

S8500交换机实现MSTP技术介绍

一、MSTP原理介绍

STP的主要作用:

防止MAC地址表震荡: 环路导致MAC地址不断刷新。

消除环路: 通过阻断冗余链路来消除网络中可能存在的路径回环。

链路备份: 当前活动路径发生故障时, 激活冗余备份链路, 恢复网络连通性。

MSTP的报文结构:

MST BPDU Standard Format	
Field	Octet
Protocol Identifier	2
Protocol Version Identifier	1
BPDU Type	1
CIST Flags	1
CIST Root Identifier	8
CIST External Path Cost	4
CIST Regional Root Identifier	8
CIST Port Identifier	2
Message Age	2
Max Age	2
Hello Time	2
Forward Delay	2
Version 1 Length = 0	2
Version 3 Length	2
MST Configuration Identifier	50
CIST Internal Root Path Cost	4
CIST Bridge Identifier	8
CIST Remaining Hops	1
MSTI Configuration Messages (may be absent)	

MSTP的基本思想:

基本思想: MSTP引入了“域 (Region)”和“实例 (Instance)”的概念。实例就是多个VLAN的一个集合, 通过多个VLAN捆绑到一个实例中去的方法可以节省通信开销和资源占用率。在域内MSTP各个实例拓扑的计算是独立的, 在这些实例上就可以实现负载均衡。VLAN在端口上转发状态将取决于对应实例在MSTP里的状态。

MSTP 实例:

CIST (公共与内部生成树) 在域内和域间都存在, 在域内被称为IST, 在域间被称为CST, 它保证整个网络的连通。MSTI (多生成树实例) 只在域内存在。每个实例对应一个或一组VLAN, 每个VLAN只能映射到一个实例。未配置VLAN与实例的映射关系时, 所有VLAN映射到实例CIST。域内每个实例的生成树可以有不同的拓扑, 拓扑可以人为通过配置来确定。每个端口在不同实例上的生成树参数、角色、状态可以不同。每个实例的信息被组装到一个BPDU中发送。

MSTP 域:

判断运行MSTP协议的交换机是否属于同一个域, 利用配置ID来表示, 配置ID(MCID)由四部分组成

Format Selector -----等于0

Configuration Name ----最长为32个字节的字符串(域名)

