DEPARTMENT OF INFORMATION TECHNOLOGY

CCN LAB 3: Router Configuration   DATE: 24 -1 - 2018

<u>Previous lab :</u>

1. Simulation with Hub and switch
2. Difference between hub and switch
3. IP configuration for nodes
4. Running Ping application between nodes and observing its results

<u>Today's Lab Objective:</u>

1. To learn about router configuration
2. To understand about network addresses
3. To know the working of ICMP, ARP and RIP protocols

Part – 1
ROUTER and SWITCH

Routers are computers and include many of the same hardware and software components found in a typical PC, such as CPU, RAM, ROM, and an operating system.
The main purpose of a router is to connect multiple networks and forward packets from one network to the next. This means that a router typically has multiple interfaces. Each interface is a member or host on a different IP network.
The router has a routing table, which is a list of networks known by the router. The routing table includes network addresses for its own interfaces, which are the directly connected networks, as well as network addresses for remote networks. A remote network is a network that can only be reached by forwarding the packet to another router.
Remote networks are added to the routing table in two ways: either by the network administrator manually configuring static routes or by implementing a dynamic routing protocol. Static routes do not have as much overhead as dynamic routing protocols; however, static routes can require more maintenance if the topology is constantly changing or is unstable.
Dynamic routing protocols automatically adjust to changes without any intervention from the network administrator. Dynamic routing protocols require more CPU processing and also use a certain amount of link capacity for routing updates and messages. In many cases, a routing table will contain both static and dynamic routes.
Routers make their primary forwarding decision at Layer 3, the Network layer. However, router interfaces participate in Layers 1, 2, and 3. Layer 3 IP packets are encapsulated into a Layer 2 data link frame and encoded into bits at Layer 1. Router interfaces participate in Layer 2 processes associated with their encapsulation. For example, an Ethernet interface on a router participates in the ARP process like other hosts on that LAN.

Router Components and their Functions

Like a PC, a router also includes:
• Central Processing Unit (CPU)
• Random-Access Memory (RAM)
• Read-Only Memory (ROM)

CPU
The CPU executes operating system instructions, such as system initialization, routing functions, and switching functions.
RAM
RAM stores the instructions and data needed to be executed by the CPU. RAM is used to store these components:
• Operating System: The Cisco IOS (Internetwork Operating System) is copied into RAM during bootup.
• Running Configuration File: This is the configuration file that stores the configuration commands that the router IOS is currently using. With few exceptions, all commands configured on the router are stored in the running configuration file, known as running-config.
• IP Routing Table: This file stores information about directly connected and remote networks. It is used to determine the best path to forward the packet.
• ARP Cache: This cache contains the IPv4 address to MAC address mappings, similar to the ARP cache on a PC. The ARP cache is used on routers that have LAN interfaces such as Ethernet interfaces.
• Packet Buffer: Packets are temporarily stored in a buffer when received on an interface or before they exit an interface.
RAM is volatile memory and loses its content when the router is powered down or restarted. However, the router also contains permanent storage areas, such as ROM, flash and NVRAM.

ROM
ROM is a form of permanent storage. Cisco devices use ROM to store:
• The bootstrap instructions
• Basic diagnostic software
• Scaled-down version of IOS

ROM uses firmware, which is software that is embedded inside the integrated circuit. Firmware includes the software that does not normally need to be modified or upgraded, such as the bootup instructions. Many of these features, including ROM monitor software, will be discussed in a later course. ROM does not lose its contents when the router loses power or is restarted.

Flash Memory
Flash memory is nonvolatile computer memory that can be electrically stored and erased. Flash is used as permanent storage for the operating system, Cisco IOS. In most models of Cisco routers, the IOS is permanently stored in flash memory and copied into RAM during the bootup

process, where it is then executed by the CPU. Some older models of Cisco routers run the IOS directly from flash. Flash consists of SIMMs or PCMCIA cards, which can be upgraded to increase the amount of flash memory.
Flash memory does not lose its contents when the router loses power or is restarted.

