Introduction to Packet Tracer

What is Packet Tracer? 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.

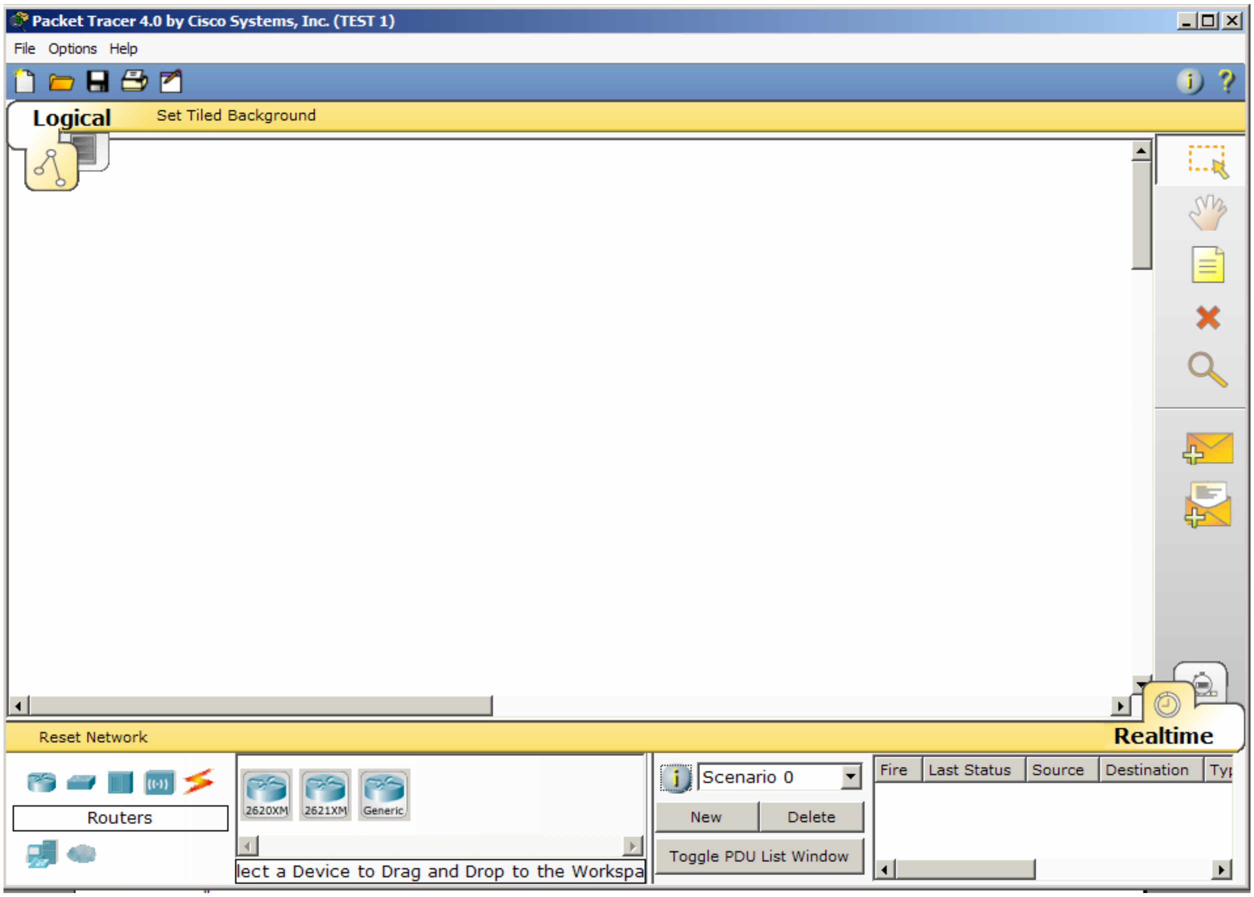
Purpose: The purpose of this lab is to become familiar with the Packet Tracer interface. Learn how to use existing topologies and build your own.

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 4.0 Beta, Test1.

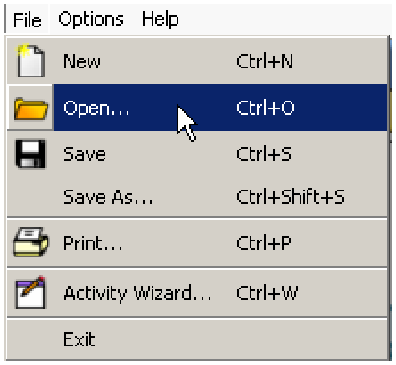
Introduction to the Packet Tracer Interface using a Hub Topology

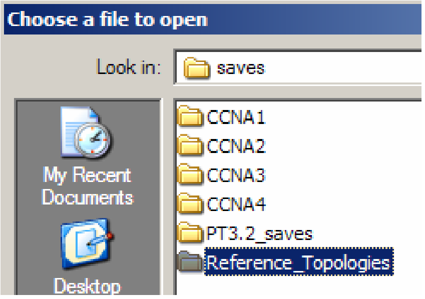
Step 1: Start Packet Tracer and Entering Simulation Mode

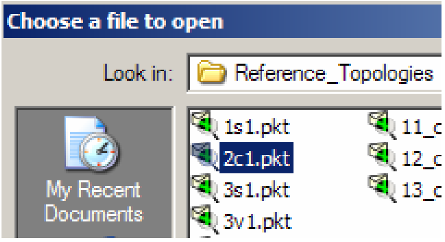


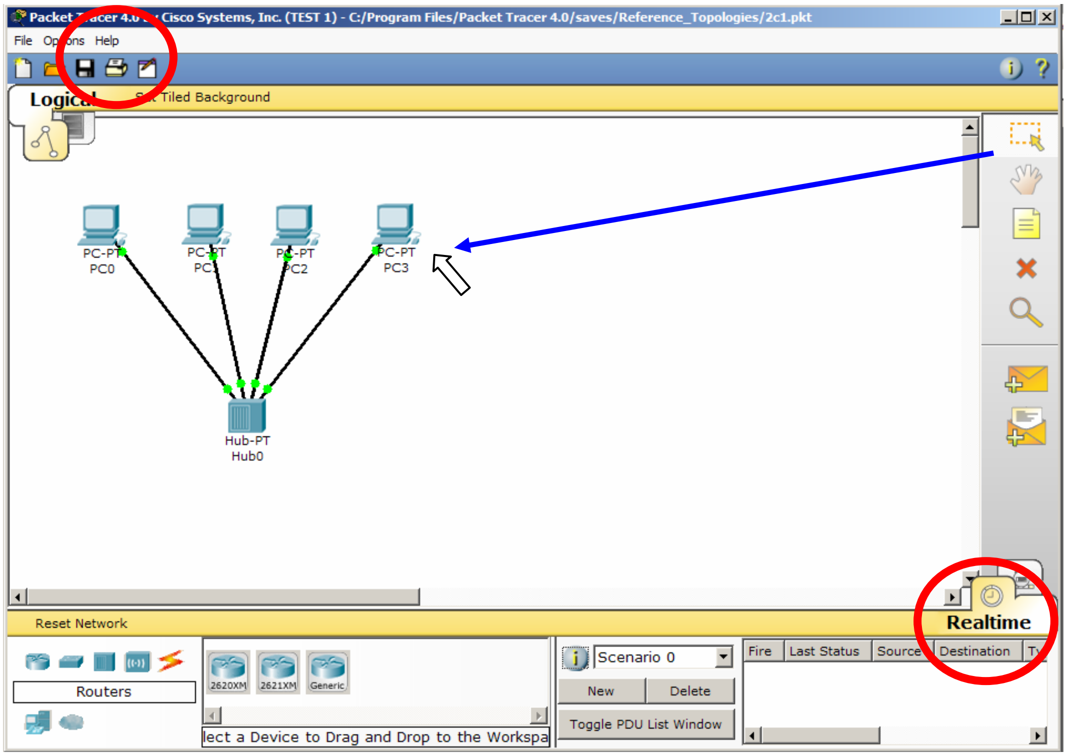
Step 2: Open an existing topology

Perform the following steps to open the **2c1.pkt** topology.







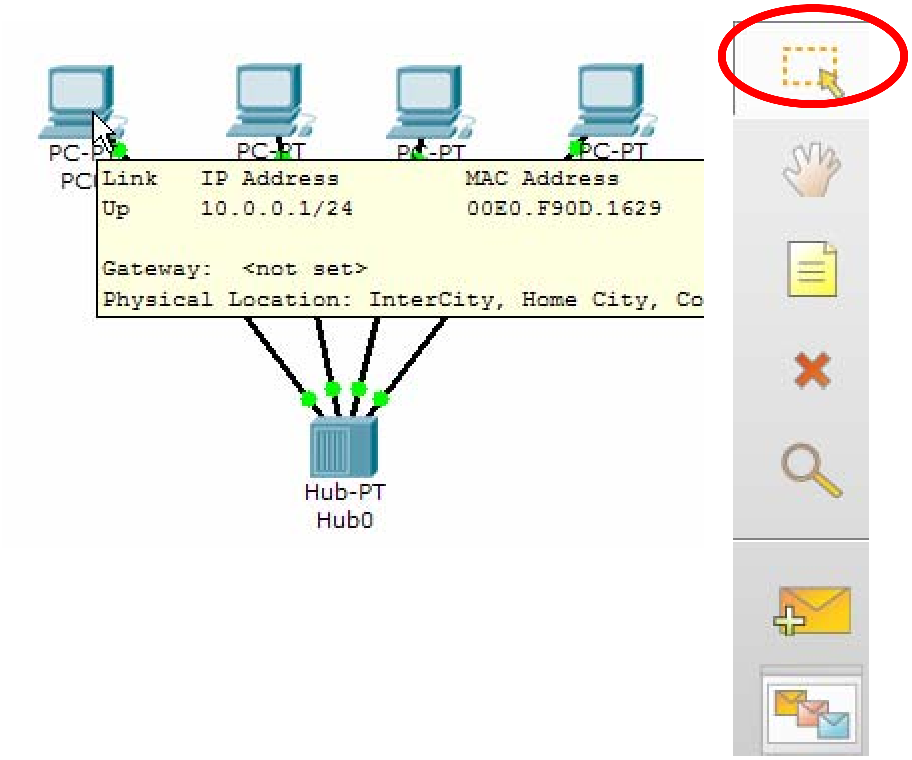


By default, the topology opens in **Realtime** mode. We will examine the difference between **Realtime** and **Simulation** modes in a moment.