Revision Level ----- 2字节整数

Configuration Digest --- 利用HMAC-MD5算法将MSTP的VLAN实例映射关系加密成16字节的摘要(配置摘要)。

MCID缺省时, 域名等于桥的MAC地址, 配置摘要表示所有的VLAN均映射到CIST实例。

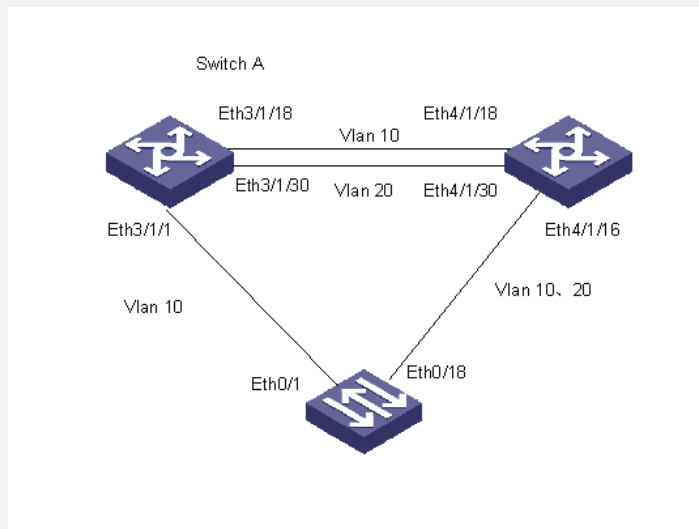
MCID完全相同的交换机直接相连, 才认为属于同一个MSTP域。

二、S8500典型配置实例

2.1 组网需求

使用MSTP使组网图中不同VLAN的报文按照不同的生成树转发。

2.2 组网图



SWITCH A的基本配置情况:

```
#
stp enable
stp region-configuration
region-name vlan1020
instance 10 vlan 10
instance 20 vlan 20
active region-configuration
#
vlan 1
#
vlan 10
#
vlan 20
#
interface Ethernet3/1/1
port link-type trunk
port trunk permit vlan 1 10
#
interface Ethernet3/1/18
port link-type trunk
port trunk permit vlan 1 10
#
interface Ethernet3/1/30
port link-type trunk
port trunk permit vlan 1 20
SWITCH B的基本配置情况:
```

```
#
stp enable
stp region-configuration
region-name vlan1020
instance 10 vlan 10
instance 20 vlan 20
active region-configuration
#
interface Ethernet4/1/16
port link-type trunk
port trunk permit vlan 1 10 20
#
interface Ethernet4/1/17
#
interface Ethernet4/1/18
port link-type trunk
port trunk permit vlan 1 10
#
interface Ethernet4/1/30
```

```

port link-type trunk
port trunk permit vlan 1 20
Switch C的基本配置情况:
#
stp enable
#
vlan 1
#
vlan 10
#
vlan 20
#

```

```

interface Ethernet0/1
port link-type trunk
port trunk permit vlan 1 10 20
#
interface Ethernet0/18
port link-type trunk
port trunk permit vlan 1 10 20

```

三、正常状态信息查看

#显示stp的简要信息。可以看到，对于instance 10，port eth4/1/18为root port，对于instance 20，port eth4/1/30为root port，对于CIST的0实例，port eth4/1/30为alternate port。由此可知，此网桥为指定网桥。

```
[Quidway]dis stp br
```

MSTID	Port	Role	STP State	Protection
0	Ethernet4/1/16	DESI	FORWARDING	NONE
0	Ethernet4/1/18	ROOT	FORWARDING	NONE
0	Ethernet4/1/30	ALTE	DISCARDING	NONE
10	Ethernet4/1/16	DESI	FORWARDING	NONE
10	Ethernet4/1/18	ROOT	FORWARDING	NONE
20	Ethernet4/1/16	DESI	FORWARDING	NONE
20	Ethernet4/1/30	ROOT	FORWARDING	NONE

#显示stp实例10的信息，包括各实例的端口详细信息。可以看出，Root Port和Designated Port的指定桥是不同的，因为Root Port的指定桥是对端的桥ID：

```
[Quidway]dis stp insta 10
```

```
-----[MSTI 10 Global Info]-----
```

```

MSTI Bridge ID   :32768.00e0-fc36-45b1      为指定桥
MSTI RegRoot/IRPC :32768.00e0-fc00-0001 / 200  域根ID/域内root path cost

```

```
MSTI RootPortId :128.226                    根端口ID
```

```
Master Bridge   :32768.00e0-fc00-0001 主交换机（区域边界离总根最近的Bridge）
```

```
Cost to Master  :200
```

```
TC received    :0
```

```
----[Port224(Ethernet4/1/16)][FORWARDING]----
```

```
Port Role      :Designated Port           端口角色
```

```
Port Priority   :128                       端口优先级（默认）
```

```
Port Cost(Legacy) :COnfig=auto / Active=200  端口COST
```

```
Desg. Bridge/Port :32768.00e0-fc36-45b1 / 128.224  指定桥/端口ID
```

```
Port Edged(Admin) :disabled                边界端口（未设置）
```

```
Point-to-point   :COnfig=auto / Active=true 点对点链路（默认=auto）
```

```
Transmission Limit :3 packets/hello-time
```

```
Protection Type   :None                    保护方式
```

```
Num of Vlans Mapped :1                      vlan映射数
```

```
Port Times       :RemHops 19                还剩19跳
```

```
----[Port226(Ethernet4/1/18)][FORWARDING]----
```

```
Port Role      :Root Port
```

```
Port Priority   :128
```

```
Port Cost(Legacy) :COnfig=auto / Active=200
```

```
Desg. Bridge/Port :32768.00e0-fc00-0001 / 128.174  root端口的BID是对端桥ID
```

```
Port Edged(Admin) :disabled
```

```

Point-to-point :COnfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times :RemHops 20
----[Port242(Ethernet4/1/34)][DOWN]----
Port Role :Disabled Port
Port Priority :128
Port Cost(Legacy) :COnfig=auto / Active=200000
Desg. Bridge/Port :32768.00e0-fc36-45b1 / 128.242
Port Edged(Admin) :disabled
Point-to-point :COnfig=auto / Active=false
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times :RemHops 20

