

Experiment 3: Protocol Visualization with Packet Tracer

Learning Objectives:

- Explore Packet Tracer Real-time mode
- Explore the Logical Workspace
- Explore Packet Tracer operation
- Connect devices
- Examine a device configuration
- Review the standard lab setup
- Overview of the devices

Background

Packet Tracer is a protocol simulator developed by Dennis Frezzo and his team at Cisco Systems. Packet Tracer (PT) is a powerful and dynamic tool that displays the various protocols used in networking, in either Real Time or Simulation mode. This includes layer 2 protocols such as Ethernet and PPP, layer 3 protocols such as IP, ICMP, and ARP, and layer 4 protocols such as TCP and UDP. Routing protocols can also be traced.

Packet Tracer is a supplement to and not a replacement for experience with real equipment. Students are encouraged to compare the results obtained from Packet Tracer network models with the behavior of real equipment.

You are also encouraged to examine the Help files built into Packet Tracer, which include an extensive "My First PT Lab", tutorials, and information on the strengths and limitations of using Packet Tracer to model networks.

This activity will provide an opportunity to explore the standard lab setup using Packet Tracer simulator. Packet Tracer has two file formats it can create: .pkt files (network simulation model files) and .pka files (activity files for practice). When you create your own networks in Packet Tracer, or modify existing files from your instructor or your peers, you will often use the .pkt file format. When you launched this activity from the curriculum, these instructions appeared. They are the result of the .pka, Packet Tracer activity file format. At the bottom of these instructions are two buttons: Check Results (which gives you feedback on how much of the activity you have completed) and Reset Activity (which starts the activity over, if you want to clear your work or gain more practice).

Task: Complete the pka file handed by your instructor. The file must be completed at 100% completion.

Instructor's Signature: _____

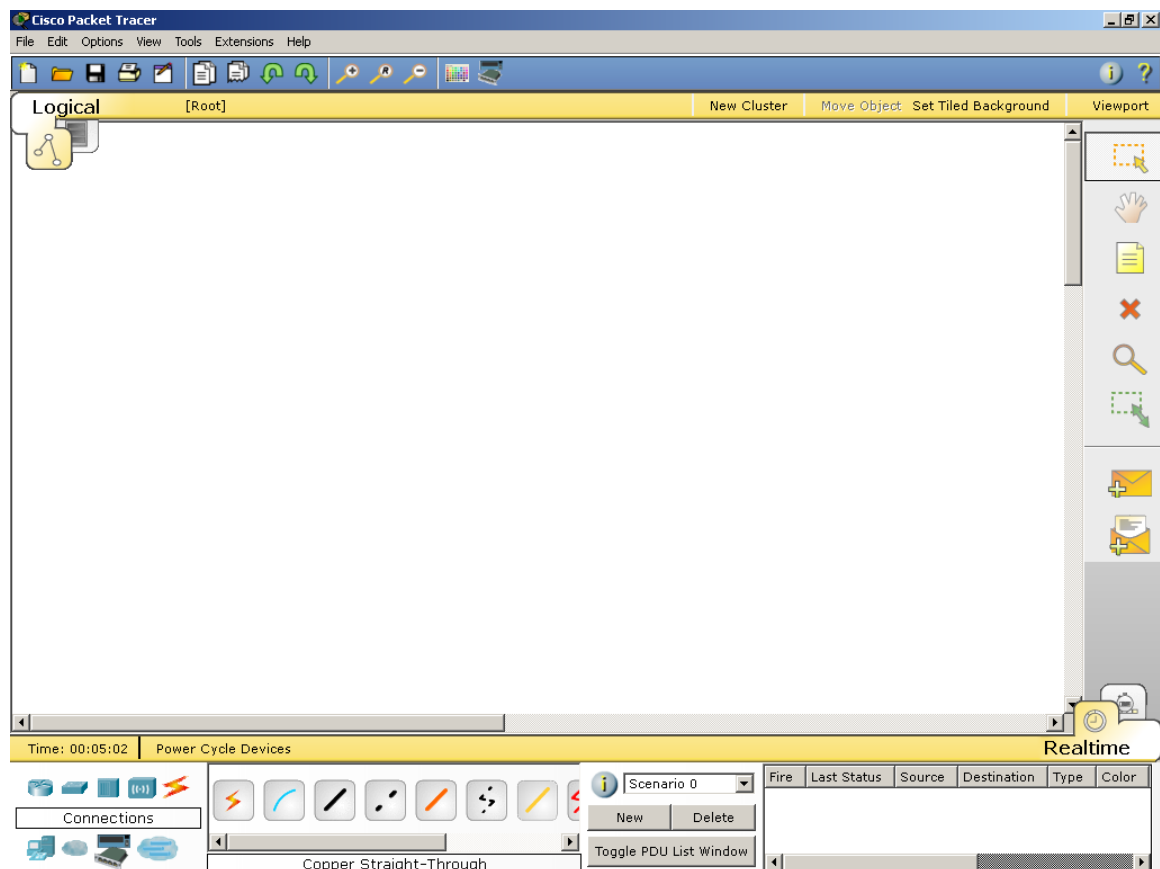
Packet Tracer – Creating a New Topology

Purpose: The purpose of this lab is to become familiar with building topologies in Packet Tracer.

Requisite knowledge: This lab assumes some understanding of the Ethernet protocol. At this point we have not discussed other protocols, but will use Packet Tracer in later labs to discuss those as well.

Version: This lab is based on Packet Tracer 5.3.

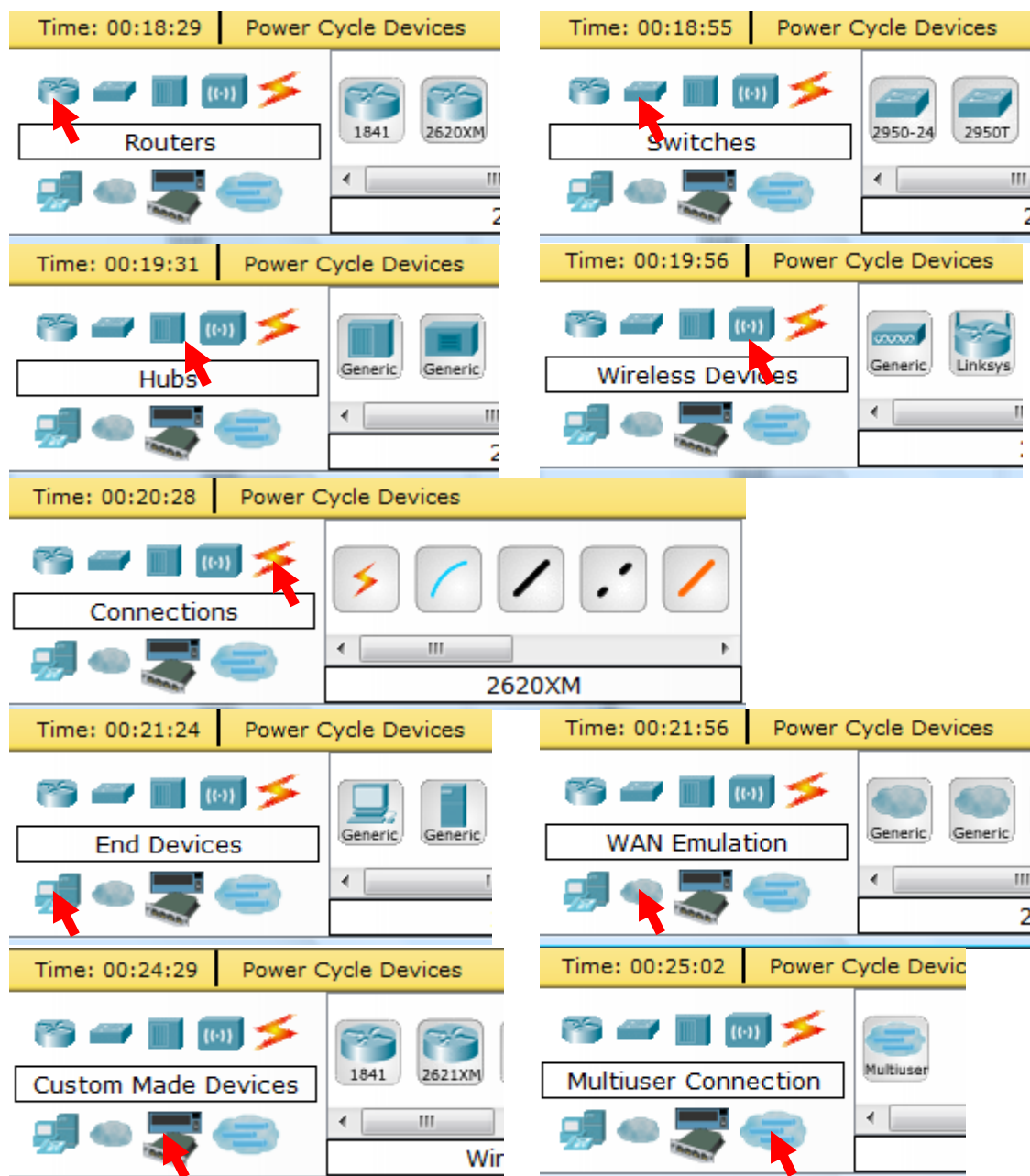
Step 1: Start Packet Tracer



Step 2: Choosing Devices and Connections

We will begin building our network topology by selecting devices and the media in which to connect them. Several types of devices and network connections can be used. For this lab we will keep it simple by using End Devices, Switches, Hubs, and Connections.

