Lab 10.3.2: How Many Networks?

Learning Objectives

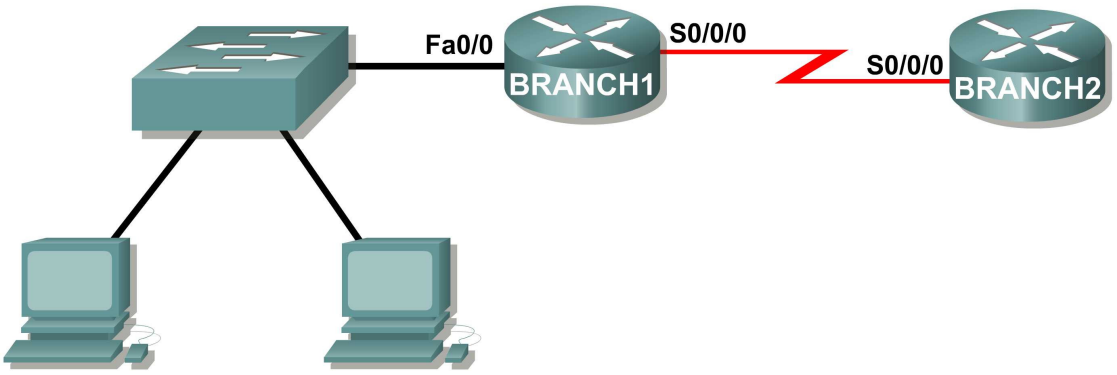
Upon completion of this lab, you will be able to:

- Determine the number of subnets.
- Design an appropriate addressing scheme.
- Assign addresses and subnet mask pairs to device interfaces.
- Examine the use of the available network address space.

Scenario

In this lab, you have been given the network address 192.168.26.0/24 to subnet and provide the IP addressing for the networks shown in the Topology Diagrams. You must determine the number of networks needed then design an appropriate addressing scheme. Place the correct address and mask in the Addressing Table. In this example, the number of hosts is not important. You are only required to determine the number of subnets per topology example.

Topology Diagram A



Task 1: Determine the Number of Subnets in the Topology Diagram.

Step 1: How many networks are there? __2__
Step 2: How many bits should you borrow to create the required number of subnets? __2__
Step 3: How many usable host addresses and usable subnets did this give you? __62/4__
Step 4: What is the new subnet mask in decimal form? __255.255.255.192__

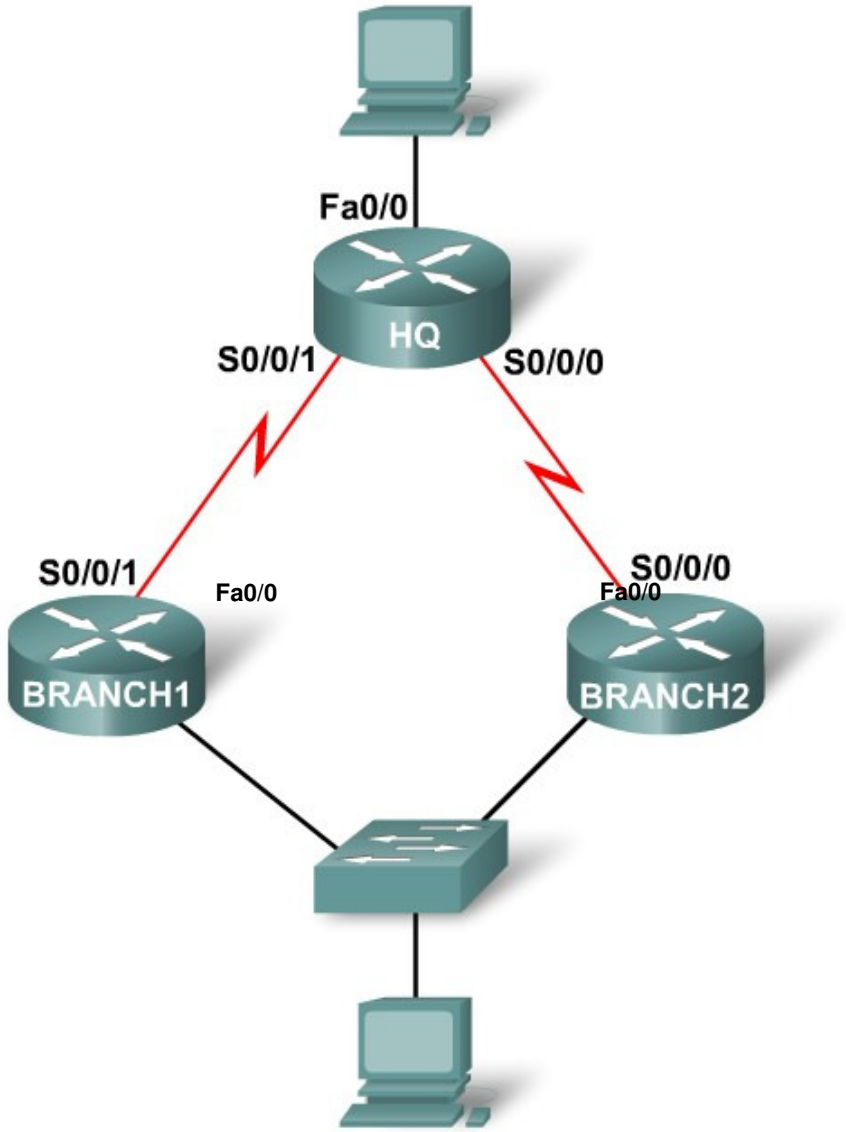
Step 5: How many subnets are available for future use? __0__

Task 2: Record Subnet Information.

Step 1: Fill in the following chart with the subnet information.

Subnet Number	Subnet Address	First Usable Host Address	Last Usable Host Address	Broadcast Address
0	192.168.26.0	192.168.26.1	192.168.26.62	192.168.26.63
1	192.168.26.64	192.168.26.65	192.168.26.126	192.168.26.127
2	192.168.26.128	192.168.26.129	192.168.26.190	192.168.26.191
3	192.168.26.192	192.168.26.193	192.168.26.254	192.168.26.255
4				
5				
6				
7				

Topology Diagram B



Task 1: Determine the Number of Subnets in the Topology Diagram.

Step 1: How many networks are there? 4
Step 2: How many bits should you borrow to create the required number of subnets? 3
Step 3: How many usable host addresses and usable subnets did this give you? 30/8
Step 4: What is the new subnet mask in decimal form? 255.255.255.224

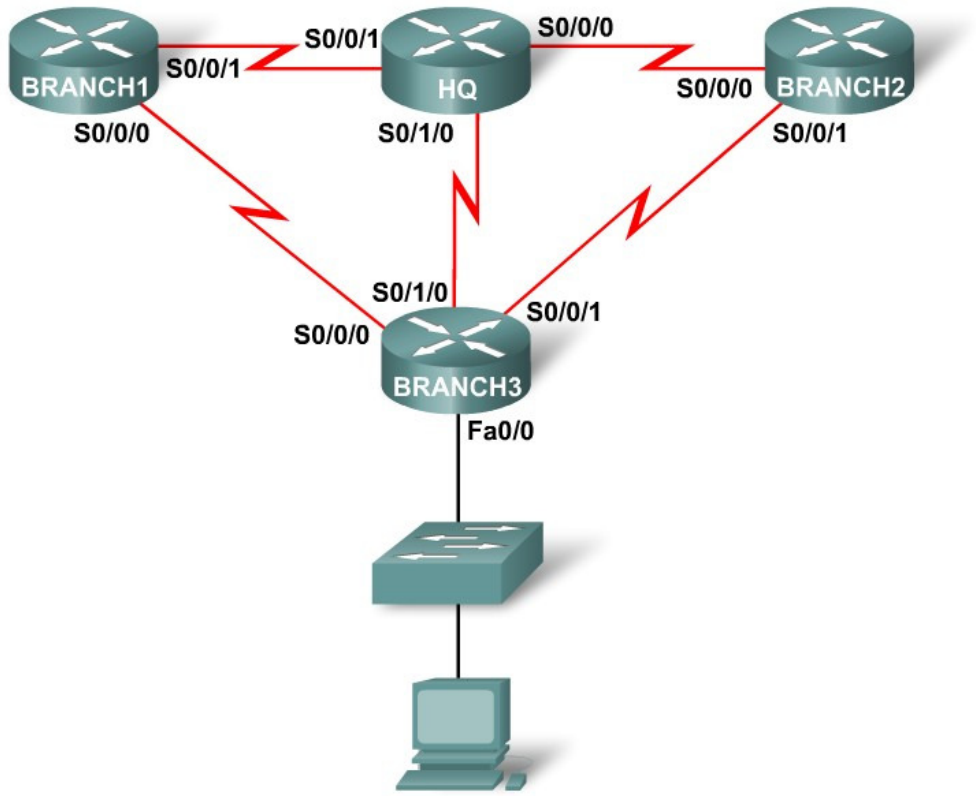
Step 5: How many subnets are available for future use? 4

Task 2: Record Subnet Information.

Step 1: Fill in the following chart with the subnet information.

Subnet Number	Subnet Address	First Usable Host Address	Last Usable Host Address	Broadcast Address
0	192.168.26.0	192.168.26.1	192.168.26.30	192.168.26.31
1	192.168.26.32	192.168.26.33	192.168.26.62	192.168.26.63
2	192.168.26.64	192.168.26.65	192.168.26.94	192.168.26.95
3	192.168.26.96	192.168.26.97	192.168.26.126	192.168.26.127
4	192.168.26.128	192.168.26.129	192.168.26.158	192.168.26.159
5	192.168.26.160	192.168.26.161	192.168.26.190	192.168.26.191
6	192.168.26.192	192.168.26.193	192.168.26.222	192.168.26.223
7	192.168.26.224	192.168.26.225	192.168.26.254	192.168.26.255

Topology Diagram C



Task 1: Determine the Number of Subnets in the Topology Diagram.