```

#显示stp简要信息，可知，SWITCH A即为总根，又为域根。其端口在各个实例中全部为指定端口。

```
[Quidway]dis stp br
```

MSTID	Port	Role	STP State	Protection
0	Ethernet3/1/1	DESI	FORWARDING	NONE
0	Ethernet3/1/18	DESI	FORWARDING	NONE
0	Ethernet3/1/30	DESI	FORWARDING	NONE
10	Ethernet3/1/1	DESI	FORWARDING	NONE
10	Ethernet3/1/18	DESI	FORWARDING	NONE
20	Ethernet3/1/30	DESI	FORWARDING	NONE

#显示stp实例10的信息，可以看出，SWITCH A是本区域的主桥。

```
[Quidway]dis stp instance 10
```

```
-----[MSTI 10 Global Info]-----
```

```

MSTI Bridge ID :32768.00e0-fc00-0001
MSTI RegRoot/IRPC :32768.00e0-fc00-0001 / 0
MSTI RootPortId :0.0
Master Bridge :32768.00e0-fc00-0001 还为主桥
Cost to Master :0
TC received :4

```

```
----[Port157(Ethernet3/1/1)][FORWARDING]----
```

```

Port Role :Designated Port
Port Priority :128
Port Cost(Legacy) :COnfig=auto / Active=200
Desg. Bridge/Port :32768.00e0-fc00-0001 / 128.157
Port Edged(Admin) :disabled
Point-to-point :COnfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times :RemHops 20

```

```
----[Port174(Ethernet3/1/18)][FORWARDING]----
```

```

Port Role :Designated Port
Port Priority :128
Port Cost(Legacy) :COnfig=auto / Active=200
Desg. Bridge/Port :32768.00e0-fc00-0001 / 128.174
Port Edged(Admin) :disabled
Point-to-point :COnfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times :RemHops 20

```

#显示端口eth 0/1 eth 0/18的stp信息，可以看出Switch C只支持RSTP，这样，其他交换机收到Switch C发来的BPDU配置消息都是RSTP消息，就默认这个消息是区域间的消息，所以Switch C属于不同的区域，其总根仍为Switch A。在此交换机中只存在一个实例，就是CIST的实例0。所以，Switch C以Switch A为其根桥，可以看出连接到Switch A的接口Ethernet0/1被设置为根端口，而另一个端口Ethernet0/18则被设置为Alternate 接口，处于Discarding状态。

```
[Quidway]dis stp int eth 0/1 eth 0/18
```

```

Protocol mode: IEEE RSTP          只支持RSTP
The bridge ID (Pri.MAC): 32768.00e0-fc22-c68f
The bridge times: Hello Time 2 sec, Max Age 20 sec, Forward Delay 15 sec
Root bridge ID(Pri.MAC): 32768.00e0-fc00-0001      总根
Root path cost: 200
Bridge bpd-protection: disabled
Timeout factor: 3
Port 1 (Ethernet0/1) of bridge is Forwarding
  Port spanning tree protocol: enabled
  Port role: Root Port          根端口
  Port path cost: 200
  Port priority: 128
  Designated bridge ID(Pri.MAC): 32768.00e0-fc00-0001
  The Port is a non-edged port
  Connected to a point-to-point LAN segment
  Maximum transmission limit is 3 Packets / hello time
  Times: Hello Time 2 sec, Max Age 20 sec
        Forward Delay 15 sec, Message Age 0
  BPDU sent: 4
        TCN: 0, RST: 4, Config BPDU: 0
  BPDU received: 5933
        TCN: 0, RST: 5933, Config BPDU: 0
Port 18 (Ethernet0/18) of bridge is Discarding      DISCARDING状
态
  Port spanning tree protocol: enabled
  Port role: Alternate Port      选择端口
  Port path cost: 200
  Port priority: 128
  Designated bridge ID(Pri.MAC): 32768.00e0-fc36-45b1
  The Port is a non-edged port
  Connected to a point-to-point LAN segment
  Maximum transmission limit is 3 Packets / hello time
  Times: Hello Time 2 sec, Max Age 20 sec
        Forward Delay 15 sec, Message Age 0
  BPDU sent: 107
        TCN: 0, RST: 107, Config BPDU: 0
  BPDU received: 6032
        TCN: 0, RST: 6032, Config BPDU: 0

