Birzeit University

Faculty of Engineering and Technology
Electrical and Computer Engineering Department
Computer Networks Lab

Switching and VLANs --- Part 1

Router on Stick - RoS

Color Code

Text colors throughout the experiment are used as follows:

Color	Meaning
Black – Normal	Explanation of different experiment parts
Red	Vital notes and concepts
Dark Blue	Explanation of topology configuration steps, you need to follow up with these steps when doing the procedure, especially on Packet Tracer

Introduction

Switching is a core subject in computer networks. It discusses the different operations that a switch does in parallel to other kinds of concepts such as VLANs, multilayer switching, trunks, layering model of switches, bundle of cables… etc.

This experiment will be an introduction to switching in general and VLANs. The main concept of VLANs which will be discussed here is the router on stick. There are other ways to implement VLANs such as the SVI concept that will be discussed in the next experiment.

Theory

- How does a switch work?

A switch usually works as soon as it is plugged into a power source. Whenever a device is sends a frame at one of its ports, the switch extracts the MAC address of that device and links it to the port. At the end, a switch builds a table of MAC-Port mappings so it can deliver packets from one device to another.

For a quick switch performance demonstration, please watch the following:

https://www.youtube.com/watch?v=1YT7hsfYxz8 **(Prelab)**

For a quick overview on VLANs and how do they work, please read the following page (Linux Support is NOT important)

http://www.microhowto.info/tutorials/802.1q.html **(Prelab)**

Question: What happens if a switch does not know the MAC address of the destination device?

- What is Vlan?

A Vlan is an abbreviation of the term Virtual LAN. It is mainly a logical grouping of the switch ports into different subnets.

Short for virtual LAN, a network of computers that behave as if they are connected to the same wire even though they may actually be physically located on different segments of a LAN. VLANs are configured through software rather than hardware, which makes them extremely flexible. One of the biggest advantages of VLANs is that when a computer is physically moved to another location, it can stay on the same VLAN without any hardware reconfiguration.

- Trunk

This is a special kind of cable that is used in case we have VLANs. The main purpose of trunk is to manage the VLAN traffic. It uses a concept called tagging to mark each packet so each switch knows where to forward the traffic.

There are many cases that we can use a trunk. It can be used between two switches or between a router and switch in case of RoS. It can also be used between a layer three switch and ordinary switch as we will discuss in the coming experiment.

- Sub interface

This is a part of a main interface on a router. It takes part of the bandwidth and passes special kind of traffic. It has also its own ip address and encapsulation number (which is used to tag traffic). Main interface does not have to get an ip address in case of sub interfaces.

Concepts & Configuration

Step 1: Creating a VLAN

You can create a specific vlan on a switch using the following command

Switch(config)# VLAN 10

Then you can check that this VLAN is configures using

Switch# show VLAN

In this experiment, we need to configure two VLANs on each of the switched using this command and the VLAN table should be as follows:

```
VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
1    default                          active    Fa0/3, Fa0/4, Fa0/5, Fa0/
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/
                                                Fa0/11, Fa0/12, Fa0/13, F
                                                Fa0/15, Fa0/16, Fa0/17, F
                                                Fa0/19, Fa0/20, Fa0/21, F
                                                Fa0/24
10   VLAN0010                         active    Fa0/1
20   VLAN0020                         active    Fa0/2
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

Figure -1-

As we can notice, figure 1 show that the switch has two VLANs named as VLAN10 and VLAN20.

Step 2: Assigning an interface to an existing VLAN

Switch(conf-if)# switchport access VLAN 10

This command assigns the interface to VLAN 10. You can also assign a group of interfaces to a VLAN.

Switch(config)#interface range fastethernet0/1 – 20

This command creates a range of interfaces, and then you can assign them to any VLAN using the access command.

In this experiment, we need to assign a random interface to each created VLAN. Figure 1 show that interface fast Ethernet 0/1 is assigned to VLAN10 and interface fast Ethernet 0/2 is assigned to VLAN20.

Note: An empty VLAN may not work properly. So assigning an interface to a vlan is somehow important.

- Trunk

Configuring a trunk cable on switch is simple. You have to access the needed port and perform the following command

Switch(conf-if)# switchport mode trunk

When one end of a link is configured as a trunk, the other end changes automatically to trunk mode. This cable is now managing VLANs traffic.

To check the mode of a cable, we can use the following command

Switch# show interface fastEthernet 0/24 switchport

In this experiment, we have to configure many trunk cables based on the following:

1- **Each "Switch to Router" cabling should be configured as a TRUNK.**
2- **Each "Switch to Switch" cabling should be configured as a TRUNK.**

In light of that, we will have four trunk cables; an example of switch 2 trunk would be as in figure 2. At this case, interface fast Ethernet 0/24 was configured as TRUNK. Notice the Operational mode of the interface in figure 2.