Step 1: How many networks are there? 6
Step 2: How many bits should you borrow to create the required number of subnets? 3
Step 3: How many usable host addresses and usable subnets did this give you? 30/8
Step 4: What is the new subnet mask in decimal form? 255.255.255.225

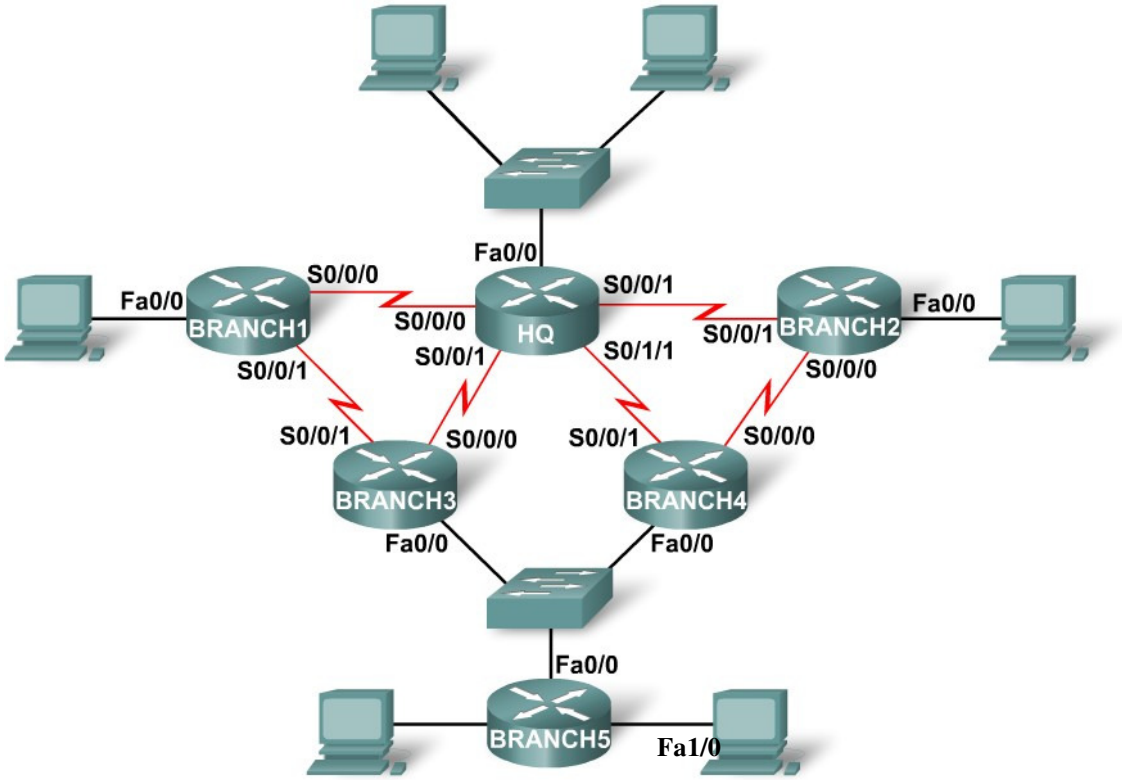
Step 5: How many subnets are available for future use? 2

Task 2: Record Subnet Information.

Step 1: Fill in the following chart with the subnet information.

Subnet Number	Subnet Address	First Usable Host Address	Last Usable Host Address	Broadcast Address
0	192.168.26.0	192.168.26.1	192.168.26.30	192.168.26.31
1	192.168.26.32	192.168.26.33	192.168.26.62	192.168.26.63
2	192.168.26.64	192.168.26.65	192.168.26.94	192.168.26.95
3	192.168.26.96	192.168.26.97	192.168.26.126	192.168.26.127
4	192.168.26.128	192.168.26.129	192.168.26.158	192.168.26.159
5	192.168.26.160	192.168.26.161	192.168.26.190	192.168.26.191
6	192.168.26.192	192.168.26.193	192.168.26.222	192.168.26.223
7	192.168.26.224	192.168.26.225	192.168.26.254	192.168.26.255
8				
9				
10				

Topology Diagram D



Task 1: Determine the Number of Subnets in the Topology Diagram.

Step 1: How many networks are there? 12
Step 2: How many bits should you borrow to create the required number of subnets? 4
Step 3: How many usable host addresses and usable subnets did this give you? 14
Step 4: What is the new subnet mask in decimal form? 255.255.255.240

Step 5: How many subnets are available for future use? 4

Task 2: Record Subnet Information.

Step 1: Fill in the following chart with the subnet information.

Subnet Number	Subnet Address	First Usable Host Address	Last Usable Host Address	Broadcast Address
0	192.168.26.0	192.168.26.1	192.168.26.14	192.168.26.15
1	192.168.26.32	192.168.26.33	192.168.26.46	192.168.26.47
2	192.168.26.48	192.168.26.49	192.168.26.62	192.168.26.63
3	192.168.26.64	192.168.26.65	192.168.26.78	192.168.26.79
4	192.168.26.80	192.168.26.81	192.168.26.94	192.168.26.97
5	192.168.26.112	192.168.26.113	192.168.26.126	192.168.26.127
6	192.168.26.128	192.168.26.129	192.168.26.142	192.168.26.143
7	192.168.26.160	192.168.26.161	192.168.26.174	192.168.26.175
8	192.168.26.192	192.168.26.193	192.168.26.206	192.168.26.207
9	192.168.26.208	192.168.26.209	192.168.26.222	192.168.26.223
10	192.168.26.240	192.168.26.241	192.168.26.254	192.168.26.255
11				
12				
13				
14				
15				
16				

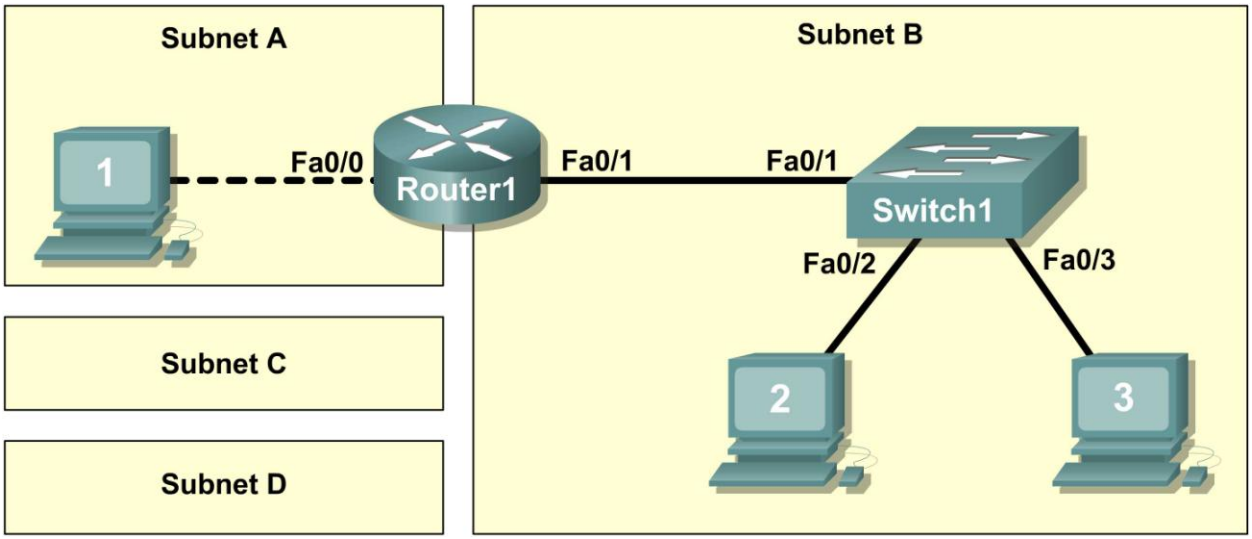
Reflection

What information is needed when determining an appropriate addressing scheme for a network?

number of networks and number of hosts

Lab 10.6.1: Creating a Small Lab Topology

Topology Diagram



Learning Objectives

Upon completion of this lab, you will be able to:

- Design the logical network.
- Configure the physical lab topology.
- Configure the logical LAN topology.
- Verify LAN connectivity.

Background

Hardware	Qty	Description
Cisco Router	1	Part of CCNA Lab bundle
Cisco Switch	1	Part of CCNA Lab bundle
*Computer (host)	3	Lab computer
Cat-5 or better straight-through UTP cables	3	Connects Router1 and computers Host1 and Host2 to Switch1
Cat-5 crossover UTP cable	1	Connects computer Host1 to Router1

Table 1. Equipment and Hardware for Lab

Gather the necessary equipment and cables. To configure the lab, refer to the equipment and hardware listed in Table 1.

Scenario

In this lab you will create a small network that requires connecting network devices and configuring host computers for basic network connectivity. SubnetA and SubnetB are subnets that are currently needed. SubnetC and SubnetD are anticipated subnets, not yet connected to the network. The 0th subnet will be used.

Note: Appendix 1 contains a subnet chart for the last IP address octet.

Task 1: Design the Logical Network.

Given an IP address and mask of `172.20.0.0 / 24 (address / mask)`, design an IP addressing scheme that satisfies the following requirements:

Subnet	Number of Hosts
SubnetA	2
SubnetB	6
SubnetC	47
SubnetD	125

Host computers from each subnet will use the first available IP address in the address block. Router interfaces will use the last available IP address in the address block.

Step 1: Design SubnetD address block.

Begin the logical network design by satisfying the requirement of SubnetD, which requires the largest block of IP addresses. Refer to the subnet chart, and pick the first address block that will support SubnetD.

Fill in the following table with IP address information for SubnetD:

Network Address	Mask	First Host Address	Last Host Address	Broadcast
172.20.0.0	255.255.255.128	172.20.0.1	172.20.0.126	172.20.0.127

What is the bit mask in binary? 11111111.11111111.11111111.10000000

Step 2: Design SubnetC address block.

Satisfy the requirement of SubnetC, the next largest IP address block. Refer to the subnet chart, and pick the next available address block that will support SubnetC.

Fill in the following table with IP address information for SubnetC:

Network Address	Mask	First Host Address	Last Host Address	Broadcast
172.20.0.128	255.255.255.192	172.20.0.129	172.20.0.190	172.20.0.191

What is the bit mask in binary? 11111111.11111111.11111111.11000000

Step 3: Design SubnetB address block.

Satisfy the requirement of SubnetB, the next largest IP address block. Refer to the subnet chart, and pick the next available address block that will support SubnetB.

Fill in the following table with IP address information for SubnetB:

Network Address	Mask	First Host Address	Last Host Address	Broadcast
172.20.0.192	255.255.255.248	172.20.0.193	172.20.0.198	172.20.0.199

What is the bit mask in binary? 11111111.11111111.11111111.11111000

Step 4: Design SubnetA address block.

Satisfy the requirement of SubnetA. Refer to the subnet chart, and pick the next available address block that will support SubnetA.

Fill in the following table with IP address information for SubnetA:

Network Address	Mask	First Host Address	Last Host Address	Broadcast
172.20.0.200	255.255.255.252	172.20.0.201	172.20.0.202	172.20.0.203

What is the bit mask in binary? 11111111.11111111.11111111.11111100

Task 2: Configure the Physical Lab Topology.

Step 1: Physically connect devices.

