MICROSOFT
TRAINING
AND CERTIFICATION

Microsoft Official Curriculum

Module 7: Examining IP Addressing

Contents

Microsoft

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Simulations and interactive exercises were made with Macromedia Authorware

Instructor Notes

Presentation:
60 Minutes

Labs:
60 Minutes

This module provides students with an overview of classful IP addressing, subnetting, assigning IP addresses, and viewing the TCP/IP configuration. The first section defines the components of an IP address and describes the IP address classes. The second section then explains the process of subnetting with subnets and subnet masks. In the lab that follows these sections, the students identify the class of an IP address, its components, and default subnet mask. The third section describes the addressing guidelines and valid ranges of network IDs and host IDs. In the lab that follows this section, students allocate IP addresses and identify valid IP configurations.

The last section in the module discusses static and dynamic addressing and the methods for viewing TCP/IP information. The key function of the section is to identify the different reasons for using each tool. In the lab that follows, the students use two methods—the Ipconfig utility and the **Internet Protocol (TCP/IP) Properties** dialog box—to view the TCP/IP information on their computers. They also identify the appropriate use of both methods.

At the end of this module, students will be able to:

- Define IP address classes and describe the features of each class.
- Define subnetting and describe the components used to subnet a network.
- Describe the issues involved in planning the IP addresses to be used in a network.
- Describe the methods used to assign an IP address by using the tools provided by Microsoft® Windows® 2000.

Materials and Preparation

This section provides you with the required materials and preparation tasks that are needed to teach this module.

Required Materials

To teach this module, you need the following materials:

- Microsoft PowerPoint® file 2151A_07.ppt
- Module 7, "Examining IP Addressing"

Preparation Tasks

To prepare for this module, you should:

- Read all of the materials for this module.
- Read the white papers, *Introduction to TCP/IP* and *TCP/IP Implementation Details for Windows 2000*, on the Trainer Materials compact disc.
- Read the IP Addressing topic in Windows 2000 Help.
- Complete the three labs.
- Review the Delivery Tips and Key Points for each section and topic.
- Study the review questions and prepare alternative answers for discussion.
- Anticipate the questions that students may ask and prepare answers to them.

Module Strategy

Use the following strategy to present this module:

- Classful IP Addressing

  Begin the module with a review of the concept of an IP address that was introduced in module 6, "Examining TCP/IP," in course 2151A, *Microsoft Windows 2000 Network and Operating System Essentials*. Describe the components of an IP address. Next, give an overview of classful addressing, and then explain the types of address classes and their function in identifying the components of an IP address.

- Subnetting a Network

  Describe the reason for creating subnets in a network. Continue by explaining the concepts of subnetting and subnet masks and the reason why custom subnet masks are useful for dividing an existing network ID. Then describe the procedure for determining whether two hosts are local or remote with respect to each other.

- Planning IP Addressing

  Explain the restrictions on the values of the network ID and host ID that must be considered before assigning an IP address. Then describe the valid ranges of network IDs and host IDs that can be assigned.

- Assigning TCP/IP Addresses

  Differentiate between static and automatic IP addressing. Demonstrate how to assign an IP address to a host, and then explain the two methods for viewing TCP/IP information. Demonstrate how to use the Ipconfig utility, and then describe the situations in which the use of each of these methods is most appropriate.

Customization Information

This section identifies the lab setup requirements for a module and the configuration changes that occur on student computers during the labs. This information is provided to assist you in replicating or customizing Microsoft Official Curriculum (MOC) courseware.

Important The labs in this module are also dependent on the classroom configuration that is specified in the Customization Information section at the end of the Classroom Setup Guide for course 2151A, *Microsoft Windows 2000 Network and Operating System Essentials*.

Lab Results

There are no configuration changes on student computers that affect replication or customization.

Overview

Slide Objective
To provide an overview of the module topics and objectives.

Lead-in
In this module, you will learn how IP addresses are used to determine the address class of a computer, how networks are subnetted, how IP addresses are planned, and how they are assigned in a network.

- **Classful IP Addressing**
- **Subnetting a Network**
- **Planning IP Addressing**
- **Assigning TCP/IP Addresses**

The primary function of Internet Protocol (IP) is to add address information to data packets and to route them across the network to the correct destination. To understand how IP accomplishes this, it is necessary to be familiar with the concepts that determine the intermediate and final destination addresses of the data packet.

To determine the location of a destination host with respect to the source computer, IP addresses are organized into classes. This is called classful IP addressing. You must assign IP addresses to all computers that are connected on the network. Network segments connected by a router are called subnets. Breaking down the network into subnets for the purpose of assigning IP addresses is called *subnetting*.

Based on the rules that govern classful IP addressing, you plan and assign the IP addresses for each computer by using the tools provided by Microsoft® Windows® 2000.

Note The word *host* is often used to describe any device on a network that sends and receives information by using an IP address. All of the computers, printers, and routers in a TCP/IP network are hosts and require at least one IP address to communicate.

At the end of this module, you will be able to:

- Describe classful IP addressing and describe the features of each class.
- Describe the procedure for subnetting a network.
- Describe the issues involved in planning the IP addresses for a network.
- Describe the procedure used to assign an IP address using the tools provided by Windows 2000.

Classful IP Addressing

Slide Objective
To introduce the concept of IP address classes.

Lead-in
A computer needs to determine the location of another computer before it can send data to it.

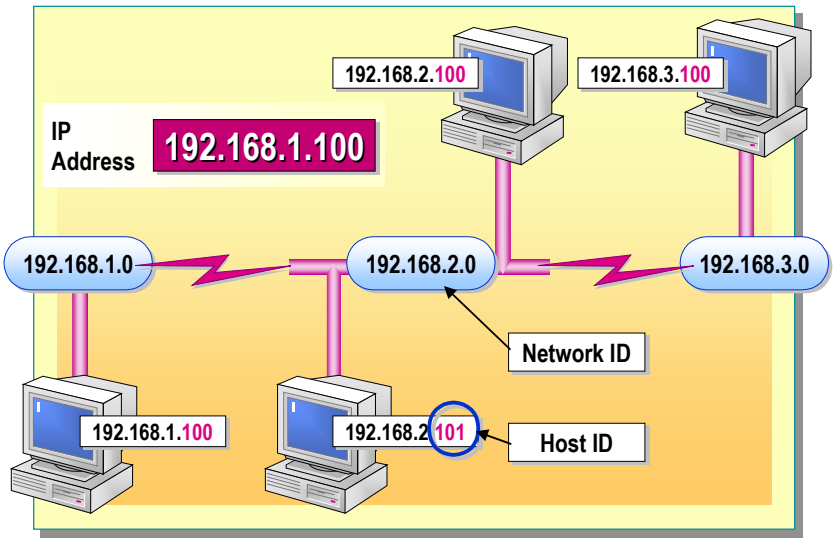
- IP Addresses
- IP Address Classes

To be able to communicate on a network, each computer must have a unique IP address. In classful IP addressing, there are three address classes used to assign IP addresses to computers. The size and type of a network determines the IP address class that you apply when you provide IP addresses for the computers and other hosts on your network.

