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Congestion control Fast Recovery and Load Balancing in LAN

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Abstract
To control the congestion in local area network (LAN) Spanning tree protocol (STP) is used. Spanning Tree Protocol (STP) is IEEE approved standard 802.1 d. STP block the redundant ports in switched layer-2 networks. STP takes 30 to 60 seconds for recovering a link. Rapid spanning tree protocol (RSTP) is used to make the fast recovery for uplinks and downlinks. RSTP makes a fast recovery in switched network and takes seem less time to recover a link. Virtual local area networks (VLANs) and Multi instance spanning tree protocol (MSTP) is used to make load balancing and control the flood of BPDU's in local area switched network. Virtual-Local Area Network (VLAN's) and Multi Instance Spanning-Tree Protocol (MSTP) are associated with each other and Provide load balancing in switched network.
Keywords: Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), Multi Instance Spanning Tree Protocol (MSTP), Virtual Local Area Network (VLAN), Bridge protocol data unit (BPDU), Switched Network.

1. INTRODUCTION

Layer 2 network commonly introduces the congestion into a network design, which can create the problems. To make congestion free layer-2 switched network Spanning-tree protocol (STP) is used. In switched network topology 1 switch is Root Bridge (RB) over a network. The best path to pass is from this Root Bridge (RB). Spanning tree protocol (STP) takes 30 to 60 seconds to come in forward state in a link goes down. Rapid spanning tree protocol (RSTP) takes seems less time to come in forward state if 1 link goes down. In spanning-tree protocol (STP) as well Rapid spanning-tree protocol (RSTP) there isn't load equalizing or balancing mechanism [1]. Virtually local area network (VLAN's) and Multi instance spanning-tree protocol (MSTP) have traffic engineering mechanism with the association of each other. MSTP also control the flood of BPDU's [2].

2. SPANNING TREE ANALYSIS

It is a layer-2 switched protocol which is used to control the congestion. This protocol is IEEE proved which is defined as 802.1d. This protocol shut the redundant ports in a local-area network to avoid the congestion in network.

2.1 Ports Roles in STP

Root Bridge (RB), Non- Root Bridge (NRB), Designated Port (DP), Root Port (RP) and Non-Designated Port (NDP)

Are the port roles in STP. RB becomes after an election between switches. This election based on Bridge ID. Bridge ID based on Priority No. and Mac address of switches. Only 1 Root Bridge become in all switched network. DP and RP are the forward ports and NDP is block port. RP receive the best BPDU and DP sends the best BPDU [3].

2.2 Bridge Protocol Data Unit (BPDU)

Bridge protocol data unit (BPDU) is the master mind of Root Bridge. It has different Fields which works differently. BPDU exchanges the information between all the Switches in a network for the selection of Root switch. Switch sends
BPDU after every 2 seconds on all network. RB take the help of BPDU. RB tells that which switch will be at receiving end and which switch will be at transmit end for the BPDU.

2.3 Fields of BPDU

There are different field of BPDU.

1. Root bridge ID (Priority no + Mac address)
2. Cost to the root (link cost from the Root)
3. Sender Bridge ID (sender priority+ Mac sender)
4. Sender port ID (sender port priority no + sender port no)

Every switch has its own priority number and Mac address. Best BPDU is which have less port no, Mac address or port priority. Switch which has best BPDU it wins the election and becomes the Root Bridge [4].

2.4 BPDU Write

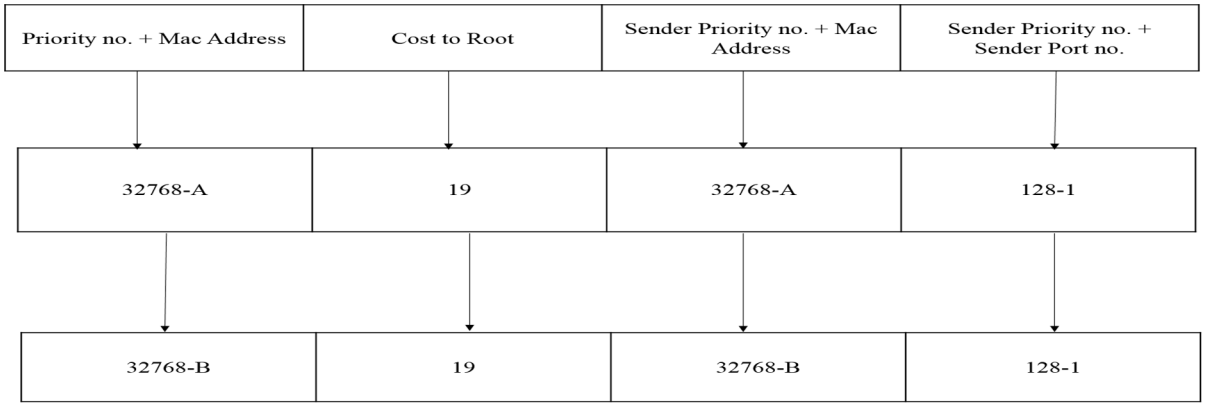

Figure 1. Election between BPDUs based on Mac address with default priority and port no.