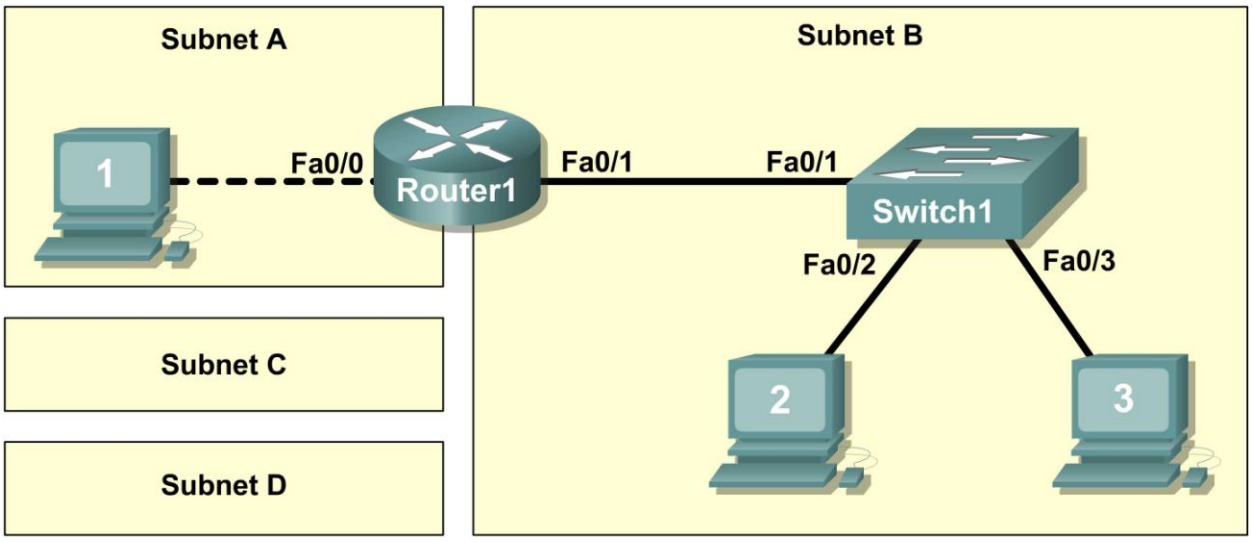


Figure 1. Cabling the Network

Cable the network devices as shown in Figure 1.

What cable type is needed to connect Host1 to Router1, and why? x-over cable same network interface

What cable type is needed to connect Host1, Host2, and Router1 to Switch1, and why? straight-through cable / different network interfaces

If not already enabled, turn power on to all devices.

Step 2: Visually inspect network connections.

After cabling the network devices, take a moment to verify the connections. Attention to detail now will minimize the time required to troubleshoot network connectivity issues later. Ensure that all switch connections show green. Any switch connection that does not transition from amber to green should be investigated. Is the power applied to the connected device? Is the correct cable used? Is the correct cable good?

What type of cable connects Router1 interface `Fa0/0` to Host1? x-over

What type of cable connects Router1 interface `Fa0/1` to Switch1? straight-through

What type of cable connects Host2 to Switch1? straight

What type of cable connects Host3 to Switch1? straight

Is all equipment turned on? _____

Task 3: Configure the Logical Topology.

Step 1: Document logical network settings.

The host computer Gateway IP address is used to send IP packets to other networks. Therefore, the Gateway address is the IP address assigned to the router interface for that subnet.

From the IP address information recorded in Task 1, write down the IP address information for each computer:

Host1	
IP Address	172.20.0.201
IP Mask	255.255.255.252
Gateway Address	172.20.0.202

Host2	
IP Address	172.20.0.193
IP Mask	255.255.255.248
Gateway Address	172.20.0.195

Host3	
IP Address	172.20.0.194
IP Mask	255.255.255.248
Gateway Address	172.20.0.198

Step 2: Configure Host1 computer.

On Host1, click **Start > Control Panel > Network Connections**. Right-click the **Local Area Connection** device icon and choose **Properties**.

On the **General** tab, select **Internet Protocol (TCP/IP)**, and then click the **Properties** button.

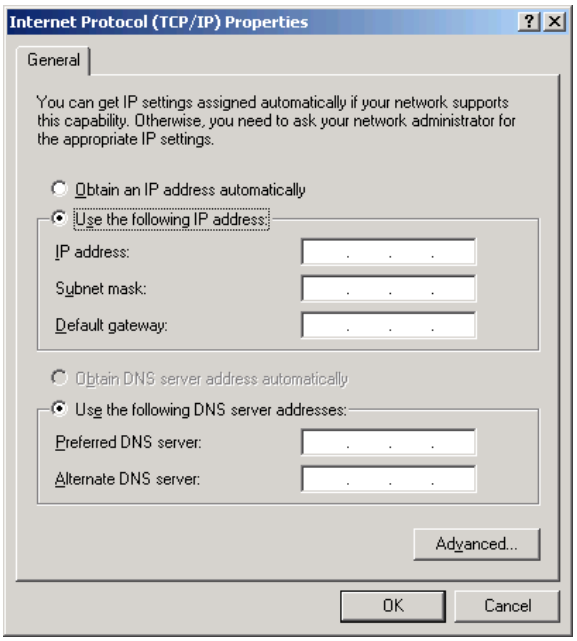


Figure 2. Host1 IP Address and Gateway Settings

Refer to Figure 2 for Host1 IP address and gateway settings. Manually enter the following information, recorded in Step 1, above:

```
IP address: Host1 IP address
Subnet mask: Host1 subnet mask
Default gateway: Gateway IP address
```

When finished, close the Internet Protocols (TCP/IP) Properties window by clicking **OK**. Close the Local Area Connection window. Depending on the Windows operating system, the computer may require a reboot for changes to be effective.

Step 3: Configure Host2 and Host3 computers.

Repeat Step 2 for computers Host2 and Host3, using the IP address information for those computers.

Task 4: Verify Network Connectivity.

Verify with your instructor that Router1 has been configured. Otherwise, connectivity will be broken between LANs. Switch1 should have a default configuration.

Network connectivity can be verified with the Windows **`ping`** command. Open a windows terminal by clicking **Start > Run**. Type **`cmd`** and press **Enter**.

Use the following table to methodically verify and record connectivity with each network device. Take corrective action to establish connectivity if a test fails:

From	To	IP Address	Ping Results
Host1	Gateway (Router1, `Fa0/0`)	172.20.0.202	
Host1	Router1, `Fa0/1`	172.20.0.198	
Host1	Host2	192.20.0.193	
Host1	Host3	172.20.0.194	
Host2	Host3	172.20.0.194	
Host2	Gateway (Router1, `Fa0/1`)	172.20.0.198	
Host2	Router1, `Fa0/0`	172.20.0.202	
Host2	Host1	172.20.0.201	
Host3	Host2	172.20.0.193	
Host3	Gateway (Router1, `Fa0/1`)	172.20.0.198	
Host3	Router1, `Fa0/0`	172.20.0.202	
Host3	Host1	172.20.0.201	

Note any break in connectivity. When troubleshooting connectivity issues, the topology diagram can be extremely helpful.

In the above scenario, how can a malfunctioning Gateway be detected?

wouldnt be able to ping hosts on either side of the gateway.

Task 5: Reflection

Review any physical or logical configuration problems encountered during this lab. Be sure that you have a thorough understanding of the procedures used to verify network connectivity.

This is a particularly important lab. In addition to practicing IP subnetting, you configured host computers with network addresses and tested them for connectivity.

It is best to practice host computer configuration and verification several times. This will reinforce the skills you learned in this lab and make you a better network technician.

Task 6: Challenge

Ask your instructor or another student to introduce one or two problems in your network when you aren't looking or are out of the lab room. Problems can be either physical (wrong UTP cable) or logical (wrong IP address or gateway). To fix the problems:

1. Perform a good visual inspection. Look for green link lights on Switch1.

2. Use the table provided in Task 3 to identify failed connectivity. List the problems:

_____

_____

_____

_____

_____

3. Write down your proposed solution(s):

_____

_____

_____

_____

_____

4. Test your solution. If the solution fixed the problem, document the solution. If the solution did not fix the problem, continue troubleshooting.

_____

_____

_____

_____

_____

_____

_____

_____

Task 7: Clean Up.

Unless directed otherwise by the instructor, restore host computer network connectivity, and then turn off power to the host computers.

Carefully remove cables and return them neatly to their storage. Reconnect cables that were disconnected for this lab.

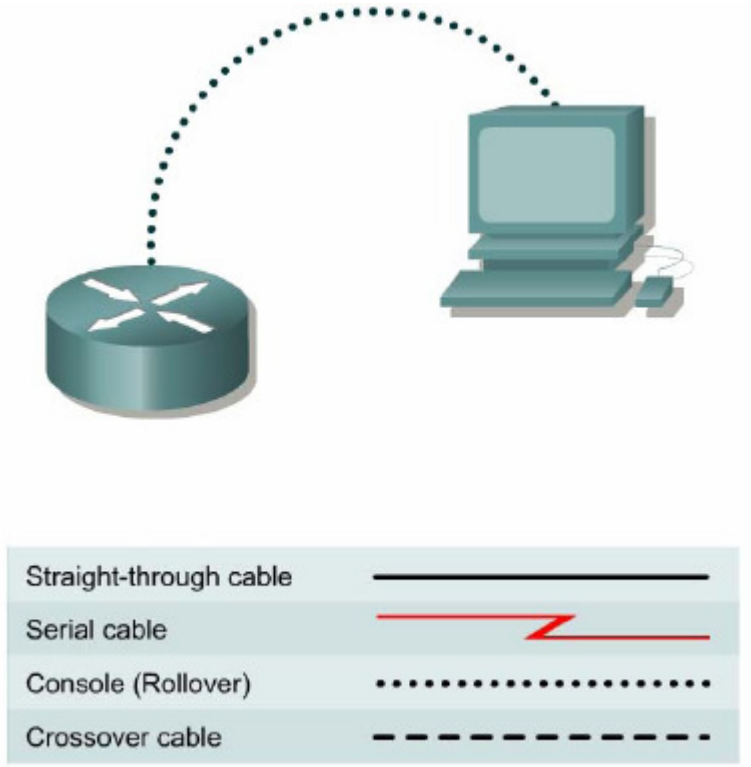
Remove anything that was brought into the lab, and leave the room ready for the next class.

