第三章 STP和RSTP

实验 3-1 配置 STP

学习目标

- 掌握启用和禁用STP的方法

- 掌握修改交换机STP模式的方法

- 掌握修改桥优先级，控制根桥选举的方法

- 掌握修改端口优先级，控制根端口和指定端口选举的方法

- 掌握修改端口开销，控制根端口和指定端口选举的方法

- 掌握边缘端口的配置方法

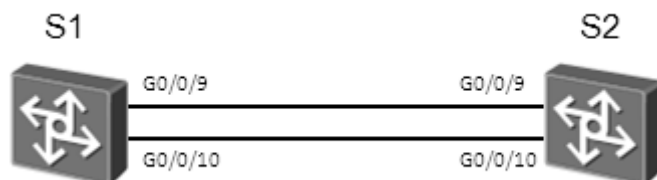## 拓扑图

图3.1 配置STP实验拓扑图

场景

您是公司的网络管理员,为了避免网络中的环路问题,需要在网络中的交换机上配置STP。本实验中，您还需要通过修改桥优先级来控制STP的根桥选举,并通过配置STP的一些特性来加快STP的收敛速度。

操作步骤

.步骤一 配置 STP 并验证

为了保证实验结果的准确性，必须先关闭无关的端口。

配置STP之前，先关闭S3上的E0/0/1、E0/0/13、E0/0/23端口，S4上的E0/0/14和E0/0/24端口。确保设备以空配置启动。如果STP被禁用，则执行stp enable命令启用STP。

```
<Quidway>system-view

[Quidway]sysname S3

[S3]interface Ethernet 0/0/1

[S3-Ethernet0/0/1]shutdown

[S3-Ethernet0/0/1]quit

[S3]interface Ethernet 0/0/13

[S3-Ethernet0/0/13]shutdown

[S3-Ethernet0/0/13]quit

[S3]interface Ethernet 0/0/23

[S3-Ethernet0/0/23]shutdown


<Quidway>system-view

[Quidway]sysname S4

[S4]inter Ethernet 0/0/14

[S4-Ethernet0/0/14]shutdown

[S4-Ethernet0/0/14]quit

[S4]interface Ethernet 0/0/24

[S4-Ethernet0/0/24]shutdown
```

本实验中，S1和S2之间有两条链路。在S1和S2上启用STP，并把S1配置为根桥。

```
<Quidway>system-view

Enter system view, return user view with Ctrl+Z.

[Quidway]sysname S1

[S1]stp mode stp

[S1]stp root primary


<Quidway>system-view

Enter system view, return user view with Ctrl+Z.
```

```
[Quidway]sysname S2

[S2]stp mode stp

[S2]stp root secondary
```

> 用交换机构建三层路由网络时，互联接口的STP要关闭，因为交换机的STP默认为开启状态，并且STP运算是以物理环路为主。

执行**display stp brief**命令查看STP信息。

```
<S1>display stp brief

    MSTID Port                    Role    STP State   Protection

      0       GigabitEthernet0/0/9    DESI    FORWARDING  NONE

      0       GigabitEthernet0/0/10   DESI    FORWARDING  NONE


<S2>display stp brief

    MSTID Port                    Role    STP State   Protection

      0       GigabitEthernet0/0/9    ROOT    FORWARDING  NONE

      0       GigabitEthernet0/0/10   ALTE    DISCARDING  NONE
```