NVRAM

NVRAM (Nonvolatile RAM) does not lose its information when power is turned off. This is in contrast to the most common forms of RAM, such as DRAM, that requires continual power to maintain its information. NVRAM is used by the Cisco IOS as permanent storage for the startup configuration file (startup-config). All configuration changes are stored in the running-config file in RAM, and with few exceptions, are implemented immediately by the IOS. To save those changes in case the router is restarted or loses power, the running-config must be copied to NVRAM, where it is stored as the startup-config file. NVRAM retains its contents even when the router reloads or is powered off.

ROM, RAM, NVRAM, and flash are discussed in the following section which introduces the IOS and the bootup process. They are also discussed in more detail in a later course relative to managing the IOS.

It is more important for a networking professional to understand the function of the main internal components of a router than the exact location of those components inside a specific router. The internal physical architecture will differ from model to model.

Router Interfaces

Management ports

Routers have physical connectors that are used to manage the router. These connectors are known as management ports. Unlike Ethernet and serial interfaces, management ports are not used for packet forwarding. The most common management port is the console port. The console port is used to connect a terminal, or most often a PC running terminal emulator software, to configure the router without the need for network access to that router. The console port must be used during initial configuration of the router.

Another management port is the auxiliary port. Not all routers have auxiliary ports. At times the auxiliary port can be used in ways similar to a console port. It can also be used to attach a modem.

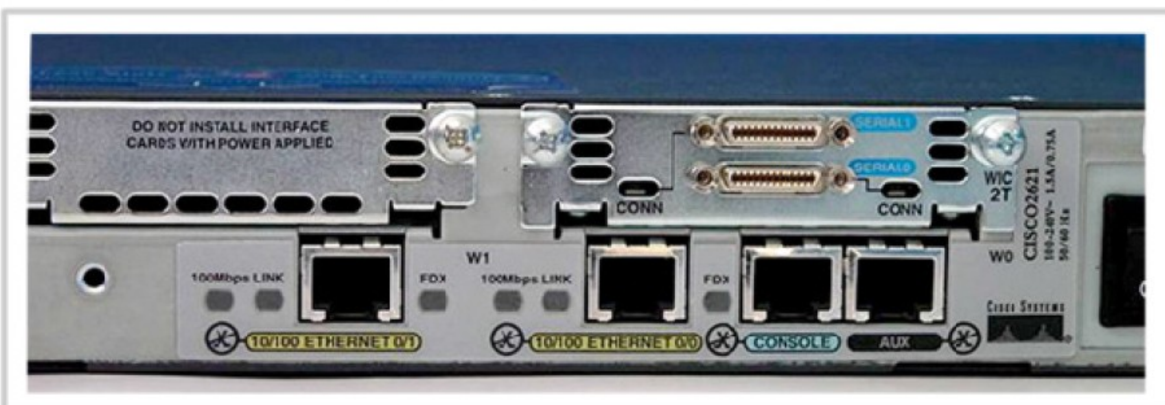
Network Interfaces

The term interface refers to a physical connector on the router whose main purpose is to receive and forward packets. Routers have multiple interfaces that are used to connect to multiple networks. Typically, the interfaces connect to various types of networks, which means that different types of media and connectors are required. Often a router will need to have different types of interfaces. For example, a router usually has FastEthernet interfaces for connections to different LANs and various types of WAN interfaces to connect a variety of serial links including T1, DSL and ISDN.

Like interfaces on a PC, the ports and interfaces on a router are located on the outside of the router. Their external location allows for convenient attachment to the appropriate network cables and connectors.
Like most networking devices, routers use LED indicators to provide status information. An interface LED indicates the activity of the corresponding interface. If an LED is off when the interface is active and the interface is correctly connected, this may be an indication of a problem with that interface. If an interface is extremely busy, its LED will always be on. Depending on the type of router, there may be other LEDs as well.

The network switch plays an integral part in most Ethernet LANs. Mid-to-large sized LANs contain a number of linked managed switches. A switch operates at the data-link layer of the OSI model to create a different collision domain per switch port.
Similar components available on switches as described above for routers, a switch has a console port for management and a set of Ethernet interfaces for LANs connections.

