Content

Chapter 1 MSTP Configuration

1.1 Introduction to MSTP

The MSTP (Multiple STP) is a new spanning-tree protocol which is based on the STP and the RSTP. It runs on all the bridges of a bridged-LAN. It calculates a common and internal spanning tree (CIST) for the bridge-LAN which consists of the bridges running the MSTP, the RSTP and the STP. It also calculates the independent multiple spanning-tree instances (MSTI) for each MST domain (MSTP domain). The MSTP, which adopts the RSTP for its rapid convergence of the spanning tree, enables multiple VLANs to be mapped to the same spanning-tree instance which is independent to other spanning-tree instances. The MSTP provides multiple forwarding paths for data traffic and enables load balancing. Moreover, because multiple VLANs share a same MSTI, the MSTP can reduce the number of spanning-tree instances, which consumes less CPU resources and reduces the bandwidth consumption.

1.1.1 MSTP Region

Because multiple VLANs can be mapped to a single spanning tree instance, IEEE 802.1s committee raises the MST concept. The MST is used to make the association of a certain VLAN to a certain spanning tree instance.

A MSTP region is composed of one or multiple bridges with the same MCID (MST Configuration Identification) and the bridged-LAN (a certain bridge in the MSTP region is the designated bridge of the LAN, and the bridges attaching to the LAN are not running STP). All the bridges in the same MSTP region have the same MSID.

MSID consists of 3 attributes:

☞ Configuration Name: Composed by digits and letters

☞ Revision Level

☞ Configuration Digest: VLANs mapping to spanning tree instances

The bridges with the same 3 above attributes are considered as in the same MST region.

When the MSTP calculates CIST in a bridged-LAN, a MSTP region is considered as a bridge. See the figure below:
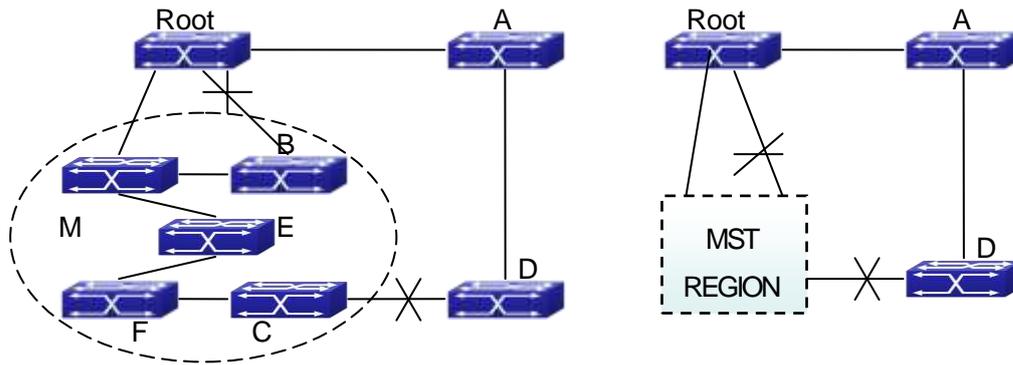
Fig 1-1 Example of CIST and MST Region

In the above network, if the bridges are running the STP or the RSTP, one port between Bridge M and Bridge B should be blocked. But if the bridges in the yellow range run the MSTP and are configured in the same MST region, MSTP will treat this region as a bridge. Therefore, one port between Bridge B and Root is blocked and one port on Bridge D is blocked.

1.1.1.1 Operations within an MSTP Region

The IST connects all the MSTP bridges in a region. When the IST converges, the root of the IST becomes the IST master, which is the switch within the region with the lowest bridge ID and path cost to the CST root. The IST master is also the CST root if there is only one region within the network. If the CST root is outside the region, one of the MSTP bridges at the boundary of the region is selected as the IST master.

When an MSTP bridge initializes, it sends BPDUs claiming itself as the root of the CST and the IST master, with both of the path costs to the CST root and to the IST master set to zero. The bridge also initializes all of its MST instances and claims to be the root for all of them. If the bridge receives superior MST root information (lower bridge ID, lower path cost, and so forth) than currently stored for the port, it relinquishes its claim as the IST master.

