
  2   GigabitEthernet0/0/23     DESI  LEARNING      NONE
  2   GigabitEthernet0/0/24     DESI  LEARNING      NONE


[S4]display stp brief
 MSTID  Port              Role  STP State    Protection
  0   Ethernet0/0/1         DESI  DISCARDING    ROOT
  0   Ethernet0/0/24        DESI  DISCARDING    ROOT
```

The interfaces of S4 enter the DISCARDING state and do not forward packets. This indicates that the roles of these interfaces do not change and S4 is still the root switch.

Delete the priority configurations of instance 0 from S2.

```
[S2]undo stp instance 0 priority
```

View STP information about S2 and S4.

```
[S2]display stp brief
 MSTID  Port                 Role  STP State    Protection
  0   GigabitEthernet0/0/10    DESI  FORWARDING    NONE
  0   GigabitEthernet0/0/23    DESI  FORWARDING    NONE
  0   GigabitEthernet0/0/24    ROOT  FORWARDING    NONE
  1   GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
  1   GigabitEthernet0/0/23    DESI  FORWARDING    NONE
  1   GigabitEthernet0/0/24    MAST  FORWARDING    NONE
  2   GigabitEthernet0/0/10    ROOT  FORWARDING    NONE
  2   GigabitEthernet0/0/23    DESI  FORWARDING    NONE
  2   GigabitEthernet0/0/24    MAST  FORWARDING    NONE


[S4]display stp brief
 MSTID  Port              Role  STP State    Protection
  0   Ethernet0/0/1         DESI  FORWARDING    ROOT
  0   Ethernet0/0/24        DESI  FORWARDING    ROOT
```

The interfaces restore to the original state (FORWARDING) if they do not receive configuration messages with higher priorities within the period specified by **Max Age**. The default period is 20 seconds.

Step 6 **Configure edge interface protection.**

Enable the G0/0/9 interface of S2.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]undo shutdown
```

Configure the G0/0/9 interface of S1 as an edge interface and enable edge interface protection in global mode.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]undo shutdown
[S1-GigabitEthernet0/0/9]stp edged-port enable
[S1-GigabitEthernet0/0/9]quit
[S1]stp bpdu-protection
```

View STP information about S1.

```
[S1]display stp interface GigabitEthernet 0/0/9 brief
 MSTID  Port                    Role STP State      Protection
   0    GigabitEthernet0/0/9     DESI  FORWARDING     BPDU
```

Enable the G0/0/9 interface of S1 so that it can receive BPDU packets and simulate an attack to S1.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]undo shutdown
```

Observe S1.

```
Dec 21 2011 08:39:51-05:13 S1 %%01IFNET/4/IF_STATE(l)[3]:Interface
GigabitEthernet0/0/9 has turned into UP state.
Dec 21 2011 08:39:51-05:13 S1 %%01MSTP/4/BPDU_PROTECTION(l)[4]:This edged-port
GigabitEthernet0/0/9 that enabled BPDU-Protection will be shutdown, because it
received BPDU packet!
Dec 21 2011 08:39:52-05:13 S1 %%01IFNET/4/IF_STATE(l)[5]:Interface
GigabitEthernet0/0/9 has turned into DOWN state.
```

After edge interface protection is configured, the edge interface receives BPDU packets once being enabled, and then this interface is disabled automatically.

Step 7 **Configure loop protection.**

Configure loop protection on the E0/0/23 interface of S3.

```
[S3]interface Ethernet0/0/23
[S3-Ethernet0/0/23]stp loop-protection
```

View STP information about the E0/0/23 interface of S3.

```
[S3]display stp interface Ethernet 0/0/23 brief
MSTID  Port                 Role  STP State   Protection
  0    Ethernet0/0/23       ROOT  FORWARDING    LOOP
  1    Ethernet0/0/23       ALTE  DISCARDING    LOOP
  2    Ethernet0/0/23       ALTE  DISCARDING    LOOP
```

Step 8 **Configure TC-BPDU protection.**

Enable the protection function for TC-BPDU packets.

```
[S1]stp tc-protection
```

Additional Exercises: Analyzing and Verifying

Figure out the impact if the MSTP region names are the same but the revision levels are different on switches.

In step 4, figure out the status changes of the interfaces of the four switches if the priority is changed to 0 for S3 in instance 1.