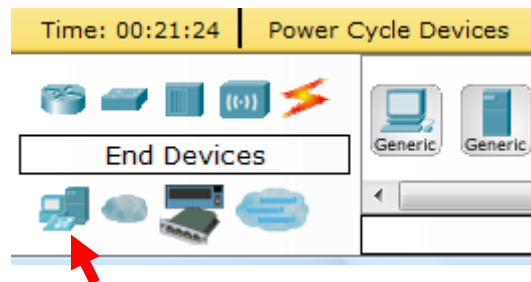
Single click on each group of devices and connections to display the various choices. The devices you see may differ slightly.



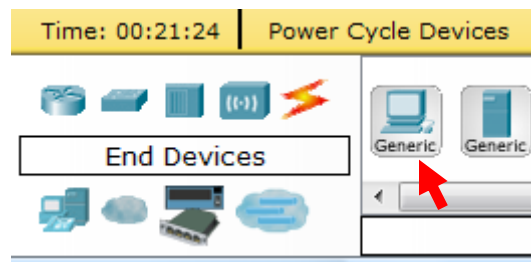
1. Other than generic routers, name 3 router models available on the simulation software.
2. What are the two types of serial cables available for WAN connectivity?
3. What are the two types of copper cable connectors?
4. Other than generic end devices, enumerate four end devices available.

Step 3: Building the Topology – Adding Hosts

Single click on the End Devices.



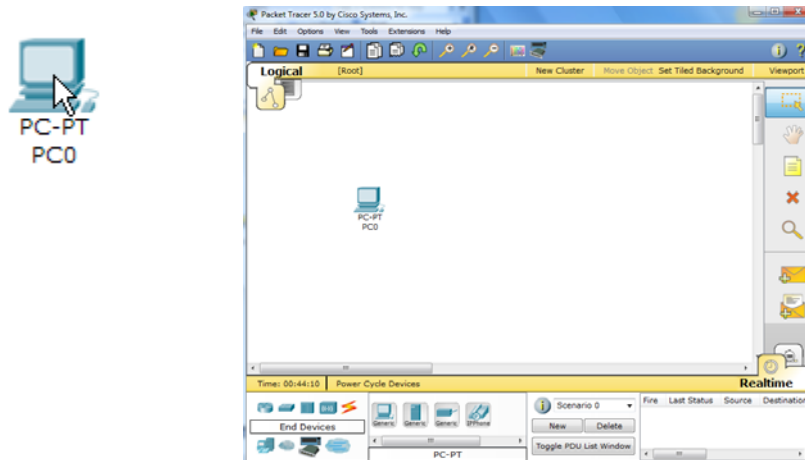
Single click on the Generic host.



Move the cursor into topology area. You will notice it turns into a plus "+" sign.

+

Single click in the topology area and it copies the device.



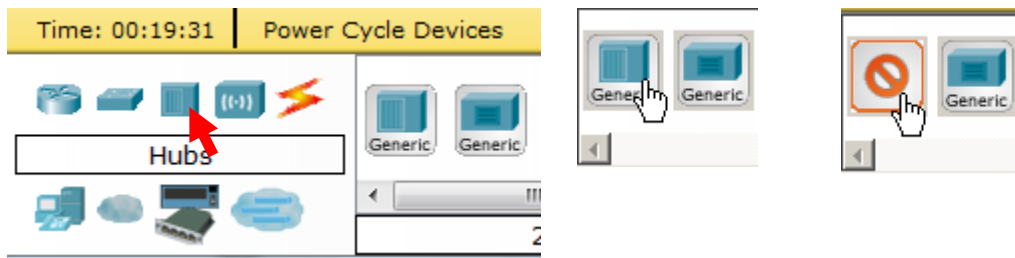
Add three more hosts.



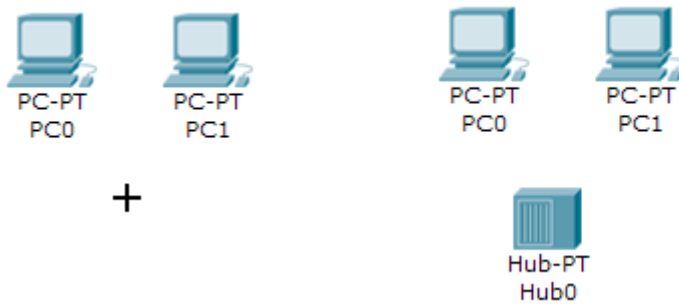
Step 4: Building the Topology – Connecting the Hosts to Hubs and Switches

Adding a Hub

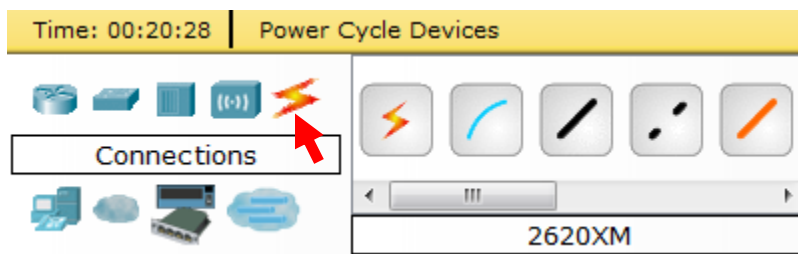
Select a hub, by clicking once on Hubs and once on a Generic hub.



Add the hub by moving the plus sign "+" below PC0 and PC1 and click once.



Connect PC0 to Hub0 by first choosing Connections.

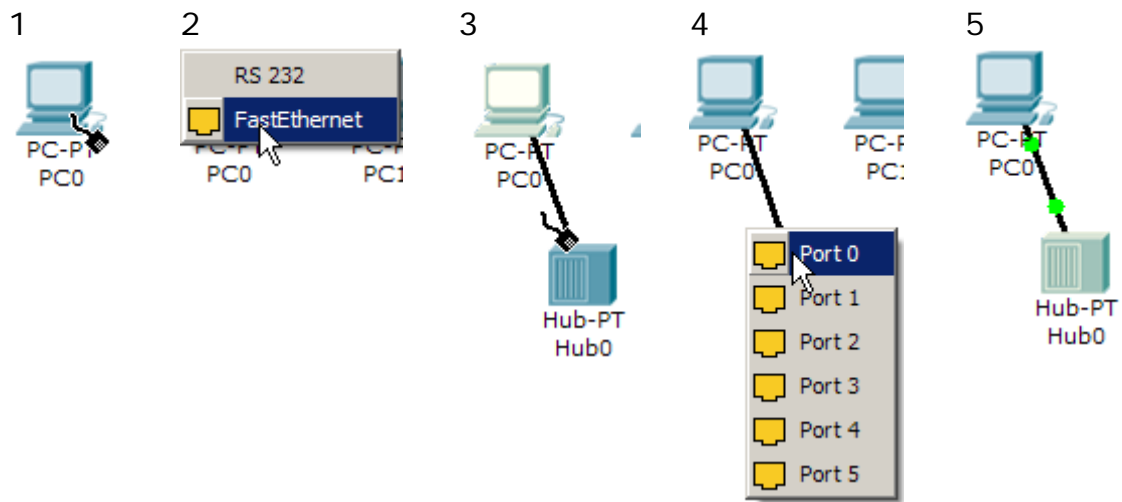


Click once on the Copper Straight-through cable.

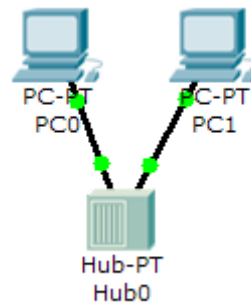


Perform the following steps to connect PC0 to Hub0:

1. Click once on PC0
2. Choose FastEthernet
3. Drag the cursor to Hub0
4. Click once on Hub0 and choose Port 0
5. Notice the green link lights on both the PC0 Ethernet NIC and the Hub0 Port 0 showing that the link is active.