Appendix 1

	/25 (1 subnet bit) 2 subnets 126 hosts	/26 (2 subnet bits) 4 subnets 62 hosts	/27 (3 subnet bits) 8 subnets 30 hosts	/28 (4 subnet bits) 16 subnets 14 hosts	/29 (5 subnet bits) 32 subnets 6 hosts	/30 (6 subnet bits) 64 subnets 2 hsots
.0	.0	.0 (.1- .62)	.0 .1- .30)	.0 (.1- .14)	.0 (.1- .6)	.0 (.1- .2)
.4						.4 (.5- .6)
.8					.8 (.9- .14)	.8 (.9- .10)
.12						.12 (.13- .14)
.16				.16 (.17- .30)	.16 (.17- .22)	.16 (.17- .18)
.20						.20 (.21- .22)
.24					.24 (.25- .30)	.24 (.25- .26)
.28						.28 (.29- .30)
.32			.32 .33- .62)	.32 (.33- .46)	.32 (.33- .38)	.32 (.33- .34)
.36						.36 (.37- .38)
.40					.40 (.41- .46)	.40 (.41- .42)
.44						.44 (.45- .46)
.48				.48 (.49- .62)	.48 (.49- .54)	.48 (.49- .50)
.52						.52 (.53- .54)
.56					.56 (.57- .62)	.56 (.57- .58)
.60						.60 (.61- .62)
.64		.64 (.65- .126)	.64 (.65- .94)	.64 (.65- .78)	.64 (.65- .70)	.64 (.65- .66)
.68						.68 (.69- .70)
.72					.72 (.73- .78)	.72 (.73- .74)
.76						.76 (.77- .78)
.80				.80 (.81- .94)	.80 (.81- .86)	.80 (.81- .82)
.84						.84 (.85- .86)
.88					.88 (.89- .94)	.88 (.89- .90)
.92						.92 (.93- .94)
.96			.96 (.97- .126)	.96 (.97- .110)	.96 (.97- .102)	.96 (.97- .98)
.100						.100 (.101- .102)
.104					.104 (.105- .110)	.104 (.105- .106)
.108						.108 (.109- .110)
.112				.112 (.113- .126)	.112 (.113- .118)	.112 (.113- .114)
.116						.116 (.117- .118)
.120					.120 (.121- .126)	.120 (.121- .122)
.124						.124 (.125- .126)
.128	.128	.128 (.129- .190)	.128 (.129- .158)	.128 (.129- .142)	.128 (.129- .134)	.128 (.129- .130)
.132						.132 (.133- .134)
.136					.136 (.137- .142)	.136 (.137- .138)
.140						.140 (.141- .142)
.144				.144 (.145- .158)	.144 (.145- .150)	.144 (.145- .146)
.148						.148 (.149- .150)
.152					.152 (.153- .158)	.152 (.153- .154)
.156						.156 (.157- .158)
.160			.160 (.161- .190)	.160 (.161- .174)	.160 (.161- .166)	.160 (.161- .162)
.164						.164 (.165- .166)
.168					.168 (.169- .174)	.168 (.169- .170)
.172						.172 (.173- .174)
.176				.176 (.177- .190)	.176 (.177- .182)	.176 (.177- .178)
.180						.180 (.181- .182)
.184					.184 (.185- .190)	.184 (.185- .186)
.188						.188 (.189- .190)
.192		.192 (.193- .254)	.192 (.193- .222)	.192 (.193- .206)	.192 (.193- .198)	.192 (.193- .194)
.196						.196 (.197- .198)
.200					.200 (.201- .206)	.200 (.201- .202)
.204						.204 (.205- .206)
.208				.208 (.209- .222)	.208 (.209- .214)	.208 (.209- .210)
.212						.212 (.213- .214)
.216					.216 (.217- .222)	.216 (.217- .218)
.220						.220 (.221- .222)
.224			.224 (.225- .254)	.224 (.225- .238)	.224 (.225- .230)	.224 (.225- .226)
.228						.228 (.229- .230)
.232					.232 (.233- .238)	.232 (.233- .234)
.236						.236 (.237- .238)
.240				.240 (.241- .254)	.240 (.241- .246)	.240 (.241- .242)
.244						.244 (.245- .246)
.248					.248 (.249- .254)	.248 (.249- .250)
.252						.252 (.253- .254)
	/25 (1 subnet bit) 2 subnets 126 hosts	/26 (2 subnet bits) 4 subnets 62 hosts	/27 (3 subnet bits) 8 subnets 30 hosts	/28 (4 subnet bits) 16 subnets 14 hosts	/29 (5 subnet bits) 32 subnets 6 hosts	/30 (6 subnet bits) 64 subnets 2 hsots

Lab 10.6.2: Establishing a Console Session with HyperTerminal

Topology Diagram



Learning Objectives

Upon completion of this lab, you will be able to:

- Connect a router and computer using a console cable.
- Configure HyperTerminal to establish a console session with a Cisco IOS router.
- Configure HyperTerminal to establish a console session with a Cisco IOS switch.

Background

HyperTerminal is a simple Windows-based terminal emulation program for serial communication that can be used to connect to the console port on Cisco IOS devices. A serial interface on a computer is connected to the Cisco device via a rollover cable. Using HyperTerminal is the most basic way to access a router for checking or changing its configuration. Another popular serial communication utility is TeraTerm Web. Instructions for TeraTerm Web use are contained in Appendix A.

Scenario

Set up a network similar to the one in the Topology Diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. The following resources will be required:

- Computer with a serial interface and HyperTerminal loaded
- Cisco router
- Console (rollover) cable for connecting the workstation to the router

Task 1: Connect a Router and Computer with a Console Cable.

Step 1: Set up basic physical connection.

Connect the console (rollover) cable to the console port on the router. Connect the other cable end to the host computer with a DB-9 or DB-25 adapter to the COM 1 port.

Step 2: Power on devices.

If not already powered on, enable power to the computer and router.

Task 2: Configure HyperTerminal to Establish a Console Session with a Cisco IOS Router.

Step 1: Start HyperTerminal application.

From the Windows taskbar, start the HyperTerminal program by clicking **Start > Programs > Accessories > Communications > HyperTerminal**.

Step 2: Configure HyperTerminal.

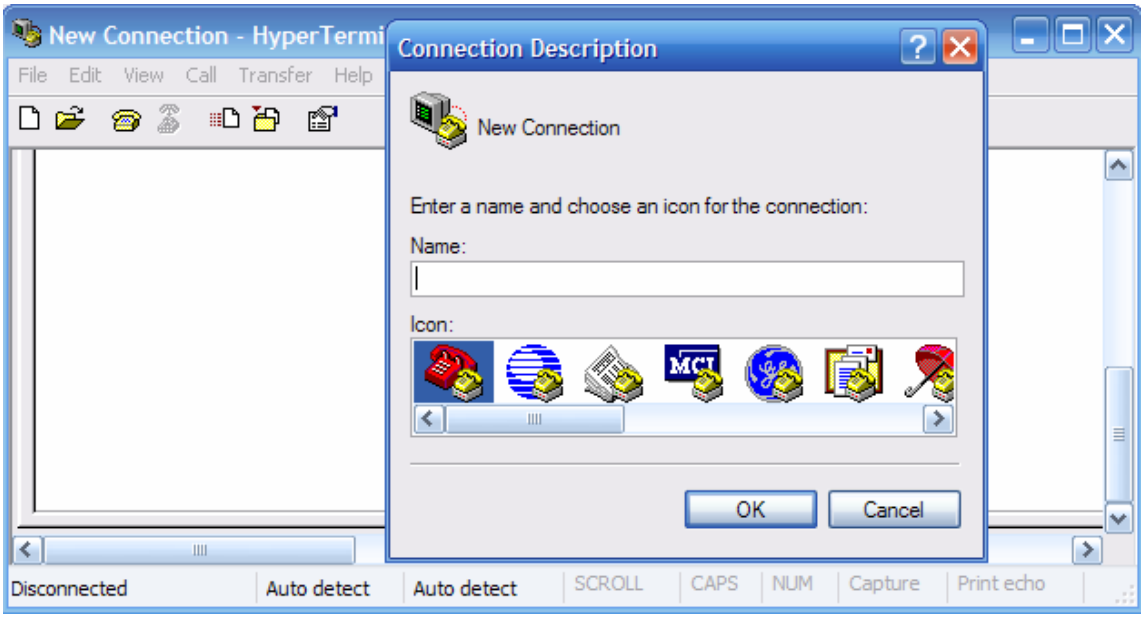


Figure 1. HyperTerminal Name Configuration Window

Refer to Figure 1 for a description of the opening HyperTerminal configuration window. At the Connection Description window, enter a session name in the Name field. Select an appropriate icon, or leave the default. Click **OK**.

Figure 2. HyperTerminal Connection Type

Refer to Figure 2. Enter the appropriate connection type, COM 1, in the Connect using field. Click **OK**.

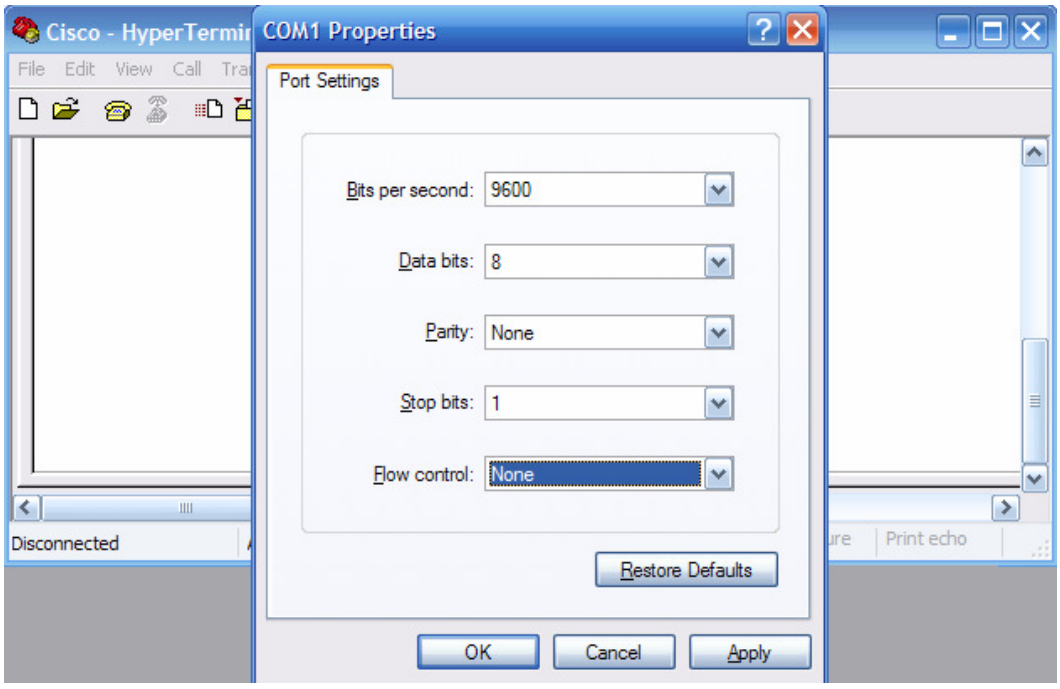


Figure 3. HyperTerminal COM1 Port Settings

Refer to Figure 3. Change port settings to the following values:

Setting	Value
Bits per second	**9600**
Data bits	**8**
Parity	**None**
Stop bits	**1**
Flow control	**None**

Click **OK**.