IP Addresses

Slide Objective
To illustrate an IP address.

Lead-in
IP addresses form the backbone of the TCP/IP communication process.



Delivery Tip
The slide shows four computers with IP addresses, located on three different networks. The slide shows how the IP addresses could represent the same host ID or network ID, but that the entire IP address must be unique to communicate with another computer.

Key Point
An IP address is not just an identifier; it is also a way to locate a computer on the network. This is why we introduce network ID and host ID on this page. At this point, the students need to know that the IP addresses themselves are unique and that the first portion is used for the network ID and the second is used for the host ID. The exact formatting of the host ID and the network ID is discussed on the following page.

The IP address is the unique identifier that differentiates one computer from another in a network and helps to locate where that computer resides in the network. An IP address is required for each computer and network component, such as a router, that communicates using TCP/IP.

The IP address identifies a computer's location on the network; similar to the way a numerical address identifies a house in a city. Just as the address for a specific house must be unique but follow certain addressing conventions, an IP address should be unique but conform to a standard format. An IP address consists of a set of four numbers, each of which can range from 0 to 255.

Components of an IP Address

In the same way that a house address has two parts—a street address and a postal delivery area code (ZIP code)—an IP address also has two parts—the host ID and the network ID.

Network ID

The first part of the IP address is the network ID, which identifies the network segment on which the computer is located. All computers on the same segment must have the same network ID, just as all houses in a specific area must have the same postal delivery area code.

Host ID

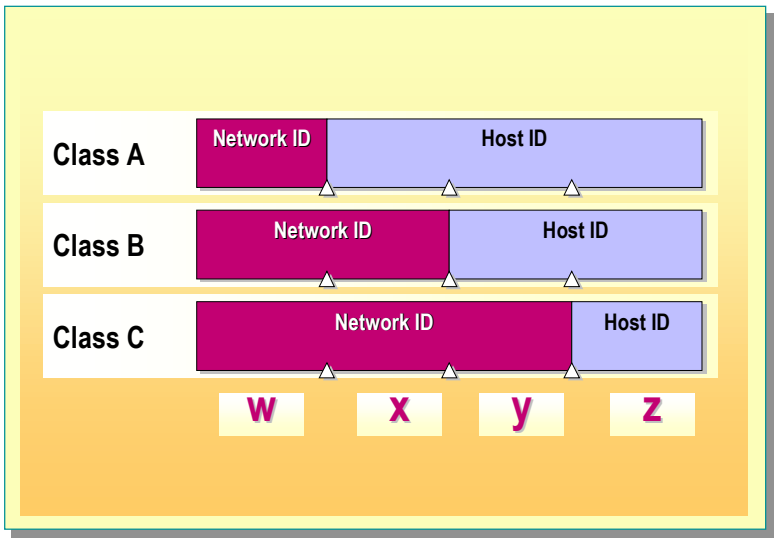
The second part of the IP address is the host ID, which identifies a computer, router, or other device within a segment. The host ID for each host must be unique within the network ID, in the same way that the street address for a house must be unique within the postal delivery area code.

It is important to note that just as two different postal delivery areas can have the same street address within them, two computers with different network IDs can have the same host ID. However, the combination of the network ID and the host ID must be unique to all computers in communication with each other.

IP Address Classes

Slide Objective
To illustrate the IP address classification system.

Lead-in
IP addresses are divided into five categories for ease of management, three of which are used to assign IP addresses to computers.



Key Point
Ensure that the students understand that only class A, B, and C addresses are assigned to hosts. Also point out that besides separating host IDs and network IDs, classes are used to allocate IP addresses to allow communication on the Internet.

Address classes are used to assign network IDs to organizations so that the computers on their networks can communicate on the Internet. Address classes are also used to define the dividing point between the network ID and host ID. An organization is assigned a block of IP addresses, which are referred to by the addressees' network ID and which are based on the organization's size. For example, an organization with 200 hosts is assigned a class C network ID; whereas an organization with 20,000 hosts is assigned a class B network ID.

Class A

Class A addresses are assigned to networks with a very large number of hosts. This class allows for 126 networks, by using the first number for the network ID. The remaining three numbers are used for the host ID, allowing for 16,777,214 hosts per network.

Class B

Class B addresses are assigned to networks that range from medium to large in size. This class allows for 16,384 networks, by using the first two numbers for the network ID. The remaining two numbers are used for the host ID, allowing for 65,534 hosts per network.

Class C

Class C addresses are used for small, local area networks (LANs). This class allows for approximately 2,097,152 networks, by using the first three numbers for the network ID. The remaining number is used for the host ID, allowing for 254 hosts per network.

Classes D and E

Classes D and E are not allocated to hosts. Class D addresses are used for multicasting, and the class E addresses are reserved for future use.

Determining the Address Class

Classful IP addressing is based on the structure of the IP address and provides a systematic way to differentiate network IDs from host IDs. There are four numerical segments of an IP address. An IP address can be represented as *w*.*x*.*y*.*z*, where *w*, *x*, *y*, and *z* are numbers with values ranging from 0 to 255. Based on the value of the first number, *w* in the numerical representation, IP addresses are categorized into five address classes as illustrated in the following table.

IP address class	IP address	Network ID	Range of values of *w*
A	***w***.*x*.*y*.*z*	*w*.0.0.0	1 - 126*
B	***w***.*x*.*y*.*z*	*w*.*x*.0.0	128 – 191
C	***w***.*x*.*y*.*z*	*w*.*x*.*y*.0	192 – 223
D	***w***.*x*.*y*.*z*	Not available	224 – 239
E	***w***.*x*.*y*.*z*	Not available	240 - 255

*The network ID 127.0.0.0 is reserved for testing connectivity.

Determining the Network and Host ID

For the IP addresses in class A, the network ID is the first number in the IP address. For class B, the network ID is the first two numbers; and for class C, the network ID is the first three numbers in the IP address. The remaining numbers identify the host ID.

The network ID has a four-number structure like the IP address. Therefore, if the first number, *w*, in an IP address represents the network ID, the structure of the network ID is *w*.0.0.0, with the three remaining numbers being 0. The structure of the host ID is *x*.*y*.*z*. Note that the host is not preceded by a 0.

For example, the IP address 172.16.53.46 would be a class B address because *w*=172 and is between 128 and 191. That makes the network ID 172.16.0.0 and the host ID 53.46 (without a period at the end).

Subnetting a Network

Slide Objective
To introduce the concept of subnetting.

Lead-in
Subnets enable a large number of computers to effectively communicate in a network. To accomplish this, the computers must be able to differentiate between a computer on the same subnet and one on a different subnet.

- **Subnets**
- **Subnet Masks**
- **Determining Local and Remote Hosts**

You can expand a network by using physical devices, such as routers and bridges, to add network segments. You can also use physical devices to divide a network into smaller segments in order to increase the network's efficiency. Network segments separated by routers are called *subnets*.