```

四、排错(可debugging 信息)

在得到上面的拓扑的稳定状态后, 改变SWITCH B的优先级:

```
SWITCH B priority 0
```

#显示调试信息, 可以看出, Switch B成为了总根。

```
<Quidway>deb stp pac
```

```
*0.15032074 Quidway MSTP/8/PKT:
```

```
Port224 Send Packet(Length: 155)
```

```
ProtocolVersionID: 03
```

```
BPDUDType : 02
```

```
CIST Root ID : 0x0000.00e0-fc36-45b1      总根变为SWITCH
```

```
B
```

```
External RPC : 0x00000000
```

```
Reg Root ID : 0x0000.00e0-fc36-45b1
```

```
Internal RPC : 0x00000000
```

```
CIST Bridge ID : 0x0000.00e0-fc36-45b1
```

```
CIST Port ID : 128.224
```

```
Instance : 0,10,20
```

```
Flags : 6c,6c,6c
```

```
*0.15032554 Quidway MSTP/8/PKT:
```

```
Port226 Send Packet(Length: 129)
```

```
ProtocolVersionID: 03
```

```
BPDUDType : 02
```

```
CIST Root ID : 0x0000.00e0-fc36-45b1
```

```
External RPC : 0x00000000
```

```
Reg Root ID : 0x0000.00e0-fc36-45b1
```

```
Internal RPC : 0x00000000
```

```

CIST Bridge ID : 0x0000.00e0-fc36-45b1
CIST Port ID : 128.226
Instance : 0,10
Flags : 6c,68
*0.15033039 Quidway MSTP/8/PKT:
Port238 Send Packet(Length: 129)
ProtocolVersionID: 03
BPDUType : 02
CIST Root ID : 0x0000.00e0-fc36-45b1
External RPC : 0x00000000
Reg Root ID : 0x0000.00e0-fc36-45b1
Internal RPC : 0x00000000
CIST Bridge ID : 0x0000.00e0-fc36-45b1
CIST Port ID : 128.238
Instance : 0,20
Flags : 5e,68
#显示stp简要信息，可以看出，Switch B为总根后，其CIST 0实例下的各端口都为指定端口，但是其他实例下的各端口状态并不改变。
[Quidway]dis stp br
MSTID Port Role STP State Protection
0 Ethernet4/1/16 DESI FORWARDING NONE
0 Ethernet4/1/18 DESI FORWARDING NONE
0 Ethernet4/1/30 DESI FORWARDING NONE
10 Ethernet4/1/16 DESI FORWARDING NONE
10 Ethernet4/1/18 ROOT FORWARDING NONE
20 Ethernet4/1/16 DESI FORWARDING NONE
20 Ethernet4/1/30 ROOT FORWARDING NONE
#设置stp实例10的优先级。
[Quidway]stp instance 10 priority 0
#显示stp的简单信息，可以看出，在实例10下，其端口都是Designated Port，说明Switch B成为了实例10的根桥，但是CIST的实例0，以及实例20的各端口角色都没有变化。
[Quidway]dis stp br
MSTID Port Role STP State Protection
0 Ethernet4/1/16 DESI FORWARDING NONE
0 Ethernet4/1/18 DESI FORWARDING NONE
0 Ethernet4/1/30 DESI FORWARDING NONE
10 Ethernet4/1/16 DESI FORWARDING NONE
10 Ethernet4/1/18 DESI FORWARDING NONE
20 Ethernet4/1/16 DESI FORWARDING NONE
20 Ethernet4/1/30 ROOT FORWARDING NONE
#显示stp实例10的信息，可以看到TC received变为了2，说明收到了拓扑改变的通知。
[Quidway]dis stp instance 10
-----[MSTI 10 Global Info]-----
MSTI Bridge ID :0.00e0-fc36-45b1
MSTI RegRoot/IRPC :0.00e0-fc36-45b1 / 0 实例10的域根变为SWITCH B

MSTI RootPortId :0.0
Master Bridge :0.00e0-fc36-45b1
Cost to Master :0
TC received :2 收到了TC通知
---[Port224(Ethernet4/1/16)][FORWARDING]---
Port Role :Designated Port
Port Priority :128
Port Cost(Legacy) :CConfig=auto / Active=200
Desg. Bridge/Port :0.00e0-fc36-45b1 / 128.224
Port Edged(Admin) :disabled
Point-to-point :CConfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times :RemHops 20
---[Port226(Ethernet4/1/18)][FORWARDING]---

