2020

Network switching protocols

LAB03

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Objectives

Switching Network

Switching network protocol

STP and RSTP protocol

Introduction

A switch is a network communication device that is used to send and receive the data over the LAN and WAN. In Ethernet a switch is considered as a best replacement to the hub as it does not broadcast the data like in the hub. A switch is an intelligent device and it maintains a switching table that contains the information of the MAC address and IP addresses of all the computers in a network. A typical Switch supports 10 Mbps to 10/100, 1000 and 10,000 Mbps data transmission speed. Network switches can be connected with each other which allows the more computers and devices to join the same network. A typical switch provides the following features.

1. MAC address filtering.
2. Turn on and off ports.
3. Port mirroring
4. Duplex settings
5. Use of the Spanning Tree Protocol
6. Advanced switches can be configured according to your requirements.

Spanning Tree Protocol (STP).

STP is used by switches to prevent loops occurring on a network, this process is implemented by using spanning tree algorithm in disabling unwanted links and blocking ports that could cause loop. Loops and duplicate frames can have severe consequences on a network. Most LANs are designed to provide redundancy so that if a particular link fails another one can take over the forwarding of frame across the LAN.

Rapid STP (RSTP)

One big disadvantage of STP is the low convergence which is very important in switched network. To overcome this problem, in 2001, the IEEE with document 802.1w introduced an evolution of the Spanning Tree Protocol: Rapid Spanning Tree Protocol (RSTP), which significantly reduces the convergence time after a topology change occurs in the network. While STP can take 30 to 50 seconds to transit from a blocking state to a forwarding state, RSTP is typically able to respond less than 10 seconds of a physical link failure.

RSTP works by adding an alternative port and a backup port compared to STP. These ports are allowed to immediately enter the forwarding state rather than passively wait for the network to converge.

RSTP bridge port roles:

- Root port – A forwarding port that is the closest to the root bridge in terms of path cost
- Designated port – A forwarding port for every LAN segment
- Alternate port – A best alternate path to the root bridge. This path is different than using the root port. The alternative port moves to the forwarding state if there is a failure on the designated port for the segment.
- Backup port – A backup/redundant path to a segment where another bridge port already connects. The backup port applies only when a single switch has two links to the same segment (collision domain). To have two links to the same collision domain, the switch must be attached to a hub.
- Disabled port – Not strictly part of STP, a network administrator can manually disable a port

Now let’s see an example of three switches Figure 1:

Suppose all the switches have the same bridge priority so the switch with lowest MAC address will become root bridge -> Sw1 is the root bridge and therefore all of its ports will be Designated ports (forwarding). Two ports fa0/0 on Sw2 & Sw3 are closest to the root bridge (in terms of path cost) so they will become root ports. On the segment between Sw2 and Sw3, because Sw2

has lower MAC than Sw3 so it will advertise better BPDU on this segment -> fa0/1 of Sw2 will be designated port and fa0/1 of Sw3 will be Alternative port.

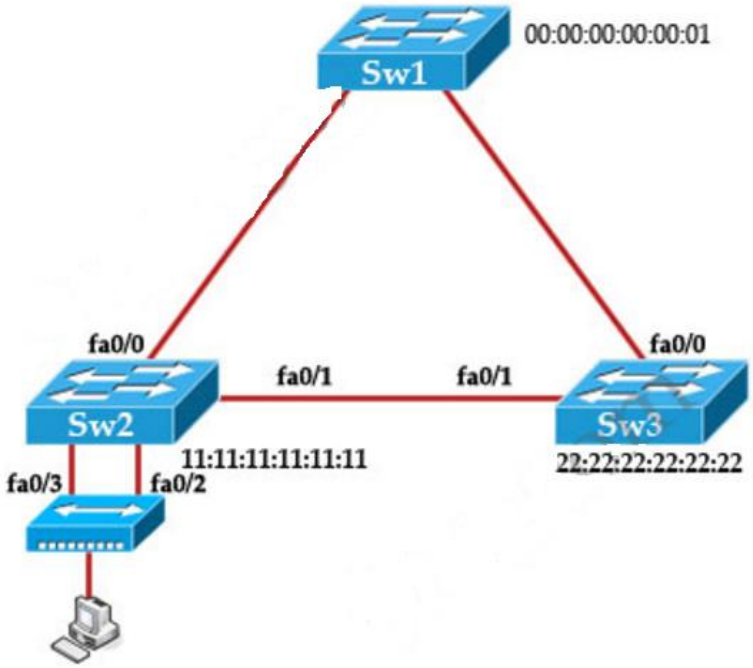

Figure 1.

Now for the two ports connecting to the hub, we know that there will have only one designated port for each segment (notice that the two ports fa0/2 & fa0/3 of Sw2 are on the same segment as they are connected to a hub). The other port will be Backup port according to the definition of Backup port above. But how does Sw2 select its Designated and Backup port? The decision process involves the following parameters inside the BPDU:

- Lowest path cost to the Root
- Lowest Sender Bridge ID (BID)
- Lowest Port ID

Well, both fa0/2 & fa0/3 of Sw2 has the same “path cost to the root” and “sender bridge ID” so the third parameter “lowest port ID” will be used. Because fa0/2 is inferior to fa0/3, Sw2 will select fa0/2 as its designated port.

