Introduction to Packet Tracer

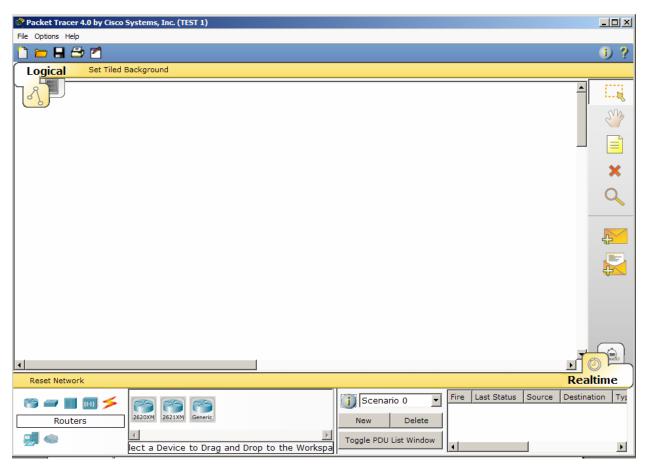
What is Packet Tracer? Packet Tracer is a protocol simulator developed by Dennis Frezzo and his team at Cisco Systems. Packet Tracer (PT) is a powerful and dynamic tool that displays the various protocols used in networking, in either Real Time or Simulation mode. This includes layer 2 protocols such 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.

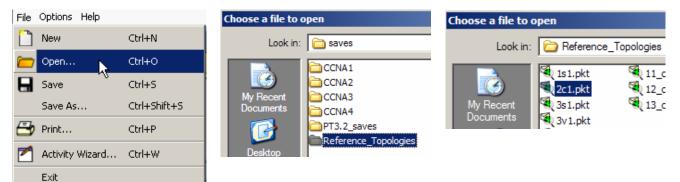
Introduction to the Packet Tracer Interface using a Hub Topology



Step 1: Start Packet Tracer and Entering Simulation Mode

Step 2: Open an existing topology

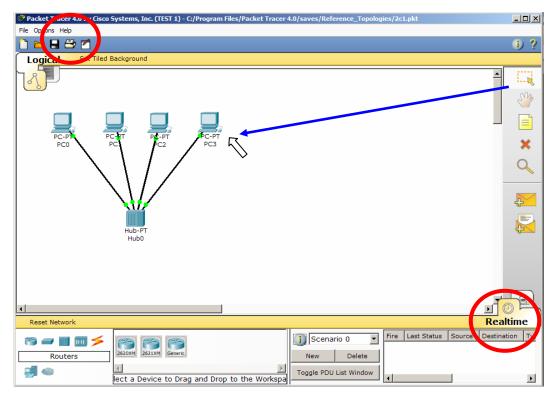
Perform the following steps to open the 2c1.pkt topology.



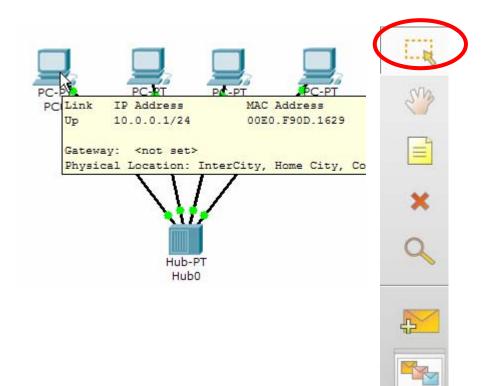
By default, the topology opens in **Realtime** mode. We will examine the difference between **Realtime** and **Simulation** modes in a moment.

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.

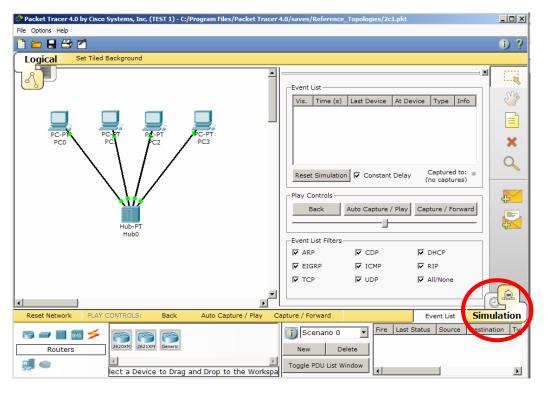
To view the IP address, subnet mask, default gateway, and MAC address of a host, move the cursor over that computer. Be sure the **Select** box is checked at the top of the tool box.