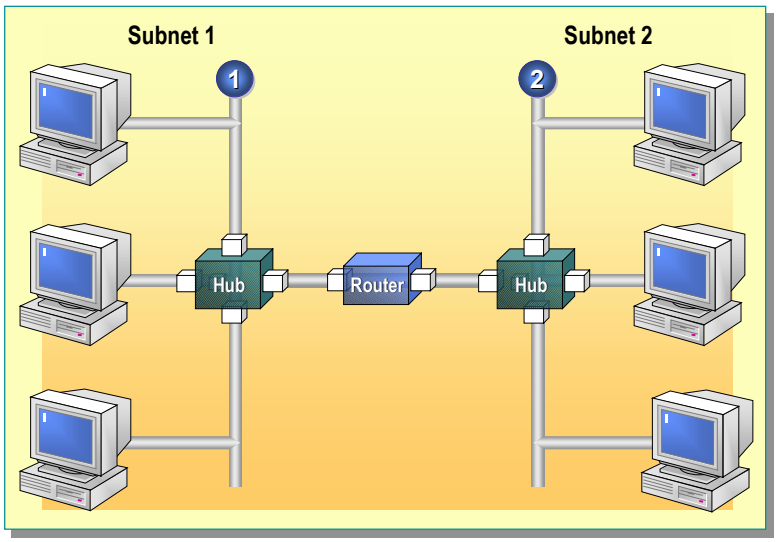
When you create subnets, you must break up the network ID for the hosts on the subnets. Dividing the network ID used to communicate on the Internet into smaller (based on the number of IP addresses identified) network IDs for a subnet is called *subnetting* a network. To then identify the new network ID for each subnet, you must use a subnet mask to specify which portion of the IP address is to be used for the new network ID of the subnet.

You can locate a host on a network by analyzing the host's network ID. Matching network IDs show which hosts are on the same subnet. If the network IDs are not the same, you know that they are on different subnets and that you need a router to establish communication between them.

Subnets

Slide Objective
To illustrate the structure of a subnet.

Lead-in
This topic explains why networks are subdivided into smaller network segments.



Key Point
Make sure to point out that in creating a subnet, each subnet receives its own network ID. Also stress the important function of a router as the boundary between subnets. This arrangement between subnets and routers leads to the term internetwork, which describes a network divided into subnets.

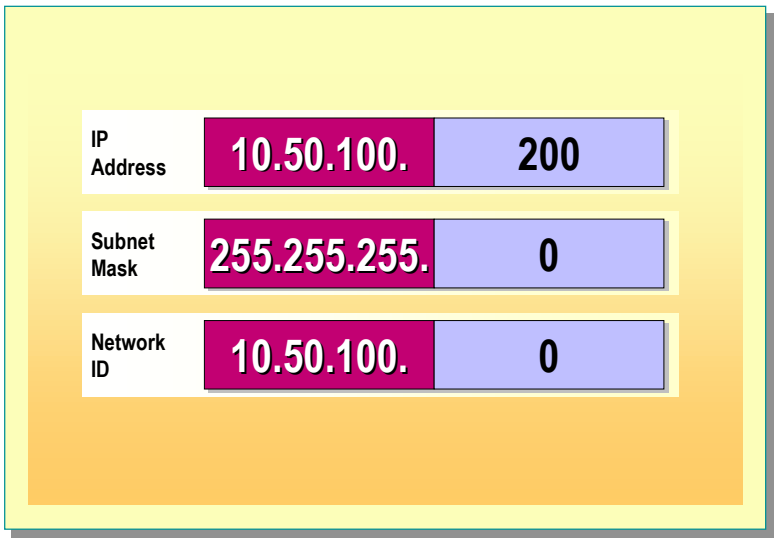
Most Windows 2000 networks are based on Ethernet technology, in which computers use broadcasts to transmit information. As the number of computers and the volume of traffic on an Ethernet network increase, there is a corresponding increase in data collision and a decrease in network performance. To solve this problem, computers in an Ethernet network are grouped together into physical divisions, called segments, which are separated by a physical device, such as a router or bridge.

In a TCP/IP environment, segments that are separated by routers are known as subnets. All of the computers that belong to one subnet have the same network ID in their IP addresses. Every subnet must have a different network ID to communicate with other subnets. Based on the network ID, subnets define the logical divisions of a network. Computers that are on different subnets need to pass their communication through routers.

Subnet Masks

Slide Objective
To illustrate the division of an IP address into the network and host ID by using a subnet mask.

Lead-in
This topic explains the process by which the computer differentiates the network ID from the host ID by using a subnet mask.



Delivery Tip
Although it is possible to use subnet masks other than the ones mentioned here, the goal is to introduce the topic of subnet masks in a fashion that allows the student to configure a subnet mask without using classful boundaries. A second goal is to recognize how a subnet mask can identify the network ID in an IP address. Because the focus is on the network ID, the slide is animated and shows that the 10.50.100.200 IP address could have different subnet masks.

In the classful method, the number of networks and hosts available for a specific address class is pre-determined. As a result, an organization that is allocated a network ID has a single, fixed network ID and a specific number of hosts as determined by the address class to which the IP address belongs.

With the single network ID, the organization can have only one network connecting its allocated number of hosts. If the number of hosts is large, the single network will not be able to perform efficiently. To solve this problem, the concept of subnetting was introduced.

Subnetting allows a single classful network ID to be divided into smaller (as defined by the number of IP addresses identified) network IDs. Using these multiple smaller network IDs, the single network can be segmented into subnets, each with a different network ID, also known as a subnet ID.

Structure of Subnet Masks

To divide a network ID, you use a subnet mask. A subnet mask is a screen that differentiates the network ID from a host ID in an IP address but is not restricted by the same rules used in the classful method. A subnet mask consists of a set of four numbers, similar to an IP address. These numbers can range in value from 0 to 255.

In the classful method, each of the four numbers can assume only the maximum value 255 or the minimum value 0. The four numbers are then arranged as contiguous maximum values followed by contiguous minimum values. The maximum values represent the network ID and the minimum values represent the host ID. For example, 255.255.0.0 is a valid subnet mask, whereas 255.0.255.0 is not. The subnet mask 255.255.0.0 identifies the network ID as the first two numbers in the IP address.

Default Subnet Masks

In the classful method, every address class has a default subnet mask. The following table lists the default subnet masks for each address class.

