2.2 Lab 2: Spanning Tree

2.2.1 Introduction

2.2.1.1 About This Lab

On a switched Ethernet network, redundant links are used to implement link backup and enhance network availability. However, redundant links may produce loops, leading to broadcast storms and an unstable MAC address table, deteriorating or even interrupting communications. To prevent loops, IEEE introduced the Spanning Tree Protocol (STP).

STP defined in IEEE 802.1D has evolved to the Rapid Spanning Tree Protocol (RSTP) defined in IEEE 802.1W, and the Multiple Spanning Tree Protocol (MSTP) defined in IEEE 802.1S.

In this lab activity, you will learn the basic STP configuration and understand its principles and some features of RSTP.

2.2.1.2 Objectives

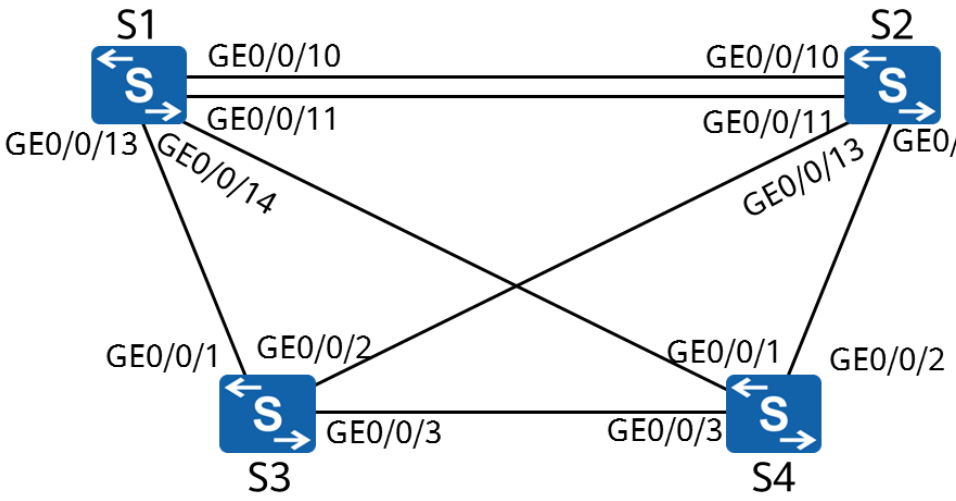
Upon completion of this task, you will be able to:

- Learn how to enable and disable STP/RSTP
- Learn how to change the STP mode of a switch
- Learn how to change bridge priorities to control the root bridge election
- Learn how to change port priorities to control the election of the root port and designated port
- Learn how to change port costs to control the election of the root port and designated port
- Learn how to configure edge ports
- Learn how to enable and disable RSTP

2.2.1.3 Networking Topology

A company need to deploy redundant links on its Layer 2 switched network to improve network availability. In the meantime, the company also needs to deploy STP to prevent redundant links from forming loops and causing broadcast storms and MAC address flapping.

Figure 2-1 Lab topology for configuring STP



2.2.2 Lab Configuration

2.2.2.1 Configuration Roadmap

1. Enable STP.
2. Change bridge priorities to control the root bridge election.
3. Modify port parameters to determine the port role.
4. Change the protocol to RSTP.
5. Configure edge ports.

2.2.2.2 Configuration Procedure

Step 1 # Shut down unnecessary ports. This step applies only to the environment described in *HCIA-Datacom Lab Construction Guide V1.0*.

Shut down GigabitEthernet0/0/12 between S1 and S2.

```
[S1]interface GigabitEthernet 0/0/12
[S1-GigabitEthernet0/0/12]shutdown
```

```
[S2]interface GigabitEthernet 0/0/12
[S2-GigabitEthernet0/0/12]shutdown
```

Step 2 Enable STP.

Enable STP globally.

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

The **stp enable** command enables STP, RSTP, or MSTP on a switching device or a port. By default, STP, RSTP, or MSTP is enabled on switches.

Change the spanning tree mode to STP.

```
[S1]stp mode stp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

The **stp mode**{**mstp** | **rstp** | **stp**} command sets the operation mode of the spanning tree protocol on a switching device. By default, the switching device operates in MSTP mode. The spanning tree mode of the current device has been changed to STP.