Router Interfaces - Physical Representation



RIP Protocol:

RIP (Routing Information Protocol) is a widely-used protocol for managing router information within a self-contained network such as a corporate local area network (LAN) or an interconnected group of such LANs. RIP is classified by the Internet Engineering Task Force (IETF) as one of several internal gateway protocols (Interior Gateway Protocol).

Using RIP, a gateway host (with a router) sends its entire routing table (which lists all the other hosts it knows about) to its closest neighbor host every 30 seconds. The neighbor host in turn will pass the information on to its next neighbor and so on until all hosts within the network have the same knowledge of routing paths, a state known as *network convergence*. RIP

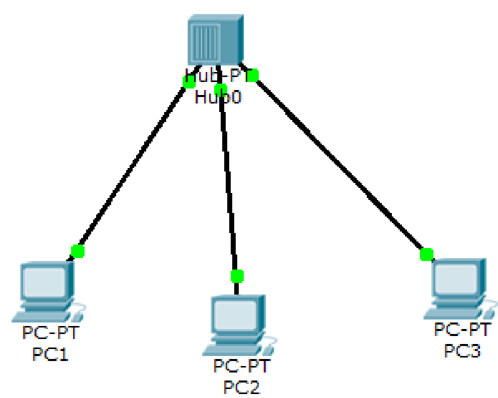
uses a hop count as a way to determine network distance. (Other protocols use more sophisticated algorithms that include timing as well.) Each host with a router in the network uses the routing table information to determine the next host to route a packet to for a specified destination.

RIP is considered an effective solution for small homogeneous networks. For larger, more complicated networks, RIP's transmission of the entire routing table every 30 seconds may put a heavy amount of extra traffic in the network.

Part 2
Router Configuration

Step 1: Create a network with one hub and 3 nodes and assign addresses as follows.

Host	IP address	Subnet Mask
PC0	**192.168.1.10**	**255.255.255.0**
PC1	**192.168.1.11**	**255.255.255.0**
PC2	**192.168.1.12**	**255.255.255.0**

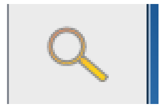


Observation1: Set Simple PDU transfer between PC0 to PC1.
Observation2: View ARP tables on each PC.

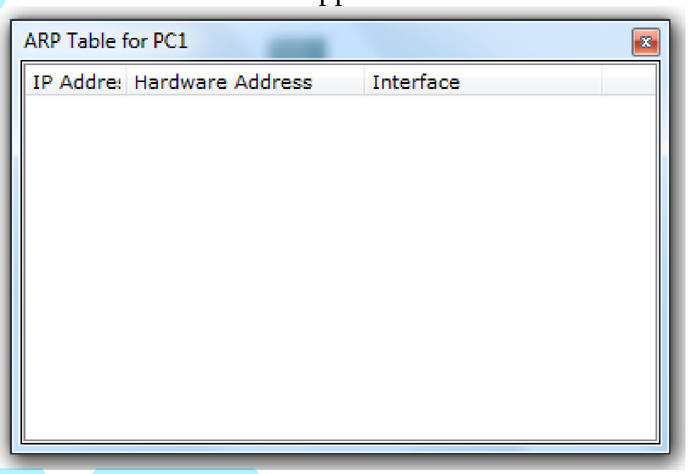
a) Choose the Auto Capture / Play button and allow the simulation to run completely.
b) Click on PC-0 and select the Desktop tab.
c) Select the Command Prompt and type the command arp -a.

d) Notice that the MAC address for PC1 is in the ARP table (to view the MAC address of PC1, click on PC1 and select the Config tab.

e) To examine the ARP tables for PC1 and PC2 in another way, click on the Inspect Tool.



Then click on PC1 and the ARP table will appear in a new window.