When the HyperTerminal session window comes up, press the **Enter** key. There should be a response from the router. This indicates that connection has been successfully completed. If there is no connection, troubleshoot as necessary. For example, verify that the router has power. Check the connection to the correct COM 1 port on the PC and the console port on the router. If there is still no connection, ask the instructor for assistance.

Step 3: Close HyperTerminal.

When finished, close the HyperTerminal session. Click **File > Exit**. When asked whether to save the session, click **Yes**. Enter a name for the session.

Step 4: Reconnect the HyperTerminal session.

Reopen the HyperTerminal session as described in Task 2, Step 1. This time, when the Connection Description window opens (see Figure 1), click **Cancel**.

Click **File > Open**. Select the saved session and then click **Open**. Use this technique to reconnect the HyperTerminal session to a Cisco device without reconfiguring a new session.

When finished, exit TeraTerm.

Task 3: Configure HyperTerminal to Establish a Console Session with a Cisco IOS Switch.

Serial connections between Cisco IOS routers and switches are very similar. In this task, you will make a serial connection between the host computer and a Cisco IOS switch.

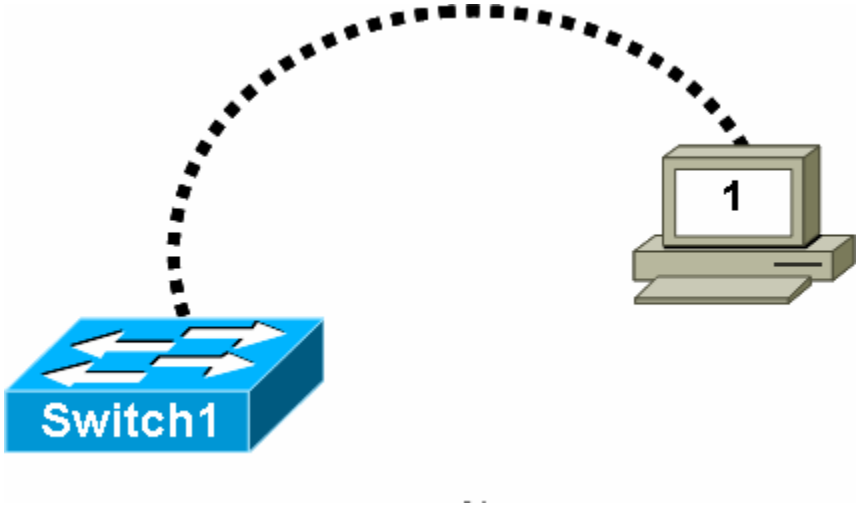


Figure 4. Serial Connection Between a Host Computer and Cisco Switch

Step 1: Set up basic physical connection.

Refer to Figure 4. Connect the console (rollover) cable to the console port on the router. Connect the other cable end to the host computer with a DB-9 or DB-25 adapter to the COM 1 port.

Step 2: Power on devices.

If not already powered on, enable power to the computer and switch.

Step 3: Start HyperTerminal application.

From the Windows taskbar, start the HyperTerminal program by clicking **Start > Programs > Accessories > Communications > Hyper Terminal**.

Step 4: Configure HyperTerminal.

Use the procedure described in Task 2, Step 2, to configure HyperTerminal.

Refer to Figure 1 of the opening HyperTerminal configuration window. At the Connection Description window, enter a session name in the Name field. Select an appropriate icon, or leave the default. Click **OK**.

Refer to Figure 2. Enter the appropriate connection type, COM 1, in the Connect using field. Click **OK**.

Refer to Figure 3. Change port settings to the following values:

Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Click **OK**.

When the HyperTerminal session window comes up, press the **Enter** key. There should be a response from the switch. This indicates that connection has been successfully completed. If there is no connection, troubleshoot as necessary. For example, verify that the switch has power. Check the connection to the correct COM 1 port on the PC and the console port on the switch. If there is still no connection, ask the instructor for assistance.

Step 5: Close HyperTerminal.

When finished, close the HyperTerminal session. Click **File > Exit**. When asked whether to save the session, click **No**.

Task 3: Reflection

This lab provided information for establishing a console connection to a Cisco IOS router and switch.

Task 4: Challenge

Draw the pin connections for the rollover cable and straight-through cable. Compare the differences, and be able to identify the different cable types.

Task 5: Clean Up

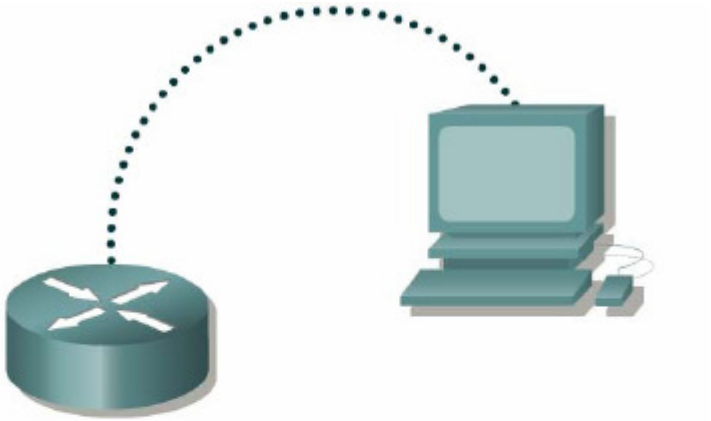
Unless directed otherwise by the instructor, turn off power to the host computer and router. Remove the rollover cable.

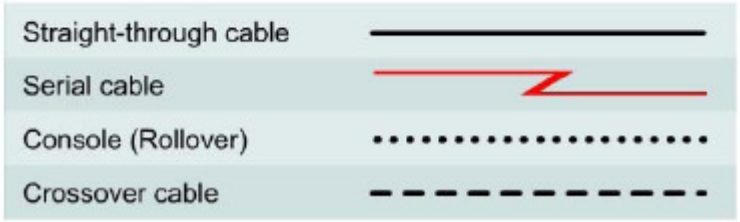
Remove anything that was brought into the lab, and leave the room ready for the next class.

Appendix A

Establishing a Console Session with TeraTerm

Topology Diagram





Learning Objectives

Upon completion of this lab, you will be able to:

- Connect a router and computer using a console cable.
- Configure TeraTerm to establish a console session with the router.

Background

TeraTerm Web is another simple Windows-based terminal emulation program for serial communication that can be used to connect to the console port on Cisco IOS devices.

Scenario

Cable a network similar to the Topology Diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. The following resources will be required:

- Computer with a serial interface and TeraTerm Pro loaded
- Cisco router
- Console (rollover) cable for connecting the workstation to the router

Task 1: Connect a Router and Computer with a Console Cable.

Step 1: Set up basic physical connection.

Ensure that power is turned off on the computer and Cisco router. Connect the console (rollover) cable to the console port on the router. Connect the other cable end to the PC with a DB-9 or DB-25 adapter to the COM 1 port.

Step 2: Power on devices.

Enable power to the computer and router.

Task 2: Configure TeraTerm Web to Establish a Console Session with the Router.

Step 1: Start TeraTerm Web application.

From the Windows taskbar, start the TeraTerm Web program by opening the TeraTerm Web folder, and starting the TeraTerm Web application, **`ttermpro`**.

Step 2: Configure TeraTerm Web.

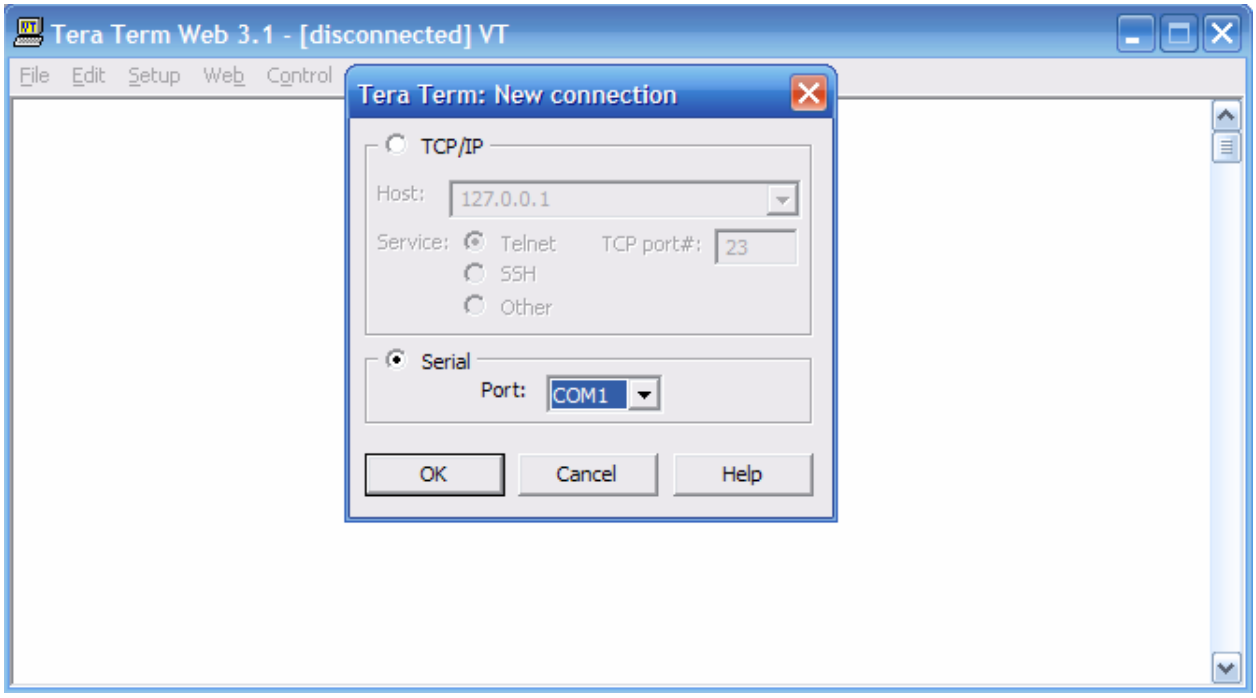


Figure 1. TeraTerm Web Connection Configuration Window

Click **File > New Connection**. Refer to Figure 1. Select the appropriate serial COM port. Click **OK**.

When the TeraTerm Web session window comes up, press the **Enter** key. There should be a response from the router. The connection has been successfully completed. If there is no connection, troubleshoot as necessary. For example, verify that the router has power. Check the connection to the COM 1 port on the PC and the console port on the router. If there is still no connection, ask the instructor for assistance.