IP address class	IP address	Subnet mask	Network ID	Host ID
A	*w.x.y.z*	255.0.0.0	*w.0.0.0*	*x.y.z*
B	*w.x.y.z*	255.255.0.0	*w.x.0.0*	*x.y*
C	*w.x.y.z*	255.255.255.0	*w.x.y.0*	*z*

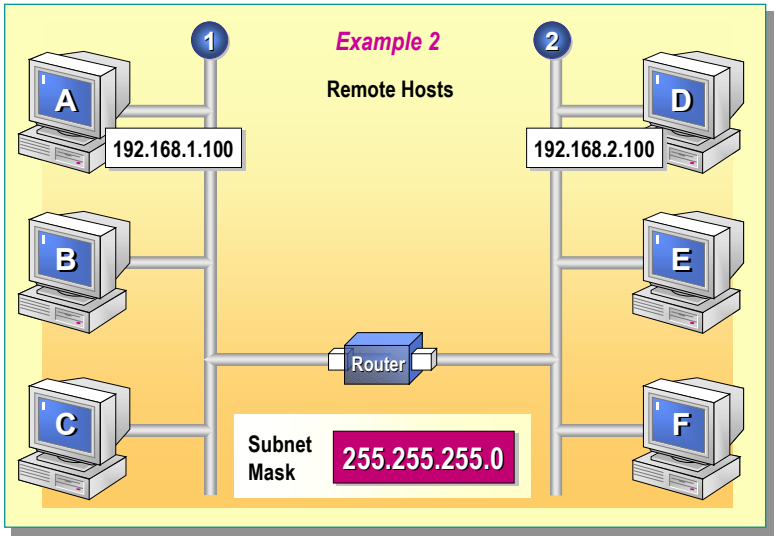
Custom Subnet Masks

When subnetting an existing network ID to create additional subnets, you can use any of the above subnet masks with any IP address or network ID. So the IP address 172.16.2.200 could have the subnet mask 255.255.255.0 and network ID 172.16.2.0, as opposed to the default subnet mask 255.255.0.0 with the network ID 172.16.0.0. This allows an organization to subnet an existing class B network ID of 172.16.0.0 into smaller network IDs to match the actual configuration of their network.

Determining Local and Remote Hosts

Slide Objective
To illustrate local and remote hosts.

Lead-in
After the network IDs of IP addresses are identified, determine whether two hosts are local or remote with respect to each other.



Delivery Tip
Remind the students that if a network is not divided into subnets, then all communication must be local. And if the network IDs do not match, communication does not occur. Again, reinforce the idea that IP is responsible for getting a packet to its destination. The focus here is how IP determines if a router is needed for communication. Note that the IP addresses in the examples are the same, but the subnet mask varies. This shows the importance of a properly configured subnet mask.

After the network ID of a host is identified, it is easy to determine whether another host is local or remote with respect to it. To do so, you compare the network IDs of both hosts. If the network IDs match, the two hosts are on the same subnet. If the network IDs do not match, then the hosts are on different subnets and a router is required to transmit data between them.

Example 1

Consider the two computers A and B with the IP addresses 192.168.1.100 and 192.168.2.100 and a subnet mask of 255.255.0.0. As illustrated in the following table, the network IDs of their IP addresses match. Therefore, computers A and B are local.

	Computer A	Computer B
IP Address	192.168.1.100	192.168.2.100
Subnet Mask	255.255.0.0	255.255.0.0
Network ID	**192.168.0.0**	**192.168.0.0**

Example 2

As another example, consider the computers A and D with the IP addresses 192.168.1.100 and 192.168.2.100 and a subnet mask of 255.255.255.0. The network IDs of these IP addresses do not match as illustrated by the following table. Therefore, computer A is remote with respect to computer D.

	Computer A	Computer D
IP Address	192.168.1.100	192.168.2.100
Subnet Mask	255.255.255.0	255.255.255.0
Network ID	**192.168.1.0**	**192.168.2.0**

Lab A: Determining Class Addresses and Subnet Masks

Slide Objective
To introduce the lab.

Lead-in
In this lab, you will identify the correct address class and subnet mask for a given IP address and then determine the host ID and network ID of the IP address.

Objectives

After completing this lab, you will be able to:

- Identify the class of an IP address.
- Identify the default subnet mask of an IP address.
- Identify the network ID of an IP address.
- Identify the host ID of an IP address.

Estimated time to complete this lab: 15 minutes

Exercise 1
Using IP Address Classes to Determine Network and Host IDs

Scenario

You are an administrator and need to identify the network and host ID for a given IP address, so that you can determine if a router is needed to communicate between the two computers.

Goal

In this exercise, you will identify the class of IP address and the default subnet. You will then separate the network ID from the host ID.

Tasks	Detailed Steps
Identify the class, subnet mask, network ID, and host ID for the IP address 131.107.2.1	**a.** Use the first number of the IP address to identify the default class and associated subnet mask for the address. **b.** Calculate the network ID by using the numeric values in the IP address that correspond to 255 in the subnet mask, and then fill in the remaining portion with zeros (0s). **c.** Calculate the host ID by using the numeric values in the IP address that correspond to 0 in the subnet mask.

Note: Repeat for each IP address in the table below. The first IP address is filled in as an example.

IP address	Class/Subnet mask	Network ID	Host ID
129.102.197.23	**B/255.255.0.0**	**129.102.0.0**	**197.23**
131.107.2.1			
199.32.123.54			
32.12.54.23			
1.1.1.1			
221.22.64.7			
93.44.127.235			
23.46.92.184			
152.79.234.12			
192.168.2.200			
168.192.3.26			
224.224.224.224			
200.100.50.25			
172.71.243.2			
163.37.212.32			
76.35.61.23			

(*continued*)

Tasks	Detailed Steps
	What does calculating the network ID allow you to determine? **You calculate the network ID so that you can compare it with the network ID of the destination computer. If the two network IDs are equal, then the two computers are on the same segment. If the two network IDs are not equal, then you must use a router to communicate.**
	Although the host ID can be used to identify a computer on a specific segment, what address does the TCP/IP suite use to determine if it is communicating with the correct computer? **Although the host ID is a user-friendly way to identify a computer, the MAC address is always the most basic identifier used for communication between computers. The host ID is still important because it must be unique on a given segment so that the IP address can be resolved to a MAC address.**
	What type of communication transmission is used to identify the MAC address and limit the identification of a MAC address to only those computers on the same segment? **The TCP/IP suite uses ARP, which in turn uses a broadcast message to resolve a MAC address from an IP address. Since ARP queries all of the computers on the same segment, it is important that each of the computers on that segment have a unique IP address.**

(*continued*)

Tasks	Detailed Steps
	Why is it important to use routers to physically segment a network? **Physically segmenting a network allows more computers to communicate by avoiding the need for each computer to listen to every packet that is sent. This way, only the limited number of computers that exist on the same segment will see all the packets that are sent. The specific packets that are destined for other segments are the only packets seen by more than one segment.**

Planning IP Addressing

Slide Objective
To introduce the guidelines for assigning network and host IDs.

Lead-in
After a network is established, IP addresses are required for all of the computers in it. This section explains how to plan the assignment of IP addresses so that there are no conflicts.