执行**display stp interface**命令查看端口的STP状态。

```
<S1>display stp interface GigabitEthernet 0/0/10

----[CIST][Port10(GigabitEthernet0/0/10)][FORWARDING]----

 Port Protocol      :Enabled

 Port Role          :Designated Port

 Port Priority      :128

 Port Cost(Dot1T )  :Config=auto / Active=20000

 Designated Bridge/Port   :0.4c1f-cc45-aace / 128.10

 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

 BPDU Encapsulation :Config=stp / Active=stp

 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 20

 TC or TCN send     :17

 TC or TCN received :33

 BPDU Sent          :221

        TCN: 0, Config: 221, RST: 0, MST: 0

 BPDU Received      :68

        TCN: 0, Config: 68, RST: 0, MST: 0
```

```
<S2>display stp interface GigabitEthernet 0/0/10

----[CIST][Port10(GigabitEthernet0/0/10)][DISCARDING]----

 Port Protocol       :Enabled

 Port Role           :Alternate Port

 Port Priority       :128

 Port Cost(Dot1T )   :Config=auto / Active=20000

 Designated Bridge/Port   :0.4c1f-cc45-aace / 128.10

 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

 BPDU Encapsulation  :Config=stp / Active=stp

 PortTimes           :Hello 2s MaxAge 20s FwDly 15s RemHop 0

 TC or TCN send      :17

 TC or TCN received  :17

 BPDU Sent           :35

       TCN: 0, Config: 35, RST: 0, MST: 0

 BPDU Received       :158

       TCN: 0, Config: 158, RST: 0, MST: 0
```

.步骤二　控制根桥选举

　　执行**display stp**命令查看根桥信息。根桥设备的CIST Bridge与CIST Root/ERPC字段取值相同。

```
<S1>display  stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge          :0    .4c1f-cc45-aace

Bridge Times         :Hello 2s MaxAge 20s FwDly 15s MaxHop 20

CIST Root/ERPC       :0    .4c1f-cc45-aace / 0

CIST RegRoot/IRPC    :0    .4c1f-cc45-aace / 0

CIST RootPortId      :0.0

BPDU-Protection      :Disabled

CIST Root Type       :Primary root

TC or TCN received   :108

TC count per hello   :0
```

CIST

公共和内部生成树CIST是通过STP或RSTP协议计算生成的，连接一个交换网络内所有交换设备的单生成树。如上图6所示，所有MST域的IST加上CST就构成一棵完整的生成树，即CIST。

```
STP Converge Mode   :Normal

Share region-configuration :Enabled

Time since last TC :0 days 0h:9m:23s

……output omit……


<S2>display stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge        :4096 .4c1f-cc45-aacc

Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20

CIST Root/ERPC     :0    .4c1f-cc45-aace / 20000

CIST RegRoot/IRPC  :4096 .4c1f-cc45-aacc / 0

CIST RootPortId    :128.9

BPDU-Protection    :Disabled

CIST Root Type     :Secondary root

TC or TCN received :55

TC count per hello :0

STP Converge Mode  :Normal

Share region-configuration :Enabled

Time since last TC :0 days 0h:9m:30s

……output omit……
```

通过配置优先级，使S2为根桥，S1为备份根桥。桥优先级取值越小，则优先级越高。把S1和S2的优先级分别设置为8192和4096。

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


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

执行**display stp**命令查看新的根桥信息。

```
<S1>display stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge        :8192 .4c1f-cc45-aace

Bridge Times       :Hello 2s MaxAge 20s FwDly 15s 0

CIST Root/ERPC     :4096 .4c1f-cc45-aacc / 20000

CIST RegRoot/IRPC  :8192 .4c1f-cc45-aace / 0

CIST RootPortId    :128.9

BPDU-Protection    :Disabled
```

```
TC or TCN received :143

TC count per hello  :0

STP Converge Mode   :Normal

Share region-configuration :Enabled

Time since last TC  :0 days 0h:0m:27s

……output omit……


<S2>display  stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge        :4096 .4c1f-cc45-aacc

Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20

CIST Root/ERPC     :4096 .4c1f-cc45-aacc / 0

CIST RegRoot/IRPC  :4096 .4c1f-cc45-aacc / 0

CIST RootPortId    :0.0

BPDU-Protection    :Disabled

TC or TCN received :55

TC count per hello  :0

STP Converge Mode   :Normal

Share region-configuration :Enabled

Time since last TC  :0 days 0h:14m:7s

……output omit……
```