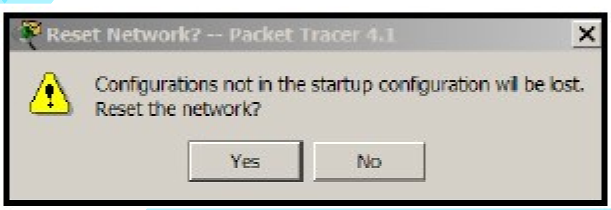


NOTE: To deactivate the Inspect Tool, click on the Select Tool

Note:

Choose the Power Cycle Devices button on the bottom left, above the device icons.

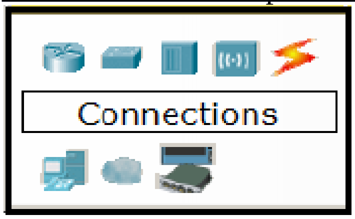
Choose Yes



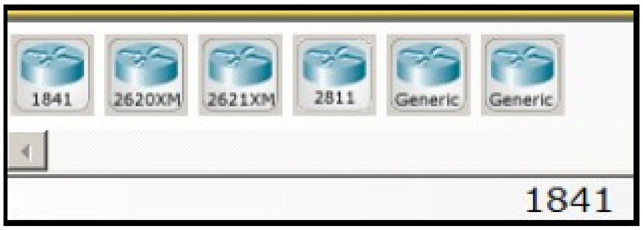
Notice that both the ICMP and ARP envelopes are now present. The Power Cycle Devices will clear any configuration changes not saved and clear the MAC / ARP tables.

Step 2: Adding Routers and installing modules

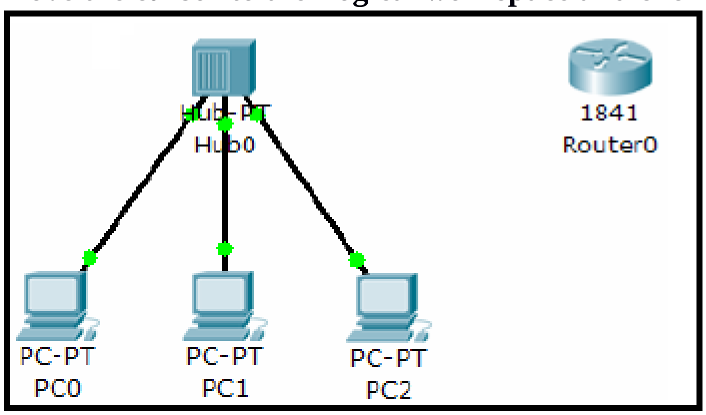
a) <u>In the Network Component Box, click on the router.</u>



b) Select router 1841



c) Move the cursor to the Logical workspace and click on the desired location



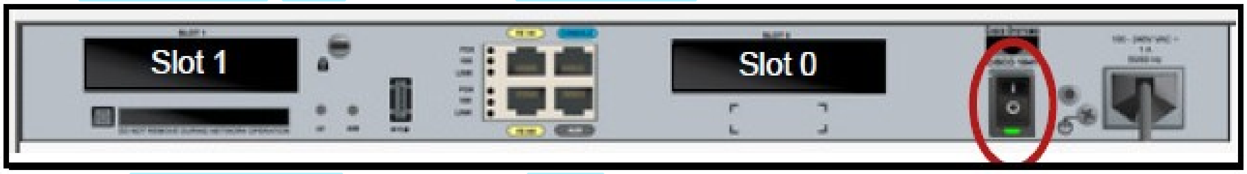
NOTE: If multiple instances of the same device are needed press and hold the **Ctrl** button, click on the desired device, and then release the **Ctrl** button. A copy of the device will be created and can now be move to the desired location.

d) Click on the router to bring up the Configuration Window. This window has three modes:

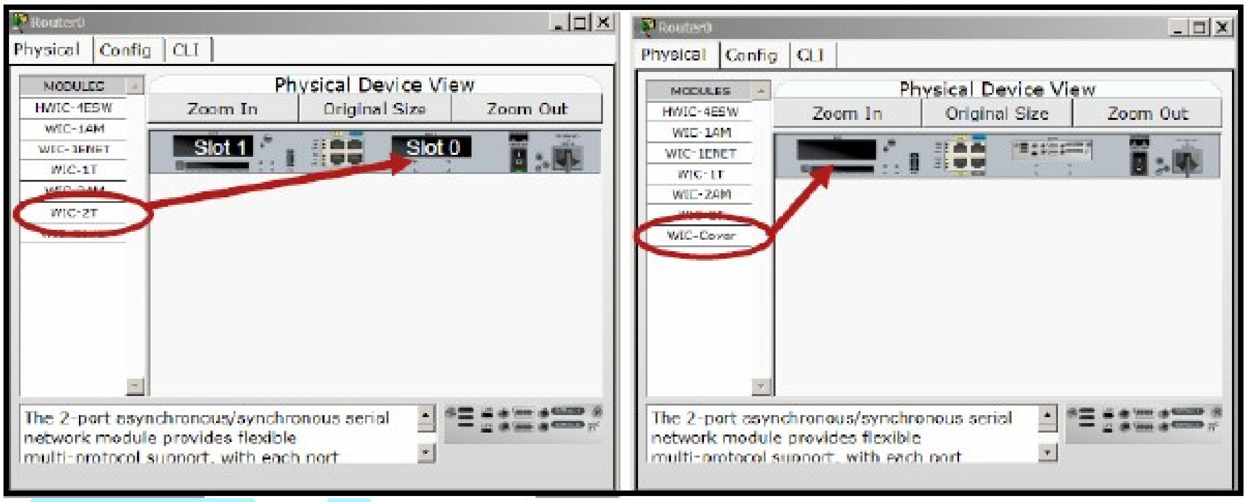
Physical, Config, and CLI (Physical is the default mode).

The Physical mode is used to add modules to a device, such as a WAN Interface Card (WIC). The Config mode is used for basic configuration. Commands are entered in a simple GUI format, with actual equivalent IOS commands shown in the lower part of the window. The CLI mode allows for advanced configuration of the device. This mode requires the user to enter the actual IOS commands just as they would on a live device.

e) In the Physical mode, click on the router power switch to turn the device off.

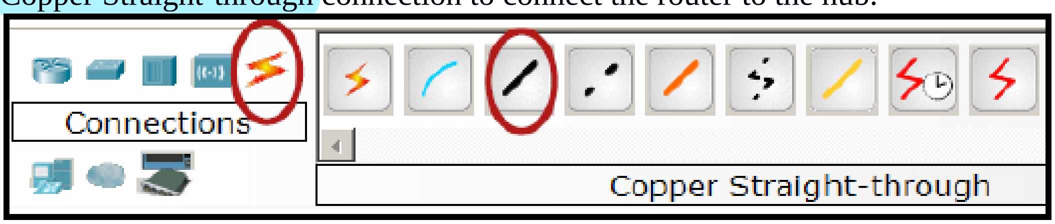


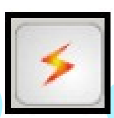
f) Select the WIC-2T module and drag it to Slot 0 on the router. Then drag a WIC Cover to Slot1.



g) Power the device back on.

h) Click on the Network Component Box and select Connections. Then select a Copper Straight-through connection to connect the router to the hub.



NOTE: The Smart Connection  can be used to automatically select the appropriate cable type. However, the user will have no choice as to which interface the connection is assigned to; it will take the first available appropriate interface.

i) Click on the hub and choose Port 3. Then click on the router and choose interface FastEthernet 0/0.

<u>Step 3: Basic router configuration</u>

<u>a) Click on the Config mode tab of Router0 to begin configuring the device</u>