Help can be obtained by using the Help menu. Both online help one each topic and tutorials are available. Please take advantage of this facilities.

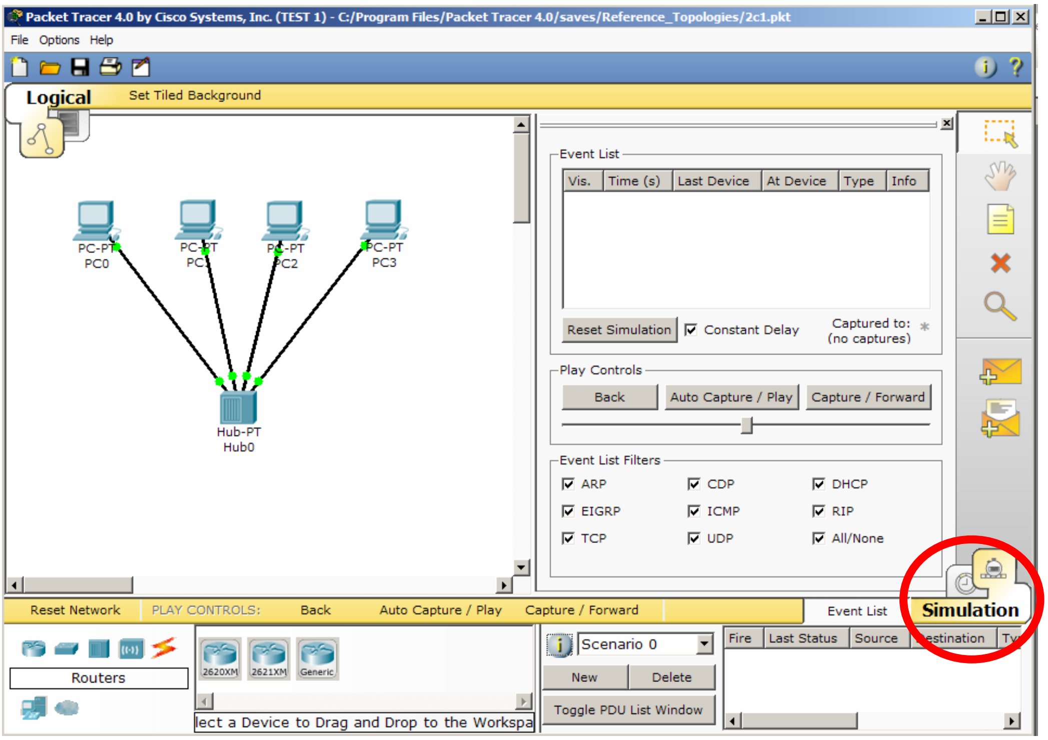
To view the IP address, subnet mask, default gateway, and MAC address of a host, move the cursor over that computer.
Be sure the **Select** box is checked at the top of the tool box.

Viewing PC0 information using the **Select** tool:



```
Link   IP Address        MAC Address
Up     10.0.0.1/24       00E0.F90D.1629

Gateway:  <not set>
Physical Location: InterCity, Home City, Co
```

Once the file is opened, click the **Simulation** icon, to enter simulation mode. Simulation mode allows you to view the a sequence of events associated with the communications between two or more devices. **Realtime** mode performs the operation with all of the sequence of events happening at "real time".



Packet Tracer 4.0 by Cisco Systems, Inc. (TEST 1) - C:/Program Files/Packet Tracer 4.0/saves/Reference_Topologies/2c1.pkt

Captured to: (no captures)

lect a Device to Drag and Drop to the Workspa

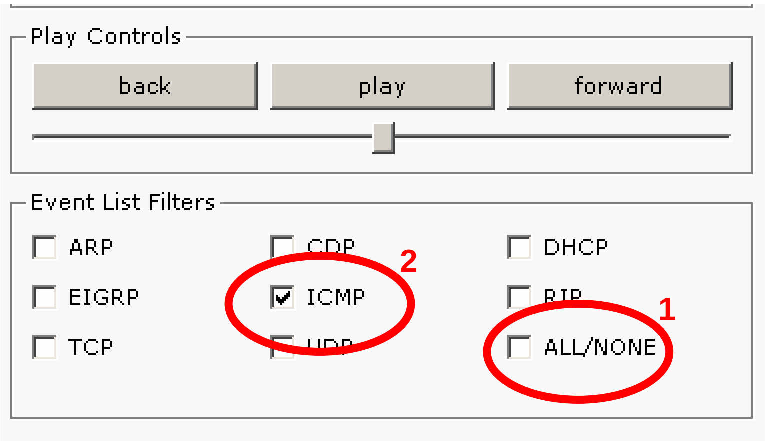
Step 3: PC0 pinging PC1

For those not familiar with ping: We will examine pings and the ICMP protocol in much more detail later. The ping program generates an IP packet with an encapsulated ICMP Echo Request message. It is a tool used to test basic layer 2 and layer 3 communications between two devices. When the user issues the ping command, most operating systems send multiple (four or five) ICMP Echo messages. When the destination device receives the ping, Echo Request, it issues an Echo Reply.

Command issued from PC0: **`ping 10.0.0.2`**

Packet Tracer allows us to either issue the command from the command prompt or to use the Add Simple PDU tool. We will look at both ways to do this.

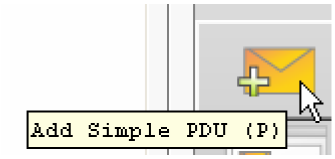
In order to view only the "pings", in the **Event List**, click on **ALL/NONE** to clear all protocols, and then click on **ICMP** to select only that protocol.



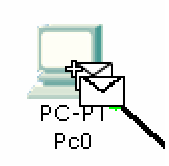
Using the Simple PDU Tool

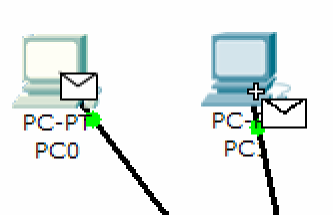
One method for pinging a device from another device is to use the **Simple PDU tool**. This tool performs the ping without having to issue the ping command.

Choose the **Add Simple PDU** tool from the tool box:

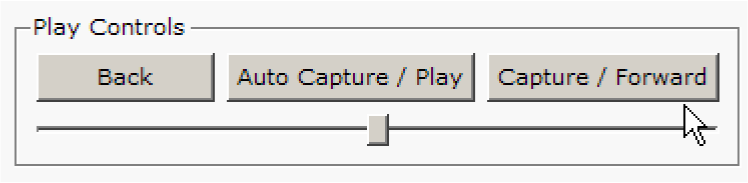


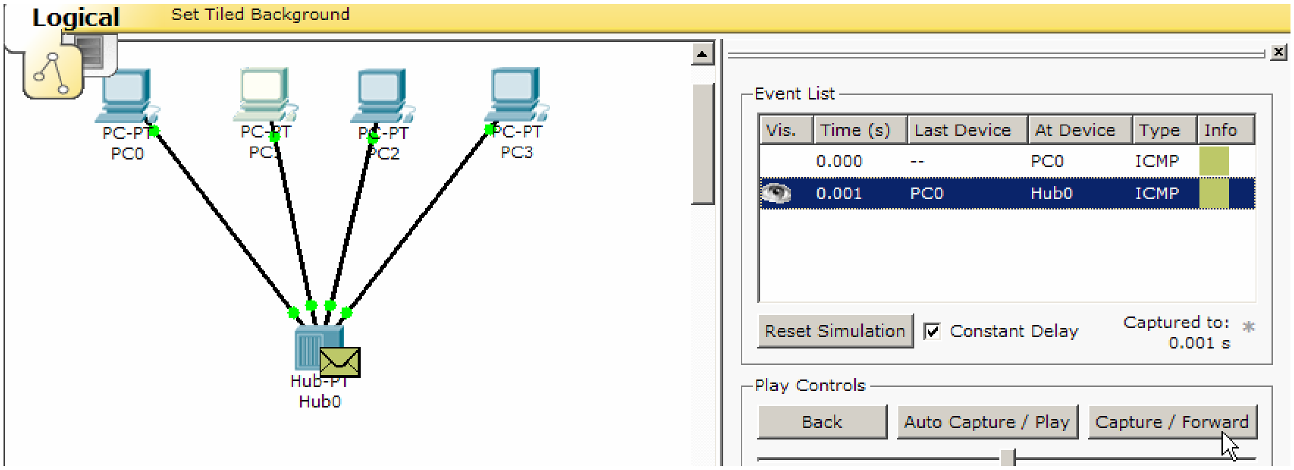
Click once on **PC0**, the device issuing the ping (ICMP Echo Request) and then click once on **PC1** (the destination of the ICMP Echo Request).





By clicking on the **Capture/Forward** button, this will forward each event. For example, the first event is the building of the ICMP packet and encapsulating it in an Ethernet frame. The next event will send this Ethernet frame from the Ethernet NIC in PC0 to the Hub.





Vis.	Time (s)	Last Device	At Device	Type	Info
	0.000	--	PC0	ICMP	🟩
	0.001	PC0	Hub0	ICMP	🟩

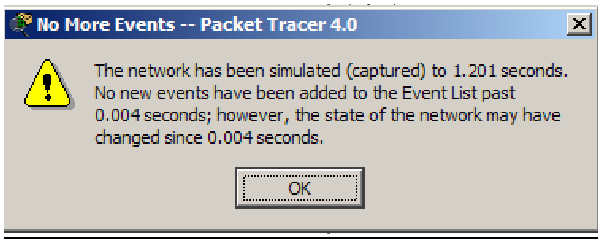
Captured to:
0.001 s

Continue to click on the **Capture/Forward** button and watch the ICMP Echo Requests and ICMP Echo Replies. ***Notice that the hub floods all of the frames out all ports except the port incoming port.***

Normally, before the ICMP Echo Request, ping, is sent out by PC0, an ARP Request might first be sent. We will discuss this later, but we disabled the display of ARP in the Event List earlier.

Note: Using this tool, only a single ping, ICMP Echo Request is sent by PC0, instead of the four pings when using the command prompt.