```
[S2]stp mode stp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

```
[S3]stp mode stp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

```
[S4]stp mode stp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

Display the spanning tree status. S1 is used as an example.

```
[S1]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge             :32768.4c1f-cc33-7359              //Bridge ID of the device.
Config Times            :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
Active Times            :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC          :32768.4c1f-cc10-5913 / 20000      //ID and path cost of the current root bridge.
CIST RegRoot/IRPC    :32768.4c1f-cc33-7359 / 0
CIST RootPortId         :128.14
BPDU-Protection         :Disabled
TC or TCN received      :47
TC count per hello      :0
STP Converge Mode       :Normal
Time since last TC      :0 days 0h:0m:38s
Number of TC            :15
Last TC occurred        :GigabitEthernet0/0/14
```

The displayed information also includes port status information, which is not included in the preceding output.

Display the brief spanning tree information on each switch.

```
[S1]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/10      DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/11      DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/13      DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/14      ROOT  FORWARDING    NONE
```

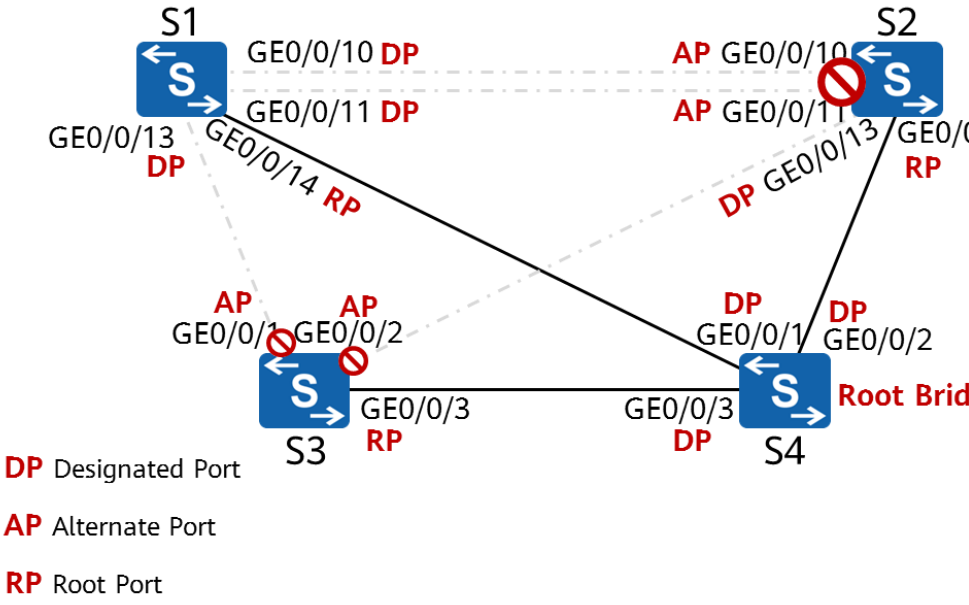
```
[S2]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/10      ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/11      ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/13      DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/14      ROOT  FORWARDING    NONE
```

```
[S3]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/1       ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/2       ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/3       ROOT  FORWARDING    NONE
```

```
[S4]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/1       DESI  FORWARDING    NONE
```

```
0    GigabitEthernet0/0/2          DESI  FORWARDING        NONE
0    GigabitEthernet0/0/3          DESI  FORWARDING        NONE
```

Based on the root bridge ID and port information on each switch, the current topology is as follows:



The dotted line indicates that the link does not forward service data.

NOTE

This topology is for reference only and may not be the same as the actual spanning tree topology in the lab environment.

Step 3 Modify device parameters to make S1 the root bridge and S2 the secondary root bridge.

Change the bridge priorities of S1 and S2.

```
[S1]stp root primary
```

Owning to the importance of the root bridge, the switch with high performance and network hierarchy is generally chosen as a root bridge. The priority of such a device, however, may be not that high. Therefore, setting a high priority for the switch is necessary so that the switch can be elected as the root bridge. The **stp root** command configures the switch as a root bridge or secondary root bridge of a spanning tree.