Final Configurations

```
<S1>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S1
#
 vlan batch 3 to 8
#
 stp bpdu-protection
 stp tc-protection
#
```

```
 stp region-configuration
  region-name RG1
  revision-level 1
  instance 1 vlan 3 to 5
  instance 2 vlan 6 to 8
  active region-configuration
#
interface GigabitEthernet0/0/9
 shutdown
stp edged-port enable
#
interface GigabitEthernet0/0/10
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
interface GigabitEthernet0/0/13
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
return
```

<S2>**display current-configuration**
```
#
!Software Version V100R006C00SPC800
 sysname S2
#
 vlan batch 3 to 8
#
 stp region-configuration
  region-name RG1
  revision-level 1
  instance 1 vlan 3 to 5
  instance 2 vlan 6 to 8
  active region-configuration
#
interface GigabitEthernet0/0/9
#
interface GigabitEthernet0/0/10
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
interface GigabitEthernet0/0/23
```

```
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
interface GigabitEthernet0/0/24
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
return

<S3>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S3
#
 vlan batch 3 to 8
#
 stp region-configuration
  region-name RG1
  revision-level 1
  instance 1 vlan 3 to 5
  instance 2 vlan 6 to 8
  active region-configuration
#
interface Ethernet0/0/1
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
interface Ethernet0/0/13
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
#
interface Ethernet0/0/23
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
 stp loop-protection
#
return

<S4>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S4
#
```

```
 vlan batch 3 to 8 30
#
 stp mode stp
 stp instance 0 priority 4096
#
interface Vlanif30
 ip address 100.100.100.8 255.255.255.0
#
interface Ethernet0/0/1
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
 stp root-protection
 undo ntdp enable
 undo ndp enable
#
interface Ethernet0/0/14
 shutdown
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface Ethernet0/0/23
 port link-type access
 port default vlan 30
 undo ntdp enable
 undo ndp enable
 bpdu disable
#
interface Ethernet0/0/24
 port link-type trunk
 port trunk allow-pass vlan 2 to 4094
 stp root-protection
 undo ntdp enable
 undo ndp enable
#
Return
```

Chapter 3 Implementing MPLS technologies

Lab 3-1 MPLS LDP Configuration

Learning Objectives

The objectives of this lab are to learn and understand:

- Methods used to enable and disable MPLS
- MPLS LDP Configuration
- Methods used to configure LSP sessions using MPLS LDP
- Methods used to modify the LDP LSP trigger policy on each LSR

Topology
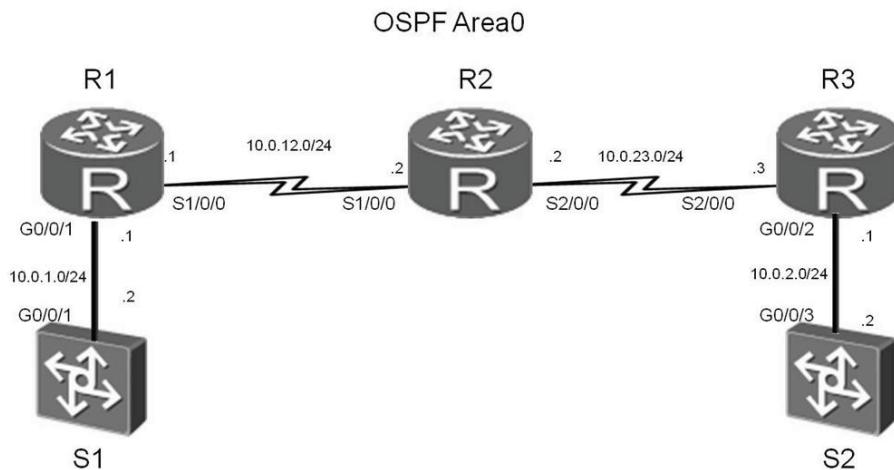

Figure 3-1 MPLS LDP topology

Scenario

Assume that you are a network administrator of an enterprise. Your enterprise uses an IP network with poor forwarding performance. You need to use MPLS to improve the forwarding rate of routers. Static LSPs are configured manually, while LDP is a protocol developed for label distribution. To perform flexible configuration, use LDP to set up MPLS LSPs.