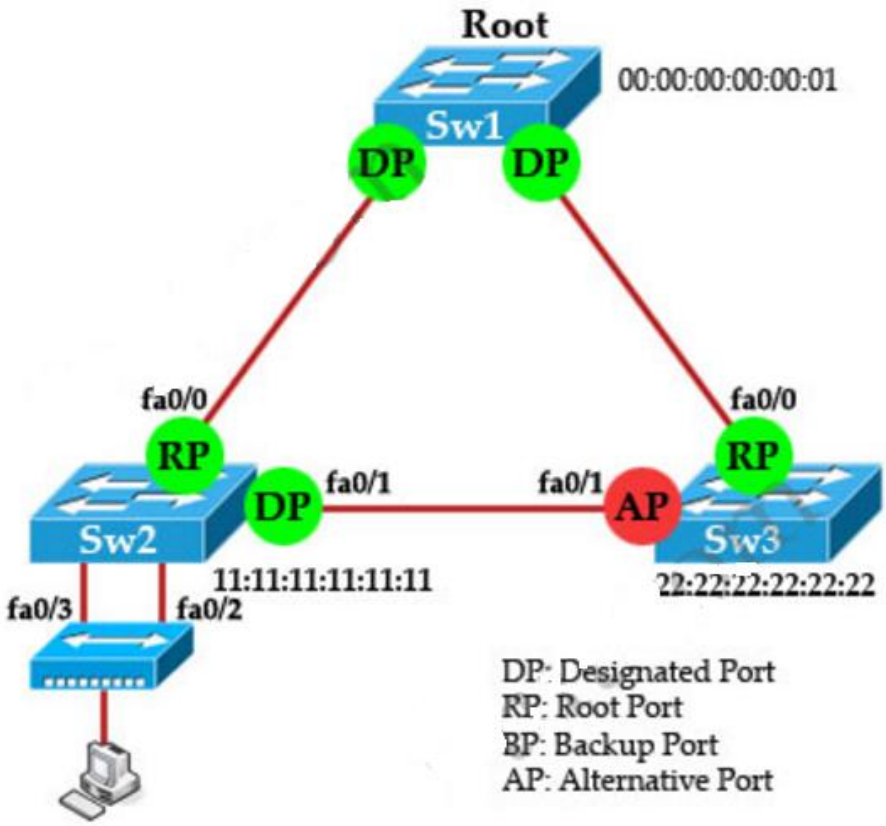

Figure 2.

Note: Alternative Port and Backup Port are in discarding state.

RSTP Port States:

There are only three port states left in RSTP that correspond to the three possible operational states. The 802.1D disabled, blocking, and listening states are merged into the 802.1w discarding state.

- Discarding – the port does not forward frames, process received frames, or learn MAC addresses but it does listen for BPDUs (like the STP blocking state)
- Learning – receives and transmits BPDUs and learns MAC addresses but does not yet forward frames (same as STP).
- Forwarding – receives and sends data, normal operation, learns MAC address, receives and transmits BPDUs (same as STP).

STP State (802.1d)	RSTP State (802.1w)
Blocking	Discarding
Listening	Discarding
Learning	Learning
Forwarding	Forwarding
Disabled	Discarding

Although the learning state is also used in RSTP but it only takes place for a short time as compared to STP. RSTP converges with all ports either in forwarding state or discarding state.

Ex. 1

Given the network in figure 3.

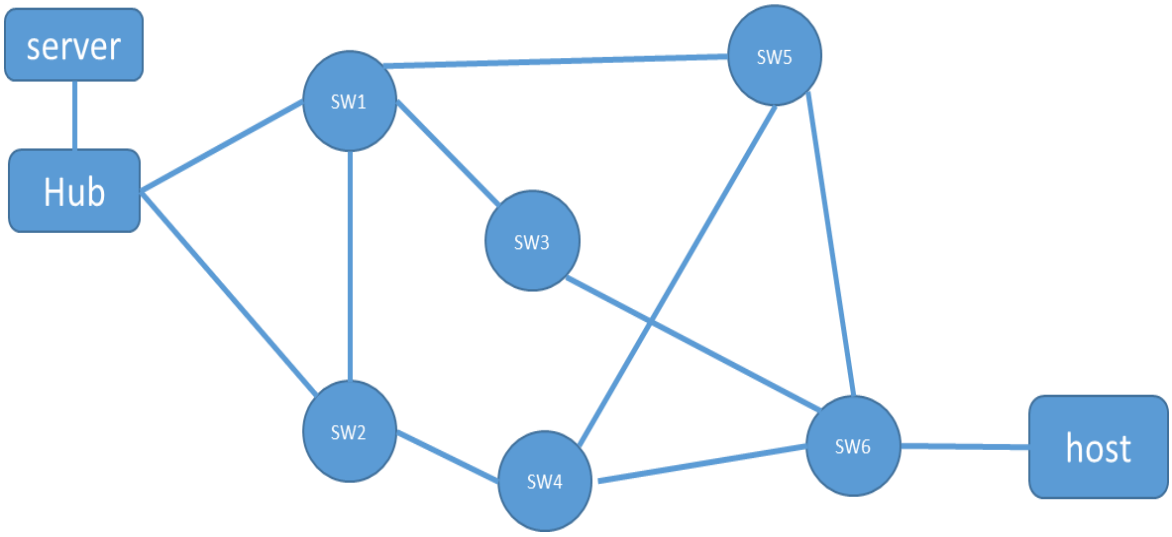

Figure 3.

1- Create a simulation scenario for the network in figure 3.
2- Analysis the effect of applying STP and RSTP in this network.
3- Draw the Spanning tree of this network given SW1 is the root
4- Assuming that SW1 shutdown after 50 seconds,
    a. Draw the spanning tree after SW1 shutdown for both STP and RSTP
5- Analysis the effect of shouting down SW1/SW2/SW3 in the network performances.

Ex. 2

Design a simulation scenario with 4 switches that demonstrates the network loops. Analysis your design and compare with the following solutions:

1- By applying the STP protocol
2- By applying RSTP protocol