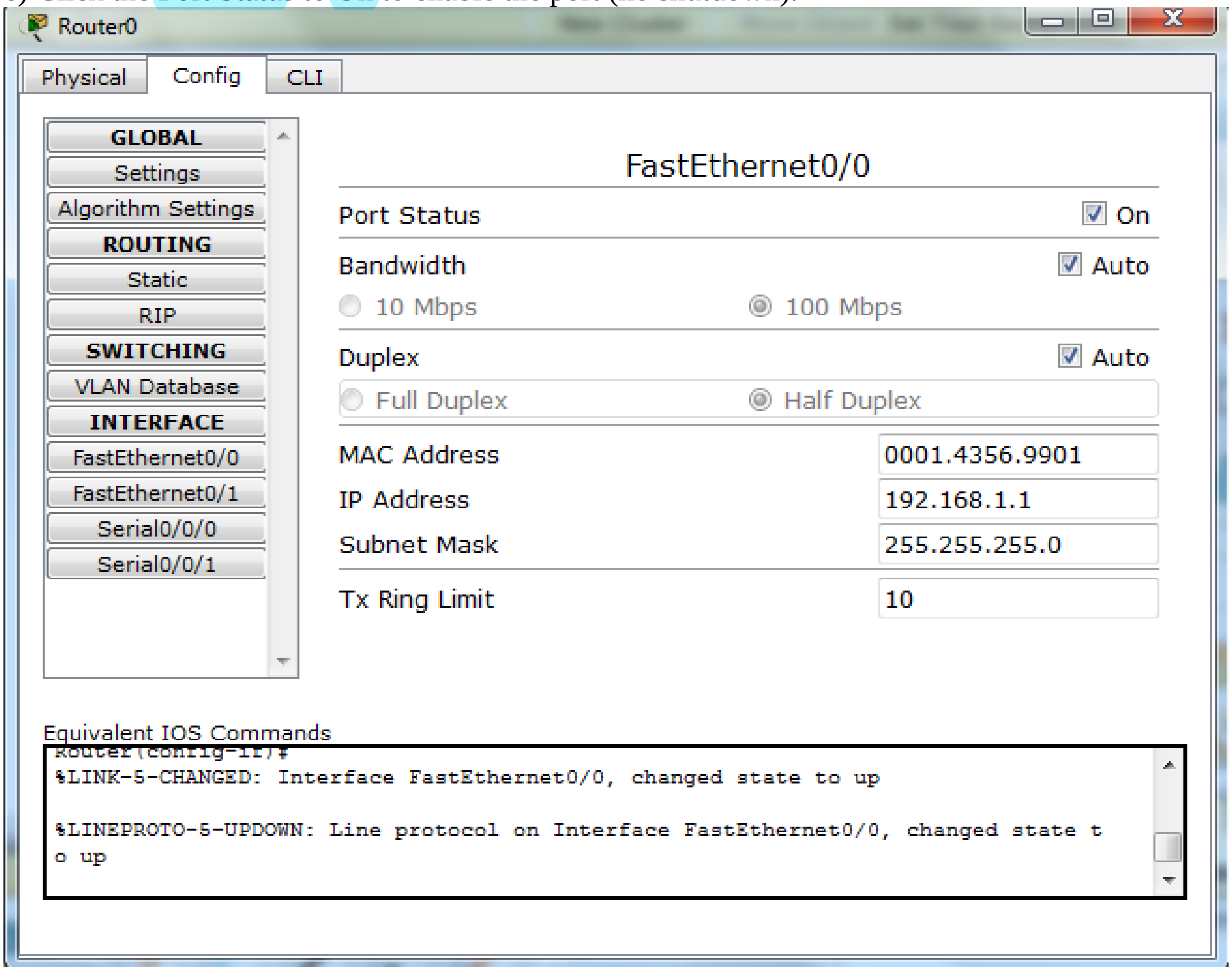
b) After the device has finished booting, change the display name of the router to CISCO_1. Changing the display name does not affect the configuration.

NOTE: If the device hangs up in the booting process, save the activity. Then close the application and reopen the file.

c) Click in the Hostname field and type CISCO_1, then press the TAB key. Note the equivalent IOS command is entered in the lower portion of the window.

d) Click on interface FastEthernet 0/0 and assign the IP address 192.168.1.1, then press the TAB key. Enter the subnet mask 255.255.255.0.

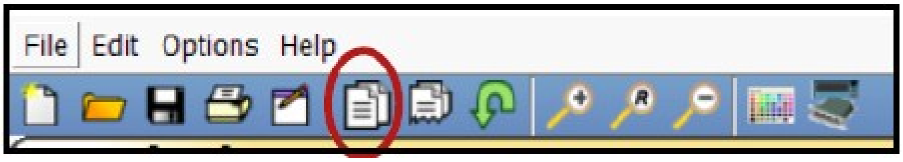
e) Click the Port Status to On to enable the port (no shutdown).