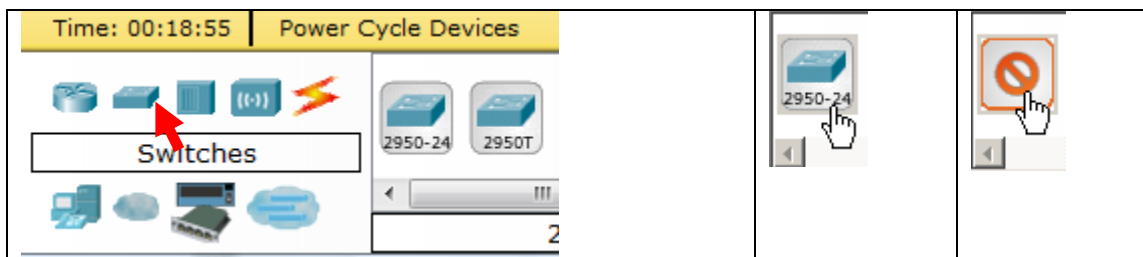


Repeat the steps above for PC1 connecting it to Port 1 on Hub0. (The actual hub port you choose does not matter.)

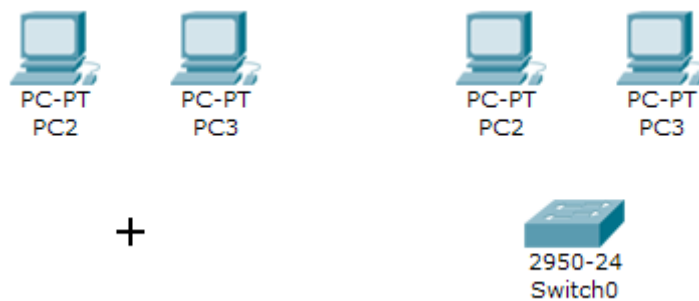


Adding a Switch

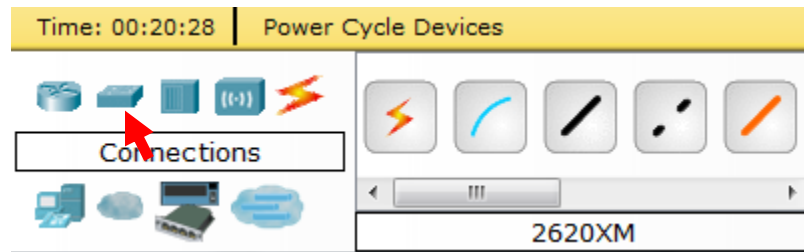
Select a switch, by clicking once on Switches and once on a 2950-24 switch.



Add the switch by moving the plus sign "+" below PC2 and PC3 and click once.



Connect PC2 to Hub0 by first choosing Connections.



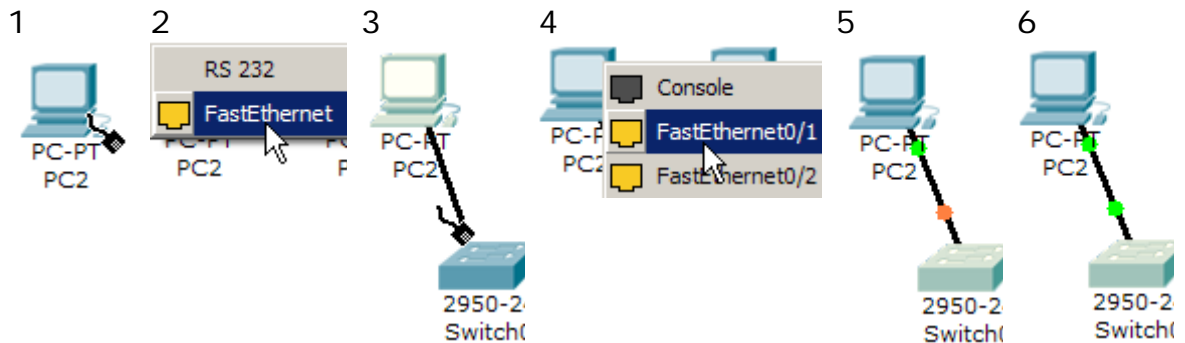
Click once on the Copper Straight-through cable.



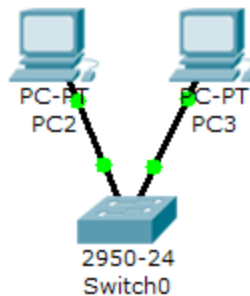
Perform the following steps to connect PC2 to Switch0:

1. Click once on PC2
2. Choose FastEthernet
3. Drag the cursor to Switch0
4. Click once on Switch0 and choose FastEthernet0/1
5. Notice the green link lights on PC2 Ethernet NIC and amber light Switch0 FastEthernet0/1 port. The switch port is temporarily not forwarding frames, while it goes through the stages for the Spanning Tree Protocol (STP) process.

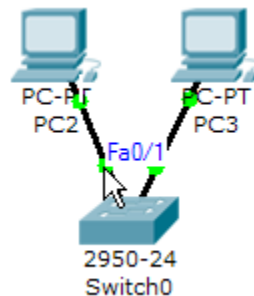
6. After a about 30 seconds the amber light will change to green indicating that the port has entered the forwarding stage. Frames can now forwarded out the switch port.



Repeat the steps above for PC3 connecting it to Port 3 on Switch0 on port FastEthernet0/2. (The actual switch port you choose does not matter.)



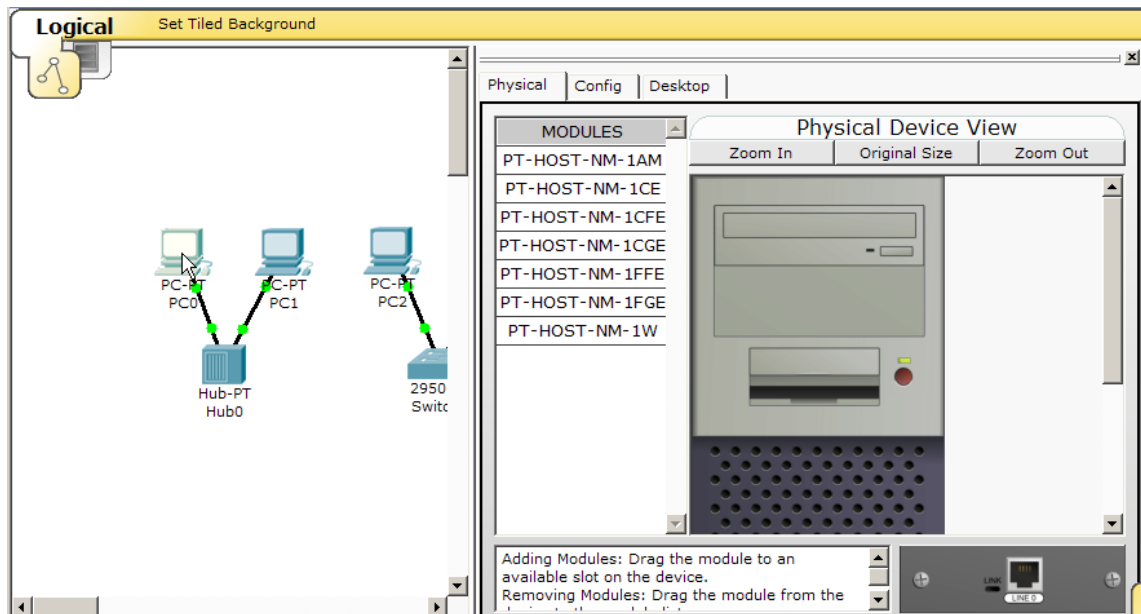
Move the cursor over the link light to view the port number. Fa means FastEthernet, 100 Mbps Ethernet.



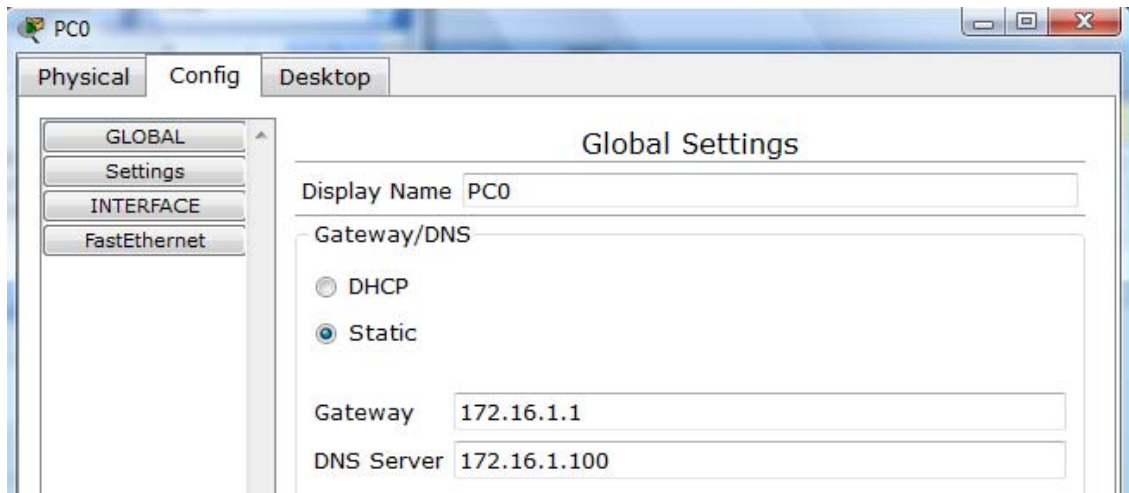
Step 5: Configuring IP Addresses and Subnet Masks on the Hosts

Before we can communicate between the hosts we need to configure IP Addresses and Subnet Masks on the devices.