- **Addressing Guidelines**
- **Assigning Network IDs**
- **Assigning Host IDs**

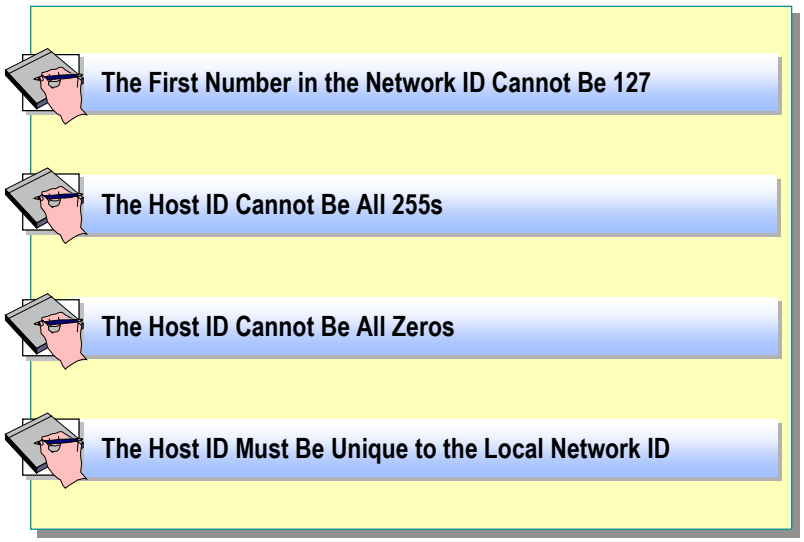
After a network is established, each computer in it needs an IP address; in much the way houses on a city block need addresses assigned to them. Without an IP address, a computer does not receive data directed to it. And like house addresses, the format of the IP address must follow certain guidelines to ensure that the data is transmitted to the correct computer.

This section explains the guidelines for assigning network and host IDs.

Addressing Guidelines

Slide Objective
To highlight the important addressing guidelines.

Lead-in
Not all possible IP addresses can be assigned to host computers.



Delivery Tip
Although these guidelines are defined further when considering binary IP addresses and subnets, they also work well for classful and simple IP address assignments (those that use only 255s in the subnet mask). The goal here is to add no additional content that is not related to the module.

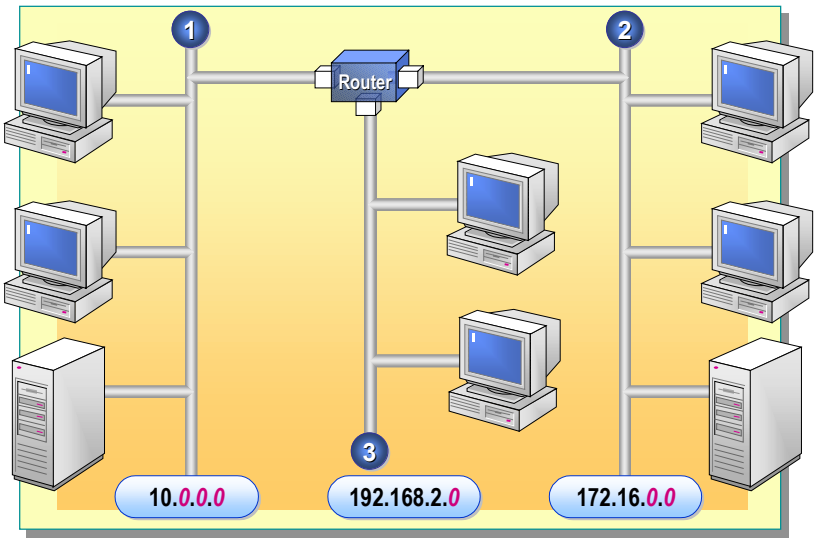
You must consider some guidelines on the numbers used for the network ID and the host ID when you assign an IP address by using classes. These guidelines are:

- The first number in the network ID cannot be 127. This ID number is reserved for testing connections, such as the local loopback.
- The numbers in the host ID cannot all be 255, as this address is used as an IP broadcast address.
- The host ID cannot be all zeros (0s) because this address is used to denote a network ID.
- The host ID must be unique to the local network ID.

Assigning Network IDs

Slide Objective
To illustrate the valid ranges of network IDs.

Lead-in
Each subnet must be identified by a network ID.



Delivery Tip
Remind the students that classes are an effective method for dividing the IP addresses for organizations on the Internet. This is why each organization that communicates on the Internet must have a unique network ID.

The network ID identifies the TCP/IP hosts that are located on the same physical subnet. All hosts on the same subnet must be assigned the same network ID to enable them to communicate with each other.

Each subnet must have a unique network ID. For example, subnet A could have the network ID 10.0.0.0, subnet B could have the network ID 192.168.2.0, and subnet C could have the network ID 172.16.0.0.

The following table lists the valid ranges of network IDs for a network.

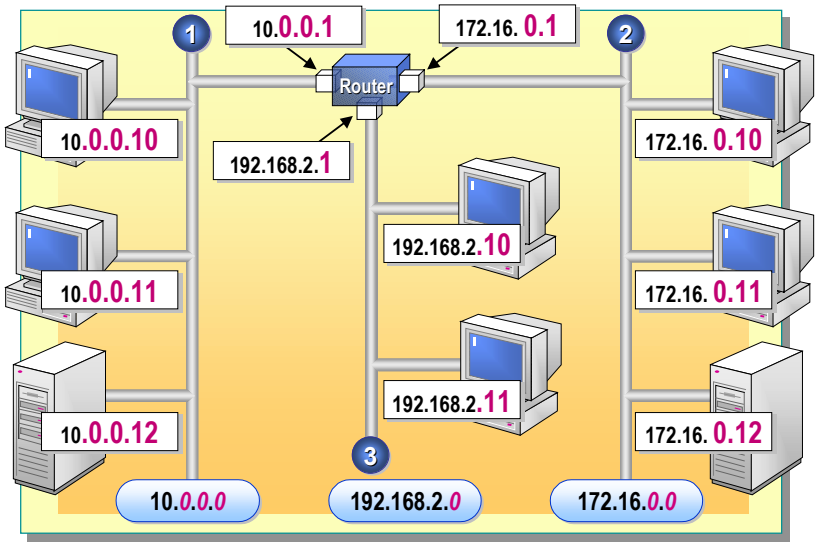
Address class	Beginning range	Ending range
Class A	1.0.0.0	126.0.0.0
Class B	128.0.0.0	191.255.0.0
Class C	192.0.0.0	223.255.255.0

Note If you plan to connect your network to the Internet, you must ensure that the network ID portion of the IP address is unique among all of the other networks on the Internet. To obtain a valid IP network number assignment, you can contact your Internet service provider. You can then subnet your network by using subnet masks to further divide your individual network.

Assigning Host IDs

Slide Objective
To illustrate the valid ranges of host IDs.

Lead-in
Consider the following issues before assigning host IDs.



Delivery Tip
Although calculating the host ID helps in assigning IP addresses in a subnet, the host ID by itself is not useful. You need a complete IP address to identify a host.

The host ID identifies a TCP/IP host within a network and must be unique to the network ID. All TCP/IP hosts, including routers, require unique host IDs. There are no rules for assigning host IDs in a subnet. For example, you can number all TCP/IP hosts consecutively, or you can number them so that they can be easily identified, such as by assigning the router on each subnet the number 1 for the last number of the host ID.

Valid Host IDs

The following table lists the valid ranges of host IDs for each class of network.