Step 4: Create a copy of the existing router complete with WIC modules already in place

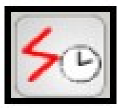
a) Make sure that the existing router is selected (it will be grayed out).

b) In the Main Tool Bar click on the Copy tool.



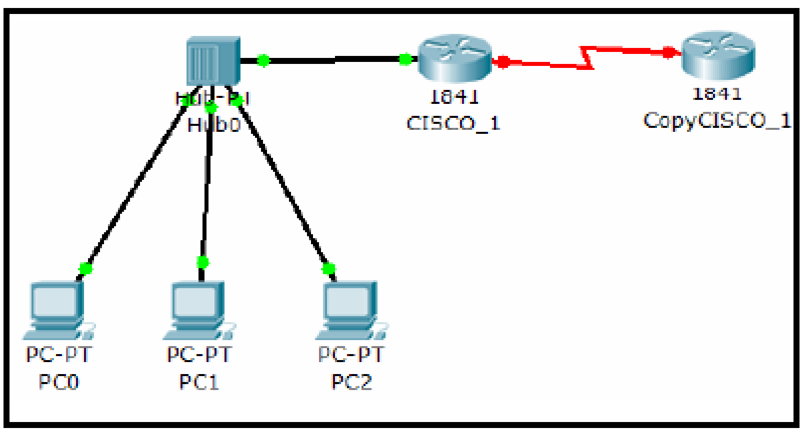
c) Click on the Paste tool and the copied device will appear in the work area.

d) Drag the new device to the desired location.

e) Click on the Network Component Box and select Connections. Then select the Serial DCE connection. 

f) Click on the CISCO_1 router and connect to the Serial 0/0/0 interface.

g) Click on the new router (copy CISCO_1) and connect to the Serial 0/0/0 interface.



Step 5: Configuring the WAN link

a) Click on the CISCO_1 router and select the Config mode

b) Select interface Serial 0/0/0

c) Configure the interface Serial 0/0/0 with the IP address 192.168.2.1, then press the TAB key and enter the subnet mask 255.255.255.0 on the interface.

d) Set the clock rate to 56000

e) Click the Port Status to On to enable the port (no shutdown).

f) Click on the new router and select the Config mode.

g) Change the Display Name and Hostname to CISCO_2.

h) Configure the interface Serial 0/0/0 with the IP address 192.168.2.2, then press the TAB key and enter the subnet mask 255.255.255.0 on the interface.

j) Click the Port Status to On to enable the port (no shutdown).

NOTE: The link lights on the serial link should change from red to green to indicate the link is active.

Step 6: Configure the routing protocol

a) Click on the CISCO_1 router and select the Config tab. Then click on RIP and add the network address 192.168.1.0 and 192.168.2.0.
b) Click on the CISCO_2 router and select the Config tab. Then click on RIP and add the network address 192.168.2.0.
c) Go to each PC and set the Default Gateway to 192.168.1.1

Step 7 Set the default gateway on the PCs

a) Click on PC0 and select the Config tab. Enter the default gateway address 192.168.1.1.
b) Click on PC1 and select the Config tab. Enter the default gateway address 192.168.1.1.
c) Click on PC2 and select the Config tab. Enter the default gateway address 192.168.1.1.

Step 8 Test the connectivity of the network

a) Click on the Simulation mode.

b) Select a Simple PDU  and click on PC-A as the source, then click on Cisco_2 as the destination. The ping should be successful.