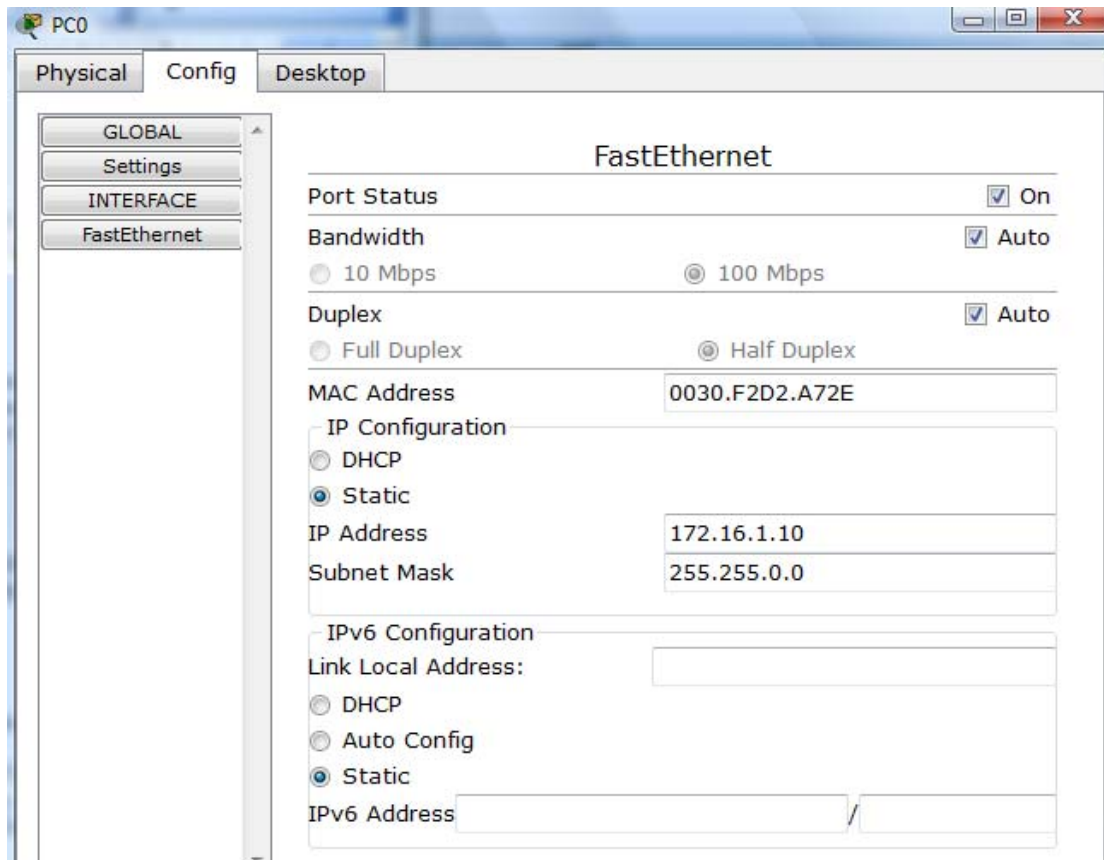
Click once on PC0.



Choose the Config tab and click on Settings. It is here that you can change the name of PC0. It is also here where you would enter a Gateway IP Address, also known as the default gateway and the DNS Server IP Address. We will discuss this later, but this would be the IP address of the local router. If you want, you can enter the Gateway IP Address 172.16.1.1 and DNS Server IP Address 172.16.1.100, although it will not be used in this lab.



Click on Interface and then FastEthernet. Although we have not yet discussed IP Addresses, add the IP Address to 172.16.1.10. Click once in the Subnet Mask field to enter the default Subnet Mask. You can leave this at 255.255.0.0.



Also, notice this is where you can change the Bandwidth (speed) and Duplex of the Ethernet NIC (Network Interface Card). The default is Auto (autonegotiation), which means the NIC will negotiate with the hub or switch. The bandwidth and/or duplex can be manually set by removing the check from the Auto box and choosing the specific option.

Bandwidth - Auto

If the host is connected to a hub or switch port which can do 100 Mbps, then the Ethernet NIC on the host will choose 100 Mbps (Fast Ethernet). Otherwise, if the hub or switch port can only do 10 Mbps, then the Ethernet NIC on the host will choose 10 Mbps (Ethernet).

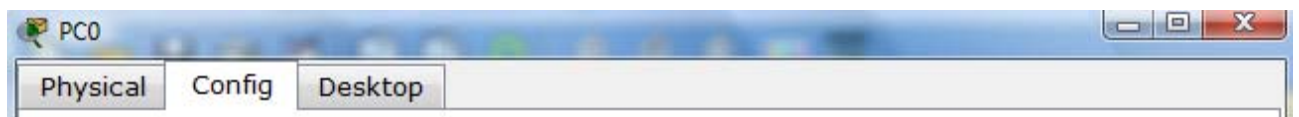
Duplex - Auto

Hub: If the host is connected to a hub, then the Ethernet NIC on the host will choose Half Duplex.

Switch: If the host is connected to a switch, and the switch port is configured as Full Duplex (or Autonegotiation), then the Ethernet NIC on the host will choose Full Duplex. If the switch port is configured as Half Duplex, then the Ethernet NIC on the host will choose Half Duplex. (Full Duplex is a much more efficient option.)

The information is automatically saved when entered.

To close this dialog box, click the "X" in the upper right.

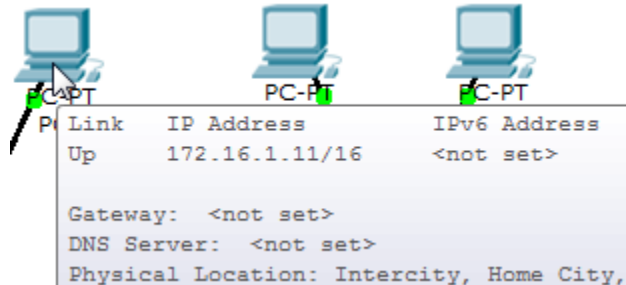


Repeat these steps for the other hosts. Use the information below for IP Addresses and Subnet Masks.

<u>Host</u>	<u>IP Address</u>	<u>Subnet Mask</u>
PC0	172.16.1.10	255.255.0.0
PC1	172.16.1.11	255.255.0.0
PC2	172.16.1.12	255.255.0.0
PC3	172.16.1.13	255.255.0.0

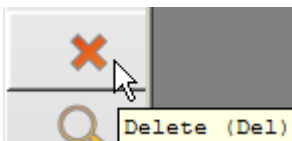
Verify the information

To verify the information that you entered, move the Select tool (arrow) over each host.



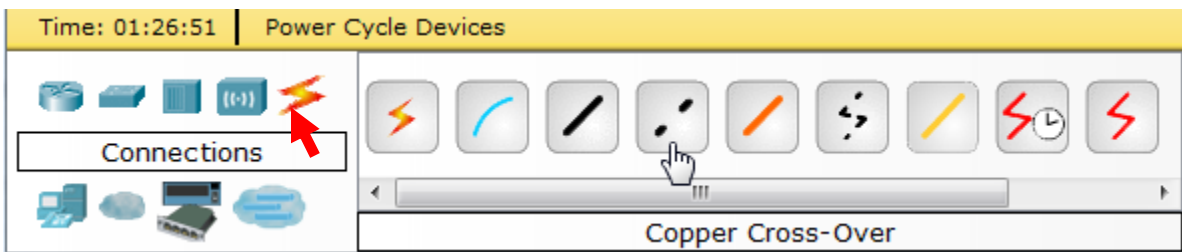
Deleting a Device or Link

To delete a device or link, choose the Delete tool and click on the item you wish to delete.