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



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".



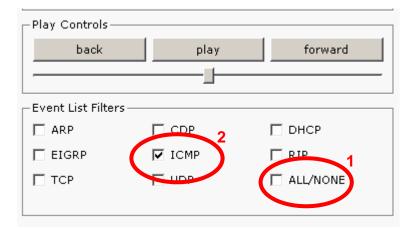
Step 3: PC0 pinging PC1

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 PCO: ping 192.168.10.37

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

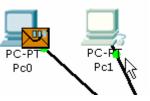
One method for pinging a device from another device is to use the **Simple PDU tool**. This tool performs the ping without having to issue the ping command.

Choose the Add Simple PDU tool from the tool box:



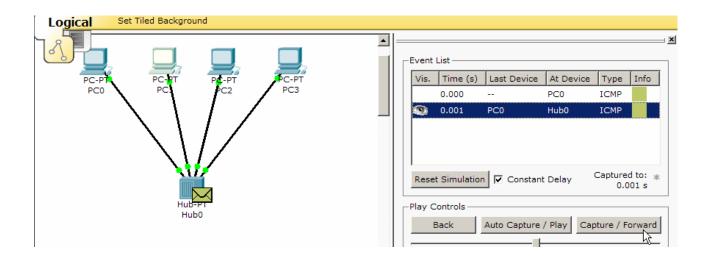
Click once on **PC0**, the device issuing the ping (ICMP Echo Request) and then click once on **PC1** (the destination of the ICMP Echo Request).





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.

Г	Play Controls —		
	Back	Auto Capture / Play	Capture / Forward
			<u>}</u>



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:



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 first event's Info box to view the Ethernet frame with the encapsulated IP Packet and the encapsulated ICMP message "At Device" PC0.

Vis.	Time (s)	Last Device	At Device	Туре	Inf <u>(</u>			
9	0.000		PC0	ICMP	Ν			
	0.001	PC0	Hub0	ICMP	-M			
	0.002	Hub0	PC1	ICMP				
	0.002	Hub0	PC2	ICMP				
•								
Reset Simulation Constant Delay Captured								

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.

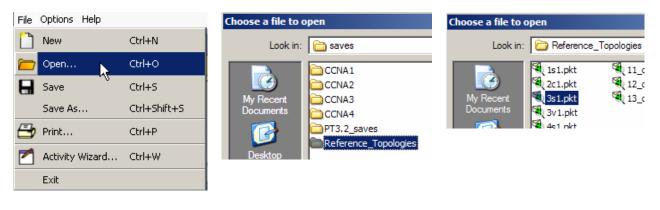
PDU Information at Device: PC0	×	PDU In	formation at	Device: PC0					
OSI Model Outbound PDU Details		OSI M	1odel Outb	ound PDU De	tails				
At Device: PC0 Source: PC0 Destination: PC1		PDU Formats							
In Layers	Out Layers	0		4	8	14	19	9 Bytes	
Layer7	Layer7		PREAM		DEST MAC:	_	RC MAC:		
Layer6	Layer6		1010	1010	0030.A32A.D1C	C 00E0	D.F90D.1629		
Layer5	Layer5		TYPE:	DATA	(VARIABLE LENGT	н)	FCS:		
Layer4	Layer4		0x800		•	·	0×0		
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	0	4 8		6 19		1 Bits		
Layer1	Layer 1: Port(s): FastEthernet		4 IHL	TOS: 0x0	TL: 0x0				
			ID:	0x0	0x0 FRAG OFFS	ET: 0x0			
1. The Ping process starts next ping req	uest. ho Request message and sends it to the		TTL: 32	PRO: 0x1	CHKSUM: ()x0			
lower process.				SRC IP:	10.0.0.1		_		
The source IP address is not specifie address.	d. The device sets it to the port's IP			DST IP:	10.0.0.2				
	ame subnet. The device sets the next-hop			OPT: 0x0		0x0			
to destination. 5. The device sets TTL in the packet her	ader.			DATA (VARIA	BLE LENGTH)]		
		10	CMP						
		0	8	1	6	3:	1 Bits		
			TYPE: 0x8	CODE: 0x0	CHECKSUM:	0x0]		
							-		
Challenge Me	<< Previous Layer Next Layer >>								
		•						•	

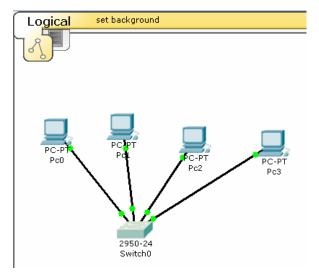
The default is the **OSI Model** view with a brief description with what is occurring with this packet. Click on the **Outbound PDU Details** tab to see the protocol details including the layer 2 Ethernet frame, the layer 3 IP packet and ICMP message.