Step 3: Close TeraTerm Web.

When finished, close the TeraTerm Web session. Click **File** | **Exit**. When asked whether to save the session, click **Yes**. Enter a name for the session.

Step 4: Reconnect the TeraTerm Web session.

Reopen the TeraTerm Web session as described in Task 2, Step 1. This time, when the New Description window opens (see Figure 1), click **Cancel**.

Click **File > Open**. Select the saved session and then click **Open**. Use this technique to reconnect the TeraTerm Web session to a Cisco device without reconfiguring a new session.

Task 3: Reflection

This lab provided information for establishing a console connection to a Cisco router. Cisco switches are accessed in the same way.

Task 4: Challenge

Draw the pin connections for the rollover cable and straight-through cable. Compare the differences, and be able to identify the different cable types.

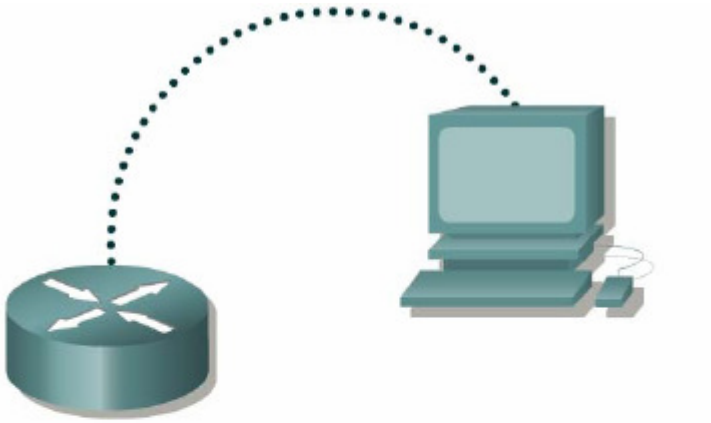
Task 5: Clean Up

Unless directed otherwise by the instructor, turn off power to the host computer and router. Remove the rollover cable.

Remove anything that was brought into the lab, and leave the room ready for the next class.

Lab 10.6.3: Establishing a Console Session with Minicom

Topology Diagram



Learning Objectives

Upon completion of this lab, you will be able to:

- Connect a router and computer using a console cable.
- Configure Minicom to establish a console session with the router.
- Perform basic commands.

Background

Minicom is a text-based UNIX terminal emulation program, similar to the Windows HyperTerminal program. Minicom can be used for many purposes, such as controlling a modem or accessing a Cisco router through the serial console connection. The Linux or UNIX operating system is required.

Scenario

Set up a network similar to the one in the Topology Diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. The following resources will be required:

- Linux/UNIX computer with a serial interface and Minicom loaded
- Cisco router
- Console (rollover) cable for connecting the workstation to the router

Task 1: Connect a Router and Computer with a Console Cable.

Step 1: Set up basic physical connection.

Ensure that power is turned off on the computer and Cisco router. Connect the console (rollover) cable to the console port on the router. Connect the other cable end to the PC with a DB-9 or DB-25 adapter to the COM 1 port.

Step 2: Power on devices.

Enable power to the computer and router.

Task 2: Configure Minicom to Establish a Console Session with the Router.

Step 1: Start Minicom application in configuration mode.

Note: To configure Minicom, root access is required. From the Linux command prompt, start **minicom** with the **-s** option. This starts Minicom in the configuration mode:

```
[root]# minicom -s <ENTER>
```

Step 2: Configure Minicom for serial communications.

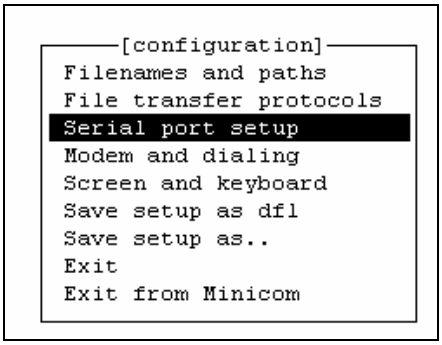


Figure 1. Main Configuration Window

Refer to Figure 1. To configure the serial port, scroll down the configuration list and select **Serial port setup**. Press **Enter**.

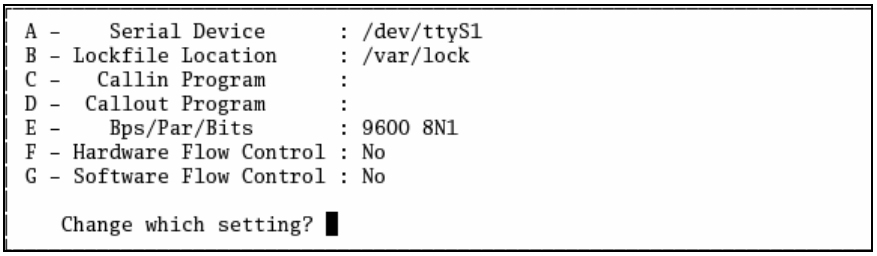


Figure 2. Serial Port Configuration Window

Refer to Figure 2. Use the letter by the field to change a setting. Refer to Table 1 for the correct values.

Option	Field	Value
A	Serial Device	/dev/ttyS0 for COM1 /dev/ttyS1 for COM2
E	Bps/Par/Bits	Bps- 9600 Par- None Bits- 8 Stop bits- 1 (or, select option 'Q')
F	**Hardware Flow Control**	Toggle- No
G	**Software Flow Control**	Toggle- No

Table 1. Serial Port Settings

Return to the Configuration menu by pressing **Enter** or **Esc**.

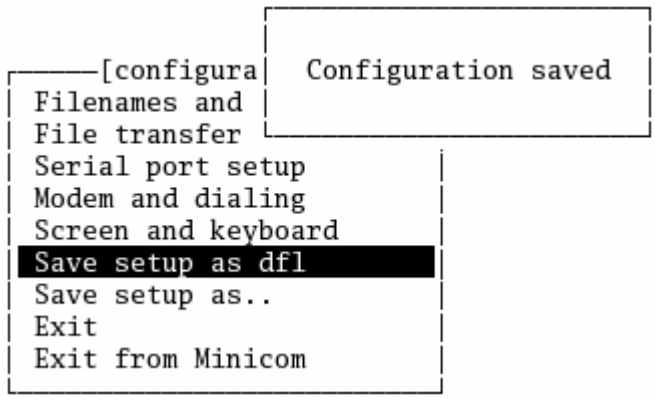


Figure 3. Serial Port Configuration Window

Refer to Figure 3. Select **Save setup as dfl** (default file). When Minicom is restarted, the default values will be reloaded.

Step 3: Close Minicom.

When finished, close the Minicom session. Select **Exit from Minicom**.

Step 4: Restart the Minicom session.

```
[root]# minicom <ENTER>
```

When the session window starts, press the **Enter** key. There should be a response from the router. This indicates that connection has been successfully completed. If there is no connection, troubleshoot as necessary. For example, verify that the router has power. Check the connection to the correct COM1 port on the PC and the console port on the router. If there is still no connection, ask the instructor for assistance.

Task 3: Perform Basic Commands.

Minicom is a text-based, menu-driven, serial communication utility. Basic commands are not intuitive. For example, users communicate with remote devices within the terminal window. However, to control the utility, use **<CTRL> A**. To get help, press **<CTRL> A**, followed by **Z**.

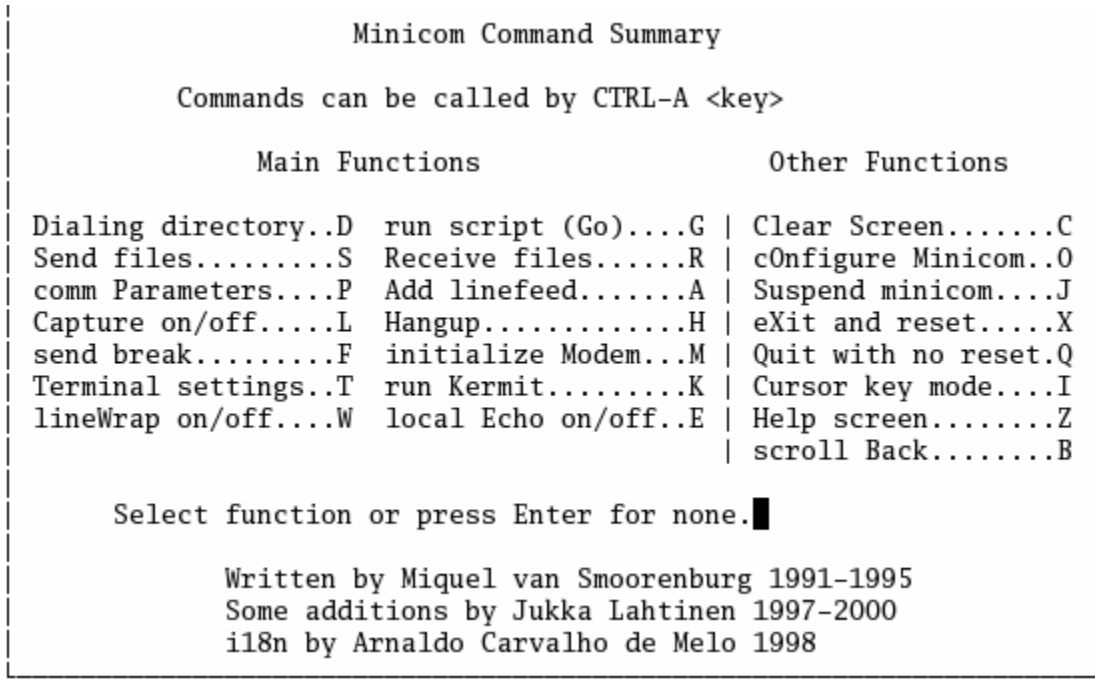


Figure 4. Minicom Command Summary Screen

Refer to Figure 4 for a list of functions and corresponding keys. To quit Minicom, press **<CTRL> A**, followed by either **Q** or **X**.

Task 4: Reflection

This lab provided information for establishing a console connection to a Cisco router using Minicom. Cisco switches are accessed in the same fashion.