- The **stp root primary** command specifies a switch as the root switching device. In this case, the priority value of the switch is 0 in the spanning tree and the priority cannot be changed.
- The **stp root secondary** command specifies a switch as the secondary root bridge. In this case, the priority value of the switch is 4096 and the priority cannot be changed.

```
[S2]stp root secondary
```

Display the STP status on S1.

```
[S1]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge                :0    .4c1f-cc33-7359          //Bridge ID of the device.
Config Times               :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
```

```
Active Times                    :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC                  :0    .4c1f-cc33-7359 / 0        //ID and path cost of the current root bridge
CIST RegRoot/IRPC               :0    .4c1f-cc33-7359 / 0
CIST RootPortId                 :0.0
BPDU-Protection                 :Disabled
CIST Root Type                  :Primary root
TC or TCN received              :84
TC count per hello              :0
STP Converge Mode               :Normal
Time since last TC              :0 days 0h:1m:44s
Number of TC                    :21
Last TC occurred                :GigabitEthernet0/0/10
```

In this case, the bridge ID of S1 is the same as the root bridge ID, and the root path cost is 0, indicating that S1 is the root bridge of the current network.

Display the brief STP status information on all devices.

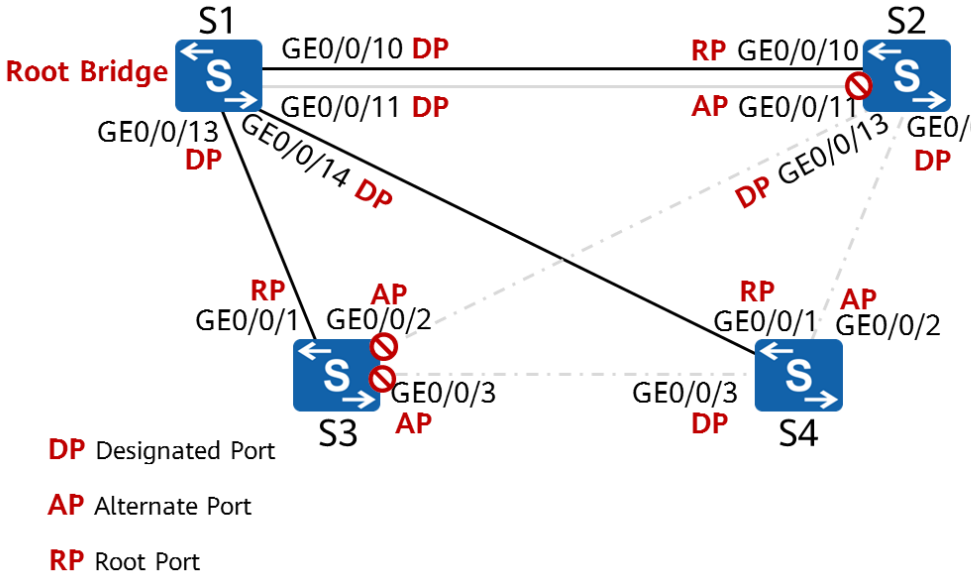
```
[S1]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/10       DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/11       DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/13       DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/14       DESI  FORWARDING    NONE
```

```
[S2]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/10       ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/11       ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/13       DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/14       DESI  FORWARDING    NONE
```

```
[S3]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/1        ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/2        ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/3        ALTE  DISCARDING    NONE
```

```
[S4]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/1        ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/2        ALTE  DISCARDING    NONE
   0    GigabitEthernet0/0/3        DESI  FORWARDING    NONE
```

Based on the root bridge ID and port information on each switch, the current topology is as follows:



Step 4 Modify device parameters to make GigabitEthernet0/0/2 of S4 the root port.

Display the STP information on S4.

```
[S4]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge                :32768.4c1f-cc10-5913
Config Times               :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
Active Times               :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC             :0    .4c1f-cc33-7359 / 20000
CIST RegRoot/IRPC          :32768.4c1f-cc10-5913 / 0
CIST RootPortId            :128.1
BPDU-Protection            :Disabled
TC or TCN received         :93
TC count per hello         :0
STP Converge Mode          :Normal
Time since last TC         :0 days 0h:9m:5s
Number of TC               :18
Last TC occurred           :GigabitEthernet0/0/1
```

The cost of the root path from S4 to S1 is 20000.