When the ICMP Echo Request and ICMP Echo Reply is finished, you will receive the following message:



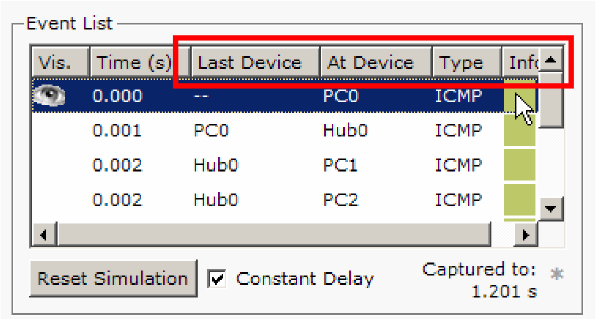
No More Events -- Packet Tracer 4.0

The network has been simulated (captured) to 1.201 seconds. No new events have been added to the Event List past 0.004 seconds; however, the state of the network may have changed since 0.004 seconds.

Step 4: Viewing the frame (Protocol Analyzer)

To examine the actual protocols being sent, click on the colored **Info** box in the **Event List**. The Event List shows where this Ethernet Frame is currently, “At Device”, the previous devices, “Last Device”, and the type of information encapsulated in the Ethernet Frame, “Info”.

Single click on the *second* event’s Info box to view the Ethernet frame with the encapsulated IP Packet and the encapsulated ICMP message **“At Device” PC0**.

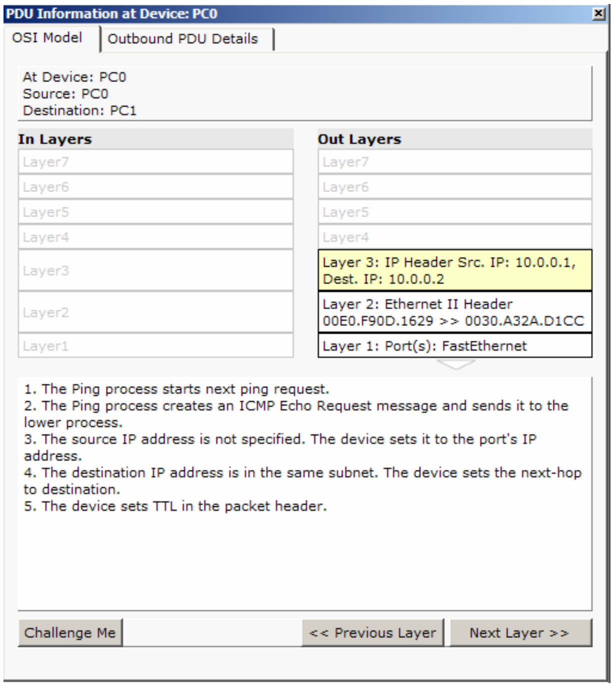


Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	0.000	--	PC0	ICMP	🟩
	0.001	PC0	Hub0	ICMP	🟩
	0.002	Hub0	PC1	ICMP	🟩
	0.002	Hub0	PC2	ICMP	🟩

Captured to:
1.201 s

The PDU (Protocol Data Unit) is displayed in two different formats, **OSI Model** and **Outbound PDU Details**. View them both, paying particular attention to the Layer 2 Ethernet frame. We will discuss IP and ICMP later. If you only see the IP packet and the ICMP message, and do not see the **Ethernet II** frame, click on the next ICMP Info box. This happened because we are looking at the IP packet before it got encapsulated into an Ethernet frame.

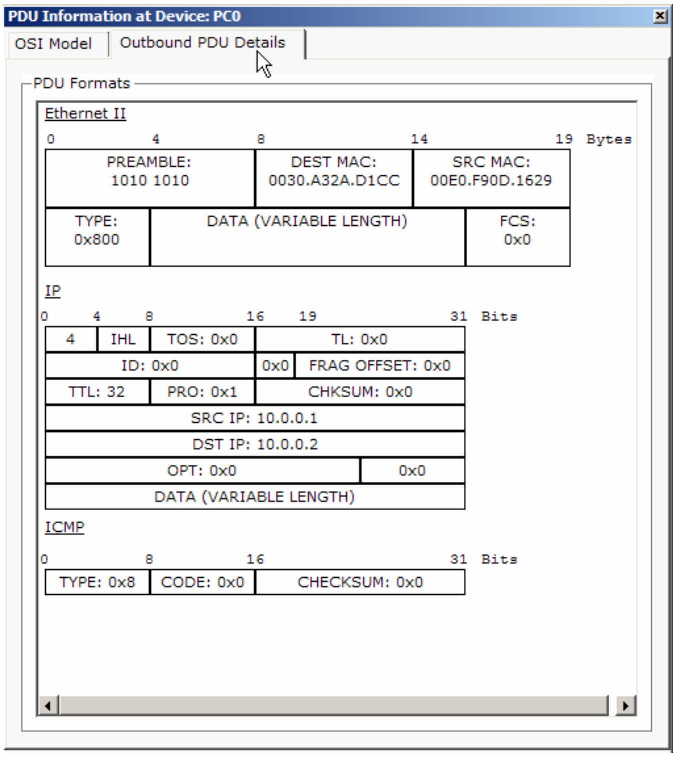


PDU Information at Device: PC0

At Device: PC0
Source: PC0
Destination: PC1

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer 3: IP Header Src. IP: 10.0.0.1, Dest. IP: 10.0.0.2
Layer2	Layer 2: Ethernet II Header 00E0.F90D.1629 >> 0030.A32A.D1CC
Layer1	Layer 1: Port(s): FastEthernet

1. The Ping process starts next ping request.
2. The Ping process creates an ICMP Echo Request message and sends it to the lower process.
3. The source IP address is not specified. The device sets it to the port's IP address.
4. The destination IP address is in the same subnet. The device sets the next-hop to destination.
5. The device sets TTL in the packet header.



PDU Information at Device: PC0

PDU Formats

Ethernet II

0 4 8 14 19 Bytes

PREAMBLE: 1010 1010	DEST MAC: 0030.A32A.D1CC	SRC MAC: 00E0.F90D.1629
TYPE: 0x800	DATA (VARIABLE LENGTH)	FCS: 0x0

IP

0 4 8 16 19 31 Bits

4	IHL	TOS: 0x0	TL: 0x0
ID: 0x0		0x0	FRAG OFFSET: 0x0
TTL: 32	PRO: 0x1	CHKSUM: 0x0	
SRC IP: 10.0.0.1			
DST IP: 10.0.0.2			
OPT: 0x0			0x0
DATA (VARIABLE LENGTH)			

ICMP

0 8 16 31 Bits

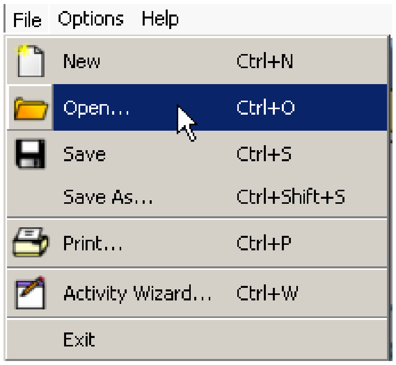
TYPE: 0x8	CODE: 0x0	CHECKSUM: 0x0

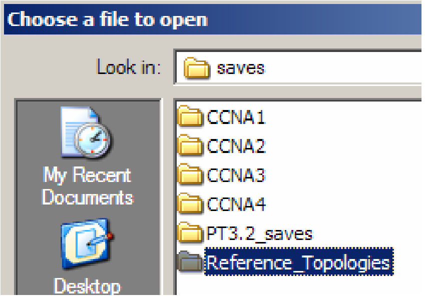
The default is the **OSI Model** view with a brief description with what is occurring with this packet. Click on the **Outbound PDU Details** tab to see the protocol details including the layer 2 Ethernet frame, the layer 3 IP packet and ICMP message.

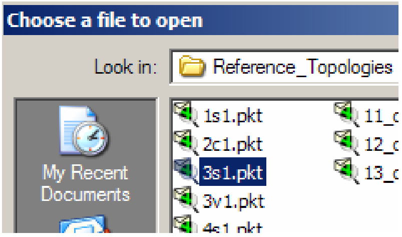
Looking at the Switch Algorithm and Switch MAC Address Tables

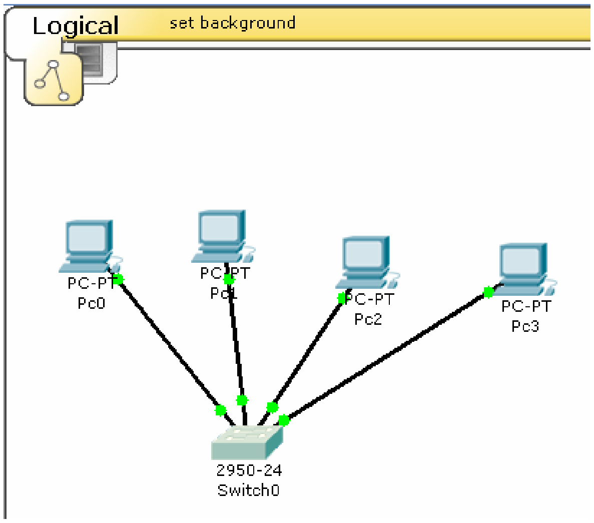
Step 1: Open the following topology

Open the file **3s1.pkt**



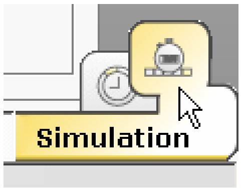




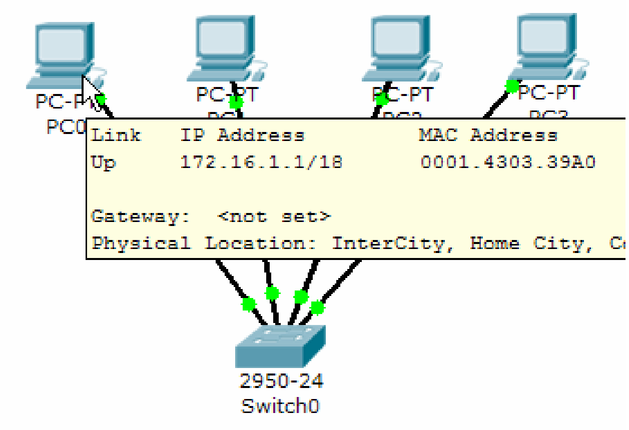


Notice that it is similar to the previous topology, but the **layer 1 hub** has been replace with a **layer 2 switch**.

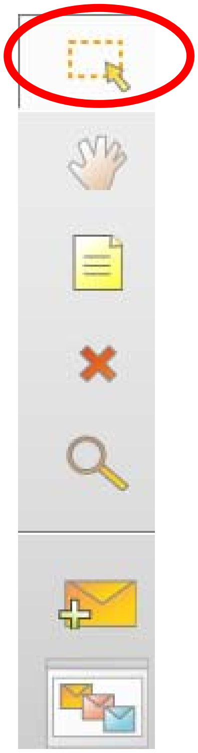
Click on the **Simulation** icon to switch to simulation mode.