```
--

Name: Fa0/24
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
```

Figure -2-

Step 3: Sub interface

When we use the concept of Router on Stick in configuring VLANs, we have to do a sub interface for each VLAN configured on the switch. A Sub interface acts as default gateway for a specific VLAN.

Initializing a sub interface is done as follows:

Router# conf t
Router(conf)# interface FastEthernet X.X // the first X stands for the interface Name and the second X stands for the Sub interface number --- Example: fastethernet 0/0.10
Router(conf-if)# ip address X.X.X.X X.X.X.X
Router(conf-if)# encapsulation dotQ X // this command is used to mark (tag) the traffic for this subinterface

Don't forget to do a No Shutdown command on the main interface before/after configuring Sub interfaces.

In this experiment, we need to create two subinterfaces for each VLAN on each router. Each one of them will be used to act as a default gateway for one of the VLANs. In other words, Sub interface 10 will be the default gateway for VLAN10 and Sub interface 20 will be the default gateway for VLAN20.

For example, router 1 needs to get two sub interfaces, and the final configuration will be as follows:

```
Router#sh ip interface brief
Interface              IP-Address      OK? Method Status                Protocol

FastEthernet0/0        unassigned      YES unset  up                    up

FastEthernet0/0.10     192.168.10.1    YES manual up                    up

FastEthernet0/0.20     192.168.20.1    YES manual up                    up
```

Figure -3-

Obviously, there is no need to insert an interface address on the main Ethernet interface. Fast Ethernet 0/0 DOES not have an IP address.

PRELAB

Configure the following topology using RoS

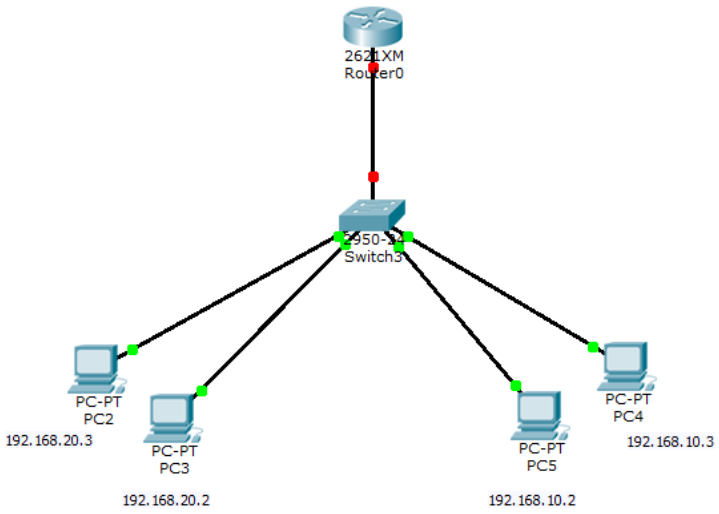

Figure -4-

Insights:

1- Perform two sub interfaces on Router 0, for example: fast ethernet0/0.10 and fast ethernet0/0.20.
2- Create two VLANs on the switch, one for 192.168.10.0 and another one for 192.168.20.0
3- Assign suitable ports to these VLANs.
4- Configure the “Router to Switch” cable as a trunk.

Ping from from-to all devices should work properly.

Note: Bring the configuration to the lab saved on your laptops.

Procedure

The experiment includes two parts. The first one has to be done using the hardware devices, and the second one has to be done during the lab. **Be prepared for a discussion concerning the second part.**

Phase 1: hardware

You have to perform a part of your prelab using hardware devices. After that you have to answer the following questions.

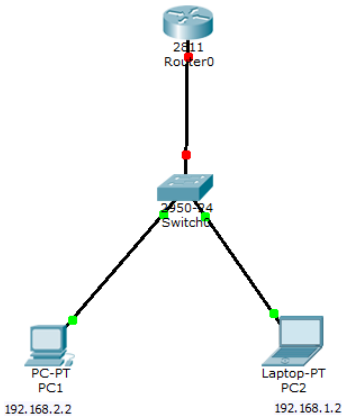

Figure -5-

Questions:

1- Perform a ping from PC1 to PC2. How does this work?
2- What is the main usage of the router in this topology (the answer is NOT Routing! You have to explain a specific case at which we need to use a router here)?
3- If we need to insert a new switch to support new ports on the existing VLANs. How would the topology change? Is that possible? Why?

Phase 2: packet tracer

You have to configure the following topology using the concepts of RoS.

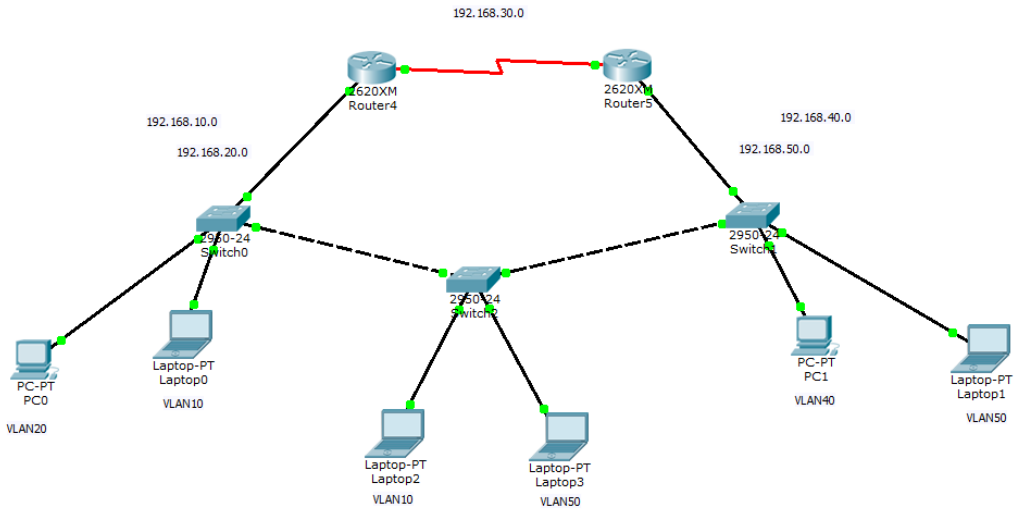

Figure -6-

Configuration would include the following:

- Suitable sub interfaces on routers. (2811 routers are preferred!)
- Suitable VLANs on switches.
- Trunk cables should be configured where needed.
- Other needed configuration from previous experiment can be used. (Routing Prtocols).

Prepared By: Muawiya Assali

Cisco Certified Instructor