由上述回显信息中的灰色部分可以看出，S2已经变成新的根桥。

关闭S2的G0/0/9和G0/0/10端口，从而隔离S1与S2，模拟S2发生故障。

```
[S2]interface GigabitEthernet 0/0/9

[S2-GigabitEthernet0/0/9]shutdown

[S2-GigabitEthernet0/0/9]quit

[S2]interface GigabitEthernet 0/0/10

[S2-GigabitEthernet0/0/10]shutdown


[S1]display  stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge        :8192 .4c1f-cc45-aace

Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20

CIST Root/ERPC     :8192 .4c1f-cc45-aace / 0

CIST RegRoot/IRPC  :8192 .4c1f-cc45-aace / 0

CIST RootPortId    :0.0
```

```
BPDU-Protection     :Disabled

TC or TCN received :146

TC count per hello  :0

STP Converge Mode   :Normal

Share region-configuration :Enabled

Time since last TC  :0 days 0h:0m:11s

……output omit……
```

在上述回显信息中，灰色部分表明当S2故障时，S1变成根桥。

开启S2之前关闭的接口。

```
[S2]interface GigabitEthernet 0/0/9

[S2-GigabitEthernet0/0/9]undo shutdown

[S2-GigabitEthernet0/0/9]quit

[S2]interface GigabitEthernet 0/0/10

[S2-GigabitEthernet0/0/10]undo shutdown


<S1>display stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge         :8192 .4c1f-cc45-aace

Bridge Times        :Hello 2s MaxAge 20s FwDly 15s 0

CIST Root/ERPC      :4096 .4c1f-cc45-aacc / 20000

CIST RegRoot/IRPC   :8192 .4c1f-cc45-aace / 0

CIST RootPortId     :128.9

BPDU-Protection     :Disabled

TC or TCN received :143

TC count per hello  :0

STP Converge Mode   :Normal

Share region-configuration :Enabled

Time since last TC  :0 days 0h:0m:27s

……output omitted……


<S2>display stp

-------[CIST Global Info][Mode STP]-------

CIST Bridge         :4096 .4c1f-cc45-aacc

Bridge Times        :Hello 2s MaxAge 20s FwDly 15s MaxHop 20

CIST Root/ERPC      :4096 .4c1f-cc45-aacc / 0

CIST RegRoot/IRPC   :4096 .4c1f-cc45-aacc / 0

CIST RootPortId     :0.0
```

```
BPDU-Protection    :Disabled

TC or TCN received :55

TC count per hello :0

STP Converge Mode  :Normal

Share region-configuration :Enabled

Time since last TC :0 days 0h:14m:7s

……output omitted……
```

在上述回显信息中，灰色部分表明S2已经恢复正常，重新变成根桥。

.步骤三　控制根端口选举

在S1上执行**display stp brief**命令查看端口角色。

```
<S1>display stp brief
   MSTID Port                Role   STP State   Protection
   0     GigabitEthernet0/0/9   ROOT   FORWARDING  NONE
   0     GigabitEthernet0/0/10  ALTE   DISCARDING  NONE
```

上述回显信息表明G0/0/9是根端口，G0/0/10是Alternate端口。通过修改端口优先级，使G0/0/10成为根端口，G0/0/9成为Alternate端口。

修改S2上G0/0/9和G0/0/10端口的优先级。

缺省情况下端口优先级为128。端口优先级取值越大，则优先级越低。在S2上，修改G0/0/9的端口优先级值为32，G0/0/10的端口优先级值为16。因此，S1上的G0/0/10端口优先级高于S2的G0/0/10端口优先级，成为根端口。

```
[S2]interface GigabitEthernet 0/0/9

[S2-GigabitEthernet0/0/9]stp port priority 32

[S2-GigabitEthernet0/0/9]quit

[S2]interface GigabitEthernet 0/0/10

[S2-GigabitEthernet0/0/10]stp port priority 16
```