Looking at the Switch Algorithm and Switch MAC Address Tables

Step 1: Open the following topology

Open the file 3s1.pkt



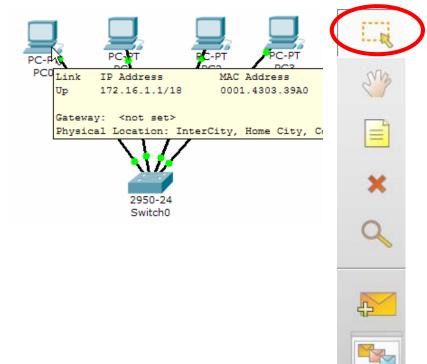


Notice that it is similar to the previous topology, but the layer 1 hub has been replace with a layer 2 switch.

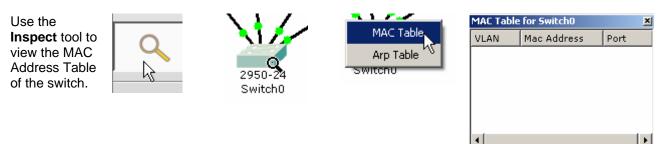
Click on the **Simulation** icon to switch to simulation mode.



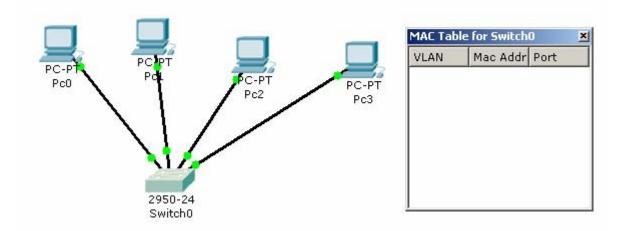
Use the **Select** tool to view IP address and MAC address information for the various hosts..



Step 2: Viewing the Switch MAC Address Table

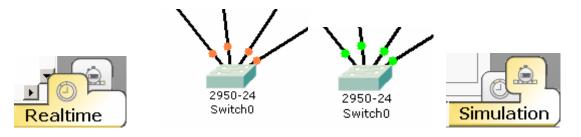


The MAC Address Table is empty as it has not learned any Source Ethernet MAC Addresses. Notice that there is also a VLAN column in this table. This will be discussed in future courses.



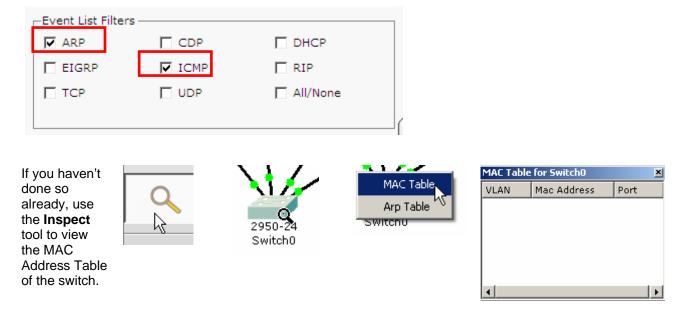
Waiting for Spanning Tree Protocol (STP)

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)

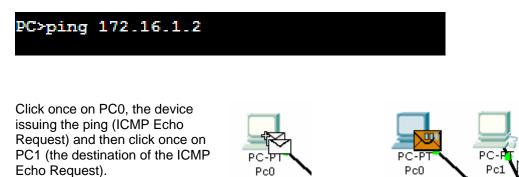


Step 3: Issuing a Ping and Viewing the MAC Address Table

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



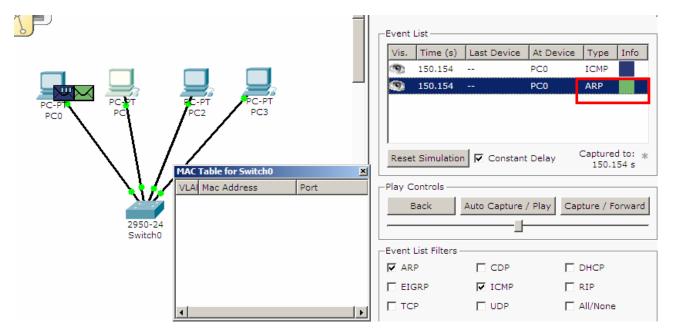
This is the same as doing:



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.