Address class	Beginning range	Ending range
Class A	*w*.0.0.1	*w*.255.255.254
Class B	*w.x*.0.1	*w.x*.255.254
Class C	*w.x.y*.1	*w.x.y*.254

Default Gateway

For a specific host, the IP address of the router that is on the same segment as the host is known as the host's default gateway. All information that the host needs to send to segments other than its own is routed through the default gateway.

Because a host and its default gateway are on the same segment, they have the same network ID but different host IDs. For example, for the host with the IP address 192.168.2.11, the IP address of the default gateway is 192.168.2.1.

Lab B: Identifying Valid IP Addresses

Slide Objective
To introduce the lab.

Lead-in
In this lab, you will allocate IP addresses and then give reasons why various IP addresses are valid for different sizes of networks.

Objectives

After completing this lab, you will be able to:

- Allocate IP addresses in a single-segment environment.
- Allocate IP addresses in a multiple-segment environment.
- Identify invalid IP configurations.

Lab Setup

This lab is a simulation. To complete this lab, you need the following:

- A computer running Microsoft Windows 2000, Microsoft Windows NT® version 4.0, Microsoft Windows 98, or Microsoft Windows 95.
- Microsoft Internet Explorer 5 or later.
- A minimum display resolution of 800 x 600 with 256 colors. Recommended display resolution of 800 x 600 with high color (16-bit).

► To start the lab

1. Log on to Windows 2000 as Administrator with a password of **password**.
2. On the desktop, double-click the **Internet Explorer** icon.
3. On the Student Materials Web page, click **Lab Simulations**.
4. Click **Identifying Valid IP Addresses**.
5. Read the introduction information, and then click the link to begin the simulation.

Estimated time to complete this lab: 30 minutes

Assigning TCP/IP Addresses

Slide Objective
To introduce the processes for assigning TCP/IP addresses.

Lead-in
After the network and host IDs are formulated, the next step is to configure the computers accordingly.

- Static IP Addressing
- Automatic IP Addressing
- Viewing TCP/IP Configuration
- Viewing TCP/IP Configuration Using Ipconfig

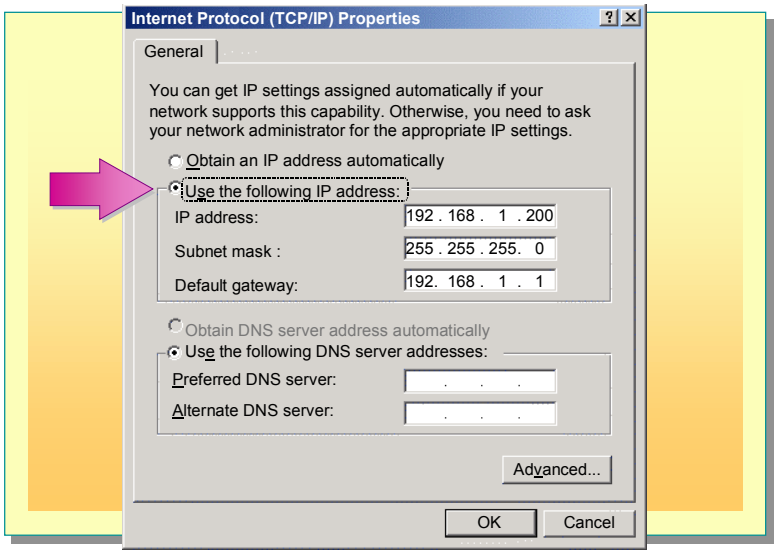
You can set IP addresses using either of two methods—static or automatic. If you choose to set the IP address statically, then you must manually configure the address at each computer in the network. If you choose to set the IP address automatically, then you can configure the IP addresses for an entire network from a single location and then dynamically assign them to each computer.

After you set the IP address, you can view its TCP/IP configuration by using either the **Internet Protocol (TCP/IP) Properties** dialog box or the Ipconfig utility.

Static IP Addressing

Slide Objective
To illustrate static IP addressing.

Lead-in
You can assign IP addresses manually using the **Internet Protocol (TCP/IP) Properties** dialog box.



Delivery Tip
Demonstrate how to use the **Internet Protocol (TCP/IP) Properties** dialog box and explain how to choose the option to set addresses statically. You can then use that as an introduction to the next page by having the students access the **Internet Protocol (TCP/IP) Properties** dialog box on their computers. Students asking why they cannot see their IP address will provide a lead-in to the next page. Note that your IP address is static, but theirs are automatic, if the standard class setup is used.

Static IP addressing refers to configuring IP addresses manually. In this method, you use a utility provided by Windows 2000 to assign an IP address. Windows 2000 provides the **Internet Protocol (TCP/IP) Properties** dialog box to manually assign an IP address to a TCP/IP host or device.

To open the TCP/IP Properties dialog box

1. From the **Start** menu, point to **Settings**, and click **Network and Dial-up Connections**.
2. In the Network and Dial-up Connections window, right-click the **Local Area Connection** icon, and then click **Properties**.
3. In the **Local Area Connection Properties** dialog box, click **Internet Protocol (TCP/IP)**, and then click **Properties** to display the **Internet Protocol (TCP/IP) Properties** dialog box.

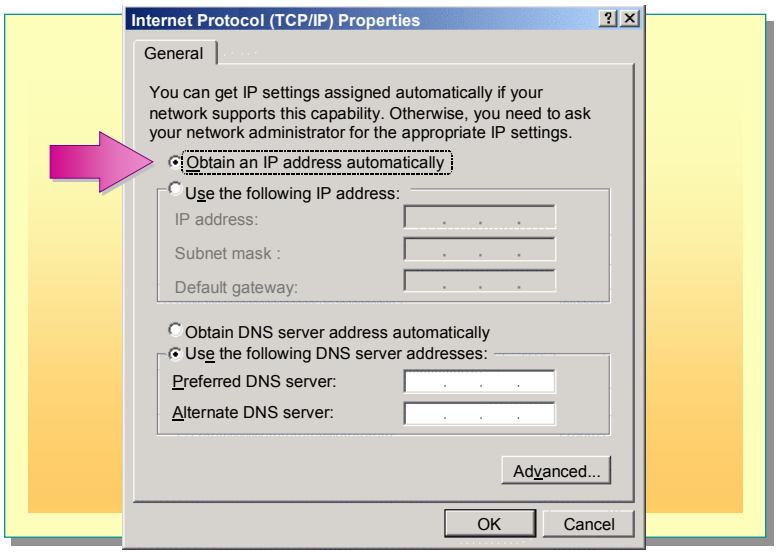
In this dialog box, click **Use the following IP address** to enter values for the IP address, subnet mask, and default gateway.

Note In general, most computers have only one network adapter installed and therefore require only a single IP address. If a device, such as a router, has multiple network adapters installed, each adapter needs its own IP address.

Automatic IP Addressing

Slide Objective
To illustrate automatic IP addressing.

Lead-in
Windows 2000 facilitates assigning IP addresses automatically.



Delivery Tip
Demonstrate the **Internet Protocol (TCP/IP) Properties** dialog box and point out the automatic options. The students' computers should be set to automatic if the standard classroom setup is used.

By default, Windows 2000 is configured to obtain an IP address automatically by using Dynamic Host Configuration Protocol (DHCP).