Tasks

Step 1 **Configure IP addresses.**

Configure IP addresses and masks for all routers.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname S1
[S1]interface Vlanif 1
[S1-Vlanif1]ip address 10.0.1.2 24


<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.1.1 24
[R1-GigabitEthernet0/0/1]quit
[R1]interface s1/0/0
[R1-Serial1/0/0]ip address 10.0.12.1 24
[R1-Serial1/0/0]quit
[R1]interface loopback 0
[R1-LoopBack0]ip address 2.2.2.2 24


<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface s1/0/0
[R2-Serial1/0/0]ip address 10.0.12.2 24
[R2-Serial1/0/0]quit
[R2]interface s2/0/0
[R2-Serial2/0/0]ip address 10.0.23.2 24
[R2-Serial2/0/0]quit
[R2]interface loopback 0
[R2-LoopBack0]ip address 3.3.3.3 24


<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]ip address 10.0.2.1 24
```

```
[R3-GigabitEthernet0/0/2]quit
[R3]interface s2/0/0
[R3-Serial2/0/0]ip address 10.0.23.3 24
[R3-Serial2/0/0]quit
[R3]interface loopback 0
[R3-LoopBack0]ip address 4.4.4.4 24


<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname S2
[S2]interface Vlanif 1
[S2-Vlanif1]ip address 10.0.2.2 24
```

After the configurations are complete, test the connectivity of direct links.

Step 2 **Configure single-area OSPF.**

Configure network segments including 10.0.12.0/24, 10.0.23.0/24, 10.0.1.0/24, and 10.0.2.0/24 to belong to OSPF area 0.

```
[S1]ospf 1 router-id 1.1.1.1
[S1-ospf-1]area 0
[S1-ospf-1-area-0.0.0.0]network 10.0.1.0 0.0.0.255

[R1]ospf 1 router-id 2.2.2.2
[R1-ospf-1]area 0
[R1-ospf-1-area-0.0.0.0]network 10.0.1.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 2.2.2.0 0.0.0.255

[R2]ospf 1 router-id 3.3.3.3
[R2-ospf-1]area 0
[R2-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
[R2-ospf-1-area-0.0.0.0]network 10.0.23.0 0.0.0.255
[R2-ospf-1-area-0.0.0.0]network 3.3.3.0 0.0.0.255

[R3]ospf 1 router-id 4.4.4.4
[R3-ospf-1]area 0
[R3-ospf-1-area-0.0.0.0]net
[R3-ospf-1-area-0.0.0.0]network 10.0.23.0 0.0.0.255
[R3-ospf-1-area-0.0.0.0]network 10.0.2.0 0.0.0.255
[R3-ospf-1-area-0.0.0.0]network 4.4.4.0 0.0.0.255
```

```
[S2]ospf 1 router-id 5.5.5.5
[S2-ospf-1]area 0
[S2-ospf-1-area-0.0.0.0]network 10.0.2.0 0.0.0.255
```

After the configurations are complete, check routing tables and test the network connectivity.

```
[R2]ping 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=253 time=36 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=253 time=31 ms
    Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=253 time=31 ms
    Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=253 time=31 ms
    Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=253 time=31 ms

  --- 10.0.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 31/32/36 ms


[R2]ping 10.0.2.2
  PING 10.0.2.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.2.2: bytes=56 Sequence=1 ttl=253 time=38 ms
    Reply from 10.0.2.2: bytes=56 Sequence=2 ttl=253 time=33 ms
    Reply from 10.0.2.2: bytes=56 Sequence=3 ttl=253 time=33 ms
    Reply from 10.0.2.2: bytes=56 Sequence=4 ttl=253 time=33 ms
    Reply from 10.0.2.2: bytes=56 Sequence=5 ttl=253 time=33 ms

  --- 10.0.2.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 33/34/38 ms
```

Run the **display ip routing-table** command to view the OSPF routing tables of each router.

