Computer Networks

Lab No.: 3

Network Devices and Basic Configuration

Objectives:

- To be familiar with Network Simulation Tool: Packet Tracer
- To be familiar with network devices: Repeater, Hub, Bridge & Switch
- To be familiar with router, and its components
- To be familiar with commands for basic configuration of a router
- To be familiar with default gateway and its need in a network

Requirements:

- Network simulation tool: Packet Tracer

Packet Tracer:

Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface. Packet Tracer makes use of a drag and drop user interface, allowing users to add and remove simulated network devices as they see fit. The software is mainly focused towards Certified Cisco Network Associate Academy students as an educational tool for helping them learn fundamental CCNA concepts. However, it allows anyone to design, test and verify complex and large networks, which is often not feasible with physical hardware, due to cost and unavailability of resources.

Repeater:

A networking device that is used to regenerate the incoming signal. Repeater works at the physical layer of the OSI model. The main purpose of using a repeater is to extend the network length. While increasing length or distance between networking devices the quality of signals degrades. Repeater helps to reduce error, and loss of data by regenerating the signal.

Hub:

Hub is a multiport repeater. Usually it regenerates the incoming signal and forwards it to all other ports except the incoming one. It works at the physical layer of the OSI model. Network devices connected via hub are on the same collision domain.

Bridge:

A networking device that is used to connect multiple communication networks or network segments. Unlike repeater, a bridge can filter network traffic between two or more network segments. It operates on Layer 2 of the OSI and is primarily used to extend as well as segment networks.

Switch:

A network switch is an equipment that allows multiple network devices to communicate with one another. Unlike hub, a switch can filter network traffic on the basis of device ID. It operates on Layer 2 of the OSI.

Router:

A router is a networking device that forwards data packets between computer networks. A packet is typically forwarded from one router to another router through the networks that constitute an internetwork (e.g. the Internet) until it reaches its destination node.

A router is connected to two or more data lines from different IP networks. When a data packet comes in on one of the lines, the router reads the network address information in the packet header to determine the ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey.

Figure: Router Rare View

Router components

- CPU
- Memory: RAM, NVRAM, ROM, Flash
- Buses
- Interfaces
- Power supply

Router external connections

- Three basic types of connections on a router are:
  - LAN interfaces
  - WAN interfaces and
  - Management ports
- LAN and WAN interfaces provide LAN and WAN connectivity respectively. These interfaces are the networking interfaces. They connect routers to a network for data packet entry and exit.

- Router Management Ports are Console and auxiliary (AUX) ports. They provide physical access for initial configuration of the router. They are asynchronous serial ports. They provide a text-based connection for the configuration and troubleshooting of a router. One of them (preferably the console port) is used for initial configuration of router

Connecting console port

- The cable used between a terminal and a console port is a rollover cable
- To connect the console port with PC, a rollover cable and a RJ-45 to DB-9 adapter are used
- Terminal emulation software such as HyperTerminal is usually used in PC [Here the PC is acting as a "dumb terminal"]
- Configure terminal emulation software on the PC as (to connect PC to console port of a router) with appropriate com port
  - 9600 baud
  - 8 data bits
  - No parity
  - 1 stop bit
  - No flow control

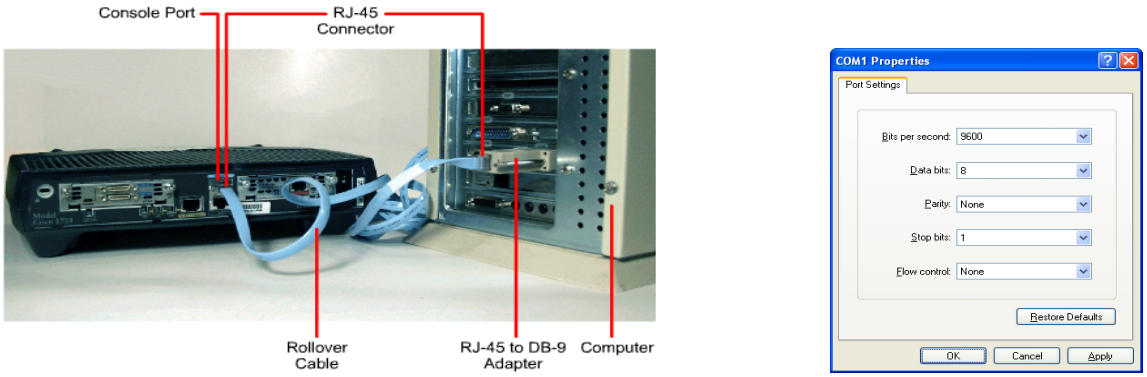


Figure: Console port connection requirements

Basic Configuration of a Router

Router user interface modes

```
Router>                    User EXEC
Router> enable
Password:
Router#                    Privileged EXEC
Router# disable
Router>                    User EXEC
```