DHCP

DHCP is a TCP/IP standard for simplifying the management of IP configuration and assignment in an internetwork. DHCP uses a DHCP server to manage the dynamic allocation of IP addresses. DHCP servers contain a database of IP addresses that can be given out to hosts on the network.

To use DHCP in a network, hosts in the network must be DHCP-enabled. To enable DHCP, you must click **Obtain an IP address automatically**, which is selected by default in Windows 2000.

DHCP reduces the complexity and amount of administrative work involved in reconfiguring computers in TCP/IP-based networks. When you move a computer from one subnet to another, you must change its IP address to reflect the new network ID. DHCP allows you to automatically assign an IP address to a host, also called a DHCP client, from a database of addresses assigned to a subnet. Also, when a computer is offline for a specific amount of time, DHCP can reassign its IP address.

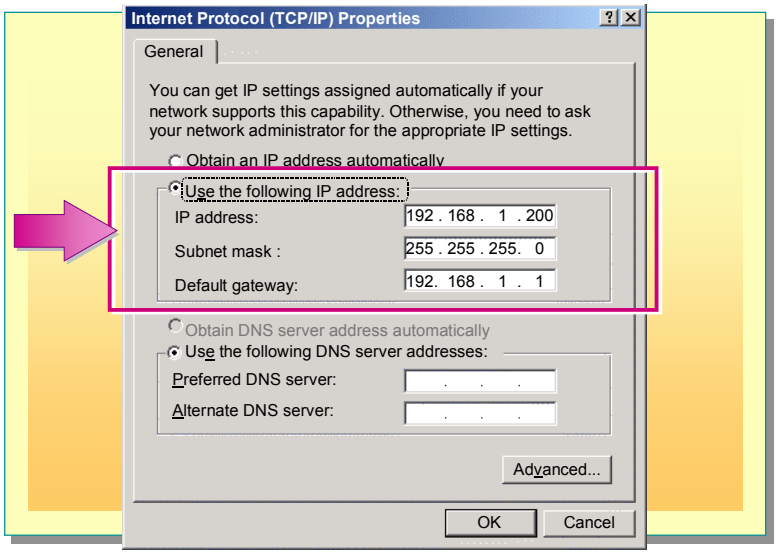
Automatic Private IP Addressing (APIPA)

If a DHCP server cannot be reached to assign an IP address automatically, Windows 2000 determines an address in the Microsoft-reserved, IP-addressing class that ranges from 169.254.0.1 through 169.254.255.254. This address is used until a DHCP server is located. This method of obtaining an IP address is termed automatic IP addressing. In this method, DNS, WINS, or a default gateway are not assigned because the method is designed only for a small network that consists of a single segment.

Viewing TCP/IP Configuration

Slide Objective
To illustrate the **Internet Protocol TCP/IP Properties** dialog box for viewing TCP/IP information.

Lead-in
After you set a TCP/IP configuration on a computer, you can view the configuration at any time, provided the IP address is static.



Delivery Tip
If students ask how they can view their IP address, use their question as an introduction to the next page. Remember: you can see your IP address but they cannot see theirs. The **Internet Protocol (TCP/IP) Properties** dialog box is important because it is used to set TCP/IP to be configured statically or automatically. The students will view the dialog box in the lab.

You may encounter situations where you need to view the IP address information for a specific computer. For example, your computer may not communicate with other computers on the network, or other computers may not be able to communicate with your computer. In such situations, you need to know the IP address of the other computers in order to determine the problem.

You can use the **Internet Protocol (TCP/IP) Properties** dialog box to view static TCP/IP information.

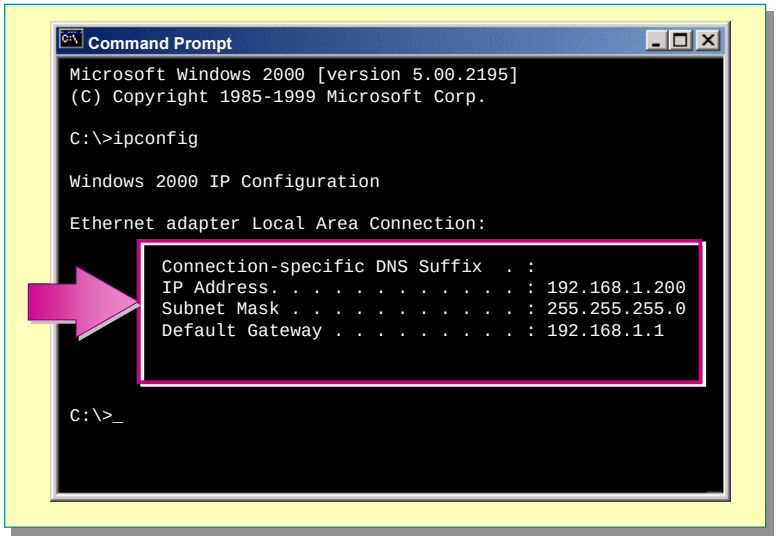
Internet Protocol (TCP/IP) Properties Dialog Box

Using the **Internet Protocol (TCP/IP) Properties** dialog box, you can determine whether the IP address configuration has been performed dynamically or statically. However, if the IP address has been configured dynamically using DHCP or configured automatically by Windows 2000, you cannot determine the values of the TCP/IP configuration options. These options include the IP address, subnet mask, and default gateway. You can determine these values only if the configuration has been done statically.

Viewing TCP/IP Configuration Using Ipconfig

Slide Objective
To illustrate the syntax of the Ipconfig utility for viewing TCP/IP information.

Lead-in
After you set a TCP/IP configuration on a computer, you can view the configuration at any time.



Delivery Tip
Demonstrate the procedure to access the Ipconfig utility. Emphasize to the students that the Ipconfig utility cannot be used to set the TCP/IP configuration. Question the students about the differences between the information displayed using Ipconfig and the **Internet Protocol (TCP/IP) Properties** dialog box. This will be the focus of the following lab.

Windows 2000 provides a command-line utility known as Ipconfig to view TCP/IP information.

Ipconfig

The Ipconfig utility is used to verify, but not set, the TCP/IP configuration options on a host, including the IP address, subnet mask, and default gateway. The command syntax for this utility is *ipconfig*.

To start the Ipconfig utility, type **ipconfig** at the command prompt. The values of the three primary configuration parameters are displayed. However, if you use this utility, you cannot determine whether the static or dynamic method has been used to assign the IP address.

Ipconfig /all

You can obtain more detailed information using the Ipconfig utility by specifying the switch, **all**, with it. To use the Ipconfig utility with this switch, type **ipconfig** /**all** at the command prompt.

The screen displays the information about all TCP/IP configuration options. You can now determine whether DHCP is enabled. If the value of the DHCP Enabled parameter is Yes and a DHCP server IP address is displayed, then it implies that the IP address has been obtained using DHCP.

A DHCP server leases an IP address to a client for a specific length of time. The Lease Obtained and Lease Expires labels display information on when the lease was obtained and when it will expire, respectively.