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.

I Model Out					
Ethernet II					
0	4	8	14	19	
PREAMBLE: 1010 1010		DEST MAC: FFFF.FFFF.FFFF	SRC MAC: 1.4303.39A0		
TYPE: 0x806	DATA	(VARIABLE LENGTH)	•	FCS: 0x0	
ARP				L]	
0				Bits	
0 HARDWARE	8 1 E TYPE: 0x1 PLEN: 0x4	.6 PROTOCOL TYPE: (OPCODE: 0x1	0x800	Bits	
0 HARDWARE HLEN: 0x6	E TYPE: 0x1 PLEN: 0x4	PROTOCOL TYPE: (0x800	Bits	
0 HARDWARE HLEN: 0x6	E TYPE: 0x1 PLEN: 0x4	PROTOCOL TYPE: (OPCODE: 0x1	0x800	. Bits	
0 HARDWARE HLEN: 0x6 SOUR	E TYPE: 0x1 PLEN: 0x4	PROTOCOL TYPE: (OPCODE: 0x1 .4303.39A0 (48 bits)	0x800	. Bits	

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

Г	Play Controls —		
	Back	Auto Capture / Play	Capture / Forward
			<u>_</u>

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

)			Г	Event	List ———				
				Vis.	Time (s)	Last Device	At Device	Туре	Info
					150.154		PC0	ICMP	
					150.154		PC0	ARP	
PC-PT PC-PT PC0 PC	PC-PT PC-PT PC2 PC3			۲	150.155	PC0	Switch0	ARP	
PC0									
ARP				Reset	t Simulatio	n 🔽 Constant	t Delay	Captured 150.1	
Request	MA(Table for Switch0	×	L					150.1	55 5
	VLA Mac Address 1 0001.4303.39A0	Port FastEthernet0/1	Γ	Play C	Controls				
	1 0001.4303.39A0	FastEthernet0/1		E	Back	Auto Capture ,	/ Play Ca	pture / Fo	orward
295								N	
Switcho				Event	List Filters				
						CDP	Г	DHCP	
					GRP	✓ ICMP	Г	RIP	
				П то				All/None	
	•	►			<i>،</i> ۲	1 ODP		Anymone	

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).

,	Γ	Event	List ———				
		Vis.	Time (s)	Last Device	At Device	е Туре	Infe
			150.154		PC0	ARP	
			150.155	PC0	Switch0	ARP	
PC-PT PC-PT PC-PT		9	150.156	Switch0	PC1	ARP	
PC-PT PC-PT PC-PT PC-PT PC3		9	150.156	Switch0	PC2	ARP	
		1					
ARP Request MAC Table for Switch0		Reset	t Simulatior	Constant	t Delay	Capture 150.1	
VLA Mac Address Port	Г	Play C	ontrols —				
1 0001.4303.39A0 FastEthernet0/1		E	Back	Auto Capture	/ Play C	apture / F	orward
2950-24 Switch0							
	Г	Event	List Filters -				
		🔽 AR	P	CDP	Г	DHCP	
			GRP	ICMP	Г	RIP	
▲ ▶		🗆 то	Ρ	UDP	Г	All/None	

ARP Reply

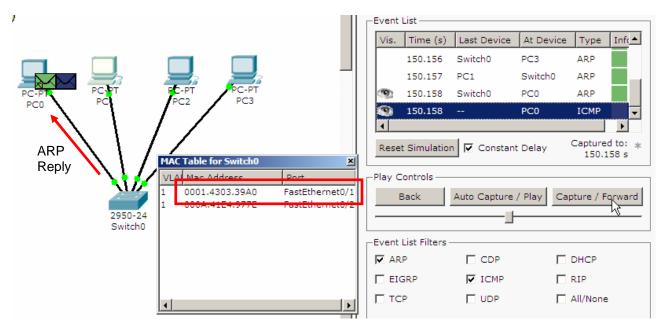
PC2 and PC3 ignore the ARP Request because PC0 is only asking for the owner of the IP Address 172.16.1.2 to reply. PC1 now sends back an ARP Reply with its MAC Address. (Again, this will be discussed later.) This time the switch updates its MAC Address Table with the Ethernet Source MAC Address of PC1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