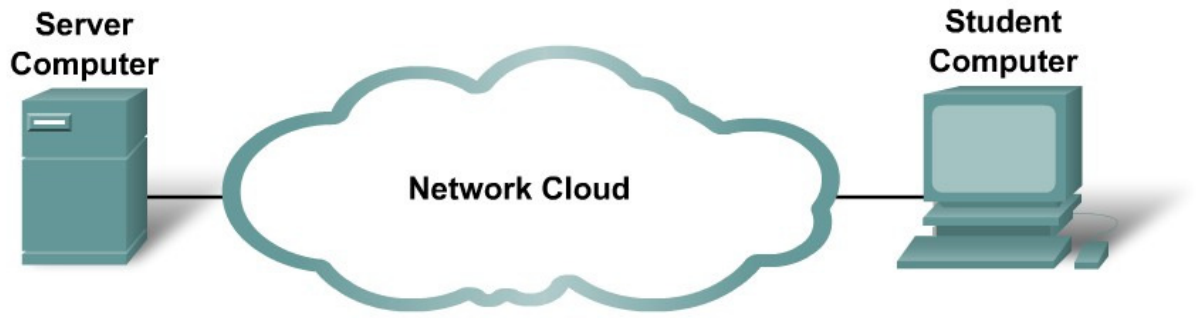
Task 5: Clean Up

Unless directed otherwise by the instructor, turn off power to the host computer and router. Remove the rollover cable.

Remove anything that was brought into the lab, and leave the room ready for the next class.

11.4.3.3: Network Latency Documentation with Ping

Topology Diagram



Learning Objectives

- Use the **ping** command to document network latency.
- Compute various statistics on the output of a **ping** capture.
- Measure delay effects from larger datagrams.

Background

To obtain realistic network latency statistics, this activity must be performed on a live network. Be sure to check with your instructor for any local security restrictions against using the **ping** command on the network.

The destination Server Computer must return ECHO replies, otherwise delay cannot be computed. Some computers have this feature disabled through a firewall, and some private networks block transit ECHO datagrams. For this experiment to be interesting, a sufficiently distant destination should be chosen. For example, destinations on the same LAN or within a few hops may return an unrepresentative low latency. With patience, a suitable destination will be found.

The purpose of this lab is to measure and evaluate network latency over time, and during different periods of the day to capture a representative sample of typical network activity. This will be accomplished by analyzing the return delay from a distant computer with the **ping** command.

Statistical analysis of throughput delay will be performed with the assistance of a spreadsheet application such as Microsoft Excel. Return delay times, measured in milliseconds, will be summarized with through computation of the average latency (mean), noting the latency value at the center of the ordered range of latency points (median), and identification of the most frequently occurring delay (mode). The Appendix contains a chart that can be submitted to the instructor when finished.

Delay will also be measured when the ICMP datagram size is increased.

Scenario

In the topology graphic above, the network cloud represents all of the network devices and cabling between the student computer and the destination Server Computer. It is normally these devices that introduce network latency. Network engineers routinely rely on networks outside of local administration for connectivity to external networks. Monitoring path latency does provide some measure of administrative diligence, which may be used in decision-making when evaluating suitable applications for wide area network (WAN) deployment.

This activity will require five days of testing. On each day, three tests will be performed. Preferably, one test will be made in the early morning, one around mid-day, and one in the evening. The idea is to note and document latency differences that occur during the different periods of the day. When finished there will be a total of 15 sets of this data.

To understand the delay effects from larger datagrams, ICMP datagrams will be sent with increasingly larger datagrams and analyzed.

Task 1: Use the `ping` Command to Document Network Latency.

Step 1: Verify connectivity between Student Computer and destination Server Computer.

To verify connectivity between the Student Computer and destination Server Computer, open a terminal window by clicking on start | run. Enter **cmd**, and then select **OK**. Attempt to ping a suitably distant destination, such as `www.yahoo.com`:

```
C:\> ping -n 1 www.yahoo.com
Pinging www.yahoo-ht3.akadns.net [209.191.93.52] with 32 bytes of data:
Reply from 209.191.93.52: bytes=32 time=304ms TTL=52
Ping  statistics for 209.191.93.5:
      Packets: Sent = 1, Received = 1, Lost = 0 (0% loss)
      Approximate round trip times in milli-seconds:
      Minimum = 304ms, Maximum = 304ms , Average = 304 ms
```

Use the **ping /?** command to answer the following questions:

What is the purpose of the `-n` option and argument `1`?

_____

_____

What option and argument would change the default size to 100 bytes? _____

Decide on a destination Server Computer, and write down the name: _____

Use the **ping** command to verify connectivity with the destination, and write down the results:

Packets sent	Packets Received	Packets Lost

If there are lost packets, use another destination and retest.

Step 2: Perform a delay test.

Write down the command that will send 100 ECHO requests to the destination:

_____

Use the ping command to send 100 ECHO requests to your destination. When finished, copy the replies into Notepad. Notepad can be opened by clicking on Start | Programs | Accessories, and select Notepad. Save the file using the name format *day-sample#*.txt, where: *day* = the day the test was performed (1-5), and *sample#* = the sample period (1-3).

Alternately, output can be redirected to a file by appending > *day-sample#*.txt to the end of the **ping** command. NOTE: the terminal will remain blank until the command has finished.

Task 2: Compute Various Statistics on the Output of a ping Capture.

Step 1: Bring the text file into the Excel Spreadsheet Application.

If not already opened, start Microsoft Excel. Select menu options File | Open. Use Browse to move to the directory that holds the text file. Highlight the filename and select Open. To format a text file for use within Excel, insure all numeric values are separated from text characters. In the Text Import Wizard, Step 1, select Fixed Width. In Step 2, follow instructions in the window to separate numeric values from text values. Refer to Figure 1.

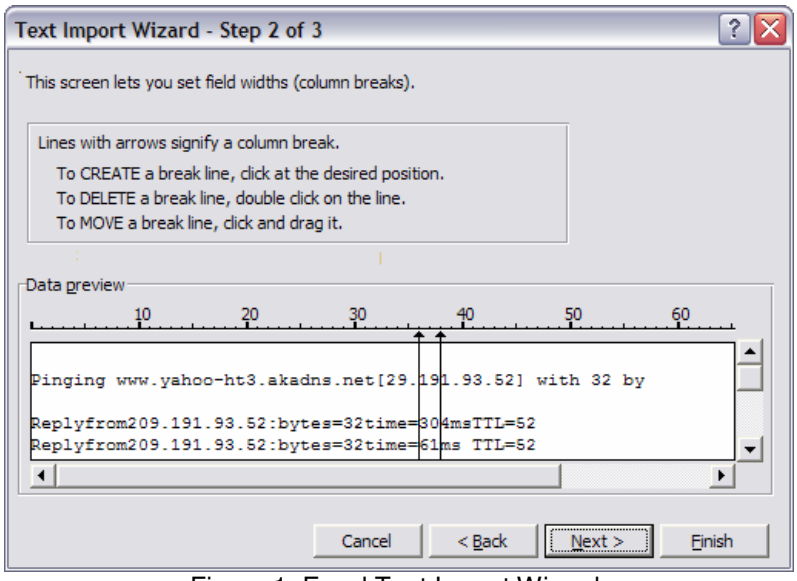


Figure 1. Excel Text Import Wizard.

Step 2. Compute mean, median and mode delay values.

When input formatting is satisfactory, select **Finish**. If the spreadsheet has numbers in different fields, manually fix the numbers. After the spreadsheet has been opened, format the columns so they are more readable. When complete, you should have a spreadsheet that looks similar to Figure 2.

	A	B	C	E	G	I
1				Bytes	Delay (ms	TTL
2	Reply	from	209.191.93.52:	32	304	52
3	Reply	from	209.191.93.52:	32	61	52
4	Reply	from	209.191.93.52:	32	56	52
5	Reply	from	209.191.93.52:	32	54	52
6	Reply	from	209.191.93.52:	32	65	52
7	Reply	from	209.191.93.52:	32	55	52

Figure 2. Partial spreadsheet correctly formatted.

Record the number of dropped packets in your chart, column Dropped Packets. Dropped packets will have a consistently large delay value.

Finally, the delay values must be ordered (sorted) when computing the median and mode values. This is accomplished with the Data | Sort menu options. Highlight all of the data fields. Figure 3 shows a partial spreadsheet highlighted and the Data | Sort menu opened. If a header row was highlighted, click on the Header row radio button. Select the column that contains the Delay values, in Figure 3 it is Column G. When finished click OK.

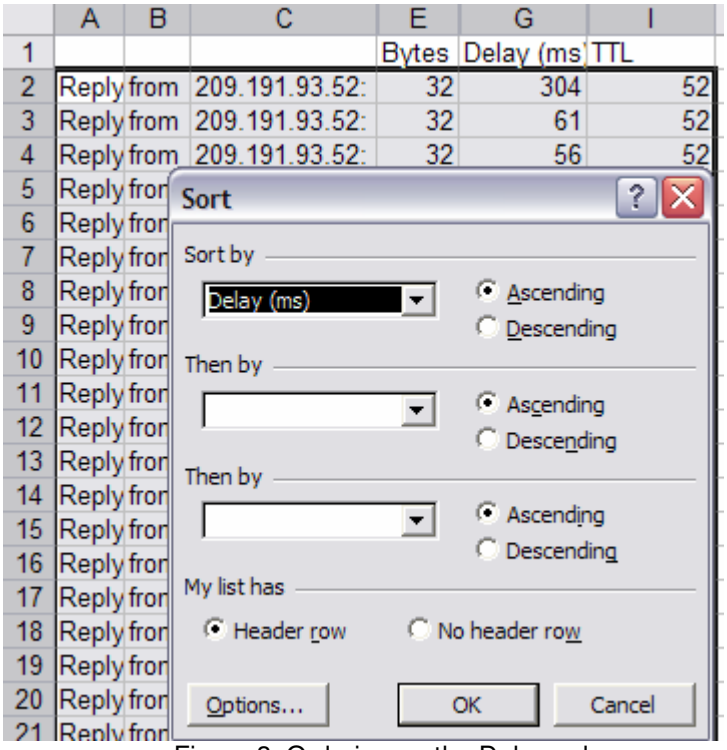


Figure 3. Ordering on the Delay column.

The formula used to compute the mean, or average, delay is the sum of the delays, divided by number of measurements. Using the example above, this would equate to the formula in cell G102: `=average(G2:G101)`. Perform a visual 'sanity check' to verify your mean value is approximately the value shown. Record this number in your chart, under column Mean.

The formula used to compute the median delay, or the delay value in the center of the ordered range, is similar to the average formula, above. For the median value, the formula in cell G103 would be

=median(G2:G101). Perform a visual 'sanity check' to verify your median value is similar to what is shown midway in the data range. Record this number in your chart, under column Median.

The formula used to compute the modal delay, or the delay value that is the most frequently occurring, is also similar. For the mode value, the formula in cell G104 would be =mode(G2:G101). Perform a visual 'sanity check' to verify your mode value is the most frequently occurring value in the data range. Record this number in your chart, under column Mode.

The new spreadsheet file may be saved or discarded as desired, but the data text file should be retained.

Task 3: Measure Delay Effects from Larger Datagrams.