提示：此处是修改S2的端口优先级，而不是修改S1的端口优先级。

```
<S2>display stp interface  GigabitEthernet 0/0/9
----[CIST][Port9(GigabitEthernet0/0/9)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Designated Port
 Port Priority      :32
 Port Cost(Dot1T )  :Config=auto / Active=20000
```

Designated Bridge/Port   :4096.4c1f-cc45-aacc / 32.9

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

BPDU Encapsulation   :Config=stp / Active=stp

PortTimes   :Hello 2s MaxAge 20s FwDly 15s RemHop 20

TC or TCN send   :22

TC or TCN received   :1

BPDU Sent   :164

        TCN: 0, Config: 164, RST: 0, MST: 0

BPDU Received   :2

        TCN: 1, Config: 1, RST: 0, MST: 0

<S2>display stp interface GigabitEthernet 0/0/10

----[CIST][Port10(GigabitEthernet0/0/10)][FORWARDING]----

 Port Protocol   :Enabled

 Port Role   :Designated Port

 Port Priority   :16

 Port Cost(Dot1T)   :Config=auto / Active=20000

 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 16.10

 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

 BPDU Encapsulation :Config=stp / Active=stp

 PortTimes   :Hello 2s MaxAge 20s FwDly 15s RemHop 20

 TC or TCN send   :35

 TC or TCN received :1

 BPDU Sent   :183

        TCN: 0, Config: 183, RST: 0, MST: 0

 BPDU Received   :2

        TCN: 1, Config: 1, RST: 0, MST: 0

在S1上执行**display stp brief**命令查看端口角色。

```
<S1>display stp brief
    MSTID Port                  Role   STP State   Protection
    0     GigabitEthernet0/0/9   ALTE   DISCARDING  NONE
    0     GigabitEthernet0/0/10  ROOT   FORWARDING  NONE
```

在上述回显信息中，灰色部分表明S1的G0/0/10端口是根端口，G0/0/9是Alternate端口。

关闭S1的GigabitEthernet 0/0/10端口，再查看端口角色。

```
[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]shutdown
<S1>display stp brief
    MSTID Port                  Role   STP State   Protection
    0     GigabitEthernet0/0/9   ROOT   FORWARDING  NONE
```

在上述回显信息中的灰色部分可以看出，S1的G0/0/9变成了根端口。在S2上恢复G0/0/9和G0/0/10端口的缺省优先级，并重新开启S1上关闭的端口。

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]undo stp port priority
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]undo stp port priority


[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]undo shutdown
```

在S1上执行**display stp brief**命令和**display stp interface**命令查看端口角色。

```
<S1>display stp brief
    MSTID Port                  Role   STP State   Protection
    0     GigabitEthernet0/0/9   ROOT   FORWARDING  NONE
    0     GigabitEthernet0/0/10  ALTE   DISCARDING  NONE


[S1]display stp interface GigabitEthernet 0/0/9
----[CIST][Port9(GigabitEthernet0/0/9)][FORWARDING]----
 Port Protocol      :Enabled
```