			Eve	ent List ———				
			Vi	s. Time (s)	Last Device	At Device	Туре	Inf
				150.156	Switch0	PC1	ARP	
				150.156	Switch0	PC2	ARP	
	PC-PT PC-PT PC2 PC3			150.156	Switch0	PC3	ARP	
			4	150.157	PC1	Switch0	ARP	
Reply								•
	AC Table for Switch0	×	Re	eset Simulation	n 🔽 Constant	t Delay	Captured 150.1	
	/LAI Mac Address	Port	Pla	y Controls —				
	0001.4303.39A0	FastEthernet0/1		Back	Auto Capture	/ Play Car	oture / Fo	orward
295	000A.41E4.977E	FastEthernet0/2						
Switch0								
			Eve	ent List Filters -				43
			•	ARP	CDP		DHCP	
				EIGRP	✓ ICMP		RIP	
•		•		ТСР	UDP		All/None	

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

Ethernet II							
0 PREA 1010	4 MBLE: 1010	Γ	8 DEST MAC: 0001.4303.39A0	14	s	RC MAC: 41E4.977	19 E
TYPE: 0x806	DAT	ΓA	(VARIABLE LENGTH)			FCS: 0x0	
ARP							
	3	_	6			Bits	
HARDWARE	TYPE: 0x1		PROTOCOL TYPE: 0			. Bits	
HARDWARE HLEN: 0x6	TYPE: 0x1 PLEN: 0x4	4	PROTOCOL TYPE: 0 OPCODE: 0x2			. Bits	
HARDWARE HLEN: 0x6	TYPE: 0x1 PLEN: 0x4	4	PROTOCOL TYPE: 0			. Bits	
HARDWARE HLEN: 0x6	TYPE: 0x1 PLEN: 0x4	4	PROTOCOL TYPE: 0 OPCODE: 0x2	2	800	. Bits	
HARDWARE HLEN: 0x6 SOURC	TYPE: 0x1 PLEN: 0x4	4	PROTOCOL TYPE: (OPCODE: 0x2 .41E4.977E (48 bits)	2	800	. Bits	
HARDWARE HLEN: 0x6 SOURC	TYPE: 0x1 PLEN: 0x4 CE MAC: 00	4)0A	PROTOCOL TYPE: (OPCODE: 0x2 .41E4.977E (48 bits)	2	800	. 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.



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.

			Vis	. Time (s)	Last Device	At Device	Туре	Inf			
				150.157	PC1	Switch0	ARP				
				150.158	Switch0	PC0	ARP				
PC-PT PC-PT	PC-PT PC-PT PC2 PC3			150.158		PC0	ICMP				
PC0 PC			۲	150.159	PC0	Switch0	ICMP				
ICMP								•			
Echo	/		Res	set Simulatio	n 🔽 Constan	t Delay	Captured 150.1				
Request,	MAC Table for Switch0	×	Play Controls								
ping 🎽 🚺 🥢	VLAI Mac Address	Port	Play	Controls							
	1 0001.4303.39A0 1 000A.41E4.977E	FastEthernet0/1 FastEthernet0/2		Back	Auto Capture	/ Play Ca	oture / Fo	prward			
2950-24	0000.4124.5772	rusternerneto, z	—								
Switch0			Ever	nt List Filters							
					—	_					
				ARP	CDP		DHCP				
			E	EIGRP	ICMP		RIP				
	•		י 🗆	ГСР	UDP	Γ	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.