Router Modes

`Router>`	User EXEC mode
`Router#`	Privileged EXEC mode
`Router(config)#`	Global configuration mode
`Router(config-...)#`	Specific configuration mode, for example:
`Router(config-if)#`	Interface configuration mode
`Router(config-subif)#`	Subinterface configuration mode
`Router(config-line)#`	Line configuration mode

Configuring router name

It is better to give a unique name for a router

```
Router#
Router# configure terminal
Router(config)#
Router(config)# hostname Lab_A
Lab_A(config)#
```

Configuring router passwords

- Password on console line

```
Router(config)# line console 0
Router(config-line)# password cisco
Router(config-line)# login
```

- Password for privileged EXEC mode

```
Router(config)# enable password class
```

- Password for virtual terminal

```
Router(config)# line vty 0 4
Router(config-line)# password cisco
Router(config-line)# login
```

- Password encryption

```
Router(config)# service password-encryption
```

Show commands

- show version: Displays version information
- show running-config: Displays current configuration (RAM)
- show startup-config: Displays startup configuration (NVRAM)
- show flash: Shows IOS file and flash space
- show interfaces: View the status of interfaces
  - show interfaces e0: for Ethernet 0
- show arp: Displays ARP table of router
- show ip route: Displays IP routing table
- show protocols: Displays the interface specific status of any configured protocols

Configuring an interface

Steps to configure an Ethernet/Serial interface:

- Enter into interface configuration mode as:
  User EXEC mode ⇒ Privileged EXEC ⇒ Global configuration mode ⇒ Interface configuration mode
- Enter IP address and subnet mask
- Set clock rate if interface is serial and is connected as DCE, else skip this step
- Turn on the interface

Configuring Ethernet Interface

```
Router> enable
Router# configure terminal
Router(config)# interface ethernet 0
Router(config-if)# ip address 192.5.5.1 255.255.255.0
Router(config-if)# no shutdown
```

Configuring Serial interface as DTE

```
Router> enable
Router# configure terminal
Router(config)# interface serial 1
Router(config-if)# ip address 201.100.11.2  255.255.255.0
Router(config-if)# no shutdown
```

Configuring Serial interface as DCE

```
Router> enable
Router# configure terminal
Router(config)# interface serial 0
Router(config-if)# ip address 201.100.11.1  255.255.255.0
Router(config-if)# clock rate 56000
Router(config-if)# no shutdown
```

Note: Clock rate is necessary when it is connected as DCE

Connectivity tests

- **`ping:`** It is a basic test mechanism which uses the ICMP protocol to verify the hardware connection and the IP address. The ping command sends a packet to the destination host and then waits for a reply packet from that host command using Internet Control Message Protocol (ICMP)
- **`traceroute`**: It uses time to live (TTL) to generate messages from each router on the path, locates failure in a path from a source to a destination

Establishing a Telnet connection

To initiate a Telnet session any of the following alternatives can be used

```
Lab_A> telnet 199.6.13.2
Lab_A> 199.6.13.2
```

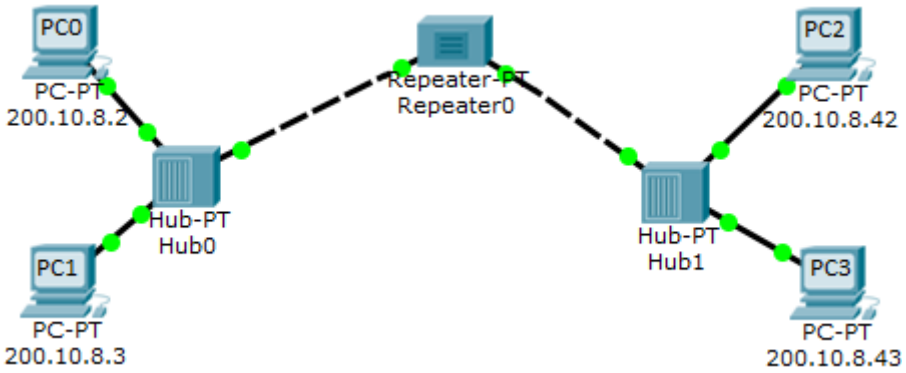
Telnet connection is terminated after ten minutes of inactivity by default or when the exit command is entered

IP address and Default gateway:

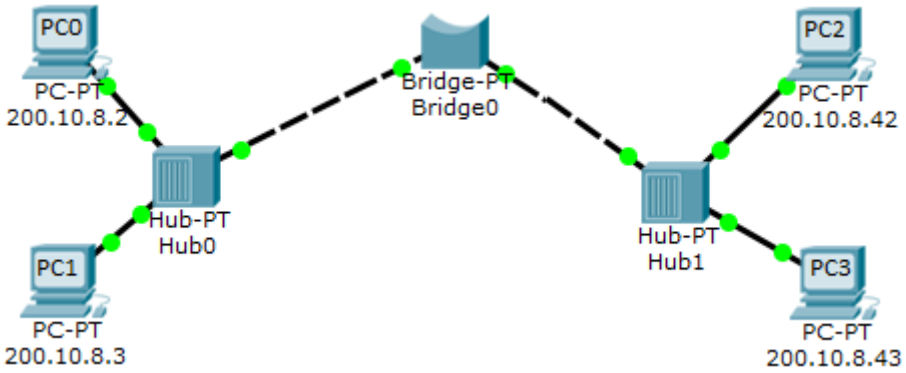
- Any computer must be configured with appropriate IP address & subnet mask to communicate with another computer in the same network
- The default gateway need to be configured in a Computer if any data packet need to be forwarded to another network from that computer
- The IP address, default gateway and other configurations can be performed in a Computer by using either of following techniques:
    - Dynamic: By using DHCP
    - Static: By administrator

Activities:

A. Create a network topology as shown in the figure below

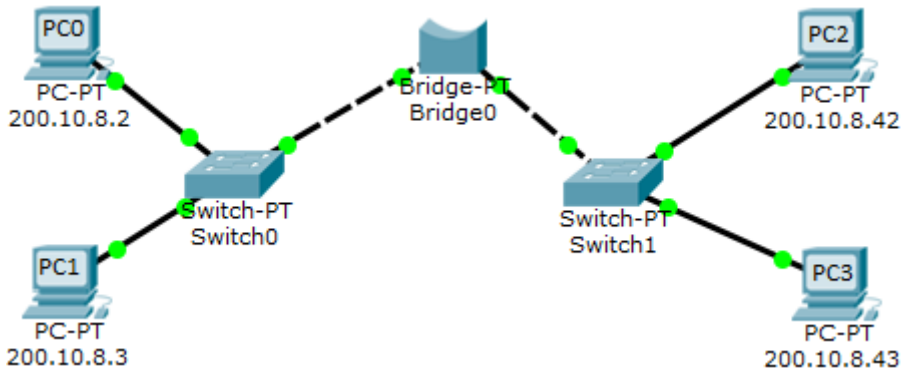


1. Set the IP address of all computers as shown in figure above and the subnet mask as 255.255.255.0 for all.
2. Test the connectivity from one computer to another using the ping command and note down the result.
3. Initiate the ping command from PC0 to PC1 in simulation mode. Observe how the packet travels in the network.
4. Observe by initiating the ping command from PC0 to PC2 and from PC2 to PC0 at once in simulation mode. Note down the result.
5. Replace the Repeater0 by a bridge as shown below:

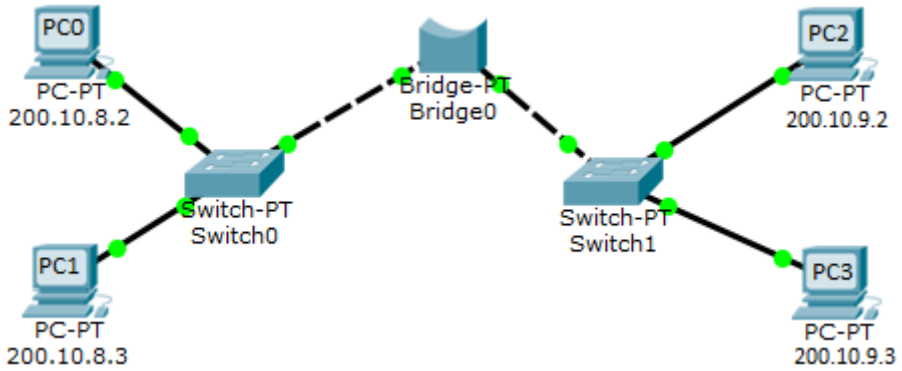


6. Now test the connectivity from one computer to another using the ping command and note down the result.
7. Initiate the ping command from PC0 to PC1 in simulation mode. Observe how the packet travels in the network and compare with that of activity 3.