Change the STP cost of GigabitEthernet 0/0/1 on S4 to 50000.

```
[S4]interface GigabitEthernet 0/0/1
[S4-GigabitEthernet0/0/1]stp cost 50000
```

Display the brief STP status information.

```
[S4]display stp brief
 MSTID  Port                    Role      STP State       Protection
   0    GigabitEthernet0/0/1              ALTE      DISCARDING      NONE
   0    GigabitEthernet0/0/2              ROOT      FORWARDING      NONE
   0    GigabitEthernet0/0/3              ALTE      DISCARDING      NONE
```

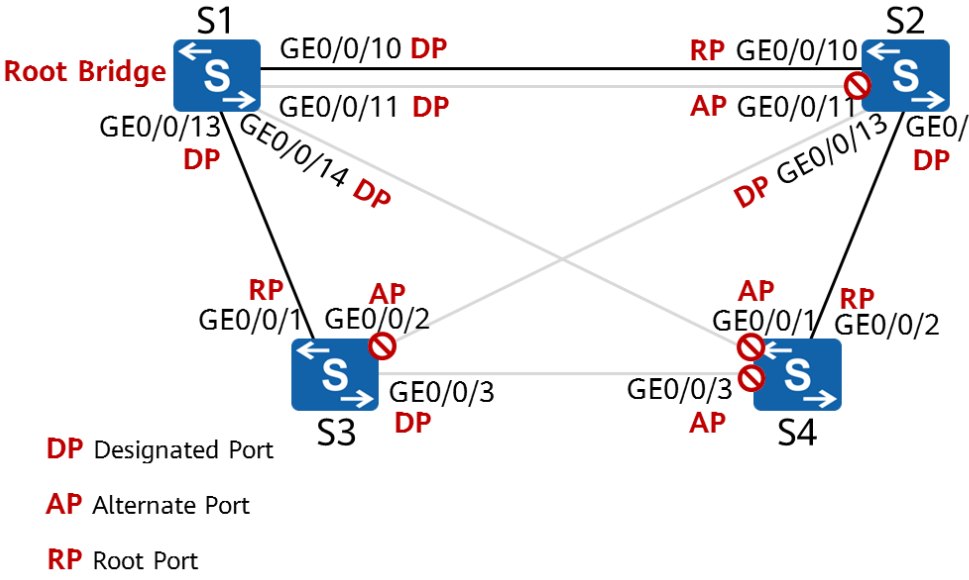
GigabitEthernet0/0/2 on S4 has become the root port.

Display the current STP status information.

```
[S4]display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge                :32768.4c1f-cc10-5913
Config Times               :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
Active Times               :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC             :0    .4c1f-cc33-7359 / 40000    //Root path cost = 20000 + 20000 = 40000
CIST RegRoot/IRPC          :32768.4c1f-cc10-5913 / 0
```

```
CIST RootPortId             :128.2
BPDU-Protection             :Disabled
TC or TCN received          :146
TC count per hello          :0
STP Converge Mode           :Normal
Time since last TC          :0 days 0h:2m:25s
Number of TC                :20
Last TC occurred            :GigabitEthernet0/0/2
```

The current topology is as follows:



Step 5 Change the spanning tree mode to RSTP.

Change the spanning tree mode on all devices.

```
[S1]stp mode rstp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

```
[S2]stp mode rstp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

```
[S3]stp mode rstp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

```
[S4]stp mode rstp
Info: This operation may take a few seconds. Please wait for a moment...done.
```

Display the spanning tree status. S1 is used as an example.

```
[S1]display stp
-------[CIST Global Info][Mode RSTP]-------
CIST Bridge                 :0    .4c1f-cc33-7359
Config Times                :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
Active Times                :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC              :0    .4c1f-cc33-7359 / 0
CIST RegRoot/IRPC           :0    .4c1f-cc33-7359 / 0
CIST RootPortId             :0.0
BPDU-Protection             :Disabled
```

```
CIST Root Type          :Primary root
TC or TCN received      :89
TC count per hello      :0
STP Converge Mode       :Normal
Time since last TC      :0 days 0h:0m:44s
Number of TC            :27
Last TC occurred        :GigabitEthernet0/0/11
```

After the mode is changed, the topology of the spanning tree is not affected.

Step 6 Configure edge ports.

GigabitEthernet 0/0/10-0/0/24 of S3 are connected only to terminals and need to be configured as edge ports.