Use the **Select** tool to view IP address and MAC address information for the various hosts..

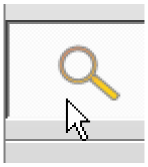


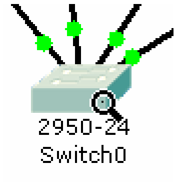
```
Link    IP Address          MAC Address
Up      172.16.1.1/18       0001.4303.39A0

Gateway:  <not set>
Physical Location: InterCity, Home City, C
```

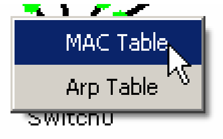


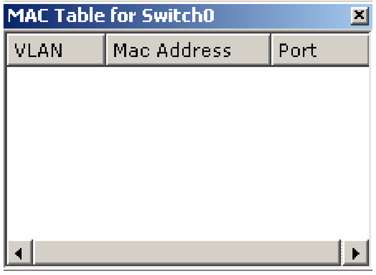
Step 2: Viewing the Switch MAC Address Table

Use the **Inspect** tool to view the MAC Address Table of the switch.





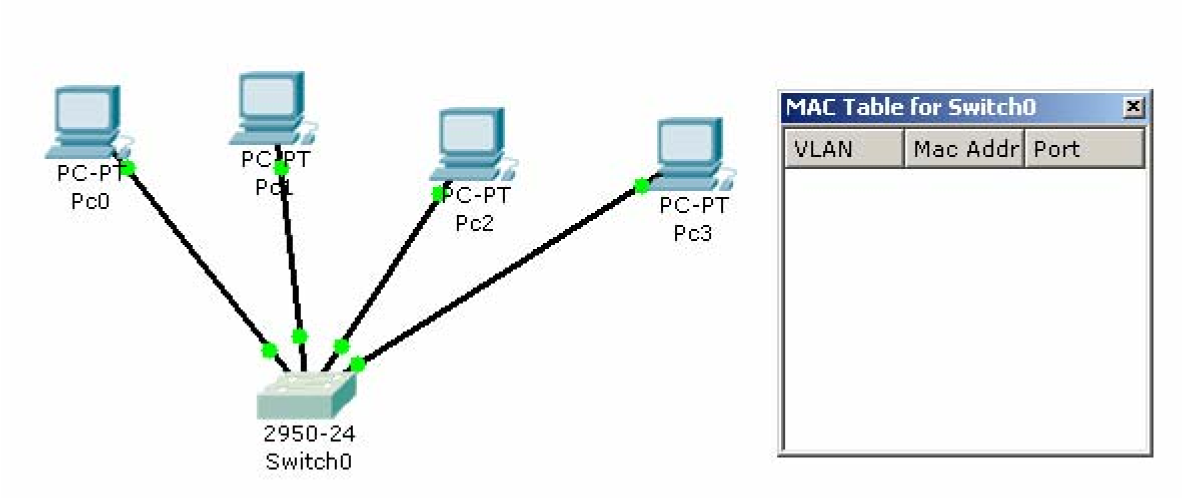




MAC Table for Switch0

VLAN	Mac Address	Port

The MAC Address Table is empty as it has not learned any Source Ethernet MAC Addresses. Notice that there is also a VLAN column in this table. This will be discussed in future courses.

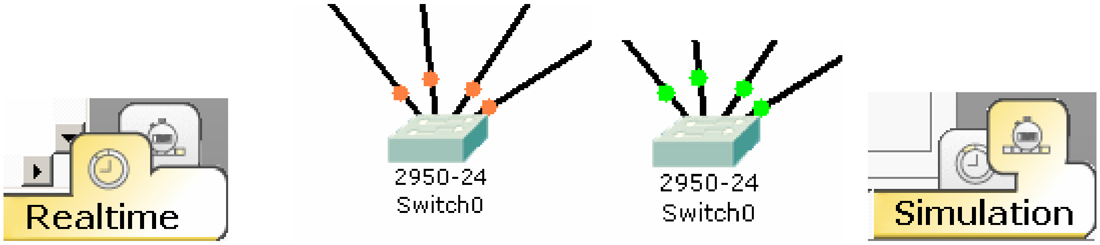


MAC Table for Switch0

VLAN	Mac Addr	Port

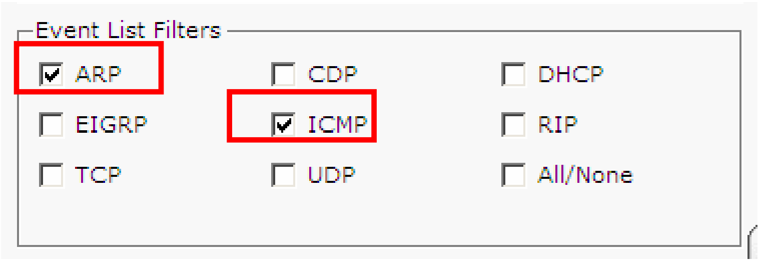
Waiting for Spanning Tree Protocol (STP)

Note: Because of how Packet Tracer also simulates the Spanning Tree Protocol (later), at times the switch may show amber lights on its interfaces. To correct this, click the **Realtime** mode icon, wait for the lights to turn green, and then click the **Simulation** mode icon, returning to where you left off.



Step 3: Setting the Event List Protocols and Viewing the MAC Address Table

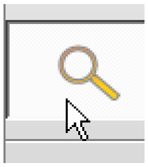
Set the **Event List Filters** to include both ICMP and ARP. We need to include the display of ARP to better examine how the switch MAC Address Table gets updated. (more later)

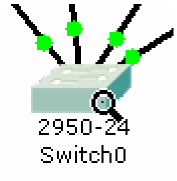


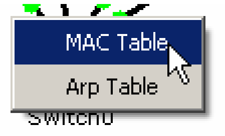
Event List Filters

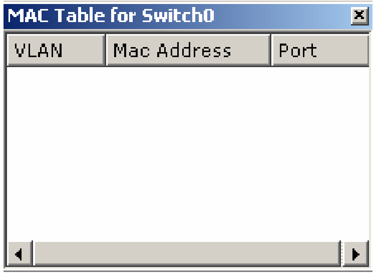
☑ ARP	□ CDP	□ DHCP
□ EIGRP	☑ ICMP	□ RIP
□ TCP	□ UDP	□ All/None

If you haven't done so already, use the **Inspect** tool to view the MAC Address Table of the switch.







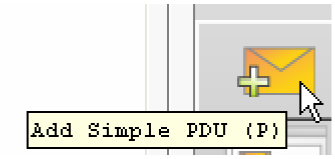


MAC Table for Switch0

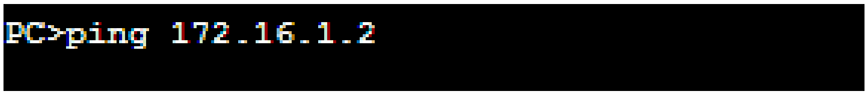
VLAN	Mac Address	Port

Step 3: Issuing a Ping and Viewing the MAC Address Table

Using the Add Simple PDU perform a ping from PC0 to PC1. Choose the **Add Simple PDU** tool from the tool box:

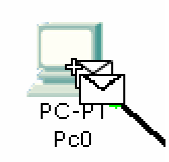


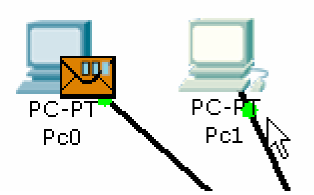
This is the same as doing:



```
PC>ping 172.16.1.2
```

Click once on PC0, the device issuing the ping (ICMP Echo Request) and then click once on PC1 (the destination of the ICMP Echo Request).

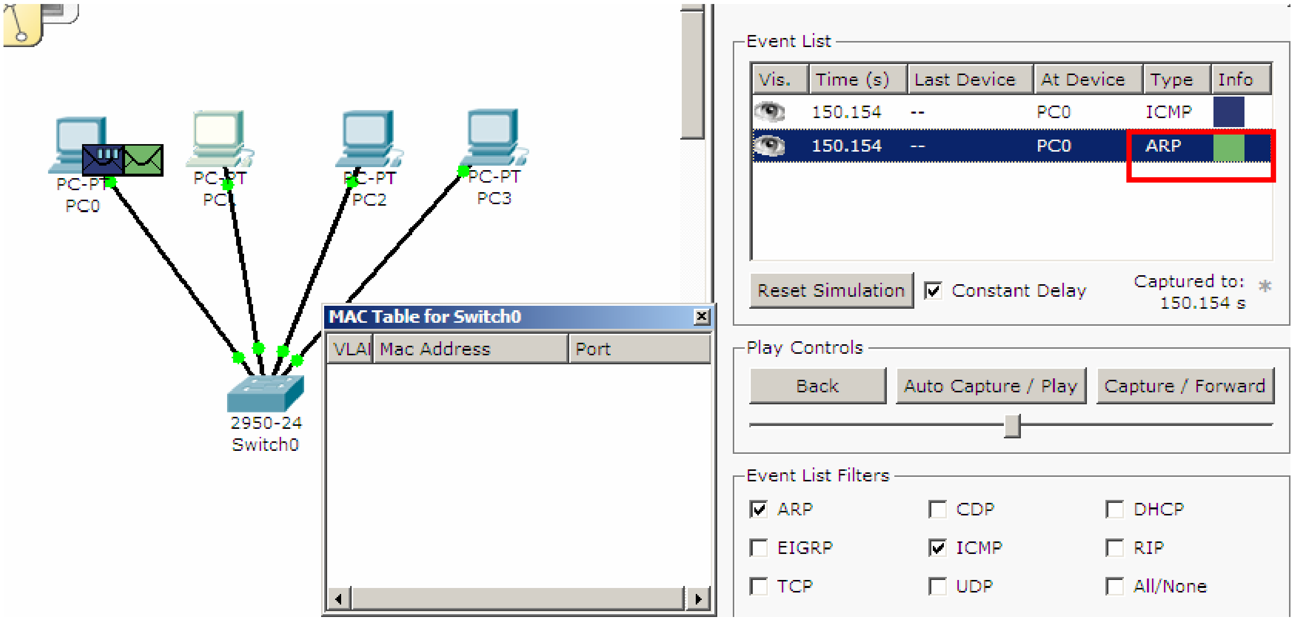




ARP Request

Before PC0 can send the ICMP Echo Request, ping, it needs to send an ARP Request. We will talk about this later, but an ARP (Address Resolution Protocol) Request is how a host that knows the Destination IP Address of a device discovers the Ethernet Destination MAC Address for that same device. (more later)

So, the ICMP Echo Request, ping is put on hold, stored in memory and an ARP Request is transmitted first.