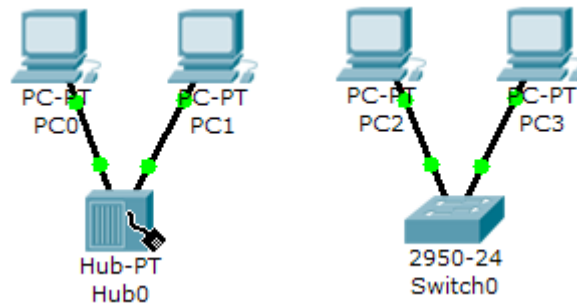


Step 6: Connecting Hub0 to Switch0

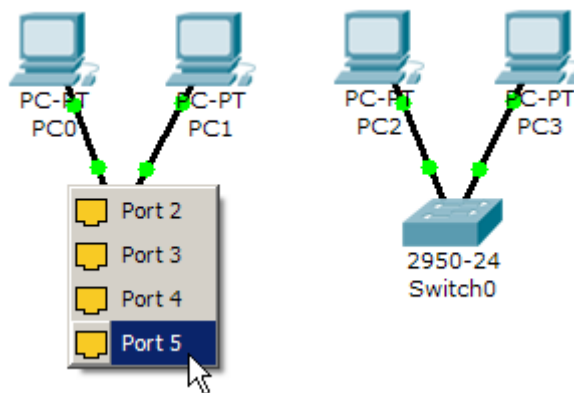
To connect like-devices, like a Hub and a Switch, we will use a Cross-over cable. Click once the Cross-over Cable from the Connections options.



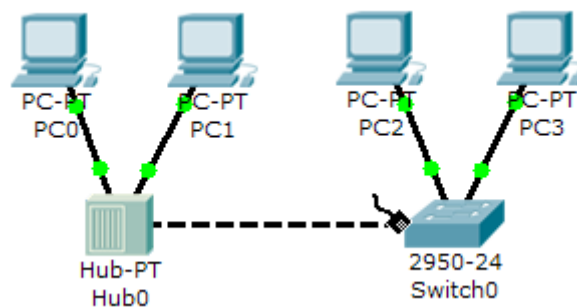
Move the Connections cursor over Hub0 and click once.



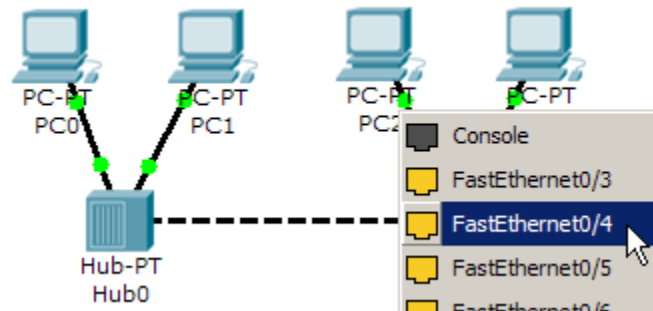
Select Port 5 (actual port does not matter).



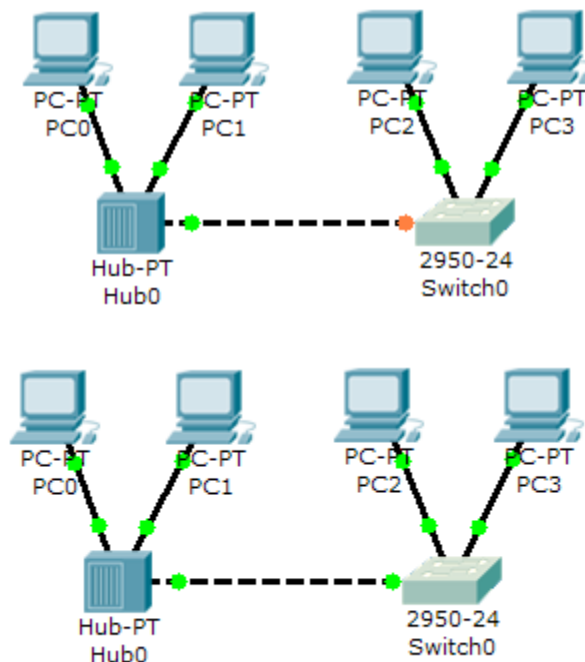
Move the Connections cursor to Switch0.



Click once on Switch0 and choose FastEthernet0/4 (actual port does not matter).

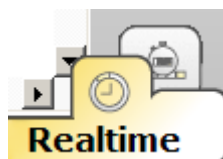


The link light for switch port FastEthernet0/4 will begin as amber and eventually change to green as the Spanning Tree Protocol transitions the port to forwarding.



Step 7: Verifying Connectivity in Realtime Mode

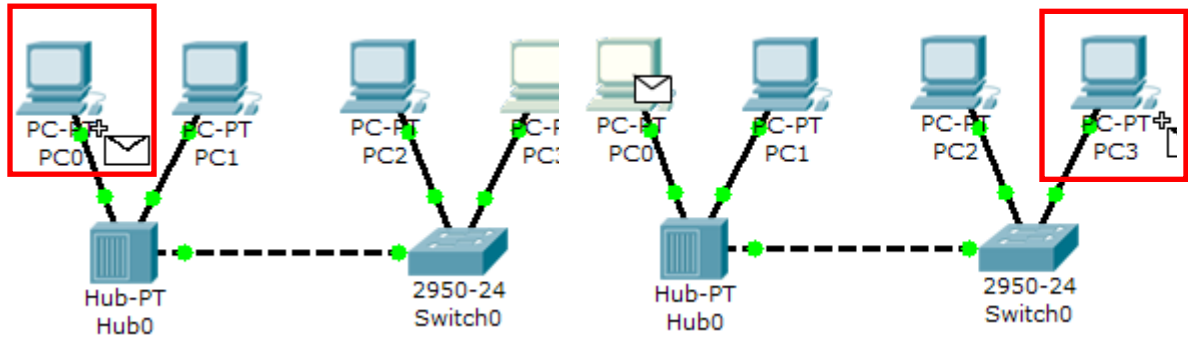
Be sure you are in Realtime mode.



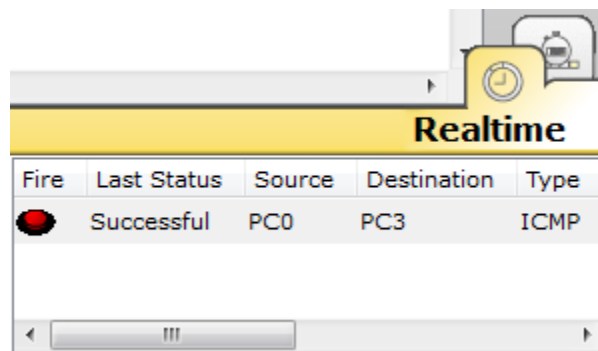
Select the Add Simple PDU tool used to ping devices.




Click once on PC0, then once on PC3.



The PDU Last Status should show as Successful.

A screenshot of a 'Realtime' window showing a table of PDU events. The table has columns for 'Fire', 'Last Status', 'Source', 'Destination', and 'Type'. A single row is visible, showing a successful ping from PC0 to PC3 using ICMP.

Fire	Last Status	Source	Destination	Type
	Successful	PC0	PC3	ICMP

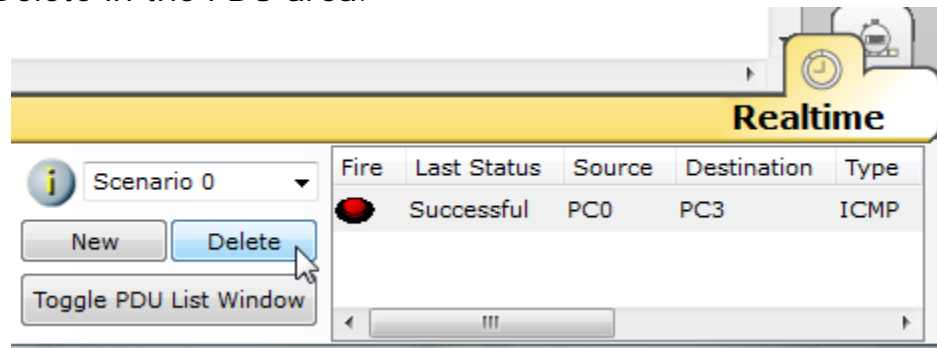
Change the IP address of PC3 to 172.16.2.13. Perform a ping from PC0 to PC3. What is the ping result?

Return the IP address of PC3 to 172.16.1.13. Change the IP address of PC2 to 172.17.1.12. Perform a ping from PC0 to PC2. What is the ping result?

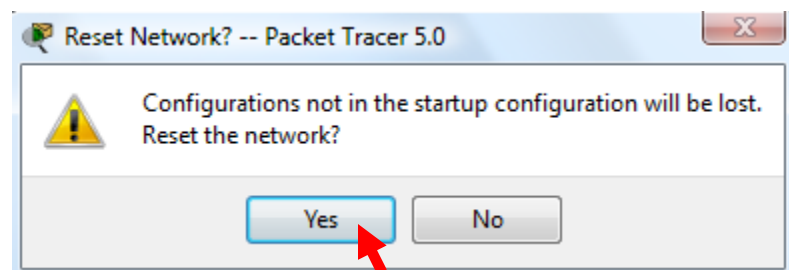
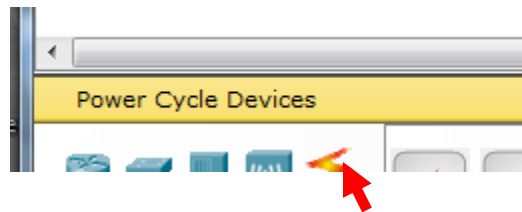
Resetting the Network

At this point we will want to reset the network, whenever you want to reset the network and begin the simulation again, perform the following tasks:

Click Delete in the PDU area.