Step 9 Save the Packet Tracer file

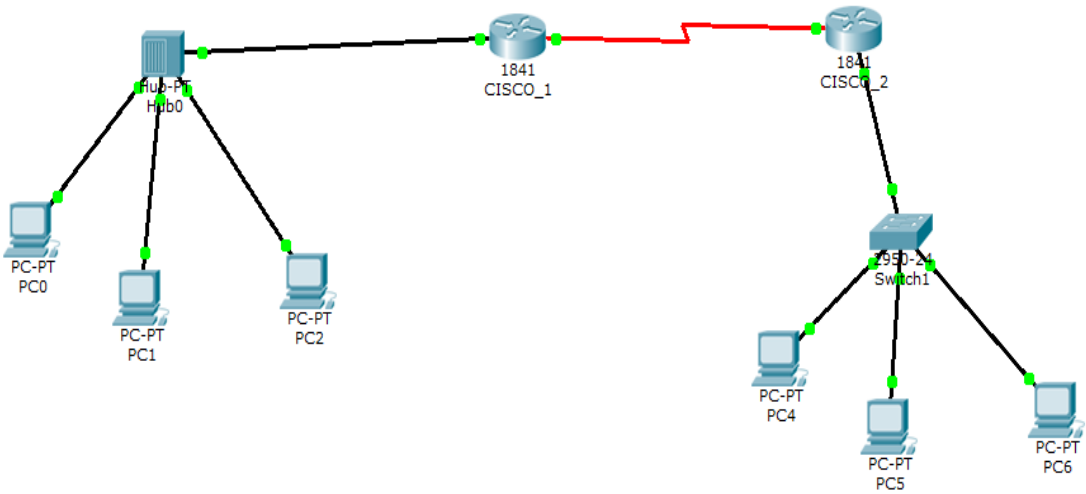
a) a) Save the Packet Tracer file as PT Basic.

Part 3

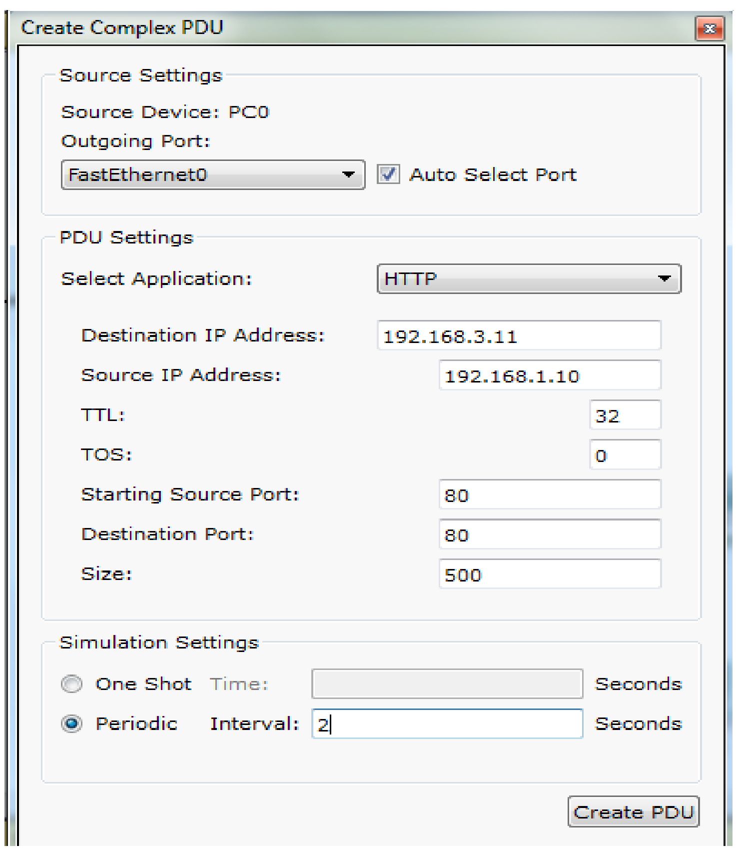
Router Exercise

Write the procedure to create topology , IP addresses and port connections values in observation book.

a) Create following topology. Set the http application between PC0 and PC5. Note down the type of packets transferred between these two nodes. (Note: Each link in router should contain separate network address). Set http transfer and check result. Repeat the experiment by connecting hub.



Setting HTTP between two nodes. Choose  Add complex PDU. Click on source and fill following things.



b) Consider following topology , do router settings and check http connection.