Within a MST region, the IST is the only spanning-tree instance that sends and receives BPDUs. Because the MST BPDU carries information for all instances, the number of BPDUs that need to be processed by a switch to support multiple spanning-tree instances is significantly reduced.

All MST instances within the same region share the same protocol timers, but each MST instance has its own topology parameters, such as root switch ID, root path cost, and so forth.

1.1.1.2 Operations between MST Regions

If there are multiple regions or legacy 802.1D bridges within the network, MSTP establishes and maintains the CST, which includes all MST regions and all legacy STP bridges in the network. The MST instances combine with the IST at the boundary of the region to become the CST.

The MSTI is only valid within its MST region. An MSTI has nothing to do with MSTIs in other MST regions. The bridges in a MST region receive the MST BPDU of other regions through Boundary Ports. They only process CIST related information and abandon MSTI information.

1.1.2 Port Roles

The MSTP bridge assigns a port role to each port which runs MSTP.

☞ CIST port roles: Root Port, Designated Port, Alternate Port and Backup Port

☞ On top of those roles, each MSTI port has one new role: Master Port.

The port roles in the CIST (Root Port, Designated Port, Alternate Port and Backup Port) are defined in the same ways as those in the RSTP.

1.1.3 MSTP Load Balance

In a MSTP region, VLANs can by mapped to various instances. That can form various topologies. Each instance is independent from the others and each distance can have its own attributes such as bridge priority and port cost etc. Consequently, the VLANs in different instances have their own paths. The traffic of the VLANs are load-balanced.

1.2 MSTP Configuration Task List

MSTP configuration task list:

1. Enable the MSTP and set the running mode

2. Configure instance parameters

3. Configure MSTP region parameters

4. Configure MSTP time parameters

5. Configure the fast migrate feature for MSTP

6. Configure the format of port packet

7. Configure the spanning-tree attribute of port

8. Configure the snooping attribute of authentication key

9. Configure the FLUSH mode once topology changes

1. Enable MSTP and set the running mode

Command	Explanation
Global Mode and Port Mode	
spanning-tree **no spanning-tree**	Enable/Disable MSTP.
Global Mode	
spanning-tree mode **{mstp|stp|rstp}** **no spanning-tree mode**	Set MSTP running mode.
Port Mode	
spanning-tree mcheck	Force port migrate to run under MSTP.

2. Configure instance parameters

Command	Explanation
Global Mode	
spanning-tree mst *<instance-id>* priority *<bridge-priority>* **no spanning-tree mst *<instance-id>* priority**	Set bridge priority for specified instance.
spanning-tree priority *<bridge-priority>* **no spanning-tree priority**	Configure the spanning-tree priority of the switch.
Port Mode	
spanning-tree mst *<instance-id>* cost *<cost>* **no spanning-tree mst *<instance-id>* cost**	Set port path cost for specified instance.
spanning-tree mst *<instance-id>* port-priority *<port-priority>* **no spanning-tree mst *<instance-id>* port-priority**	Set port priority for specified instance.
spanning-tree mst *<instance-id>* rootguard **no spanning-tree mst *<instance-id>* rootguard**	Configure currently port whether running rootguard in specified instance, configure the rootguard port can't turn to root port.
spanning-tree rootguard **no spanning-tree rootguard**	Configure currently port whether running rootguard in instance 0, configure the

	rootguard port can't turn to root port.
spanning-tree [mst <*instance-id*>] loopguard **no spanning-tree [mst <*instance-id*>] loopguard**	Enable loopguard function on specified instance, the no command disables this function.

3. Configure MSTP region parameters

Command	Explanation
Global Mode	
spanning-tree mst configuration **no spanning-tree mst configuration**	Enter MSTP region mode. The no command restores the default setting.
MSTP region mode	
show	Display the information of the current running system.
instance <*instance-id*> vlan <*vlan-list*> **no instance <*instance-id*> [vlan <*vlan-list*>]**	Create Instance and set mapping between VLAN and Instance.
name <*name*> **no name**	Set MSTP region name.
revision-level <*level*> **no revision-level**	Set MSTP region revision level.
abort	Quit MSTP region mode and return to Global mode without saving MSTP region configuration.
exit	Quit MSTP region mode and return to Global mode with saving MSTP region configuration.
no	Cancel one command or set initial value.