```
[R2]display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------
Routing Tables: Public
```

```
        Destinations : 14      Routes : 14

Destination/Mask    Proto   Pre  Cost     Flags NextHop        Interface

     10.0.1.0/24    OSPF    10   1563      D    10.0.12.1      Serial1/0/0
     10.0.2.0/24    OSPF    10   1563      D    10.0.23.3      Serial2/0/0
    10.0.12.0/24    Direct  0    0         D    10.0.12.2      Serial1/0/0
    10.0.12.1/32    Direct  0    0         D    10.0.12.1      Serial1/0/0
    10.0.12.2/32    Direct  0    0         D    127.0.0.1      InLoopBack0
  10.0.12.255/32    Direct  0    0         D    127.0.0.1      InLoopBack0
    10.0.23.0/24    Direct  0    0         D    10.0.23.2      Serial2/0/0
    10.0.23.2/32    Direct  0    0         D    127.0.0.1      InLoopBack0
    10.0.23.3/32    Direct  0    0         D    10.0.23.3      Serial2/0/0
  10.0.23.255/32    Direct  0    0         D    127.0.0.1      InLoopBack0
    127.0.0.0/8     Direct  0    0         D    127.0.0.1      InLoopBack0
    127.0.0.1/32    Direct  0    0         D    127.0.0.1      InLoopBack0
127.255.255.255/32  Direct  0    0         D    127.0.0.1      InLoopBack0
255.255.255.255/32  Direct  0    0         D    127.0.0.1      InLoopBack0
```

Step 3 Configure MPLS LDP.

Configure global MPLS and LDP on each LSR.

```
[R1]mpls lsr-id 2.2.2.2
[R1]mpls
Info: Mpls starting, please wait... OK!
[R1-mpls]mpls ldp

[R2]mpls lsr-id 3.3.3.3
[R2]mpls
Info: Mpls starting, please wait... OK!
[R2-mpls]mpls ldp

[R3]mpls lsr-id 4.4.4.4
[R3]mpls
Info: Mpls starting, please wait... OK!
[R3-mpls]mpls ldp
```

Configure MPLS and LDP on interfaces of each LSR.

```
[R1]interface Serial 1/0/0
[R1-Serial1/0/0]mpls
```

```
[R1-Serial1/0/0]mpls ldp

[R2]interface Serial 1/0/0
[R2-Serial1/0/0]mpls
[R2-Serial1/0/0]mpls ldp
[R2-Serial1/0/0]interface Serial 2/0/0
[R2-Serial2/0/0]mpls
[R2-Serial2/0/0]mpls ldp

[R3]interface Serial 2/0/0
[R3-Serial2/0/0]mpls
[R3-Serial2/0/0]mpls ldp
```

After the configurations are complete, run the **display mpls ldp session** command on R1, R2, and R3. The status of the local LDP session between R1, R2 and R3 is **Operational**.

```
[R1]display mpls ldp session
 LDP Session(s) in Public Network
 Codes: LAM(Label Advertisement Mode), SsnAge Unit(DDDD:HH:MM)
 A '*' before a session means the session is being deleted.
 ----------------------------------------------------------------------------
 PeerID          Status    LAM SsnRole SsnAge     KASent/Rcv
 ----------------------------------------------------------------------------
 3.3.3.3:0       Operational DU  Passive 0000:00:10  41/41
 ----------------------------------------------------------------------------
TOTAL: 1 session(s) Found.

[R2]display mpls ldp session
 LDP Session(s) in Public Network
 Codes: LAM(Label Advertisement Mode), SsnAge Unit(DDDD:HH:MM)
 A '*' before a session means the session is being deleted.
 ----------------------------------------------------------------------------
 PeerID          Status    LAM SsnRole SsnAge     KASent/Rcv
 ----------------------------------------------------------------------------
 2.2.2.2:0       Operational DU  Active  0000:00:11  46/46
 4.4.4.4:0       Operational DU  Passive 0000:00:10  43/43
 ----------------------------------------------------------------------------
 TOTAL: 2 session(s) Found.

[R3]display mpls ldp session
 LDP Session(s) in Public Network
```

```
Codes: LAM(Label Advertisement Mode), SsnAge Unit(DDDD:HH:MM)

A '*' before a session means the session is being deleted.

------------------------------------------------------------------------------

PeerID           Status     LAM SsnRole  SsnAge     KASent/Rcv

------------------------------------------------------------------------------

3.3.3.3:0        Operational DU  Active   0000:00:11  46/46

------------------------------------------------------------------------------

TOTAL: 1 session(s) Found.
```

Step 4 Set up LSPs using LDP.

All LSRs are triggered to establish LDP LSPs based on the host route, which is the default trigger policy.

Run the **display mpls ldp lsp** command on LSRs. All host routes are triggered to establish LDP LSPs.