Election between switches is based on priority no, Mac address and cost to root. In figure 1, switches have default priority, link cost and port number so election is based on Mac address and Switch A wins the election because switch A has less mac address number than Switch B. A is actually Mac address in short form of Mac address which, is less than B so A wins election and become the RB. Best BPDU is send through the port which has less priority no., Mac address or cost to root and it becomes DP. Port which receives best BPDU becomes RP other Ports goes in blocking state [4].

2.5 Conditions in STP

There are three conditions in STP. 1 RB per network, 1 DP per segment and 1 RP per Non Root Bridge.

2.6 STP States

STP has 5 states Disabling, Blocking, Listening, Learning, Forwarding. In STP when a link goes down it takes 30 to 60 seconds to come in forward state. Which passes from these 5 states [5].

3. RAPID SPANNING TREE PROTOCOL ANALYSIS

STP has a problem of link recovery in 30-60 seconds. This problem is mitigate by Rapid-spanning tree protocol (RSTP). RSTP has fast recovery. It recovers the link in milliseconds. The port comes in forward state milliseconds.

3.1 RSTP States

There are only 3 states in RSTP. Discarding, Learning and Forwarding Disabling, blocking and listening states comes in discarding state in RSTP. Less number of states make RSTP to come fast in forward state [6].

There is a problem in RSTP, Every VLAN has separate STP and every separate STP has a separate BPDU. If there are 100 VLANs then there are 100 BPDUs are been generated at backend which is flood of BPDUs after every 2 seconds at backend. Simply 10 VLANs BPDUs takes very much processing time. If there are 100 VLANs then the processing time increases and network become chocked [7].

4. MULTI INSTANCE SPANNING TREE PROTOCOL ANALYSIS

RSTP problem is solved by MSTP. MSTP is instance base protocol. Instance is some type of region.1 instance can have many VLANs. In MSTP BPDU is generated against instances so if there is 1 instance in MSTP then only 1 BPDU will be generate at backend. It consumes less processing time and network not chocked. When MSTP is run on switch at the same time RSTP is also running on backend so here both the problems, Fast recovery and more processing at backend due to BPDU are solved in a network [2] , [8].

4.1 MSTP Customization

All the VLANs are in instance 0 by default. So here need to customize the MSTP for load balancing. Make two instances instance2 and instance3 through the Configuration and add some VLANs on instance 2 and some on instance 3. This procedure make load balancing in network. If 2 instances are created then there will be 3 instances because instance 0 is by default in all switches and 3 BPDU will be run at backend. If traffic of instance 2 goes down then instance 0 keep traffic in forward state because instance 0 has all VLANs. This process make the load balancing in network. VLANs and MSTP have load balancing mechanism associate with each other [9].

5. EXPERIMENTAL METHODS AND RESULTS ANALYSIS

Experimental lab was carried out using Catalyst 2960 and 3550 Cisco switches. Network topologies are shown in figure 2 and 3. Number of switches could be increase.