If a DHCP server was unavailable to assign an IP address and the IP address was assigned automatically, the term autoconfiguration would precede the label for the IP address of the computer. The Autoconfiguration Enabled label would be Yes. Also, the DHCP server IP address would not be displayed.

Lab C: Examining the Configuration of TCP/IP

Slide Objective
To introduce the lab.

Lead-in
In this lab, you will evaluate a scenario and identify errors in IP address allocation.

Objectives

After completing this lab, you will be able to:

- View the configuration of TCP/IP by using the Ipconfig utility.
- View the configuration of TCP/IP by using the **Internet Protocol (TCP/IP) Properties** dialog box.
- Identify the appropriate use of both the Ipconfig utility and the **Internet Protocol (TCP/IP) Properties** dialog box.

Prerequisites

Before working on this lab, you must have:

- Knowledge of the Microsoft Windows 2000 TCP/IP suite.
- Knowledge of IP addresses.
- Knowledge of how to log on to Windows 2000.

Estimated time to complete this lab: 15 minutes

Exercise 1
Examining the Configuration of TCP/IP

Scenario

You are the administrator of a small network and want to view the configuration of the computers on your network.

Goal

In this exercise, you will use and compare the **Internet Protocol (TCP/IP) Properties** dialog box and Ipconfig utility to identify the current IP configuration of your computer.

Tasks	Detailed Steps
1. Log on as Administrator with a password of **password**, and then open the **Internet Protocol (TCP/IP) Properties** dialog box.	**a.** Log on to Windows 2000 as Administrator with a password of **password**. **b.** Click **Start**, point to **Settings**, and then click **Network and Dial-up Connections**.  *The Network and Dial-up Connections window appears.* **c.** Right-click the **Local Area Connection** icon. **d.** Click **Properties**. **e.** Click **Internet Protocol (TCP/IP)**. **f.** Click **Properties**.

Can you tell if your IP address is assigned? If yes, then how is it assigned?

The computer is configured to obtain the IP address automatically.

Can you view your IP address? If so, what is it?

No.

(*continued*)

Tasks	Detailed Steps
Can you configure TCP/IP to use a static IP address? If so, how? Yes, by clicking **Use the following IP address.**	
1. (*continued*)	**g.** Close all open windows. (Click **Cancel** when available.)
2. Use the Ipconfig utility to view your computer's IP address.	**a.** Click **Start**, point to **Programs**, point to **Accessories**, and then click **Command Prompt**. **b.** Type **ipconfig** in the Command Prompt window.
Can you tell how your IP address was assigned? If yes, how? **No.**	
Can you view your IP address? If so, what is it? **Yes, 192.168.1.*x* (where *x* is between 100 and 199).**	
What additional configuration information is displayed? Also, what is your computer's additional configuration? **Subnet mask and default gateway. 255.255.255.0 and *w.x.y.z (instructor's IP address).***	

(*continued*)

Tasks	Detailed Steps
Can you use Ipconfig to manually set your IP address? How? **No.**	
3. Use a switch with **ipconfig** to view your computer's detailed IP configuration.	**a.** Type **ipconfig /all** in the Command Prompt window.
Can you tell how your IP address was assigned? If yes, how? **Yes, DHCP.**	
Can you still view your IP address and IP configuration options from earlier? **Yes.**	
What is the IP address of the server that provided your IP address? **w.x.y.z (instructor's computer).**	

(*continued*)

Tasks	Detailed Steps
	When does your IP address expire? **Answers will vary, but the expiration date will be seven days after the last lease.**
	If you were to type **ipconfig /all** in the Command Prompt window, what results would appear if your computer is configured to obtain an IP address automatically, but a DHCP server is not available? What would not appear? **The word autoconfiguration would appear before the IP address label, and there would not be a DHCP server address.**
	What are the benefits of using the **Internet Protocol (TCP/IP) Properties** dialog box instead of the Ipconfig utility? **The Internet Protocol (TCP/IP) Properties dialog box allows an administrator to set a static IP address and switch between static and automatic IP addressing methods.**
	What are the benefits of using the Ipconfig utility instead of the **Internet Protocol (TCP/IP) Properties** dialog box? **The Ipconfig utility allows an administrator to view an IP address regardless of the method used to assign it. You can also use the Ipconfig utility to determine if autoconfiguration or the DHCP method was used.**

(*continued*)

Tasks	Detailed Steps
?	What class of IP address do you have? **Class C.**
?	Is your subnet mask the same as the default subnet mask for a class C IP address? **Yes, both are 255.255.255.0.**
?	What is your network ID? **192.168.1.0.**
?	What is the IP address of the default gateway? **192.168.1.200.**

(*continued*)

Tasks	Detailed Steps
	Does the default gateway have the same network ID as your computer? **Yes.**
	Is the default gateway located on your segment? **Yes.**
	What is another term for default gateway? **Router.**
	How many IP addresses with the same network ID could be assigned to computers on your segment? **254**
4. Close all windows and log off from Windows 2000.	**a.** Close all windows and log off from Windows 2000.

Review

Slide Objective
To reinforce module objectives by reviewing key points.

Lead-in
The review questions cover some of the key concepts taught in the module.

- Classful IP Addressing
- Subnetting a Network
- Planning IP Addressing
- Assigning TCP/IP Addresses

1. What does an IP address do?

   An IP address differentiates one computer from another as a separate entity in a network and helps locate a computer on an internetwork.

2. In each of the three classes (A, B, and C), which numbers *(w, x, y, z)* in the IP address represent the network ID and which represent the host ID?

   Class A: The network ID is the first number in the IP address. The last three numbers make up the host ID.

   Class B: The network ID consists of the first two numbers in the IP address. The last two numbers make up the host ID.

   Class C: The network ID consists of the first three numbers. The host ID is the last number.

3. As an administrator, you need to make sure that the computers in your network communicate effectively. As your network grows, what can you do to reduce the number of computers on each portion of your network?

   Break up the network into subnets.

4. You are in the process of assigning IP addresses to computers in your network. What do you need to remember when assigning IP addresses?

   Such addressing guidelines as: the network ID cannot start with 127, the host ID cannot be all zeros or 255s, and the host ID must be unique to each network ID. Also, when assigning the network ID, make sure that there is one network ID for each subnet.

5. As an administrator of a large network, you want to facilitate the assignment of IP addresses in your network. What could you use to automatically assign IP addresses to computers in your network?

   DHCP. Although IP addresses are automatically assigned by default without it, DHCP is effective only with a single subnet and does not allow communication to the Internet.

6. While working in a network, your computer is unable to communicate with other computers on the network. You want to view the IP address of the other computers to determine the problem. What are the two utilities provided by Windows 2000 to view the IP address configuration? What are the benefits and disadvantages of each of these tools?

   The Internet Protocol (TCP/IP) Properties dialog box and the command-line utility Ipconfig. The Internet Protocol (TCP/IP) Properties dialog box is useful for switching between the automatic and static IP address options as well as for assigning a static IP address. Ipconfig is useful for viewing TCP/IP configuration options, including automatic IP address and DHCP lease information.