```

```

Port Role      :Designated Port
Port Priority   :128
Port Cost(Legacy) :COnfig=auto / Active=200
Desg. Bridge/Port :0.00e0-fc36-45b1 / 128.226
Port Edged(Admin) :disabled
Point-to-point :COnfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times      :RemHops 20
----[Port242(Ethernet4/1/34)][DOWN]----
Port Role      :Disabled Port
Port Priority   :128
Port Cost(Legacy) :COnfig=auto / Active=200000
Desg. Bridge/Port :0.00e0-fc36-45b1 / 128.242
Port Edged(Admin) :disabled
Point-to-point :COnfig=auto / Active=false
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times      :RemHops 20
#Switch B收到拓扑改变信息后，Switch A的相应变化。显示stp的信息，可以看出Switch A不再是实例10的根桥了，端口Ethernet3/1/18成为根端口。
[Quidway]dis stp br
MSTID  Port          Role STP State  Protection
  0    Ethernet3/1/1  DESI FORWARDING  NONE
  0    Ethernet3/1/18  ROOT FORWARDING  NONE
  0    Ethernet3/1/30  ALTE DISCARDING  NONE
 10    Ethernet3/1/1  DESI FORWARDING  NONE
 10    Ethernet3/1/18  ROOT FORWARDING  NONE
 20    Ethernet3/1/30  DESI FORWARDING  NONE
在SWITCH A上配置其为根桥。
[Quidway]stp root primary
#显示stp信息，可以看出Switch A为CIST的实例0的根桥。
[Quidway]dis stp br
MSTID  Port          Role STP State  Protection
  0    Ethernet3/1/1  DESI FORWARDING  NONE
  0    Ethernet3/1/18  DESI FORWARDING  NONE
  0    Ethernet3/1/30  DESI FORWARDING  NONE
 10    Ethernet3/1/1  DESI FORWARDING  NONE
 10    Ethernet3/1/18  ROOT FORWARDING  NONE
 20    Ethernet3/1/30  DESI FORWARDING  NONE
SWITCH B eth4/1/34(vlan 10)连接PC机，
并配置此端口为边缘端口，同时启动BPDU PROTECTION，显示此端口stp信息。
<Quidway>dis stp int eth4/1/34
----[CIST][Port242(Ethernet4/1/34)][FORWARDING]----
Port Protocol      :enabled
Port Role          :CIST Designated Port
Port Priority       :128
Port Cost(Legacy)  :COnfig=auto / Active=200
Desg. Bridge/Port  :0.00e0-fc36-45b1 / 128.242
Port Edged(Admin)  :enabled BPDU-Protection :enabled   Edge端口BPDU保护

Point-to-point     :COnfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type     :None
Port Config
Digest Snooping    :disabled
Num of Vlans Mapped :0
PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0
BPDU Sent          :730
                   TCN: 0, Config: 0, RST: 0, MST: 730
BPDU Received      :0
                   TCN: 0, Config: 0, RST: 0, MST: 0