```
 Port Role           :Root Port

 Port Priority       :128

 Port Cost(Dot1T )   :Config=auto / Active=20000

 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 128.9

 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

 BPDU Encapsulation  :Config=stp / Active=stp

 PortTimes           :Hello 2s MaxAge 20s FwDly 15s RemHop 0

 TC or TCN send      :4

 TC or TCN received  :90

 BPDU Sent           :5

        TCN: 4, Config: 1, RST: 0, MST: 0

 BPDU Received       :622

        TCN: 0, Config: 622, RST: 0, MST: 0


[S1]display stp interface GigabitEthernet 0/0/10

----[CIST][Port10(GigabitEthernet0/0/10)][DISCARDING]----

 Port Protocol       :Enabled

 Port Role           :Alternate Port

 Port Priority       :128

 Port Cost(Dot1T )   :Config=auto / Active=20000

 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 128.10

 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

 BPDU Encapsulation  :Config=stp / Active=stp

 PortTimes           :Hello 2s MaxAge 20s FwDly 15s RemHop 0

 TC or TCN send      :3

 TC or TCN received  :90

 BPDU Sent           :4

        TCN: 3, Config: 1, RST: 0, MST: 0
```

```
BPDU Received     :637

       TCN: 0, Config: 637, RST: 0, MST: 0
```

在上述回显信息中，灰色部分表明G0/0/9和G0/0/10的端口开销缺省情况下为20000。

修改S1上的G0/0/9端口开销值为200000。

```
[S1]interface GigabitEthernet 0/0/9

[S1-GigabitEthernet0/0/9]stp cost 200000
```

在S1上执行**display stp brief**命令和**display stp interface**命令查看端口角色。

```
<S1>display stp interface GigabitEthernet 0/0/9

----[CIST][Port9(GigabitEthernet0/0/9)][DISCARDING]----

 Port Protocol      :Enabled

 Port Role          :Alternate Port

 Port Priority      :128

 Port Cost(Dot1T )   :Config=200000 / Active=200000

 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 128.9

 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

 BPDU Encapsulation  :Config=stp / Active=stp

 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0

 TC or TCN send     :4

 TC or TCN received  :108

 BPDU Sent          :5

       TCN: 4, Config: 1, RST: 0, MST: 0

 BPDU Received      :818

       TCN: 0, Config: 818, RST: 0, MST: 0


 <S1>display stp brief

    MSTID Port                 Role    STP State   Protection

    0     GigabitEthernet0/0/9    ALTE    DISCARDING  NONE

    0     GigabitEthernet0/0/10   ROOT    FORWARDING  NONE
```

此时，S1上的G0/0/10端口变为根端口。

配置文件

```
<S1>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S1
#
 stp mode stp
 stp instance 0 priority 8192
#
interface GigabitEthernet0/0/9
 stp instance 0 cost 200000
#
interface GigabitEthernet0/0/10
#
user-interface con 0
user-interface vty 0 4
#
return


<S2>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S2
#
 stp mode stp
 stp instance 0 priority 4096
#
interface GigabitEthernet0/0/9
#
interface GigabitEthernet0/0/10
#
user-interface con 0
user-interface vty 0 4
#
return
```

```
<S3>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S3
#
interface Ethernet0/0/1
 shutdown
#
interface Ethernet0/0/13
 shutdown
#
interface Ethernet0/0/23
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return


<S4>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S4
#
interface Ethernet0/0/14
 shutdown
#
interface Ethernet0/0/24
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return
```

实验 3-2 配置 RSTP

学习目标

- 掌握启用和禁用RSTP的配置方法

- 掌握边缘端口的配置方法
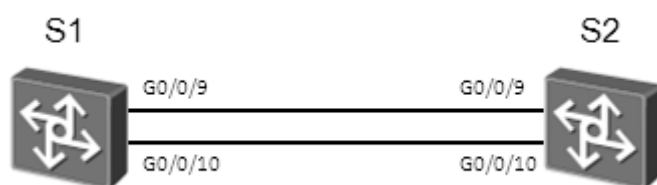
- 掌握RSTP BPDU保护功能的配置方法

- 掌握RSTP环路保护功能的配置方法

拓扑图

图3.2 配置RSTP实验拓扑图

场景

公司的网络使用了两层网络结构，核心层和接入层，并采用了冗余设计。您是公司的网络管理员，需要通过使用RSTP来避免网络中产生二层环路问题。本实验中，还将通过配置RSTP的一些特性来加快RSTP收敛速度，并配置相关保护功能。

操作步骤

.步骤一 实验环境准备

如果本实验中您使用的是空配置设备，需要从步骤1开始，并跳过步骤2。如果使用的设备包含上一个实验的配置，请直接从步骤2开始。

为了保证实验结果的准确性，必须先关闭无关的端口。

在实验配置之前，先关闭S3上的E0/0/1、E0/0/13、E0/0/23端口，以及S4

上的E0/0/14和E0/0/24端口，确保设备空配置启动。如果STP被禁用，则需执行**stp enable**命令启用STP。

```
<Quidway>system-view

Enter system view, return user view with Ctrl+Z.