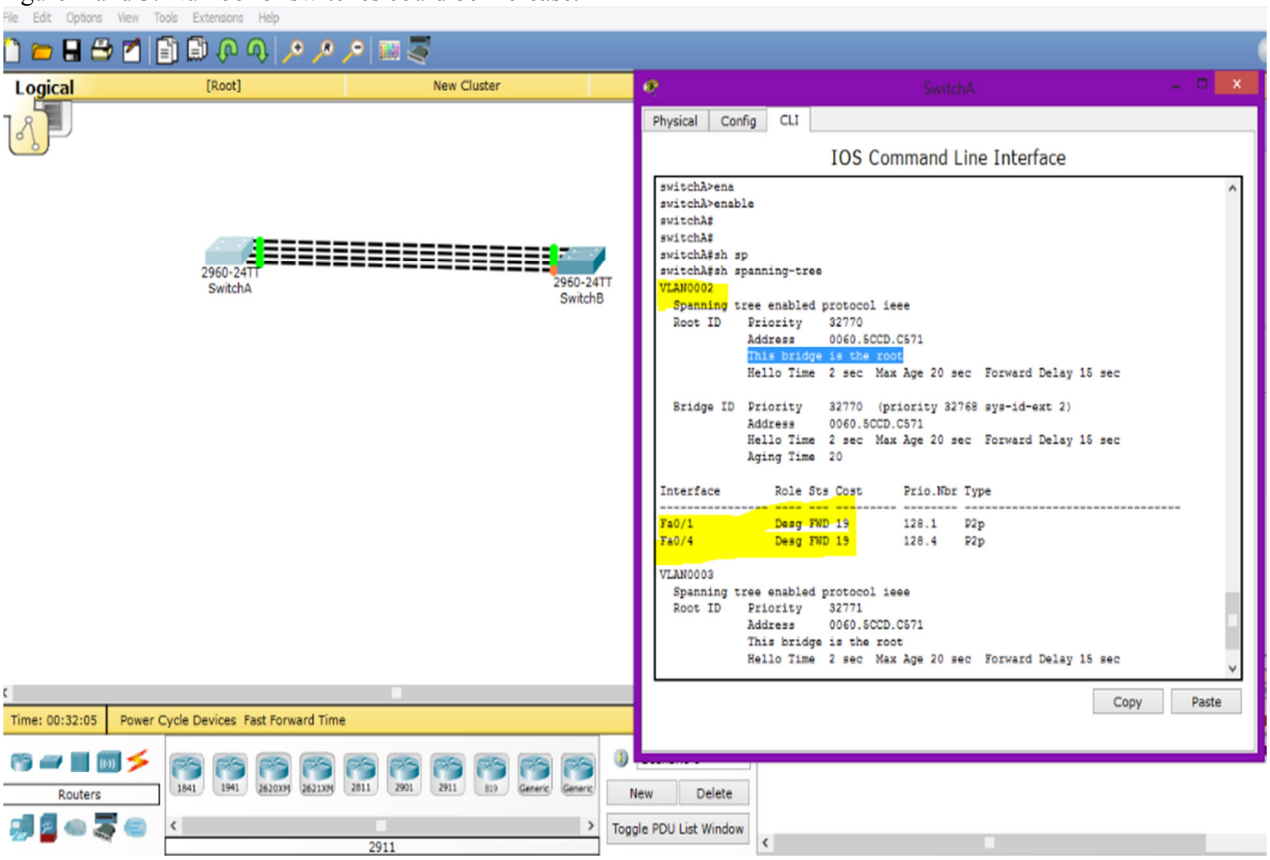

Figure 2. STP and RSTP experimental topology verification

In figure 2 VLANs 2, 3 and 4 were configured on first 3 link ports of Switch A and B to verify STP and RSTP. Link 4 have all VLANs (2, 3, and 4) traffic. From VLAN 2 verification Switch A is RB. Root ports of RB 0/1 and 0/4 were in forward state and 0/4 Port of switch B is in block state. Red dot in topology showing result. When we shut or no shut the port it takes 30 to 60 seconds to come in forward state. After STP verification RSTP mode was implemented through commands and recovery of link was in seems less time.

5.1 Instance Base MSTP process

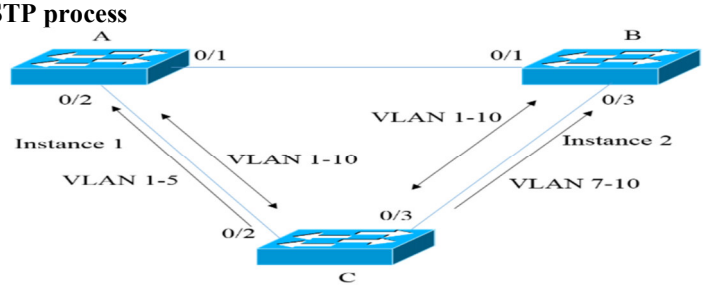

Figure 3. MSTP experimental topology

This topology was used in live environment having 10 VLANs for load balancing. Cisco catalyst 3550 switches were used. In topology Instance 1 has 1-5 VLANs traffic and instance 2 has 7-10 VLANs traffic while instance 0 has all VLANs traffic on all switches, because instance 0 is default in all switches. Topology shows load balancing in network. As per instances only 3 BPDUs are generated at backend.

5.2 STP verification and Mode commands

Sw (config-if) # switchport trunk allowed vlan (x)
Command to allow a VLAN to a port.
Sw # show interface trunk. With this command all VLANs traffic will be shown on their given interfaces
Sw # sh spanning-tree summary. Spanning tree summary can be seen using this command.
Sw # show spanning tree vlan (x). STP as per vlan.

Sw (config) # spanning-tree vlan (x) priority (x)
Priority no. of a switch can be change to pass specific vlans traffic.
Sw (confg) # show spanning-tree. STP verification

5.3 RSTP verify and Mode commands

Sw (config) # spanning-tree mode rapid-pvst. RSTP mode command.
Sw # sh spanning-tree rapid. RSTP verification.
Sw # debug spanning-tree bpdu receive. To check bpdu flood.
Sw # un all. To stop flood of bpdu.

5.4 MSTP verify and Mode commands

Sw (config) # spanning-tree mode mstp. MSTP mode command.
Sw (config) # spanning-tree mst configuration. MSTP verification command.
Sw (config) # instance 1 vlan 1-5. Instance 1 created with vlans (1-5).
Sw (config) # instance 2 vlan 7-10. Instance 2 created with vlan (7-10).
Commands were given in respective modes while configuring the switches.

6. CONCLUSION

From the lab and live environment experiments we can conclude that spanning tree STP control congestion in network. STP is IEEE approved standard 802.1d. To know the working of STP algorithm, BPDU write is very important. Rapid spanning tree protocol and multi instance spanning tree protocol are the modified versions of original spanning tree protocol 802.1d. Implementation of these protocols control the congestion, make the fast recovery time of a link, control BPDUs flood and done the load balancing in local area switches network.

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