To determine if larger datagrams affect delay, increasingly larger ECHO requests will be sent to the destination. In this analysis, 20 datagrams will be incremented by 100 bytes per **ping** request. A spreadsheet will be created with the reply results, and a chart that plots size vs. delay will be produced.

Step 1: Perform a variable sized delay test.

The easiest way to accomplish this task is to use the Windows built-in FOR loop command. The syntax is:

```
FOR /L %variable IN (start,step,end) DO command [command-parameters]

The set is a sequence of numbers from start to end, by step amount. So
(1,1,5) would generate the sequence 1 2 3 4 5 and (5,-1,1) would generate the
sequence (5 4 3 2 1)
```

In the following command, *destination* is the destination. Issue the command:
FOR /L %i IN (100,100,2000) DO ping -n 1 -l %i *destination*

Copy the output into Notepad, and save the file using the name variablesizedelay.txt.

To redirect output to a file, use the redirect append operator, **>>**, as shown below. The normal redirect operator, **>**, will clobber the file each time the ping command is executed and only the last reply will be saved. NOTE: the terminal will remain blank until the command has finished:

FOR /L %i IN (100,100,2000) DO ping -n 1 -l %i *destination* >> variablesizedelay.txt

The output of one line is shown below. All 20 replies are arranged similarly:

```
C:\> FOR /L %i IN (100,100,2000) DO ping -n 1 -l %i www.yahoo.com

C:\> ping -n 1 -l 100 www.yahoo.com

Pinging www.yahoo-ht3.akadns.net [209.191.93.52] with 100 bytes of data:
Reply from 209.191.93.52: bytes=100 time=383ms TTL=52

Ping statistics for 209.191.93.52:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 383ms, Maximum = 383ms, Average = 383ms
```

Step 2: Bring the text file into the Excel Spreadsheet Application.

Open the new text file in Excel. Refer to Figure 4.

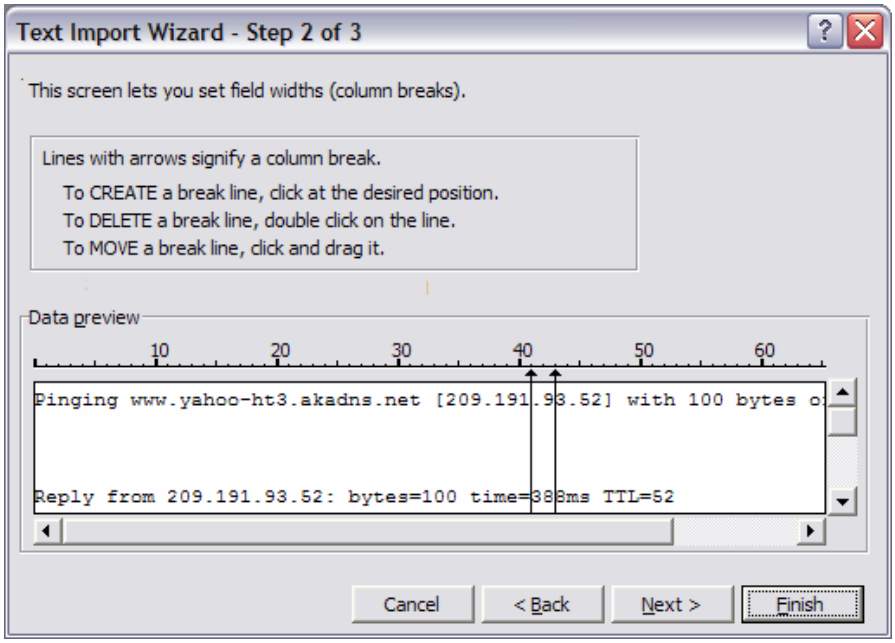
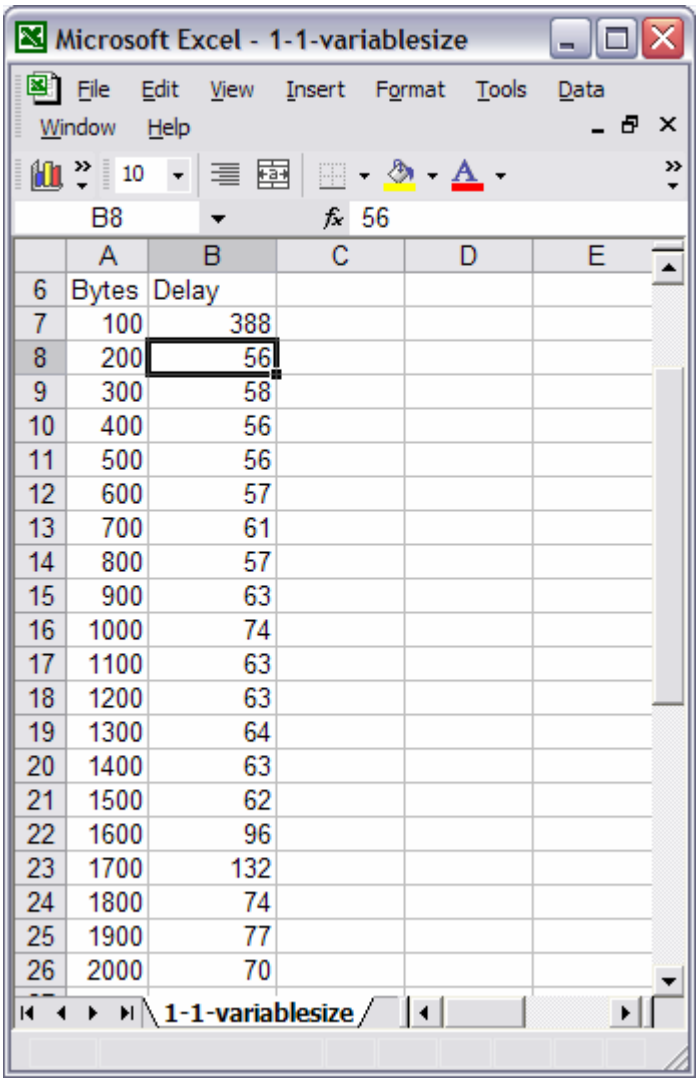


Figure 4. Excel Text Import Wizard.

The difference between this file and the previous file is that the variable size file has much more information than is really needed.

Step 3: Format the spreadsheet.

Clean and organize the spreadsheet data into two columns, Bytes and Delay. When finished, the spreadsheet should look similar to Figure 5.

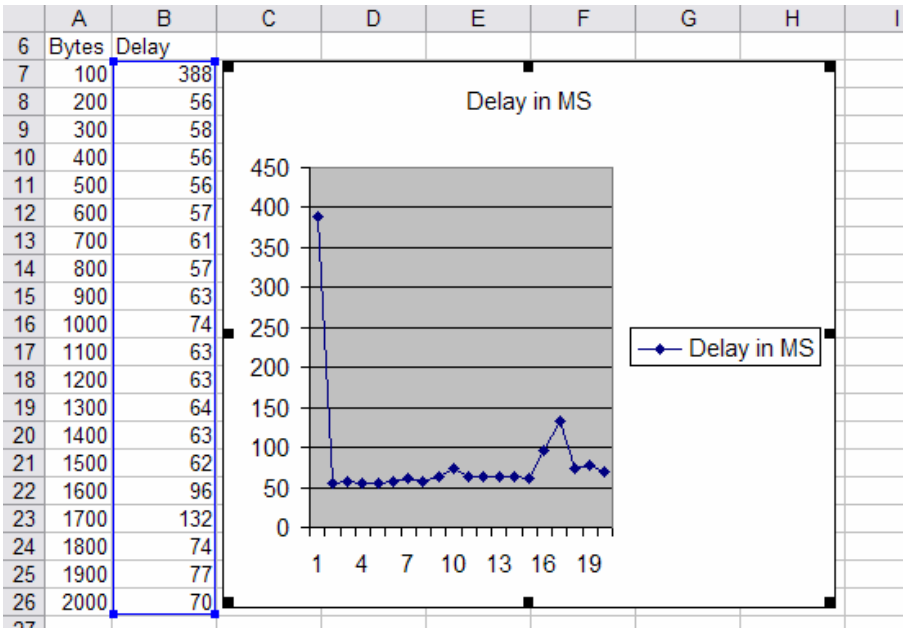


	A	B	C	D	E
6	Bytes	Delay			
7	100	388			
8	200	56			
9	300	58			
10	400	56			
11	500	56			
12	600	57			
13	700	61			
14	800	57			
15	900	63			
16	1000	74			
17	1100	63			
18	1200	63			
19	1300	64			
20	1400	63			
21	1500	62			
22	1600	96			
23	1700	132			
24	1800	74			
25	1900	77			
26	2000	70			

Figure 5. Formatted Spreadsheet.

Step 3: Create a chart of the data.

Highlight the Delay column data. Select menu options Insert | Chart. There are a number of charts that can be used to display delay data, some better than others. While a chart should be clear, there is room for individual creativity. The chart is Figure 6 is a Stacked Line chart.



	A	B
6	Bytes	Delay
7	100	388
8	200	56
9	300	58
10	400	56
11	500	56
12	600	57
13	700	61
14	800	57
15	900	63
16	1000	74
17	1100	63
18	1200	63
19	1300	64
20	1400	63
21	1500	62
22	1600	96
23	1700	132
24	1800	74
25	1900	77
26	2000	70

Figure 6. Plot of Delay vs. datagram size.

When finished, save your spreadsheet and chart and submit it to your instructor with the final delay analysis.

Are there any assumptions that can be made regarding delay when larger datagrams are sent across a network?

_____

_____

Task 4: Reflection

The **ping** command can provide important network latency information. Careful delay analysis over successive days and during different periods of the day can alert the network engineer to changes in network performance. For example, network devices may become overwhelmed during certain periods of the day, and network delay will spike. In this case, routine data transfers should be scheduled during off-peak times when delay is less. Also, many users subscribe to peer-to-peer applications such as KaZaA and Napster. When these file-sharing applications are active, valuable bandwidth will be diverted from critical business applications. If delays are caused by events within the organization, network analysis tools can be used to determine the source and corrective action taken. When the source originates from external networks, not under the control of the organization, subscribing with a different or additional Internet service provider (ISP) may prove beneficial.

Task 5: Challenge

If permitted, download a large file and perform a separate delay test while the file is downloading. Write a one or two paragraph analysis that compares these delay results against a measurement made without the download.

Appendix

NAME: _____				**Network Delay Documentation**		
Source IP Address: _____		**Destination IP Address:_____**		**TTL: _____**		
Statistical Analysis of Network Latency with 32 byte datagrams						
Day (1-5)	**Date (mm/dd/yyyy)**	**Time (hh:mm)**	**MEAN**	**MEDIAN**	**MODE**	**Dropped Packets**
1						
2						
3						
4						
5						