```

```
----[MST1 10][Port242(Ethernet4/1/34)][FORWARDING]----
Port Role      :Designated Port
Port Priority   :128
Port Cost(Legacy) :COnfig=auto / Active=200
Desg. Bridge/Port :0.00e0-fc36-45b1 / 128.242
Port Edged(Admin) :enabled BPDU-Protection :enabled
Point-to-point  :COnfig=auto / Active=true
Transmission Limit :3 packets/hello-time
Protection Type :None
Num of Vlans Mapped :1
Port Times      :RemHops 20
```

#显示debugging信息，可以看出边缘端口只发送BPDU信息。而起了BPDU保护后，如果收到BPDU配置信息后，则令端口处于DISCARDING状态。

```
<Quidway>deb stp int eth4/1/34 packet
*0.23478859 Quidway MSTP/8/PKT:
Port242 Send Packet(Length: 129)
ProtocolVersionID: 03
BPDUType      : 02
CIST Root ID  : 0x0000.00e0-fc00-0001
External RPC   : 0x00000000
Reg Root ID    : 0x0000.00e0-fc00-0001
Internal RPC   : 0x000000c8
CIST Bridge ID : 0x0000.00e0-fc36-45b1
CIST Port ID   : 128.242
Instance      : 0,10
Flags         : 6c,6c
*0.23480861 Quidway MSTP/8/PKT:
Port242 Send Packet(Length: 129)
ProtocolVersionID: 03
BPDUType      : 02
CIST Root ID  : 0x0000.00e0-fc00-0001
External RPC   : 0x00000000
Reg Root ID    : 0x0000.00e0-fc00-0001
Internal RPC   : 0x000000c8
CIST Bridge ID : 0x0000.00e0-fc36-45b1
CIST Port ID   : 128.242
Instance      : 0,10
Flags         : 6c,6c
*0.23482859 Quidway MSTP/8/PKT:
Port242 Send Packet(Length: 129)
ProtocolVersionID: 03
BPDUType      : 02
CIST Root ID  : 0x0000.00e0-fc00-0001
External RPC   : 0x00000000
Reg Root ID    : 0x0000.00e0-fc00-0001
Internal RPC   : 0x000000c8
CIST Bridge ID : 0x0000.00e0-fc36-45b1
CIST Port ID   : 128.242
Instance      : 0,10
Flags         : 6c,6c
*0.23484859 Quidway MSTP/8/PKT:
Port242 Send Packet(Length: 129)
ProtocolVersionID: 03
BPDUType      : 02
CIST Root ID  : 0x0000.00e0-fc00-0001
External RPC   : 0x00000000
Reg Root ID    : 0x0000.00e0-fc00-0001
Internal RPC   : 0x000000c8
CIST Bridge ID : 0x0000.00e0-fc36-45b1
CIST Port ID   : 128.242
Instance      : 0,10
Flags         : 6c,6c
```


*0.23486859 Quidway MSTP/8/PKT:

Port242 Send Packet(Length: 129)

ProtocolVersionID: 03

BPDUType : 02

CIST Root ID : 0x0000.00e0-fc00-0001

External RPC : 0x00000000

Reg Root ID : 0x0000.00e0-fc00-0001

Internal RPC : 0x000000c8

CIST Bridge ID : 0x0000.00e0-fc36-45b1

CIST Port ID : 128.242

Instance : 0,10

Flags : 6c,6c

ndo de

*0.23488859 Quidway MSTP/8/PKT:

Port242 Send Packet(Length: 129)

ProtocolVersionID: 03

BPDUType : 02

CIST Root ID : 0x0000.00e0-fc00-0001

External RPC : 0x00000000

Reg Root ID : 0x0000.00e0-fc00-0001

Internal RPC : 0x000000c8

CIST Bridge ID : 0x0000.00e0-fc36-45b1

CIST Port ID : 128.242

Instance : 0,10

Flags : 6c,6c