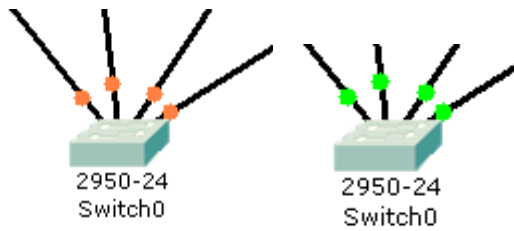


Now, Power Cycle Devices and confirm the action.



Waiting for Spanning Tree Protocol (STP)

Note: Because Packet Tracer also simulates the Spanning Tree Protocol, at times the switch may show amber lights on its interfaces. You will need to wait for the lights to turn green on the switches before they will forward any Ethernet frames.

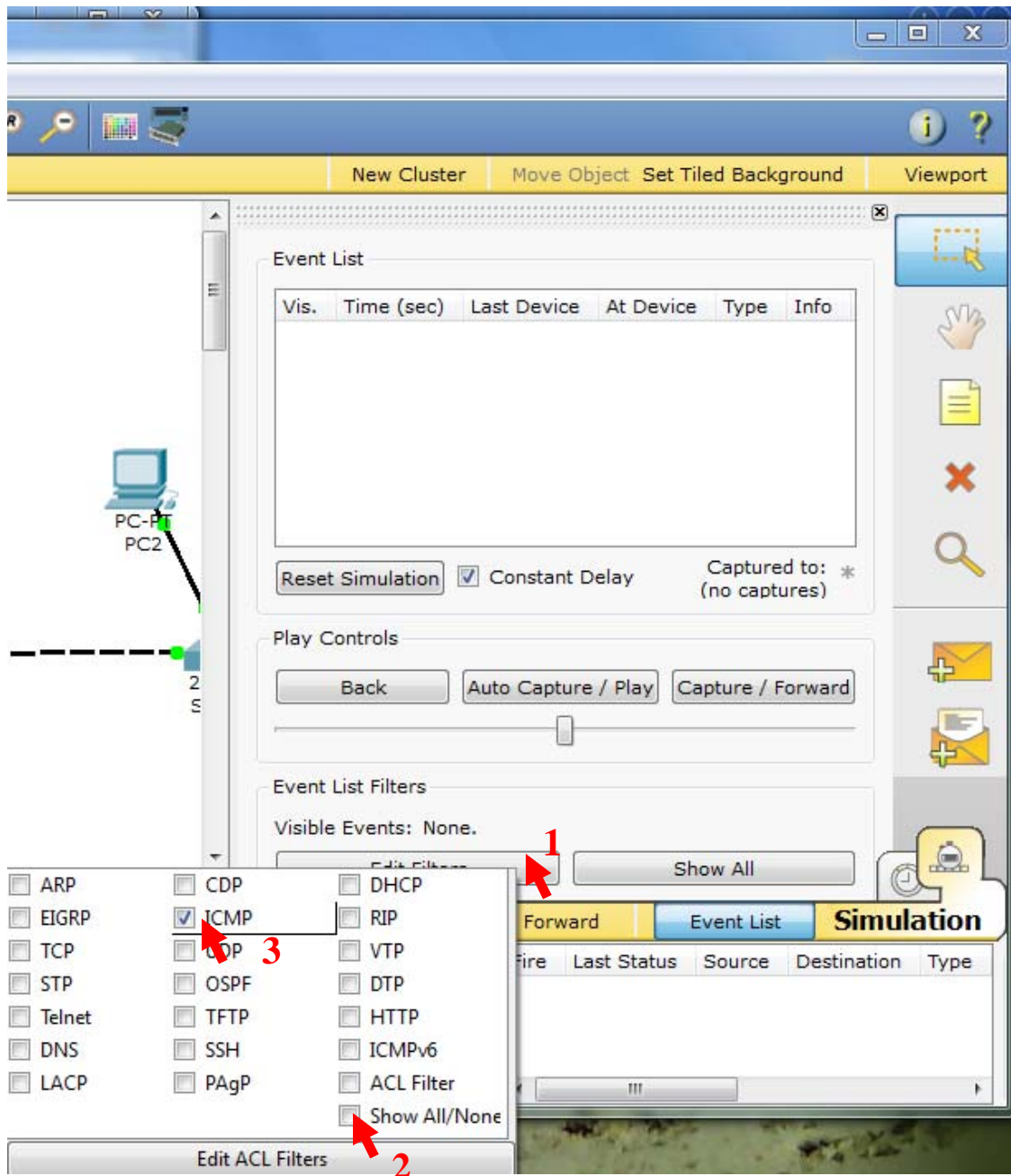


Step 8: Verifying Connectivity in Simulation Mode

Be sure you are in Simulation mode.



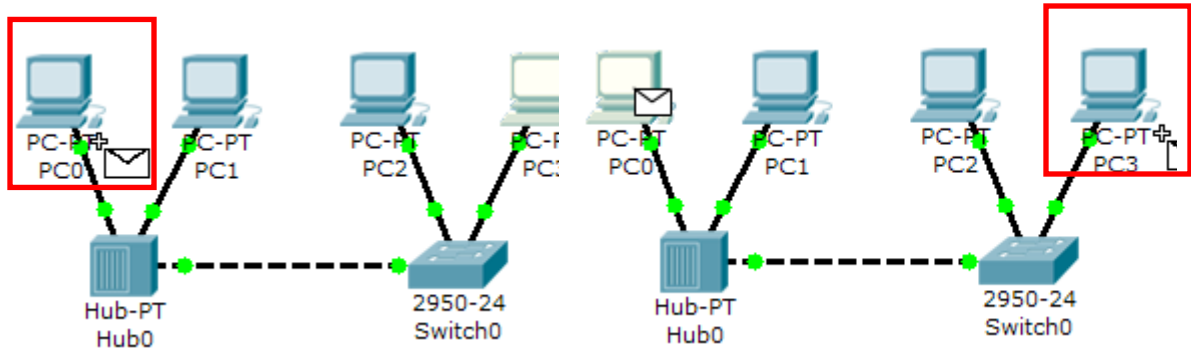
Deselect all filters (All/None) and select only ICMP.



Select the Add Simple PDU tool used to ping devices..



Click once on PC0, then once on PC3.



Continue clicking Capture/Forward button until the ICMP ping is completed. You should see the ICMP messages move between the hosts, hub and switch. The PDU Last Status should show as Successful. Click on Clear Event List if you do not want to look at the events or click Preview Previous Events if you do. For this exercise it does not matter.

The screenshot shows the Packet Tracer 5.0 interface. The main window displays a network diagram with a Hub-PT Hub0 connected to a 2950-24 Switch0. Two PCs, PC0 and PC1, are connected to Hub0. A dialog box titled "Buffer Full -- Packet Tracer 5.0" is open, displaying the following message:

The maximum number of events has been reached. You may clear the event list and continue from where you left off or adjust the filters to view previous events.

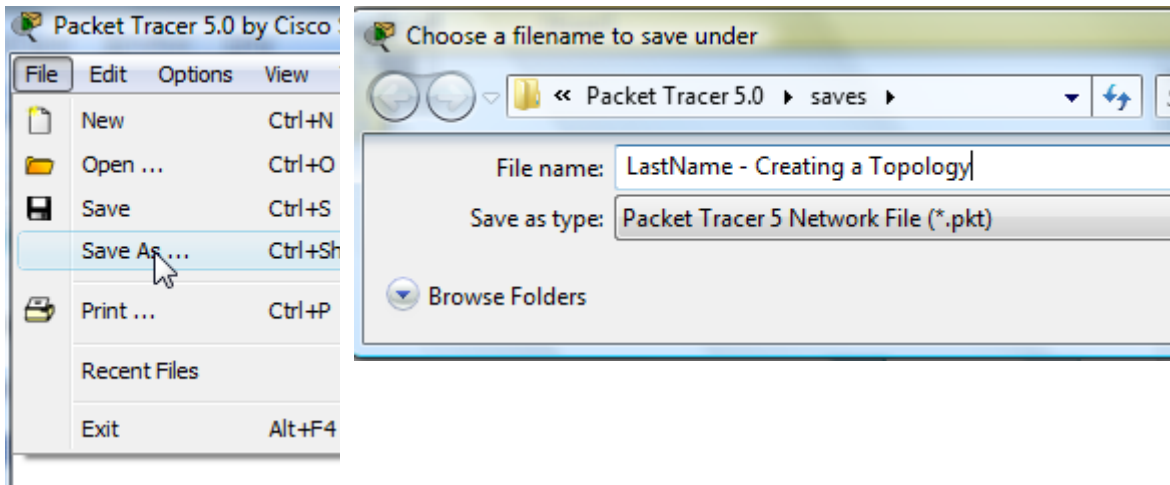
Below the dialog box, the Event List window is visible, showing a table of events:

Vis.	Time (sec)	Last Device	At Device	Type	Info
	0.009	Switch0	PC3	ICMP	
	0.010	PC3	Switch0	ICMP	
	0.011	Switch0	Hub0	ICMP	
			PC0	ICMP	
			PC1	ICMP	

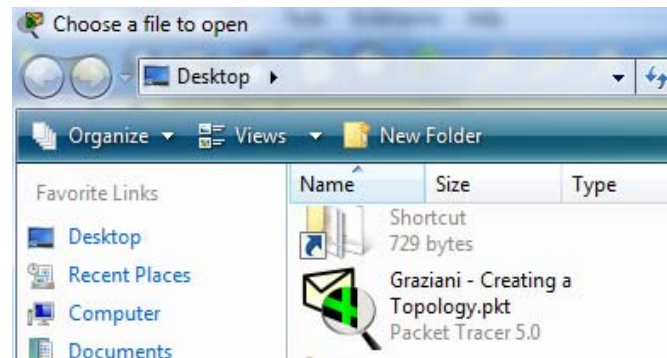
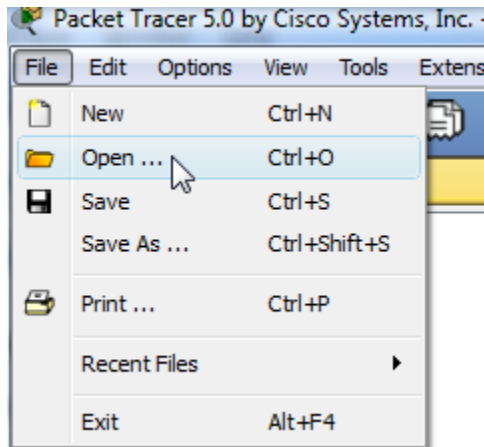
The bottom status bar shows the time as 01:45:00.969 and the simulation status as "Simulation". The "Event List" tab is selected, and the "Visible Events" are filtered to "ICMP".

Step 9: Saving the Topology

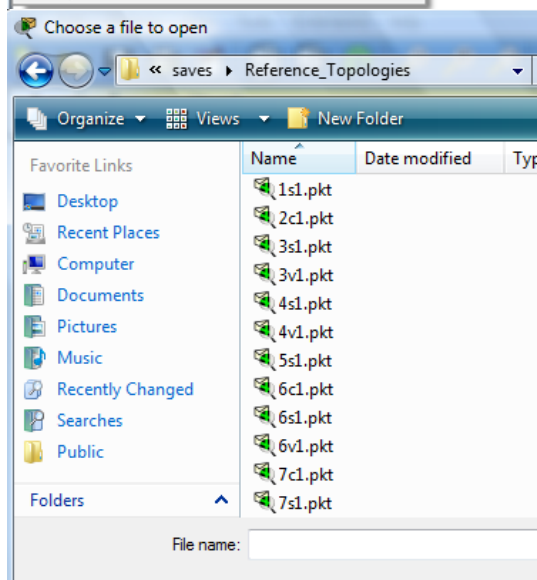
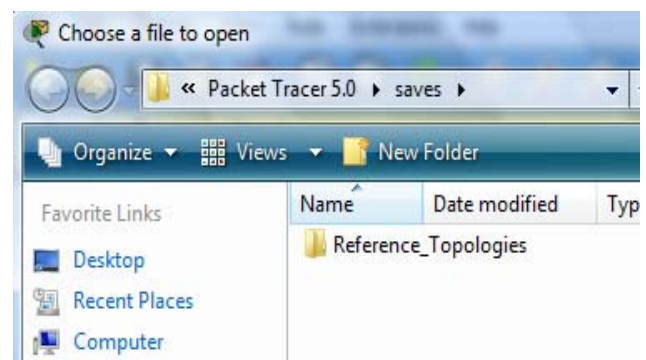
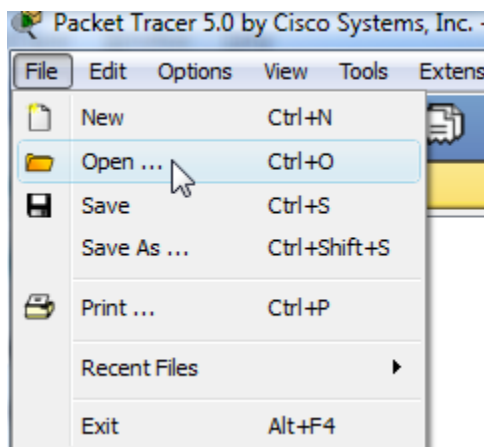
Perform the following steps to save the topology (uses .pkt file extension).



Opening Existing Topologies

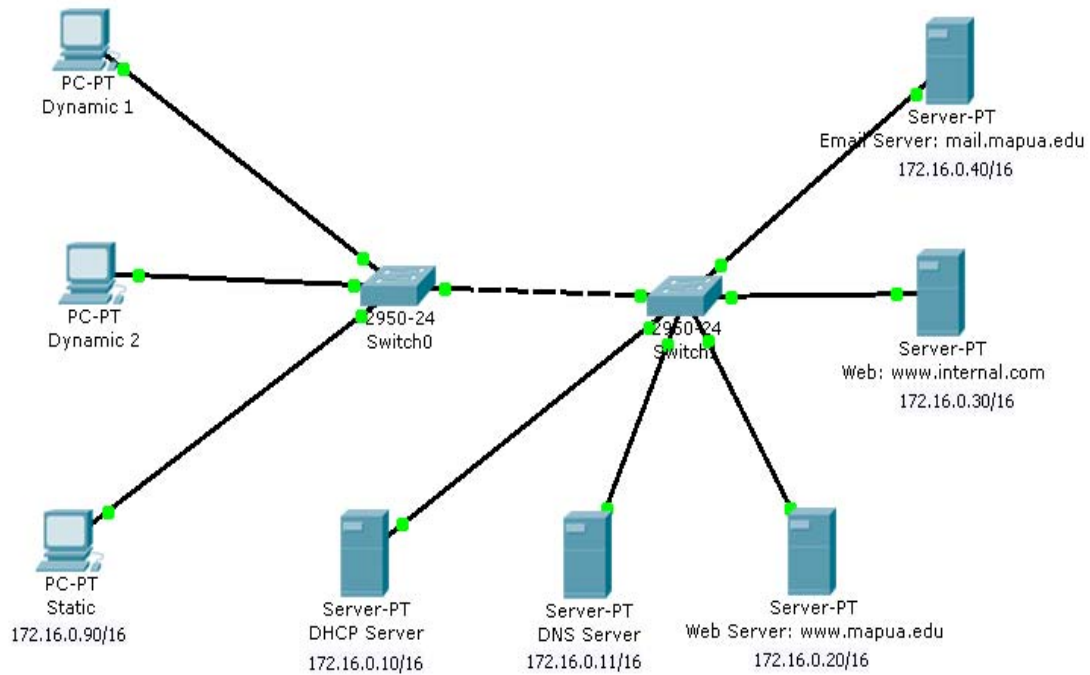


Opening Existing PT Topologies



Part III: Packet Tracer Lab

Working with the Application Layer: DHCP, DNS, HTTP, HTTPS, Email



This is an example of what your final topology should look like.

Instructions:

1. Start Packet Tracer using **Realtime** mode.

- Options -> Preferences
 - Enable "Show Link Lights"
 - Disable "Hide Device Label"

2. Configuring the DHCP Server

Add a server.

Global Settings:

- Change the Display Name to "**DHCP Server**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.10**
- Set the Subnet Mask to **255.255.0.0**

HTTP:

- Set HTTP Service and HTTPS Service to **Off**

DHCP:

- Set the Default Gateway to **172.16.0.1**
- Set the DNS Server to **172.16.0.11**
- Set the Start IP Address to **172.16.0.100**

DNS:

- Set the Service to **Off**

Email:

- Set the SMTP Service and POP3 Service to **Off**

2. Configuring the DNS Server

Add a server.

Global Settings:

- Change the Display Name to "**DNS Server**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.11**
- Set the Subnet Mask to **255.255.0.0**

HTTP:

- Set HTTP Service and HTTPS Service to **Off**

DHCP:

- Set the Service to **Off**

DNS:

- Entering the www.cabrillo.edu Domain Name
 - Enter for the Domain Name **www.mapua.edu**
 - Enter for IP Address **172.16.0.20**
 - Click **Add**
- Entering the www.internal.com Domain Name
 - Enter for the Domain Name **www.internal.com**
 - Enter for IP Address **172.16.0.30**
 - Click **Add**

Email:

- Set the SMTP Service and POP3 Service to **Off**

3. Configuring the www.mapua.edu Web Server

Add a server.