```
[R1]display mpls ldp lsp
 LDP LSP Information
 ------------------------------------------------------------------------------
 DestAddress/Mask  In/OutLabel   UpstreamPeer   NextHop       OutInterface
 ------------------------------------------------------------------------------
 2.2.2.2/32        3/NULL        3.3.3.3        127.0.0.1     InLoop0
*2.2.2.2/32        Liberal/1024                 DS/3.3.3.3
 3.3.3.3/32        NULL/3        -              10.0.12.2     S1/0/0
 3.3.3.3/32        1024/3        3.3.3.3        10.0.12.2     S1/0/0
 4.4.4.4/32        NULL/1025     -              10.0.12.2     S1/0/0
 4.4.4.4/32        1025/1025     3.3.3.3        10.0.12.2     S1/0/0
 ------------------------------------------------------------------------------
 TOTAL: 5 Normal LSP(s) Found.
 TOTAL: 1 Liberal LSP(s) Found.
 TOTAL: 0 Frr LSP(s) Found.
 A '*' before an LSP means the LSP is not established
 A '*' before a Label means the USCB or DSCB is stale
 A '*' before a UpstreamPeer means the session is in GR state
 A '*' before a DS means the session is in GR state
 A '*' before a NextHop means the LSP is FRR LSP

[R2]display mpls ldp lsp
 LDP LSP Information
 ------------------------------------------------------------------------------
 DestAddress/Mask  In/OutLabel   UpstreamPeer   NextHop       OutInterface
```

```
  ------------------------------------------------------------------------
  2.2.2.2/32      NULL/3       -           10.0.12.1    S1/0/0
  2.2.2.2/32      1024/3       2.2.2.2     10.0.12.1    S1/0/0
  2.2.2.2/32      1024/3       4.4.4.4     10.0.12.1    S1/0/0
 *2.2.2.2/32      Liberal/1024             DS/4.4.4.4
  3.3.3.3/32      3/NULL       2.2.2.2     127.0.0.1    InLoop0
  3.3.3.3/32      3/NULL       4.4.4.4     127.0.0.1    InLoop0
 *3.3.3.3/32      Liberal/1024             DS/2.2.2.2
 *3.3.3.3/32      Liberal/1025             DS/4.4.4.4
  4.4.4.4/32      NULL/3       -           10.0.23.3    S2/0/0
  4.4.4.4/32      1025/3       2.2.2.2     10.0.23.3    S2/0/0
  4.4.4.4/32      1025/3       4.4.4.4     10.0.23.3    S2/0/0
 *4.4.4.4/32      Liberal/1025             DS/2.2.2.2
  ------------------------------------------------------------------------
  TOTAL: 8 Normal LSP(s) Found.
  TOTAL: 4 Liberal LSP(s) Found.
  TOTAL: 0 Frr LSP(s) Found.
  A '*' before an LSP means the LSP is not established
  A '*' before a Label means the USCB or DSCB is stale
  A '*' before a UpstreamPeer means the session is in GR state
  A '*' before a DS means the session is in GR state
  A '*' before a NextHop means the LSP is FRR LSP


[R3]display mpls ldp lsp
 LDP LSP Information
  ------------------------------------------------------------------------
  DestAddress/Mask  In/OutLabel  UpstreamPeer   NextHop      OutInterface
  ------------------------------------------------------------------------
  2.2.2.2/32      NULL/1024    -           10.0.23.2    S2/0/0
  2.2.2.2/32      1024/1024    3.3.3.3     10.0.23.2    S2/0/0
  3.3.3.3/32      NULL/3       -           10.0.23.2    S2/0/0
  3.3.3.3/32      1025/3       3.3.3.3     10.0.23.2    S2/0/0
  4.4.4.4/32      3/NULL       3.3.3.3     127.0.0.1    InLoop0
 *4.4.4.4/32      Liberal/1025             DS/3.3.3.3
  ------------------------------------------------------------------------
  TOTAL: 5 Normal LSP(s) Found.
  TOTAL: 1 Liberal LSP(s) Found.
  TOTAL: 0 Frr LSP(s) Found.
  A '*' before an LSP means the LSP is not established
  A '*' before a Label means the USCB or DSCB is stale
  A '*' before a UpstreamPeer means the session is in GR state
```

```
A '*' before a DS means the session is in GR state
A '*' before a NextHop means the LSP is FRR LSP
```

In most cases, the default trigger policy is used. The establishment of an LDP LSP is triggered in Host mode.

Change the trigger policy to All on LSRs so that all static routes and IGP entries can trigger the establishment of the LDP LSPs.