```
[S3]interface range GigabitEthernet 0/0/10 to GigabitEthernet 0/0/24
```

A device provides multiple Ethernet ports, many of which have the same configuration. Configuring them one by one is tedious and error-prone. An easy way is to add such ports to a port group and configure the group. The system will automatically execute the commands on all ports in the group.

NOTE

This function may not be available on some products.

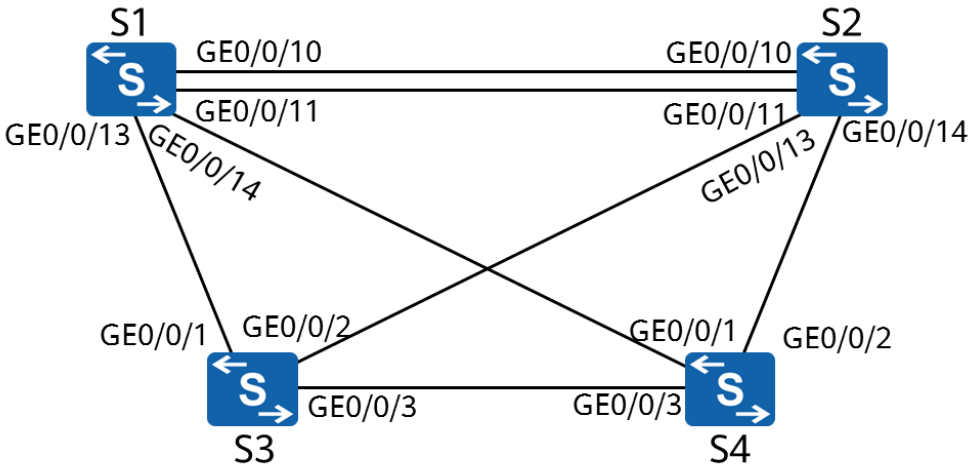
```
[S3-port-group]stp edged-port enable
```

The **stp edged-port enable** command sets the current port as an edge port. If a port of a switching device receives a BPDU after being configured as an edge port, the switching device will automatically set the port as a non-edge port and recalculate the spanning tree.

----End

2.2.3 Verification

1. Mark the root bridge and the role of each port in the lab environment based on the actual network convergence.



2. Disable any port on any switch and check whether the traffic can reach all other switches through the backup links.

2.2.4 Configuration Reference

Configuration on S1

```
#
sysname S1
#
stp mode rstp
stp instance 0 root primary
#
interface GigabitEthernet0/0/12
 shutdown
#
return
```

Configuration on S2

```
#
sysname S2
#
stp mode rstp
stp instance 0 root secondary
#
interface GigabitEthernet0/0/12
 shutdown
#
return
```

Configuration on S3

```
#
sysname S3
#
stp mode rstp
#
interface GigabitEthernet0/0/10
 stp edged-port enable
#
interface GigabitEthernet0/0/11
 stp edged-port enable
#
interface GigabitEthernet0/0/12
 stp edged-port enable
#
interface GigabitEthernet0/0/13
 stp edged-port enable
#
interface GigabitEthernet0/0/14
 stp edged-port enable
#
interface GigabitEthernet0/0/15
 stp edged-port enable
#
interface GigabitEthernet0/0/16
 stp edged-port enable
#
interface GigabitEthernet0/0/17
 stp edged-port enable
#
interface GigabitEthernet0/0/18
 stp edged-port enable
#
interface GigabitEthernet0/0/19
 stp edged-port enable
#
interface GigabitEthernet0/0/20
 stp edged-port enable
#
interface GigabitEthernet0/0/21
 stp edged-port enable
#
```

```
interface GigabitEthernet0/0/22
 stp edged-port enable
#
interface GigabitEthernet0/0/23
 stp edged-port enable
#
interface GigabitEthernet0/0/24
 stp edged-port enable
#
return
```

Configuration on S4

```
#
sysname S4
#
stp mode rstp
#
interface GigabitEthernet0/0/1
 stp instance 0 cost 5000
#
return
```

2.2.5 Quiz

1. In step 3, if the cost of GigabitEthernet 0/0/14 on S1 is changed to 50000, can the desired result be achieved? Why?
2. In the current topology, modify the configuration to make GigabitEthernet0/0/11 of S2 the root port.
3. Can the two links between S1 and S2 be in the forwarding state at the same time? Why?