Global Settings:

- Change the Display Name to "**Web Server:
www.mapua.edu**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.20**
- Set the Subnet Mask to **255.255.0.0**

DHCP:

- Set the Service to **Off**

DNS:

- Set the Service to **Off**

HTTP

- Set the both the HTTP and HTTPS Service to **On**
- Change the sentence, "<hr> Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open." to "<hr> Welcome to Mapua Institute's of Technology's public web page!" You may add other information as well.

Email:

- Set the SMTP Service and POP3 Service to **Off**

4. Configuring the www.internal.com Web Server

Add a server.

Global Settings:

- Change the Display Name to "**Web Server:
www.internal.com**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.30**
- Set the Subnet Mask to **255.255.0.0**

DHCP:

- Set the Service to **Off**

DNS:

- Set the Service to **Off**

HTTP:

- Change the sentence, "<hr> Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open." to "<hr> This is the corporate internal network!" You may add other information as well.

5. Configuring the mail.mapua.edu Email Server

Add a server.

Global Settings:

- Change the Display Name to "**Email Server:
mail.mapua.edu**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.40**
- Set the Subnet Mask to **255.255.0.0**

DHCP:

- Set the Service to **Off**

DNS:

- Set the Service to **Off**

HTTP:

- Set HTTP Service and HTTPS Service to **Off**

Email:

- Set SMTP and POP3 Service to **On**.
- Set the domain name to mail.mapua.edu
- Setup three user accounts as follows:

Users	Password
user1	datacom1
user2	datacom2
user3	datacom3

6. Configure Two Client Computers using DHCP

Add two client computers.

Global Settings:

- Change the Display Names to "**Dynamic 1**" and to "**Dynamic 2**" respectively
- Set the Gateway/DNS to **DHCP**

FastEthernet:

- Set the IP Configuration to **DHCP**

6. Configure One Client Computers using Static IP Addressing

Add two client computers.

Global Settings:

- Change the Display Name to "**Static**"
- Set the Gateway/DNS to **Static**
 - Set Gateway to **172.16.0.1**
 - Set the DNS Server to **172.16.0.11**

FastEthernet:

- Be sure the configuration is set to **Static**
- Set the IP address to **172.16.0.90**
- Set the Subnet Mask to **255.255.0.0**

7. Configure Email Configuration for Clients

The screenshot shows a window titled "Dynamic 1" with three tabs: "Physical", "Config", and "Desktop". The "Config" tab is active. Inside the window is a "Configure Mail" dialog box with a blue title bar and a close button (X). The dialog box is divided into three sections: "User Information", "Server Information", and "Logon Information".

User Information

- Your Name: <name of group mate 1>
- Email Address: user1@mail.mapua.edu

Server Information

- Incoming Mail Server: mail.mapua.edu
- Outgoing Mail Server: mail.mapua.edu

Logon Information

- User Name: user1
- Password: datacom1

At the bottom of the dialog box are two buttons: "Save" and "Reset".

Dynamic 2

Physical Config Desktop

Configure Mail

User Information

Your Name: <name of group mate 2>

Email Address: user2@mail.mapua.edu

Server Information

Incoming Mail Server: mail.mapua.edu

Outgoing Mail Server: mail.mapua.edu

Logon Information

User Name: user2

Password: datacom2

Save Reset

Static 172.16.0.90/16

Physical Config Desktop

Configure Mail

User Information

Your Name: <name of group mate 3>

Email Address: user3@mail.mapua.edu

Server Information

Incoming Mail Server: mail.mapua.edu

Outgoing Mail Server: mail.mapua.edu

Logon Information

User Name: user3

Password: datacom3

Save Reset

8. Adding switches

- Add two switches.
- Connect the servers to one switch using a straight-through cable.
- Connect the client computers to the other switch using a straight-through cable.
- Interconnect the two switches using a crossover cable.

9. Verify connectivity

- Ping (ICMP)
 - From a client computer use the Desktop Command prompt to ping the other client computers and the servers.
 - Example: From the Dynamic 1 client, C> **ping 172.16.0.20**
 - The first one or two pings may fail, but you should receive a reply on the later pings. This is due to the ping timing out while the ARP process takes place.
- Web Browser (HTTP)
 - On the client computers use the Desktop Web Browser, enter the URLs of the Web Servers www.cabrillo.edu and www.internal.com.
 - You should see the web pages that you created on these servers.
- Email (SMTP)
 - From client computer (Dynamic 1), compose an email (from Desktop tab) to another client computer (Static). To: user3@mail.mapua.edu
 - Upon sending the email, check if email was received by Static PC by clicking the email icon (Desktop tab), and clicking the Receive button after.

Please approach your instructor to verify connectivity of devices

Instructor's Signature:

10. Using Simulation Mode

Click on Simulation.

Note: To reset a simulation, click on "Reset Simulation"

Click on Edit Filters

- Choose **Show All/None** so that all the boxes (protocols) are unchecked.
- Select (check) the following protocols: **DHCP, ICMP, HTTP, DNS, HTTPS, SMTP**

Web Browser (HTTP)

- On the client computers use the Desktop Web Browser, enter the URLs of the Web Servers <http://www.mapua.edu> or <http://www.internal.com>.
- Click on **Auto Capture/Play** (automatically forwards the packets) or **Capture Forward** (must keep clicking to advance the packets)

DHCP

- Reset the simulation by clicking on "Reset Simulation"
- To view DHCP, on one of the "Dynamic "client computers using DHCP go to the Desktop Command prompt.
- To have the client computer ask for new IP address and other information from the DHCP server, enter the command: C> **ipconfig /renew**

Email

- Reset the simulation by clicking on "Reset Simulation"
- To view email, click on one of the client computers sending email to another client computer.
- Click on **Auto Capture/Play** (automatically forwards the packets) or **Capture Forward** (must keep clicking to advance the packets)

Questions:

1. With the activity conducted, briefly describe the function of the following application layer protocols:

- a. HTTP

- b. HTTPS

- c. DHCP

- d. DNS

- e. SMTP

2. Under Simulation mode, click Dynamic 1, then Command Prompt (on Desktop tab), then execute ***ipconfig /release***, then ***ipconfig /renew***. Click **Auto Capture/Play** (automatically forwards the packets) or **Capture Forward** (must keep clicking to advance the packets) until Packet Tracer finishes simulation (or reach Buffer Full Status). On the simulation panel, look for the frame DHCP 172.16.0.10/16 (Last Device column) and Switch1 (At Device column). Click the Info square-colored area on the Info column. Click Outbound PDU details at the PDU information.

	Answer
Preamble	
Source MAC address	
Destination MAC address	
Type field value	
Source IP address	
Destination IP address	

- a. A connection-oriented communication is where the sender and receiver must prearrange for communications to occur, otherwise communications fails. Connectionless services do not prearrange for communications to occur. Connection-oriented services use TCP as its transport layer protocol whereas connectionless services use UDP. Is DHCP a connection-oriented service or a connectionless service? Is DHCP running TCP or UDP services? What is the source port used by DHCP servers?

- b. From the five application protocols under study, identify the three protocols using TCP services.

3. Under Simulation mode, click Dynamic 2, then Command Prompt (on Desktop tab), then type the URL `http://www.internal.com` on the web browser. Similarly, do the same for Static PC, typing in `https://www.internal.com`. Click **Auto Capture/Play** (automatically forwards the packets) or **Capture Forward** (must keep clicking to advance the packets) until Packet Tracer finishes simulation (or reach Buffer Full Status).

- a. Before the interaction of the clients using HTTP and HTTPS, what protocol was used first?

- b. What is the source port used by HTTP servers? HTTPS servers?

- c. Look at any PDU information containing an HTTP frame and another PDU information containing HTTPS frame. Look at the difference between the data stored via HTTP with that of HTTPS.

4. Under Simulation mode, click Dynamic 1, then send email on one of the other client computers. Click **Auto Capture/Play** (automatically forwards the packets) or **Capture Forward** (must keep clicking to advance the packets) until Packet Tracer finishes simulation (or reach Buffer Full Status).

a. Before the interaction of the clients using SMTP, what protocol was used first?

b. What is the source port used by servers running SMTP?

5. By identifying the protocols serviced by TCP and UDP, identify three fields present in TCP that are not found in UDP.

6. Perform a ping from Dynamic 1 to Dynamic 2 under Simulation mode.

Note: Before doing a ping, type in **arp -d** at the command prompt of Dynamic 1 and execute **arp -a** after. Internet address and Physical address must be empty after typing arp -a

a. Before the interaction of the clients with ping, what protocol was used first?

b. Execute arp -a after the successful ping. Write down the internet address and physical address on Dynamic 1.

- c. Analyze the first ICMP frame and complete the table below.

	Answer
Source IP Address	
Destination IP Address	
ICMP Type value	
ICMP Code value	
Source Ethernet Address	
Destination Ethernet Address	
Internet Protocol version	
Time to Live (TTL) value	