MAC Table for Switch0

VLAN	Mac Address	Port

Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
👁	150.154	--	PC0	ICMP	🟦
👁	150.154	--	PC0	ARP	🟩

Reset Simulation ☑ Constant Delay Captured to: 150.154 s

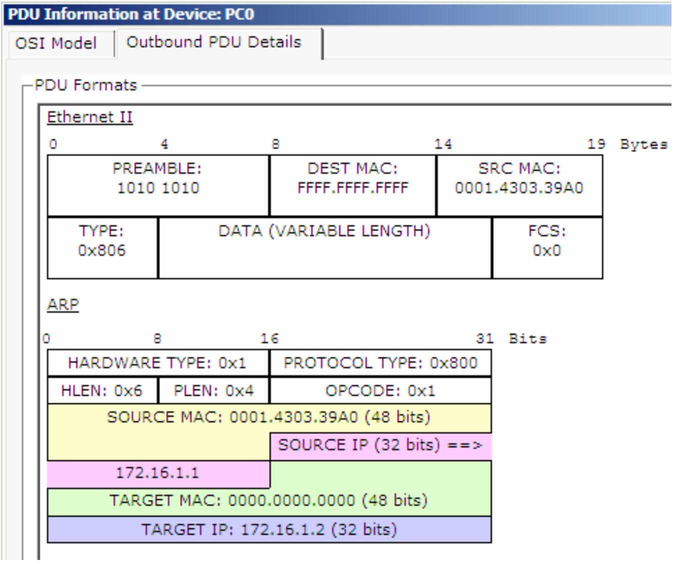
Play Controls

Back | Auto Capture / Play | Capture / Forward

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

To view the ARP Request, click on the Info box in the Event List. Notice the Destination MAC Address is a broadcast, 48 1 bits or 12 Hexadecimal Fs.



PDU Information at Device: PC0

OSI Model | Outbound PDU Details

PDU Formats

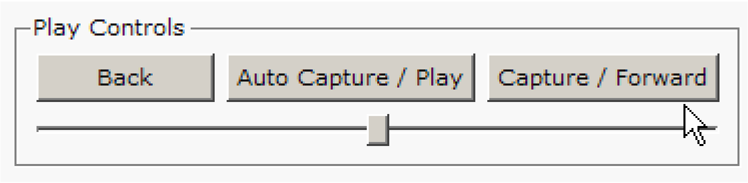
Ethernet II

0	4	8	14	19 Bytes
PREAMBLE: 1010 1010		DEST MAC: FFFF.FFFF.FFFF	SRC MAC: 0001.4303.39A0	
TYPE: 0x806	DATA (VARIABLE LENGTH)		FCS: 0x0	

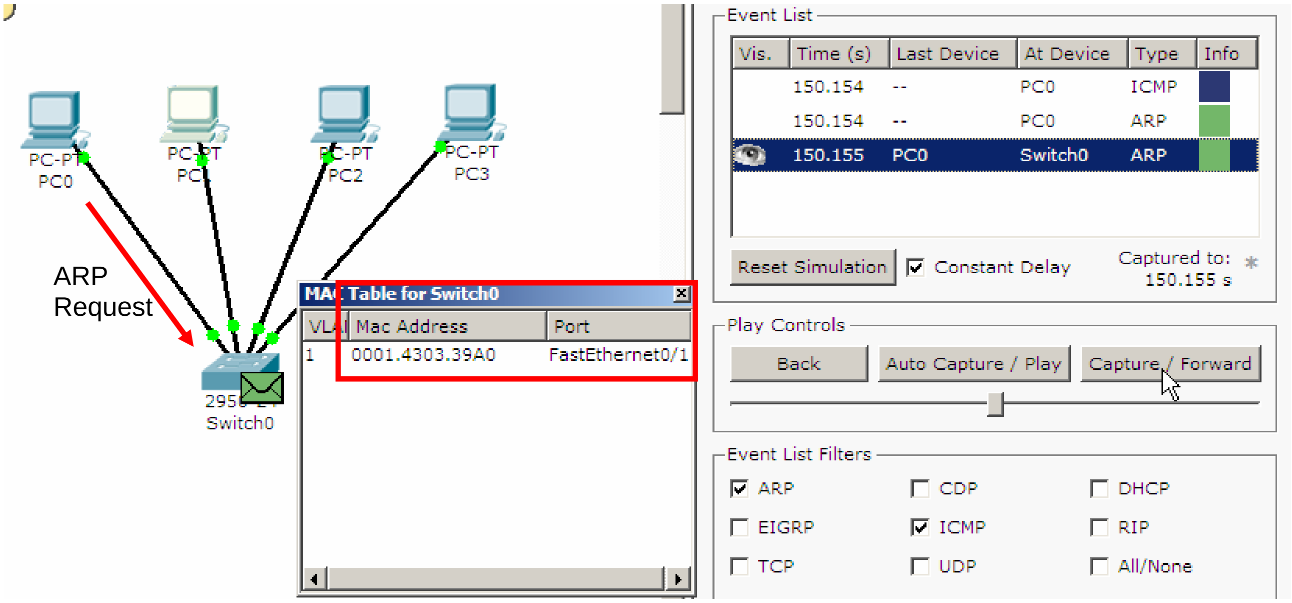
ARP

0	8	16	31 Bits
HARDWARE TYPE: 0x1		PROTOCOL TYPE: 0x800	
HLEN: 0x6	PLEN: 0x4	OPCODE: 0x1	
SOURCE MAC: 0001.4303.39A0 (48 bits)			
		SOURCE IP (32 bits) ==>	
172.16.1.1			
TARGET MAC: 0000.0000.0000 (48 bits)			
TARGET IP: 172.16.1.2 (32 bits)			

Click the Capture/Forward button to advance to the next event, the ARP Request going from PC0 to the switch.



Notice that the switch's MAC Address Table is updated with the Source MAC Address of PC0 and the incoming port number.



MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1

Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.154	--	PC0	ICMP	■
	150.154	--	PC0	ARP	🟩
👁	150.155	PC0	Switch0	ARP	🟩

Reset Simulation ☑ Constant Delay Captured to: 150.155 s

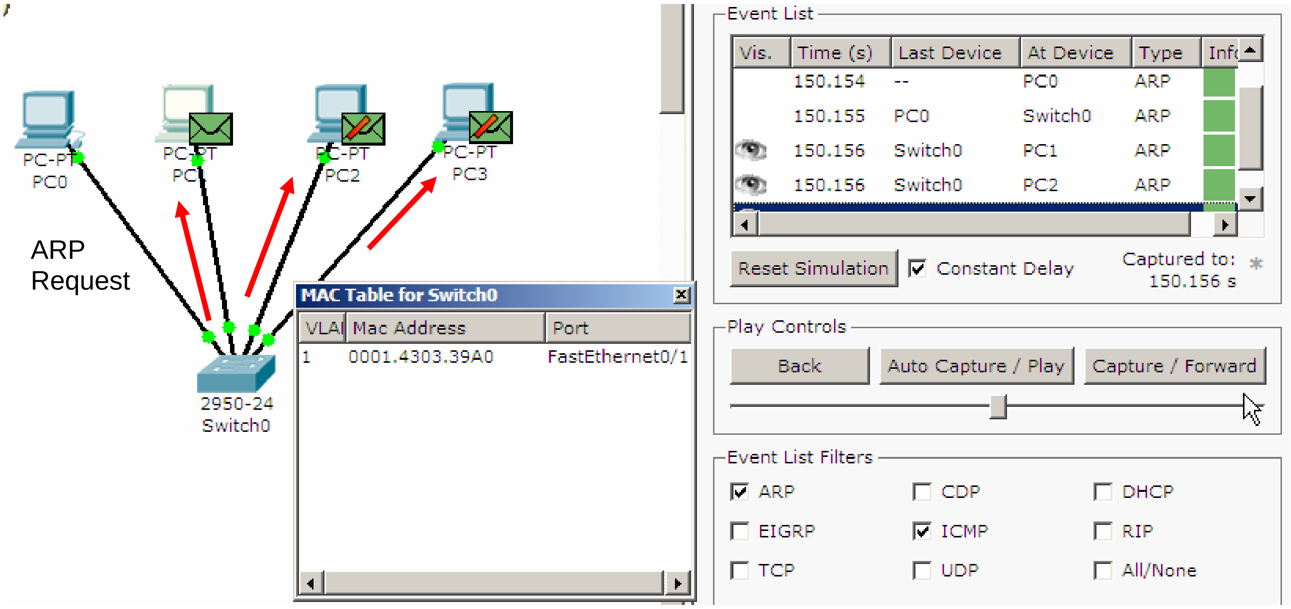
Play Controls

Back | Auto Capture / Play | Capture / Forward

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

The packet is flooded out all ports because the Destination MAC Address of an ARP Request is a broadcast (48 1 bits or all F's in Hex).



Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.154	--	PC0	ARP	🟩
	150.155	PC0	Switch0	ARP	🟩
👁	150.156	Switch0	PC1	ARP	🟩
👁	150.156	Switch0	PC2	ARP	🟩

☑ Constant Delay

Captured to:
150.156 s

MAC Table for Switch0

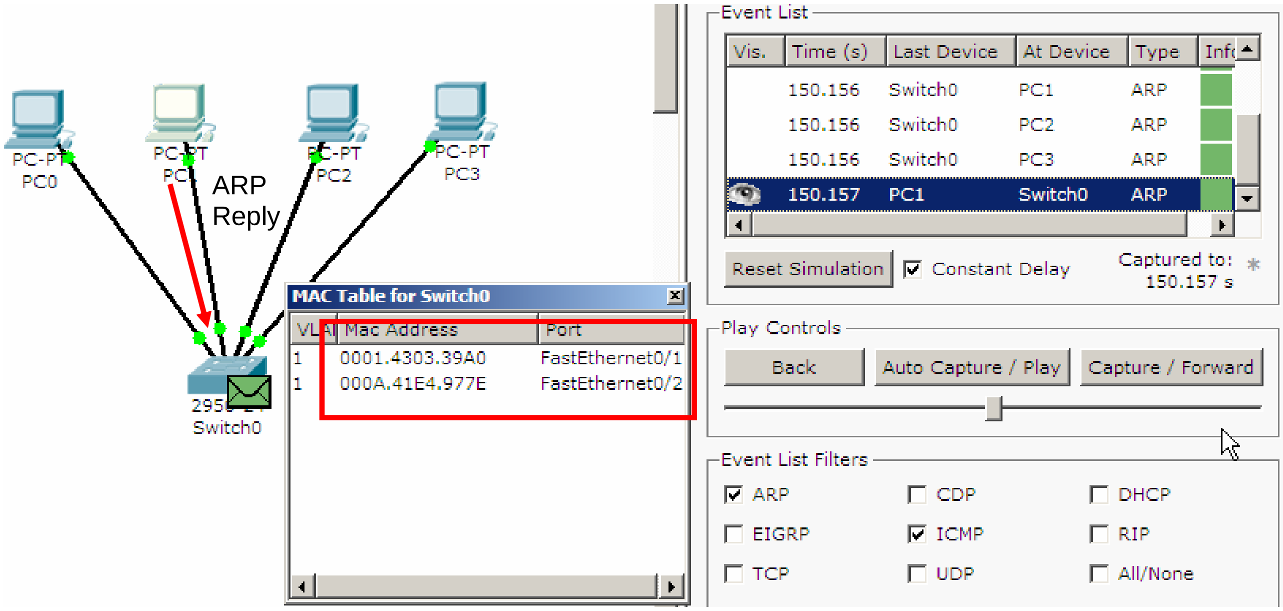
VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

ARP Reply

PC2 and PC3 ignore the ARP Request because PC0 is only asking for the owner of the IP Address 172.16.1.2 to reply. PC1 now sends back an ARP Reply with its MAC Address. (Again, this will be discussed later.) This time the switch updates its MAC Address Table with the Ethernet Source MAC Address of PC1 and the incoming port number.



Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.156	Switch0	PC1	ARP	🟩
	150.156	Switch0	PC2	ARP	🟩
	150.156	Switch0	PC3	ARP	🟩
👁	150.157	PC1	Switch0	ARP	🟩

☑ Constant Delay

Captured to:
150.157 s

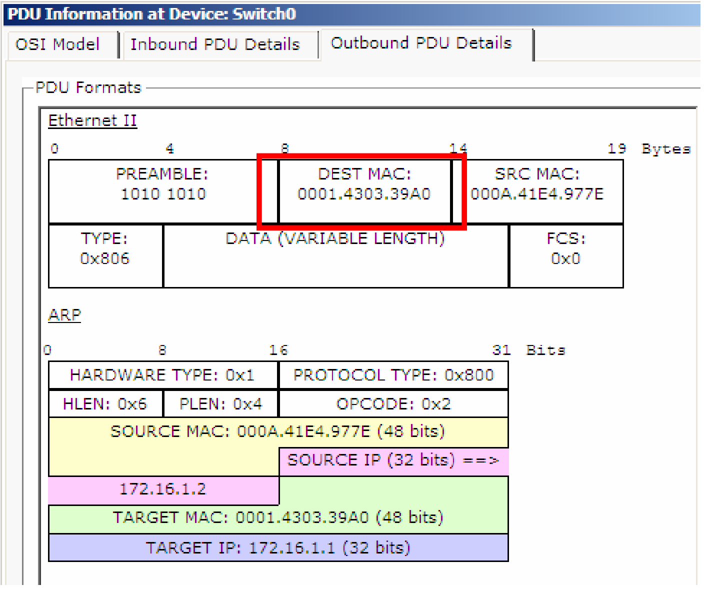
MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1
1	000A.41E4.977E	FastEthernet0/2

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

If you want to view the protocol details of the ARP Reply, click on the Info box in the Event List.



PDU Information at Device: Switch0

PDU Formats

Ethernet II

0 4 8 14 19 Bytes

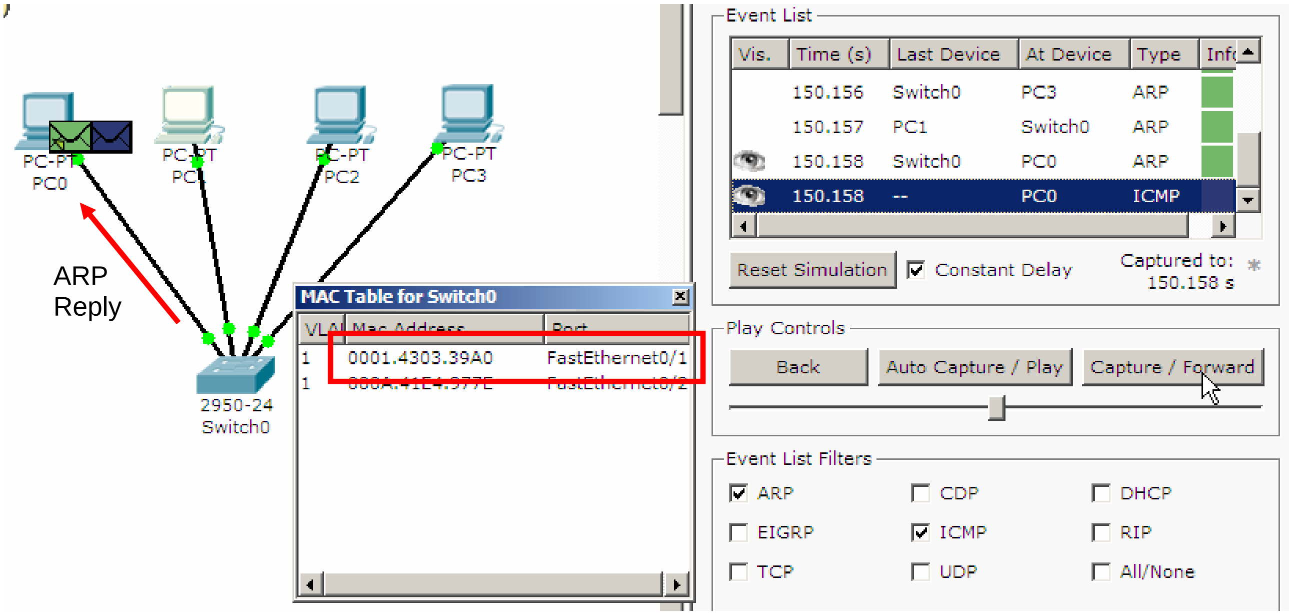
PREAMBLE: 1010 1010	DEST MAC: 0001.4303.39A0	SRC MAC: 000A.41E4.977E
TYPE: 0x806	DATA (VARIABLE LENGTH)	FCS: 0x0

ARP

0 8 16 31 Bits

HARDWARE TYPE: 0x1		PROTOCOL TYPE: 0x800	
HLEN: 0x6	PLEN: 0x4	OPCODE: 0x2	
SOURCE MAC: 000A.41E4.977E (48 bits)			
		SOURCE IP (32 bits) ==>	
172.16.1.2			
TARGET MAC: 0001.4303.39A0 (48 bits)			
TARGET IP: 172.16.1.1 (32 bits)			

Continue to click on the Capture/Forward button until the ARP Reply reaches PC0. Because the ARP Reply is encapsulated in an Ethernet frame with a unicast Destination MAC Address and that MAC Address is in the switch's MAC Address Table, the switch filters the frame by only sending it out Port FastEthernet0/1.



MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1
1	000A.41E4.977E	FastEthernet0/2

Event List

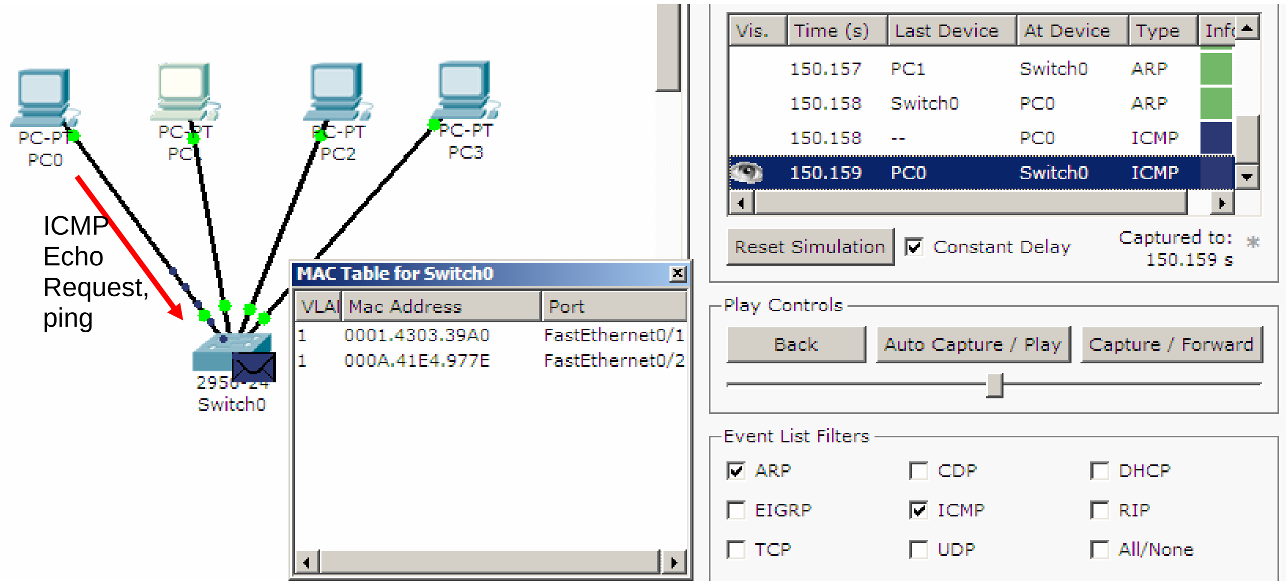
Vis.	Time (s)	Last Device	At Device	Type	Info
	150.156	Switch0	PC3	ARP	🟩
	150.157	PC1	Switch0	ARP	🟩
👁	150.158	Switch0	PC0	ARP	🟩
👁	150.158	--	PC0	ICMP	

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

Ping: ICMP Echo Request

PC0 now has the Destination MAC Address for PC1's IP Address, so it can now send out the ICMP Echo Request, ping.