[Quidway]sysname S1


<Quidway>system-view

Enter system view, return user view with Ctrl+Z.

[Quidway]sysname S2


<Quidway>system-view

[Quidway]sysname S3

[S3]interface Ethernet 0/0/1

[S3-Ethernet0/0/1]shutdown

[S3-Ethernet0/0/1]quit

[S3]interface Ethernet 0/0/13

[S3-Ethernet0/0/13]shutdown

[S3-Ethernet0/0/13]quit

[S3]interface Ethernet 0/0/23

[S3-Ethernet0/0/23]shutdown


<Quidway>system-view

[Quidway]sysname S4

[S4]interface Ethernet 0/0/14

[S4-Ethernet0/0/14]shutdown

[S4-Ethernet0/0/14]quit

[S4]interface Ethernet 0/0/24

[S4-Ethernet0/0/24]shutdown
```

.步骤二　清除设备上已有的配置

清除S1上配置的STP优先级和开销，清除S2上配置的STP优先级。

```
[S1]undo stp priority

[S1]interface GigabitEthernet 0/0/9

[S1-GigabitEthernet0/0/9]undo stp cost


[S2]undo stp priority
```

.步骤三 配置 RSTP 并验证 RSTP 配置

执行**stp mode rstp**命令配置S1和S2的STP模式为RSTP。

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

```
[S2]stp mode rstp
```

执行**display stp**命令查看RSTP的简要信息。

```
[S1]display  stp
-------[CIST Global Info][Mode RSTP]-------
CIST Bridge        :32768.4c1f-cc45-aace
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :32768.4c1f-cc45-aacc / 20000
CIST RegRoot/IRPC  :32768.4c1f-cc45-aace / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
TC or TCN received :28
TC count per hello :0
STP Converge Mode  :Normal
Share region-configuration :Enabled
Time since last TC :0 days 0h:11m:1s
……output omitted……


[S2]display  stp
-------[CIST Global Info][Mode RSTP]-------
CIST Bridge        :32768.4c1f-cc45-aacc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :32768.4c1f-cc45-aacc / 0
CIST RegRoot/IRPC  :32768.4c1f-cc45-aacc / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
TC or TCN received :14
TC count per hello :0
STP Converge Mode  :Normal
Share region-configuration :Enabled
Time since last TC :0 days 0h:12m:23s
……output omitted……
```

.步骤四 　配置边缘端口

配置连接用户终端的端口为边缘端口。边缘端口可以不通过RSTP计算直接由Discarding状态转变为Forwarding状态。在本示例中，S1和S2上的G0/0/4端口都连接的是一台路由器，可以配置为边缘端口，以加快RSTP收敛速度。

```
[S1]interface GigabitEthernet 0/0/4
[S1-GigabitEthernet0/0/4]stp edged-port enable


[S2]interface GigabitEthernet 0/0/4
[S2-GigabitEthernet0/0/4]stp edged-port enable
```

.步骤五 　配置 BPDU 保护功能

边缘端口直接与用户终端相连，正常情况下不会收到BPDU报文。但如果攻击者向交换机的边缘端口发送伪造的BPDU报文，交换机会自动将边缘端口设置为非边缘端口，并重新进行生成树计算，从而引起网络震荡。在交换机上配置BPDU保护功能，可以防止该类攻击。

执行**stp bpdu-protection**命令，在S1和S2上配置BPDU保护功能。