```
[R1]mpls
[R1-mpls]lsp-trigger all

[R2]mpls
[R2-mpls]lsp-trigger all

[R3]mpls
[R3-mpls]lsp-trigger all
```

Run the **display mpls ldp lsp** command. Information about the established LDP LSPs is displayed.

```
[R1]display mpls ldp lsp
 LDP LSP Information
 -------------------------------------------------------------------------
 DestAddress/Mask  In/OutLabel   UpstreamPeer   NextHop       OutInterface
 -------------------------------------------------------------------------
 2.2.2.0/24        3/NULL        3.3.3.3        2.2.2.2       Loop0
 2.2.2.2/32        3/NULL        3.3.3.3        127.0.0.1     InLoop0
*2.2.2.2/32        Liberal/1024                 DS/3.3.3.3
*3.3.3.0/24        Liberal/3                    DS/3.3.3.3
 3.3.3.3/32        NULL/3        -              10.0.12.2     S1/0/0
 3.3.3.3/32        1024/3        3.3.3.3        10.0.12.2     S1/0/0
 4.4.4.4/32        NULL/1025     -              10.0.12.2     S1/0/0
 4.4.4.4/32        1025/1025     3.3.3.3        10.0.12.2     S1/0/0
 10.0.1.0/24       3/NULL        3.3.3.3        10.0.1.1      GE0/0/1
*10.0.1.0/24       Liberal/1026                 DS/3.3.3.3
 10.0.2.0/24       NULL/1027     -              10.0.12.2     S1/0/0
 10.0.2.0/24       1027/1027     3.3.3.3        10.0.12.2     S1/0/0
 10.0.12.0/24      3/NULL        3.3.3.3        10.0.12.1     S1/0/0
*10.0.12.0/24      Liberal/3                    DS/3.3.3.3
 10.0.23.0/24      NULL/3        -              10.0.12.2     S1/0/0
 10.0.23.0/24      1026/3        3.3.3.3        10.0.12.2     S1/0/0
 -------------------------------------------------------------------------
 TOTAL: 12 Normal LSP(s) Found.
```

```
 TOTAL: 4 Liberal LSP(s) Found.
 TOTAL: 0 Frr LSP(s) Found.
 A '*' before an LSP means the LSP is not established
 A '*' before a Label means the USCB or DSCB is stale
 A '*' before a UpstreamPeer means the session is in GR state
 A '*' before a DS means the session is in GR state
 A '*' before a NextHop means the LSP is FRR LSP


[R2]display mpls ldp lsp
 LDP LSP Information
 -------------------------------------------------------------------------
 DestAddress/Mask  In/OutLabel   UpstreamPeer   NextHop      OutInterface
 -------------------------------------------------------------------------
 *2.2.2.0/24       Liberal/3                    DS/2.2.2.2
  2.2.2.2/32       NULL/3        -              10.0.12.1    S1/0/0
  2.2.2.2/32       1024/3        2.2.2.2        10.0.12.1    S1/0/0
  2.2.2.2/32       1024/3        4.4.4.4        10.0.12.1    S1/0/0
 *2.2.2.2/32       Liberal/1024                 DS/4.4.4.4
  3.3.3.0/24       3/NULL        2.2.2.2        3.3.3.3      Loop0
  3.3.3.0/24       3/NULL        4.4.4.4        3.3.3.3      Loop0
  3.3.3.3/32       3/NULL        2.2.2.2        127.0.0.1    InLoop0
  3.3.3.3/32       3/NULL        4.4.4.4        127.0.0.1    InLoop0
 *3.3.3.3/32       Liberal/1024                 DS/2.2.2.2
 *3.3.3.3/32       Liberal/1025                 DS/4.4.4.4
 *4.4.4.0/24       Liberal/3                    DS/4.4.4.4
  4.4.4.4/32       NULL/3        -              10.0.23.3    S2/0/0
  4.4.4.4/32       1025/3        2.2.2.2        10.0.23.3    S2/0/0
  4.4.4.4/32       1025/3        4.4.4.4        10.0.23.3    S2/0/0
 *4.4.4.4/32       Liberal/1025                 DS/2.2.2.2
  10.0.1.0/24      NULL/3        -              10.0.12.1    S1/0/0
  10.0.1.0/24      1026/3        2.2.2.2        10.0.12.1    S1/0/0
  10.0.1.0/24      1026/3        4.4.4.4        10.0.12.1    S1/0/0
 *10.0.1.0/24      Liberal/1026                 DS/4.4.4.4
  10.0.2.0/24      NULL/3        -              10.0.23.3    S2/0/0
  10.0.2.0/24      1027/3        2.2.2.2        10.0.23.3    S2/0/0
  10.0.2.0/24      1027/3        4.4.4.4        10.0.23.3    S2/0/0
 *10.0.2.0/24      Liberal/1027                 DS/2.2.2.2
  10.0.12.0/24     3/NULL        2.2.2.2        10.0.12.2    S1/0/0
  10.0.12.0/24     3/NULL        4.4.4.4        10.0.12.2    S1/0/0
 *10.0.12.0/24     Liberal/3                    DS/2.2.2.2
 *10.0.12.0/24     Liberal/1027                 DS/4.4.4.4
  10.0.23.0/24     3/NULL        2.2.2.2        10.0.23.2    S2/0/0
```