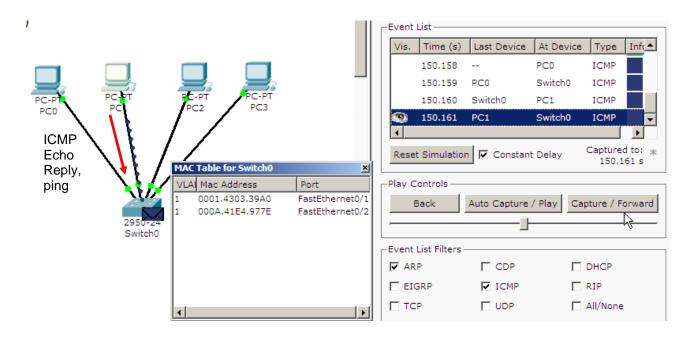
		Device: PC0					
SI Model	Out	bound PDU D	etails				
PDU For	mats —						
Ethern	et II						
0	0 4 PREAMBLE: 1010 1010				14	19	Byte
				DEST MAC:)A.41E4.977E	RC MAC: .4303.39A0		
	TYPE: DAT, 0x800			ABLE LENGTH	FCS: 0x0		
<u>IP</u> 0	4 6	3	16	19	31	Bits	
4	IHL	TOS: 0x0		TL: 0x0			
	ID:	0x0	0x0	FRAG OFFS	ET: 0x0		
TTL	: 32	PRO: 0x1		CHKSUM: 0	x0		
		SRC IP:	172.16	.1.1			
		DST IP:	172.16	.1.2			
		OPT: 0x0			0x0		
		DATA (VARI	ABLE L	ENGTH)			
<u>ICMP</u>							
0 TYPE	: 0x8	CODE: 0x0	16	CHECKSUM:		Bits	

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.

			Г	Event	List ——				
				Vis.	Time (s)	Last Device	At Device	Туре	Infe
					150.158	Switch0	PC0	ARP	
		_			150.158		PC0	ICMP	
PC-PT PC-PT	PC-PT PC-PT PC2 PC3				150.159	PC0	Switch0	ICMP	
				۲	150.160	Switch0	PC1	ICMP	
				•					•
Echo Request,	MAC Table for Switch0	×		Reset	t Simulatior	Constant	: Delay	Captured 150.1	
ping 🔨	VLAI Mac Address	Port			ontrols —				
	1 0001.4303.39A0	FastEthernet0/1							. 1
	1 000A.41E4.977E	FastEthernet0/2		E	Back	Auto Capture	/ Play Ca	pture / Fo	orward
2950-24 Switch0									
				Event	List Filters -				
				AR	P	CDP		DHCP	
					GRP	✓ ICMP		RIP	
	•	•		🗆 тс	P	UDP		All/None	

Ping: ICMP Echo Reply

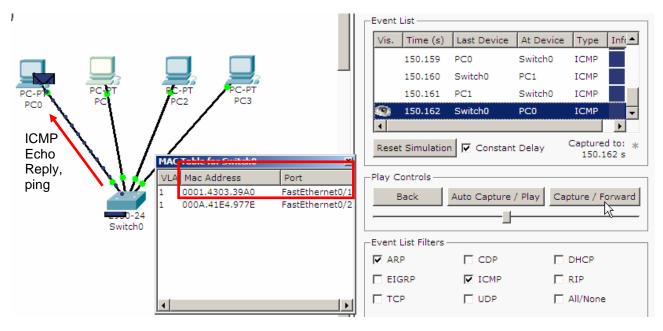
PC1 returns an ICMP Echo Reply.



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 For	mats —						
Ethern	<u>et II</u>				14		_
		4 PREAMBLE: 1010 1010		R DEST MAC: 0001.4303.39A0		19 RC MAC: 41E4.977E	Byte
	PE: 300	DATA	A (VARIABLE LENGTH)			FCS: 0x0	
	4 6	3 1	.6	19	31	Bits	
4	IHL	TOS: 0x0	TL: 0x0				
	ID: 0x0		0x0 FRAG OFFSET: 0x0				
TTL	: 32	PRO: 0x1	CHKSUM: 0x0				
		SRC IP: 1	72.16	.1.2			
		DST IP: 1	72.16	.1.1			
	OPT: 0x0			0x0			
		DATA (VARIA	BLE L	ENGTH)			
ICMP							

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.



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:

	•						r)
			Simulatio	n Panel	Sin	nulati	on
👔 Scenario 0 🗸 🔻	Fire	Last Status	Source	Destin	ation	Туре	
		Unknown	Pc0			ICMP	
New Delete	.	Unknown	Pc0			ICMP	
Remove PDU	1	Successful	Pc0	Pc1			 ▼

Click Delete in the PDU area.

Now, reset the network and confirm the action.

	►				
Reset Network PLAY CONTROLS: Bac	ck Auto Capture / Play C	Capture / Forward			
		Scenario			
Reset Network? Packet Tracer 4.0	X				
Configurations not in the startup configuration will b Reset the network2	be lost.				