8. Observe by initiating the ping command from PC0 to PC2 and from PC2 to PC0 at once in simulation mode. What are the differences you have observed as compared with activity 4 above. Note down the result.
9. Replace both hubs Hub0 and Hub1 with switches as shown below:

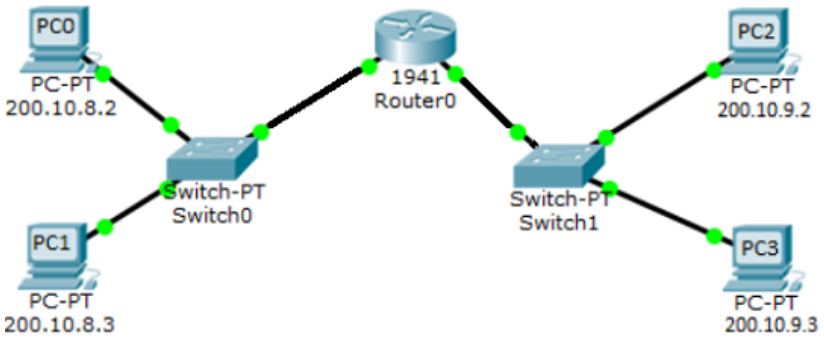


10. Now test the connectivity from one computer to another using the ping command and note down the result.
11. Initiate the ping command from PC0 to PC1 in simulation mode. Observe how the packet travels in the network and compare with that of activity 7.
12. Observe by initiating the ping command from PC0 to PC2 and from PC2 to PC0 at once in simulation mode. What differences have you observed as compared with activity 8 above. Note down the result.
13. Now change the IP addresses of PC2 and PC3 as shown in the figure below:

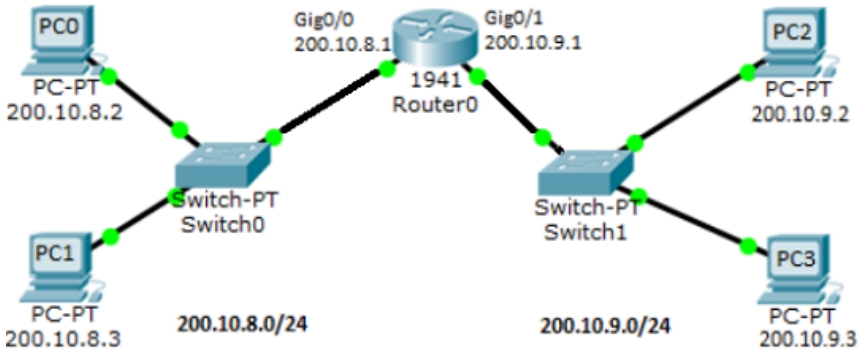


14. Now again test the connectivity from one computer to another using the ping command and note down the result. Note that in some cases there is a successful connection but from some PC to another there may not be a successful connection, why? State with reason.
15. How could the connections be made successful?

B. Modify the above network to replace the bridge by a router as shown in figure below:



1. Use the ping command to test the connectivity from PC0 to PC1, PC2 and PC3. Observe the result and note it down.
2. Similarly use the ping command to test the connectivity from PC2 to PC0, PC1 and PC3. Observe the result and note it down.
3. Now, Configure the Router0 to change the hostname of the router as your "First Name"
4. Configure the console password as your "Surname".
5. Configure the enable password as "cisco".
6. Configure the telnet password as "class".



7. Configure the IP address of 200.10.8.1 with a subnet mask of 255.255.255.0 in the given interface of the router (refer the figure above).
8. Run the command prompt in PC0 and connect to the router using telnet.
9. Configure the IP address of 200.10.9.1 with a subnet mask of 255.255.255.0 in the other interface of the router (refer the figure above).
10. Use ping command to test the connectivity from PC0 to PC1, PC2, PC3 and both IP addresses of Router. Observe the result and note it down.
11. Use ping command to test the connectivity from PC3 to PC0, PC1, PC2 and both IP addresses of Router. Observe the result and note it down.
12. Use ping command to test the connectivity from Router to PC0, PC1, PC2 and PC3. Observe the result and note it down.

13. Set the default gateway of PC0 as 200.10.8.1 and the default gateway of PC2 as 200.10.9.1.
14. Repeat steps 10 & 11 and note down the result. Also comment on your observations. Also observe in simulation mode to see how the packet is forwarded in the network.
15. Now set the default gateway of PC1 as 200.10.8.1. Similarly set the default gateway of PC3 as 200.10.9.1.
16. Test the connectivity from each PC to all other PCs as well as the router. Note down the observations.
17. Test the connectivity from the router to each PCs. Note down the observations.
18. You can use simulation mode to be even more clear on above mentioned activities (if necessary).

Exercises:

1. How do Repeater, Hub, Bridge and Switch work in a network? Explain on the basis of your observations.
2. What is a router? Explain its role in computer networks. Explain on the basis of your observations in this lab activity.
3. Note down the observation of each steps with necessary commands specified in activities A and B mentioned above and comment on it.

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