```
 10.0.23.0/24      3/NULL         4.4.4.4         10.0.23.2      S2/0/0
*10.0.23.0/24      Liberal/1026                   DS/2.2.2.2
*10.0.23.0/24      Liberal/3                      DS/4.4.4.4
 ----------------------------------------------------------------------------
 TOTAL: 20 Normal LSP(s) Found.
 TOTAL: 12 Liberal LSP(s) Found.
 TOTAL: 0 Frr LSP(s) Found.
 A '*' before an LSP means the LSP is not established
 A '*' before a Label means the USCB or DSCB is stale
 A '*' before a UpstreamPeer means the session is in GR state
 A '*' before a DS means the session is in GR state
 A '*' before a NextHop means the LSP is FRR LSP

[R3]display mpls ldp lsp
 LDP LSP Information
 ----------------------------------------------------------------------------
 DestAddress/Mask  In/OutLabel   UpstreamPeer   NextHop        OutInterface
 ----------------------------------------------------------------------------
 2.2.2.2/32        NULL/1024     -              10.0.23.2      S2/0/0
 2.2.2.2/32        1024/1024     3.3.3.3        10.0.23.2      S2/0/0
*3.3.3.0/24        Liberal/3                    DS/3.3.3.3
 3.3.3.3/32        NULL/3        -              10.0.23.2      S2/0/0
 3.3.3.3/32        1025/3        3.3.3.3        10.0.23.2      S2/0/0
 4.4.4.0/24        3/NULL        3.3.3.3        4.4.4.4        Loop0
 4.4.4.4/32        3/NULL        3.3.3.3        127.0.0.1      InLoop0
*4.4.4.4/32        Liberal/1025                 DS/3.3.3.3
 10.0.1.0/24       NULL/1026     -              10.0.23.2      S2/0/0
 10.0.1.0/24       1026/1026     3.3.3.3        10.0.23.2      S2/0/0
 10.0.2.0/24       3/NULL        3.3.3.3        10.0.2.1       GE0/0/2
*10.0.2.0/24       Liberal/1027                 DS/3.3.3.3
 10.0.12.0/24      NULL/3        -              10.0.23.2      S2/0/0
 10.0.12.0/24      1027/3        3.3.3.3        10.0.23.2      S2/0/0
 10.0.23.0/24      3/NULL        3.3.3.3        10.0.23.3      S2/0/0
*10.0.23.0/24      Liberal/3                    DS/3.3.3.3
 ----------------------------------------------------------------------------
 TOTAL: 12 Normal LSP(s) Found.
 TOTAL: 4 Liberal LSP(s) Found.
 TOTAL: 0 Frr LSP(s) Found.
 A '*' before an LSP means the LSP is not established
 A '*' before a Label means the USCB or DSCB is stale
 A '*' before a UpstreamPeer means the session is in GR state
 A '*' before a DS means the session is in GR state
 A '*' before a NextHop means the LSP is FRR LSP
```

Step 5 **Configure an inbound LDP policy.**

If labels received on R1 are not controlled, R1 will establish a large number of LSPs, consuming large memory.

After an inbound LDP policy is configured, R1 receives label mapping messages only from R2 and establishes LSPs to R2, saving resources.

Run the **display mpls lsp** command on R1. Information about established LSPs is displayed.