ICMP Echo Request, ping

MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1
1	000A.41E4.977E	FastEthernet0/2

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.157	PC1	Switch0	ARP	🟩
	150.158	Switch0	PC0	ARP	🟩
	150.158	--	PC0	ICMP	■
👁	150.159	PC0	Switch0	ICMP	■

Reset Simulation ☑ Constant Delay Captured to: 150.159 s

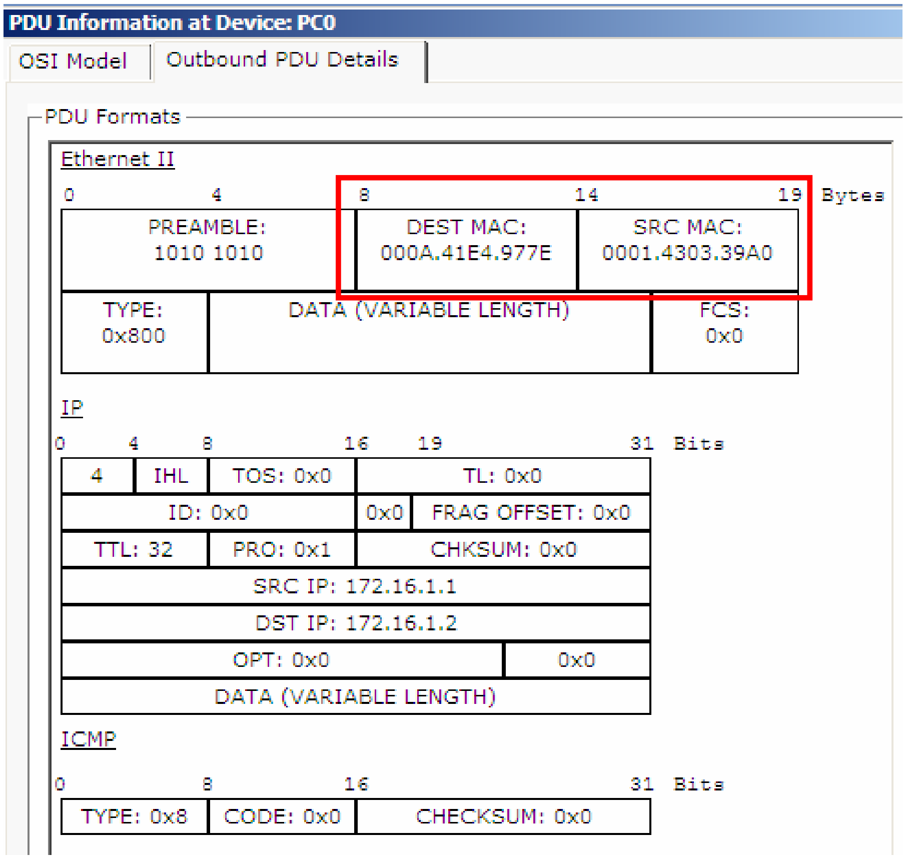
Play Controls

Back | Auto Capture / Play | Capture / Forward

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

If you want to view the protocol details of the ICMP Echo Request, click on the Info box in the Event List. Notice that the Destination MAC Address is a unicast.



PDU Information at Device: PC0

OSI Model | Outbound PDU Details

PDU Formats

Ethernet II

0 4 8 14 19 Bytes

PREAMBLE: 1010 1010 | DEST MAC: 000A.41E4.977E | SRC MAC: 0001.4303.39A0

TYPE: 0x800 | DATA (VARIABLE LENGTH) | FCS: 0x0

IP

0 4 8 16 19 31 Bits

4 | IHL | TOS: 0x0 | TL: 0x0

ID: 0x0 | 0x0 | FRAG OFFSET: 0x0

TTL: 32 | PRO: 0x1 | CHKSUM: 0x0

SRC IP: 172.16.1.1

DST IP: 172.16.1.2

OPT: 0x0 | 0x0

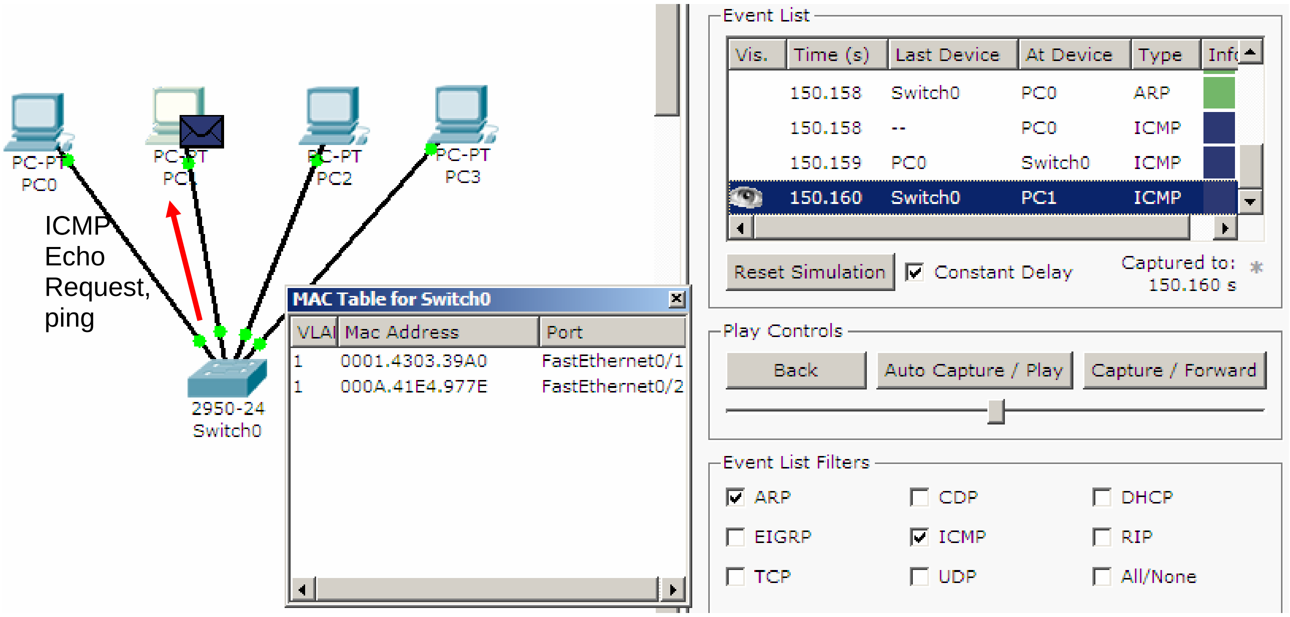
DATA (VARIABLE LENGTH)

ICMP

0 8 16 31 Bits

TYPE: 0x8 | CODE: 0x0 | CHECKSUM: 0x0

The switch has the Source MAC Address in its table so it resets the 5 minute timer. The switch also has the Destination MAC address in its table so it filters the frame by forwarding it out of only port FastEthernet0/2.



MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1
1	000A.41E4.977E	FastEthernet0/2

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.158	Switch0	PC0	ARP	🟩
	150.158	--	PC0	ICMP	■
	150.159	PC0	Switch0	ICMP	■
👁	150.160	Switch0	PC1	ICMP	■

☑ Constant Delay

Captured to: 150.160 s

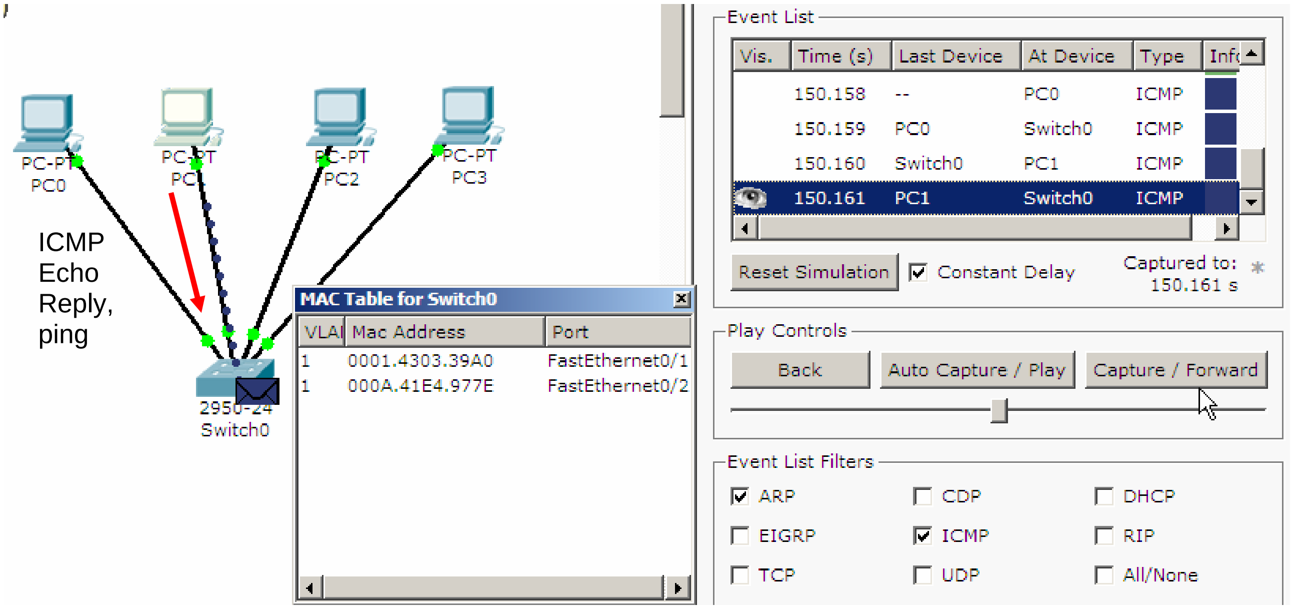
☑ ARP ☐ CDP ☐ DHCP

☐ EIGRP ☑ ICMP ☐ RIP

☐ TCP ☐ UDP ☐ All/None

Ping: ICMP Echo Reply

PC1 returns an ICMP Echo Reply.



MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1
1	000A.41E4.977E	FastEthernet0/2

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.158	--	PC0	ICMP	■
	150.159	PC0	Switch0	ICMP	■
	150.160	Switch0	PC1	ICMP	■
👁	150.161	PC1	Switch0	ICMP	■

☑ Constant Delay

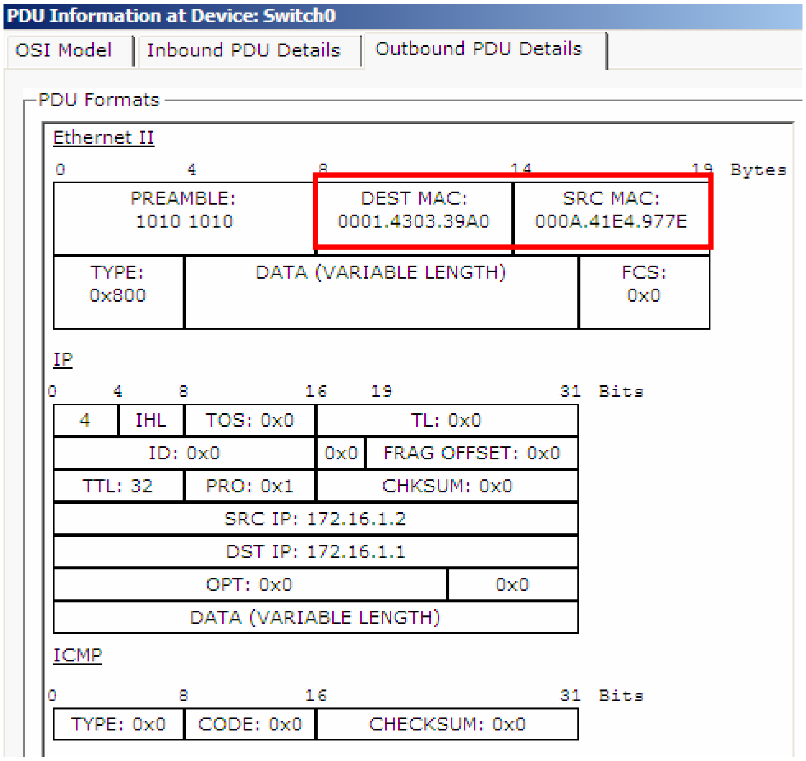
Captured to: 150.161 s

☑ ARP ☐ CDP ☐ DHCP

☐ EIGRP ☑ ICMP ☐ RIP

☐ TCP ☐ UDP ☐ All/None

If you want to view the protocol details of the ICMP Echo Reply, click on the Info box in the Event List. Notice that the Destination MAC Address is a unicast.



PDU Information at Device: Switch0

OSI Model | Inbound PDU Details | Outbound PDU Details

PDU Formats

Ethernet II

0 4 8 14 19 Bytes

PREAMBLE: 1010 1010	DEST MAC: 0001.4303.39A0	SRC MAC: 000A.41E4.977E
TYPE: 0x800	DATA (VARIABLE LENGTH)	FCS: 0x0

IP

0 4 8 16 19 31 Bits

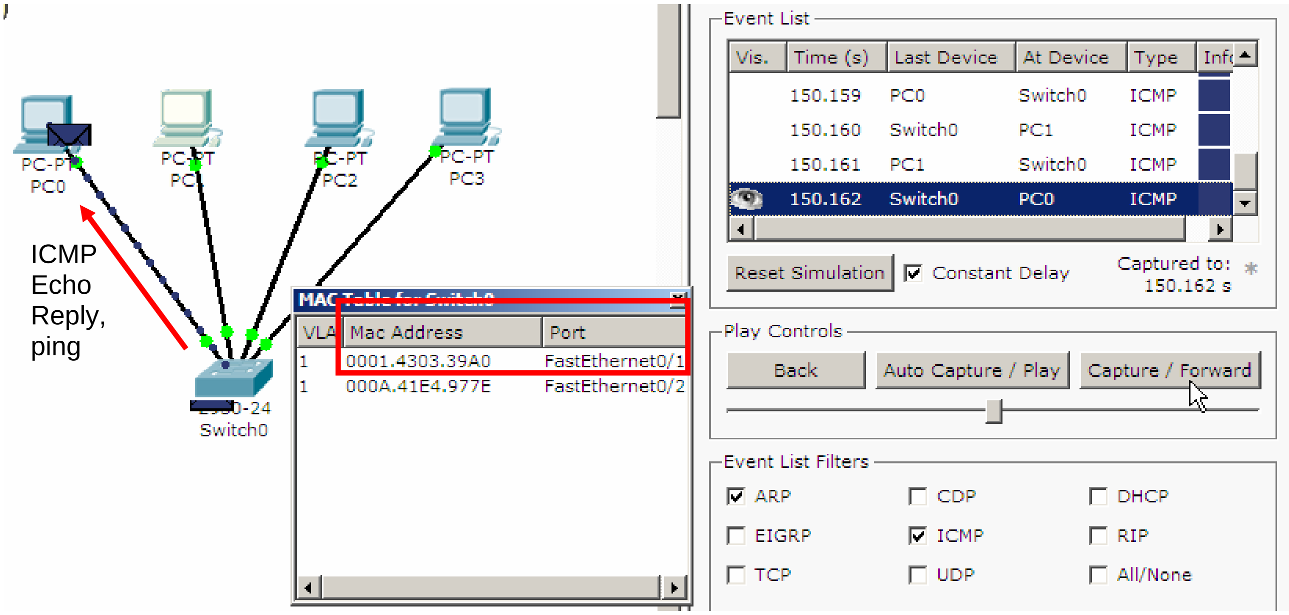
4	IHL	TOS: 0x0	TL: 0x0
ID: 0x0		0x0	FRAG OFFSET: 0x0
TTL: 32		PRO: 0x1	CHKSUM: 0x0
SRC IP: 172.16.1.2			
DST IP: 172.16.1.1			
OPT: 0x0			0x0
DATA (VARIABLE LENGTH)			

ICMP

0 8 16 31 Bits

TYPE: 0x0	CODE: 0x0	CHECKSUM: 0x0

The switch has the Source MAC Address in its table so it resets the 5 minute timer. The switch also has the Destination MAC address in its table so it filters the frame by forwarding it out of only port FastEthernet0/1.



ICMP Echo Reply, ping

MAC Table for Switch0

VLAN	Mac Address	Port
1	0001.4303.39A0	FastEthernet0/1
1	000A.41E4.977E	FastEthernet0/2

Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	150.159	PC0	Switch0	ICMP	
	150.160	Switch0	PC1	ICMP	
	150.161	PC1	Switch0	ICMP	
👁	150.162	Switch0	PC0	ICMP	

Reset Simulation ☑ Constant Delay Captured to: 150.162 s

Play Controls

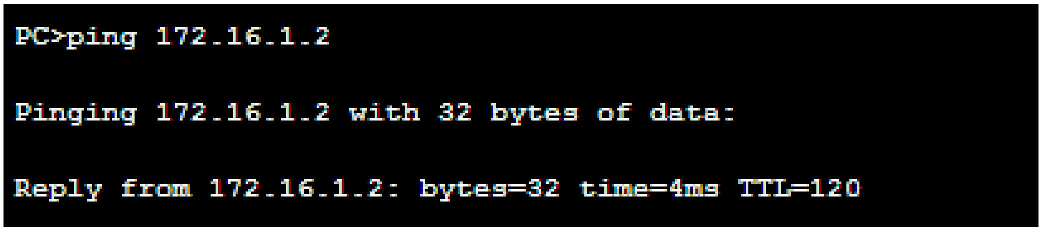
Back | Auto Capture / Play | Capture / Forward

Event List Filters

☑ ARP ☐ CDP ☐ DHCP
☐ EIGRP ☑ ICMP ☐ RIP
☐ TCP ☐ UDP ☐ All/None

Output

The result of the command is:



```
PC>ping 172.16.1.2

Pinging 172.16.1.2 with 32 bytes of data:

Reply from 172.16.1.2: bytes=32 time=4ms TTL=120
```

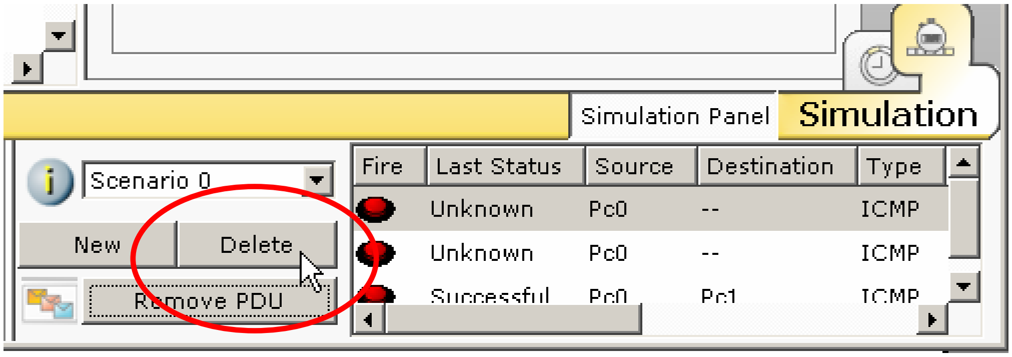
Step 4: Play

A good way to learn new software is to play and experiment. Try different tools, look at various protocols using the Event List and the Info box, and use the Help and Tutorials. Have fun!

Resetting the Network

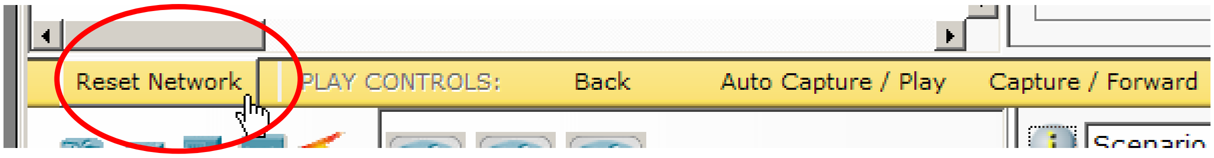
Whenever you want to reset the network and begin the simulation again, perform the following tasks:

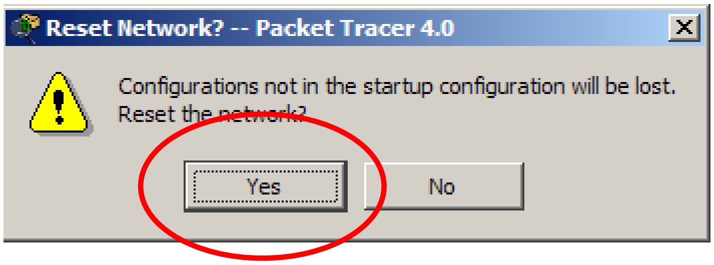
Click **Delete** in the PDU area.



Fire	Last Status	Source	Destination	Type
●	Unknown	Pc0	--	ICMP
●	Unknown	Pc0	--	ICMP
●	Successful	Pc0	Pc1	ICMP

Now, reset the network and confirm the action.





Reset Network? -- Packet Tracer 4.0

Configurations not in the startup configuration will be lost.
Reset the network?