```
[S1]stp bpdu-protection


[S2]stp bpdu-protection
```

执行**display stp brief**命令查看端口上配置的保护功能。

```
<S1>display  stp brief
 MSTID  Port                   Role  STP State    Protection
   0    GigabitEthernet0/0/4    DESI  FORWARDING    BPDU
   0    GigabitEthernet0/0/9    ROOT  FORWARDING    NONE
   0    GigabitEthernet0/0/10   ALTE  DISCARDING    NONE


<S2>display  stp brief
 MSTID  Port                   Role  STP State    Protection
   0    GigabitEthernet0/0/4    DESI  FORWARDING    BPDU
   0    GigabitEthernet0/0/9    DESI  FORWARDING    NONE
   0    GigabitEthernet0/0/10   DESI  FORWARDING    NONE
```

配置完成后，从上述回显的灰色部分可以看出，S1和S2上的G0/0/4端口已经配置BPDU保护功能。

.步骤六 　 配置环路保护功能

　　在运行RSTP协议的网络中，交换机依靠不断接收来自上游设备的BPDU报文维持根端口和Alternate端口的状态。如果由于链路拥塞或者单向链路故障导致交换机收不到来自上游设备的BPDU报文，交换机会重新选择根端口。原先的根端口会转变为指定端口，而原先的阻塞端口会迁移到转发状态，从而会引起网络环路。可以在交换机上配置环路保护功能，避免此种情况发生。

　　首先在S1上查看端口角色。

```
[S1]display  stp brief

 MSTID  Port                    Role  STP State      Protection

   0    GigabitEthernet0/0/4     DESI  FORWARDING      BPDU

   0    GigabitEthernet0/0/9     ROOT  FORWARDING      NONE

   0    GigabitEthernet0/0/10    ALTE  DISCARDING      NONE
```

　　可以看到S1上的G0/0/9和G0/0/10端口分别为根端口和Alternate端口。在这两个端口上配置环路保护功能。

```
[S1]interface GigabitEthernet 0/0/9

[S1-GigabitEthernet0/0/9]stp loop-protection

[S1-GigabitEthernet0/0/9]quit

[S1]interface GigabitEthernet 0/0/10

[S1-GigabitEthernet0/0/10]stp loop-protection
```

　　执行**display stp brief**命令查看端口上配置的保护功能。

```
<S1>display  stp brief

 MSTID  Port                    Role  STP State      Protection

   0    GigabitEthernet0/0/4     DESI  FORWARDING      BPDU

   0    GigabitEthernet0/0/9     ROOT  FORWARDING      LOOP

   0    GigabitEthernet0/0/10    ALTE  DISCARDING      LOOP
```

　　因为S2是根桥，S2上的所有端口都是指定端口，无需配置环路保护功能。配置完成后，如果您把S1配置为根桥，可以使用相同的步骤在S2的根端口和Alternate端口上配置环路保护功能。

配置文件

```
<S1>display current-configuration
 #
```

```
!Software Version V100R006C00SPC800
 sysname S1
#
 stp mode rstp
 stp bpdu-protection
#
interface GigabitEthernet0/0/4
 stp edged-port enable
#
interface GigabitEthernet0/0/9
 stp loop-protection
#
interface GigabitEthernet0/0/10
 stp loop-protection
#
user-interface con 0
user-interface vty 0 4
#
return


<S2>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S2
#
 stp mode rstp
 stp bpdu-protection
#
interface GigabitEthernet0/0/4
 stp edged-port enable
#
user-interface con 0
user-interface vty 0 4
#
return


<S3>display current-configuration
#
```

```
!Software Version V100R006C00SPC800
 sysname S3
#
interface Ethernet0/0/1
 shutdown
#
interface Ethernet0/0/13
 shutdown
#
interface Ethernet0/0/23
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return

<S4>display current-configuration
#
!Software Version V100R006C00SPC800
 sysname S4
#
interface Ethernet0/0/14
 shutdown
#
interface Ethernet0/0/24
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return
```