```
[R1]display mpls lsp
-------------------------------------------------------------------------
            LSP Information: LDP LSP
-------------------------------------------------------------------------
FEC             In/Out Label  In/Out IF                  Vrf Name
3.3.3.3/32        NULL/3       -/S1/0/0
3.3.3.3/32        1024/3       -/S1/0/0
2.2.2.2/32        3/NULL       -/-
4.4.4.4/32        NULL/1025    -/S1/0/0
4.4.4.4/32        1025/1025    -/S1/0/0
10.0.12.0/24      3/NULL       -/-
10.0.1.0/24       3/NULL       -/-
2.2.2.0/24        3/NULL       -/-
10.0.23.0/24      NULL/3       -/S1/0/0
10.0.23.0/24      1026/3       -/S1/0/0
10.0.2.0/24       NULL/1027    -/S1/0/0
10.0.2.0/24       1027/1027    -/S1/0/0
```

LSPs on R1 to R2 and R3 are displayed. If the inbound policy is configured on R1, only routes to R2 are allowed.

```
[R1]ip ip-prefix prefix1 permit 10.0.12.0 24
[R1]mpls ldp
[R1-mpls-ldp]inbound peer 3.3.3.3 fec ip-prefix prefix1
[R1-mpls-ldp]quit
[R1]display mpls lsp
-------------------------------------------------------------------------
            LSP Information: LDP LSP
-------------------------------------------------------------------------
FEC             In/Out Label  In/Out IF                  Vrf Name
```

```
2.2.2.2/32        3/NULL       -/-
10.0.12.0/24      3/NULL        -/-
10.0.1.0/24       3/NULL        -/-
2.2.2.0/24        3/NULL        -/-
```

Additional Exercises: Analyzing and Verifying

In which way can only R1 receive label mapping messages from R3?

Final Configurations

```
<R1>display current-configuration
[V200R001C00SPC200]
#
 sysname R1
#
mpls lsr-id 2.2.2.2
 mpls
  lsp-trigger all
#
mpls ldp
 inbound peer 3.3.3.3 fec ip-prefix prefix1
#
interface Serial1/0/0
 link-protocol ppp
 ip address 10.0.12.1 255.255.255.0
 mpls
 mpls ldp
#
interface GigabitEthernet0/0/1
 ip address 10.0.1.1 255.255.255.0
#
interface LoopBack0
 ip address 2.2.2.2 255.255.255.0
#
ospf 1 router-id 2.2.2.2
 area 0.0.0.0
  network 10.0.1.0 0.0.0.255
  network 10.0.12.0 0.0.0.255
  network 2.2.2.0 0.0.0.255
#
```

```
 ip ip-prefix prefix1 index 10 permit 10.0.12.0 24
#
return
```

[R2]**display current-configuration**
```
[V200R001C00SPC200]
#
 sysname R2
#
mpls lsr-id 3.3.3.3
 mpls
  lsp-trigger all
#
mpls ldp
#
interface Serial1/0/0
 link-protocol ppp
 ip address 10.0.12.2 255.255.255.0
 mpls
 mpls ldp
#
interface Serial2/0/0
 link-protocol ppp
 ip address 10.0.23.2 255.255.255.0
 mpls
 mpls ldp
#
interface LoopBack0
 ip address 3.3.3.3 255.255.255.0
#
ospf 1 router-id 3.3.3.3
 area 0.0.0.0
  network 10.0.12.0 0.0.0.255
  network 10.0.23.0 0.0.0.255
  network 3.3.3.0 0.0.0.255
#
return
```

[R3]**display current-configuration**
```
[V200R001C00SPC200]
#
 sysname R3
```

```
#
mpls lsr-id 4.4.4.4
 mpls
  lsp-trigger all
#
mpls ldp
#
interface Serial2/0/0
 link-protocol ppp
 ip address 10.0.23.3 255.255.255.0
 mpls
 mpls ldp
#
interface GigabitEthernet0/0/2
 ip address 10.0.2.1 255.255.255.0
#
interface LoopBack0
 ip address 4.4.4.4 255.255.255.0
#
ospf 1 router-id 4.4.4.4
 area 0.0.0.0
  network 10.0.2.0 0.0.0.255
  network 10.0.23.0 0.0.0.255
  network 4.4.4.0 0.0.0.255
#
Return
```