4. Configure MSTP time parameters

Command	Explanation
Global Mode	
spanning-tree forward-time *<time>* no spanning-tree forward-time	Set the value for switch forward delay time.
spanning-tree hello-time *<time>* no spanning-tree hello-time	Set the Hello time for sending BPDU messages.
spanning-tree maxage *<time>* no spanning-tree maxage	Set Aging time for BPDU messages.
spanning-tree max-hop *<hop-count>* no spanning-tree max-hop	Set Maximum number of hops of BPDU messages in the MSTP region.

5. Configure the fast migrate feature for MSTP

Command	Explanation
Port Mode	
spanning-tree link-type p2p {auto|force-true|force-false} no spanning-tree link-type	Set the port link type.
spanning-tree portfast [bpdufilter|bpduguard] [recovery *<30-3600>*] no spanning-tree portfast	Set and cancel the port to be an boundary port. bpdufilter receives the BPDU discarding; bpduguard receives the BPDU will disable port; no parameter receives the BPDU, the port becomes a non-boundary port.

6. Configure the format of MSTP

Command	Explanation
Port Mode	
spanning-tree format standard spanning-tree format privacy spanning-tree format auto no spanning-tree format	Configure the format of port spanning-tree packet, standard format is provided by IEEE, privacy is compatible with CISCO and auto means the format is determined by checking the received packet.

7. Configure the spanning-tree attribute of port

Command	Explanation
Port Mode	

spanning-tree cost no spanning-tree cost	Set the port path cost.
spanning-tree port-priority no spanning-tree port-priority	Set the port priority.
spanning-tree rootguard no spanning-tree rootguard	Set the port is root port.
Global Mode	
spanning-tree transmit-hold-count *<tx-hold-count-value>* no spanning-tree transmit-hold-count	Set the max transmit-hold-count of port.
spanning-tree cost-format {dot1d | dot1t}	Set port cost format with dot1d or dot1t.

8. Configure the snooping attribute of authentication key

Command	Explanation
Port Mode	
spanning-tree digest-snooping no spanning-tree digest-snooping	Set the port to use the authentication string of partner port. The no command restores to use the generated string.

9. Configure the FLUSH mode once topology changes

Command	Explanation
Global Mode	
spanning-tree tcflush {enable| disable| protect} no spanning-tree tcflush	Enable: the spanning-tree flush once the topology changes. Disable: the spanning tree don't flush when the topology changes. Protect: the spanning-tree flush not more than one time every ten seconds. The no command restores to default setting, enable flush once the topology changes.
Port Mode	
spanning-tree tcflush {enable| disable| protect} no spanning-tree tcflush	Configure the port flush mode. The no command restores to use the global configured flush mode.

1.3 MSTP Example

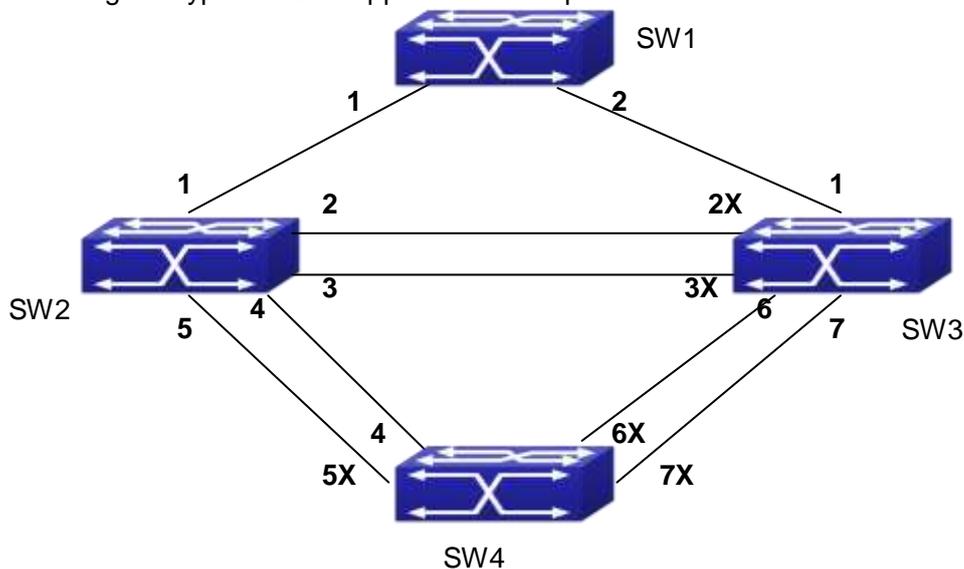The following is a typical MSTP application example:

Fig 1-2 Typical MSTP Application Scenario

The connections among the switches are shown in the above figure. All the switches run in the MSTP mode by default, their bridge priority, port priority and port route cost are all in the default values (equal). The default configuration for switches is listed below:

Bridge Name		SW1	SW2	SW3	SW4
Bridge MAC Address		…00-00-01	…00-00-02	…00-00-03	…00-00-04
Bridge Priority		32768	32768	32768	32768
Port Priority	port 1	128	128	128	
	port 2	128	128	128	
	port 3		128	128	
	port 4		128		128
	port 5		128		128
	port 6			128	128
	port 7			128	128
Route Cost	port 1	200000	200000	200000	
	port 2	200000	200000	200000	
	port 3		200000	200000	
	port 4		200000		200000
	port 5		200000		200000

	port 6			200000	200000
	port 7			200000	200000

By default, the MSTP establishes a tree topology (in blue lines) rooted with SwitchA. The ports marked with "x" are in the discarding status, and the other ports are in the forwarding status.

Configurations Steps:

Step 1: Configure port to VLAN mapping:

☞ Create VLAN 20, 30, 40, 50 in Switch2, Switch3 and Switch4.

☞ Set ports 1-7 as trunk ports in Switch2 Switch3 and Switch4.

Step 2: Set Switch2, Switch3 and Switch4 in the same MSTP:

☞ Set Switch2, Switch3 and Switch4 to have the same region name as mstp.

☞ Map VLAN 20 and VLAN 30 in Switch2, Switch3 and Switch4 to Instance 3; Map VLAN 40 and VLAN 50 in Switch2, Switch3 and Switch4 to Instance 4.

Step 3: Set Switch3 as the root bridge of Instance 3; Set Switch4 as the root bridge of Instance 4

☞ Set the bridge priority of Instance 3 in Switch3 as 0.

☞ Set the bridge priority of Instance 4 in Switch4 as 0.

The detailed configuration is listed below:

Switch2:

Switch2(config)#vlan 20

Switch2(Config-Vlan20)#exit

Switch2(config)#vlan 30

Switch2(Config-Vlan30)#exit

Switch2(config)#vlan 40

Switch2(Config-Vlan40)#exit

Switch2(config)#vlan 50

Switch2(Config-Vlan50)#exit

Switch2(config)#spanning-tree mst configuration

Switch2(Config-Mstp-Region)#name mstp

Switch2(Config-Mstp-Region)#instance 3 vlan 20;30

Switch2(Config-Mstp-Region)#instance 4 vlan 40;50

Switch2(Config-Mstp-Region)#exit

Switch2(config)#interface e1/0/1-7

Switch2(Config-Port-Range)#switchport mode trunk

Switch2(Config-Port-Range)#exit

Switch2(config)#spanning-tree

Switch3:

Switch3(config)#vlan 20

Switch3(Config-Vlan20)#exit

Switch3(config)#vlan 30

Switch3(Config-Vlan30)#exit

Switch3(config)#vlan 40

Switch3(Config-Vlan40)#exit

Switch3(config)#vlan 50

Switch3(Config-Vlan50)#exit

Switch3(config)#spanning-tree mst configuration

Switch3(Config-Mstp-Region)#name mstp

Switch3(Config-Mstp-Region)#instance 3 vlan 20;30

Switch3(Config-Mstp-Region)#instance 4 vlan 40;50

Switch3(Config-Mstp-Region)#exit

Switch3(config)#interface e1/0/1-7

Switch3(Config-Port-Range)#switchport mode trunk

Switch3(Config-Port-Range)#exit

Switch3(config)#spanning-tree

Switch3(config)#spanning-tree mst 3 priority 0

Switch4:

Switch4(config)#vlan 20

Switch4(Config-Vlan20)#exit

Switch4(config)#vlan 30

Switch4(Config-Vlan30)#exit

Switch4(config)#vlan 40

Switch4(Config-Vlan40)#exit

Switch4(config)#vlan 50

Switch4(Config-Vlan50)#exit

Switch4(config)#spanning-tree mst configuration

Switch4(Config-Mstp-Region)#name mstp

Switch4(Config-Mstp-Region)#instance 3 vlan 20;30

Switch4(Config-Mstp-Region)#instance 4 vlan 40;50

Switch4(Config-Mstp-Region)#exit

Switch4(config)#interface e1/0/1-7

Switch4(Config-Port-Range)#switchport mode trunk

Switch4(Config-Port-Range)#exit

Switch4(config)#spanning-tree

Switch4(config)#spanning-tree mst 4 priority 0

After the above configuration, Switch1 is the root bridge of the instance 0 of the entire network. In the MSTP region which Switch2, Switch3 and Switch4 belong to, Switch2 is the region root of the instance 0, Switch3 is the region root of the instance 3 and Switch4 is the region root of the instance 4. The traffic of VLAN 20 and VLAN 30 is sent through the topology of the instance 3. The traffic of VLAN 40 and VLAN 50 is sent through the topology of the instance 4. And the traffic of other VLANs is sent through the topology of the instance 0. The port 1 in Switch2 is the master port of the instance 3 and the instance 4.

The MSTP calculation generates 3 topologies: the instance 0, the instance 3 and the instance 4 (marked with blue lines). The ports with the mark "x" are in the status of discarding. The other ports are the status of forwarding. Because the instance 3 and the instance 4 are only valid in the MSTP region, the following figure only shows the topology of the MSTP region.
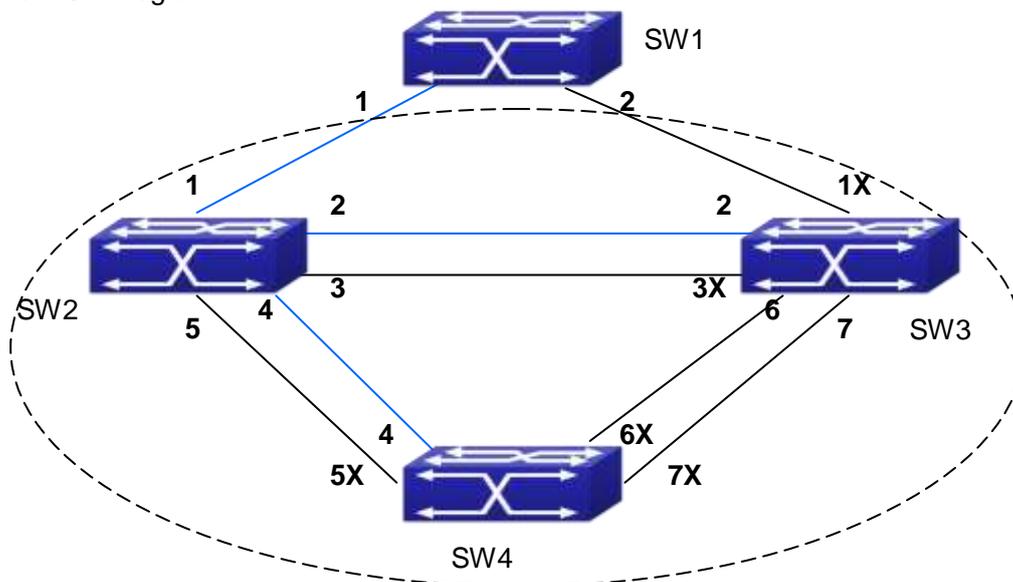

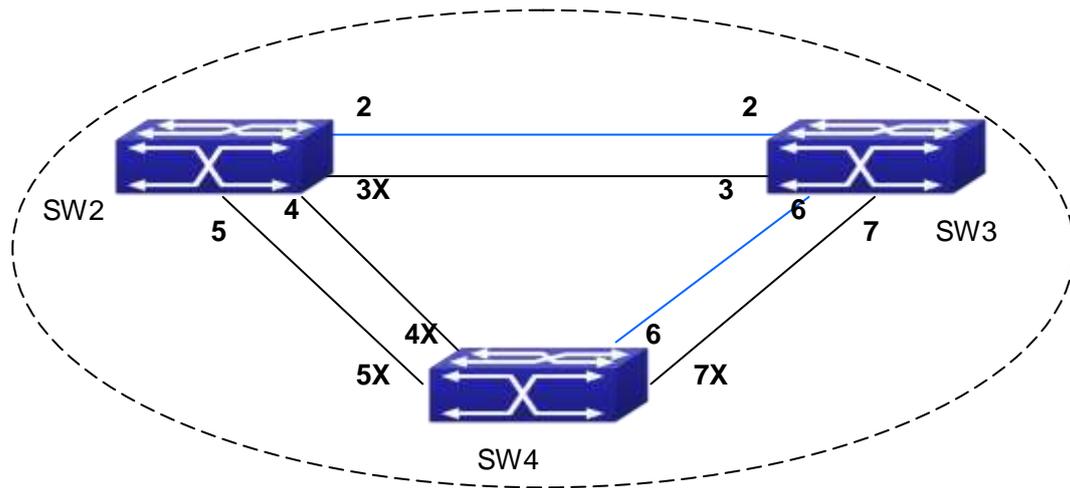Fig 1-3 The Topology Of the Instance 0 after the MSTP Calculation

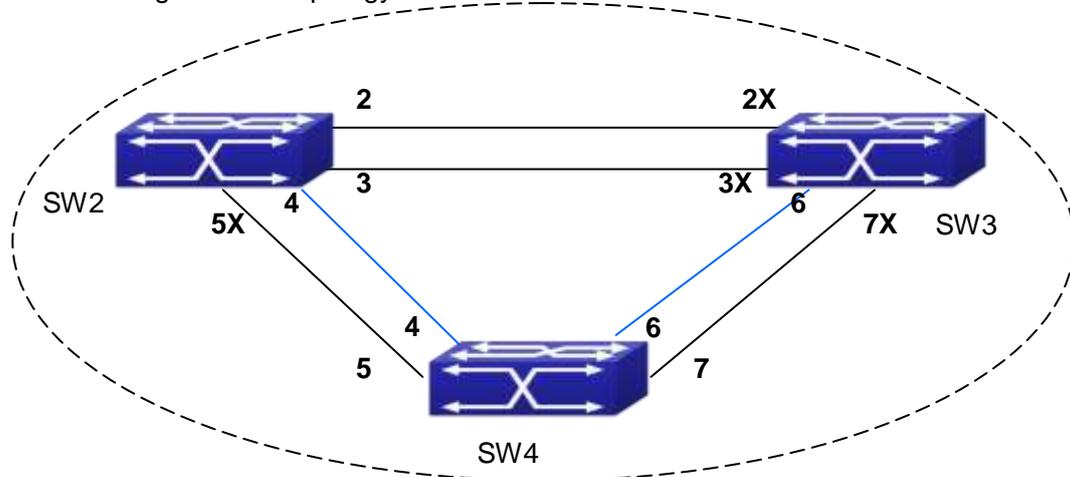Fig 1-4 The Topology Of the Instance 3 after the MSTP Calculation

Fig 1-5 The Topology Of the Instance 4 after the MSTP Calculation

1.4 MSTP Troubleshooting

☞ In order to run the MSTP on the switch port, the MSTP has to be enabled globally. If the MSTP is not enabled globally, it can't be enabled on the port.

☞ The MSTP parameters co work with each other, so the parameters should meet the following conditions. Otherwise, the MSTP may work incorrectly.

$$2 \times (Bridge\_Forward\_Delay -1.0 \text{ seconds}) >= Bridge\_Max\_Age$$

$$Bridge\_Max\_Age >= 2 \times (Bridge\_Hello\_Time + 1.0 \text{ seconds})$$

☞ When users modify the MSTP parameters, they have to be sure about the changes of the topologies. The global configuration is based on the bridge. Other configurations are based on the individual instances.