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## Chapter 6

# Resolving Network Host Names

## About This Chapter

Both clients and servers on a network must resolve the user-friendly host names to the Internet Protocol (IP) addresses used in network communications. In this chapter, you will learn how the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol resolves host names. This knowledge is important as you design your network and plan how names and IP addresses will be resolved. Advanced resolution capabilities, such as Domain Name System (DNS) and Windows Interface Name Service (WINS), are discussed in later chapters.

## Before You Begin

To complete this chapter, you must have

- Completed [Chapter 2](#), "Implementing TCP/IP"

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## Lesson 1: TCP/IP Naming Schemes

When computers connect and share data across a TCP/IP network, they use the specific, assigned IP address that is associated with their host. However, network users can remember text-based names easier than IP addresses. For example, it is much easier for users to remember *www.microsoft.com* than the specific IP address associated with this web site. Although TCP/IP hosts require an IP address to communicate, hosts can be referenced by a name rather than an IP address. Because text-based names can be used as aliases for IP addresses, a mechanism must exist for assigning those names to the appropriate IP node. This ensures the name's uniqueness and resolution to its IP address.

**After this lesson, you will be able to**

- Explain the different naming schemes used by hosts

**Estimated lesson time: 10 minutes**

## Windows 2000 Naming Schemes

Windows 2000 provides several different types of name resolution, including DNS, WINS, broadcast name resolution, and name resolution using HOSTS or LMHOSTS files. Different naming schemes are used by Microsoft Windows 2000 and other hosts such as UNIX. A Windows 2000 host can be assigned a host name, but the host name is used only with TCP/IP applications. UNIX hosts require only an IP address. Using a

host or domain name to communicate is optional.

Before communication can take place, an IP address is required on each TCP/IP host. However, the naming scheme affects the way a host is referenced; for example:

- To perform a NET USE command between two computers running Windows 2000, a user has several choices for how to specify the computer's name.

Any of the following three methods can work:

```
net use x: \\netbios_name\share
```

```
net use x: \\10.1.3.74\share
```

```
net use x: \\host.domain.com\share
```

The NetBIOS name or the host name must be resolved to an IP address before Address Resolution Protocol (ARP) can resolve the IP address to a hardware address. If an IP address is used, no name resolution is required.

- To reference a UNIX host running TCP/IP, a user specifies either the IP address or the host name. If a host name is used, the name is resolved to an IP address. If the IP address is used, name resolution is not necessary and the IP address is resolved to a hardware address.

## Lesson Summary

Windows 2000 and UNIX hosts can both be referenced by either an IP address or host name. Windows 2000 and other Microsoft network operating systems also allow naming using a NetBIOS name.

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## Lesson 2: Host Names

A host name simplifies the way a host is referenced because names are easier for people to remember than IP addresses. Host names are used in virtually all TCP/IP environments. This lesson describes how host name resolution works.

**After this lesson, you will be able to**

- Explain how the HOSTS file resolves a host name to an IP address
- Explain how a host name is resolved to an IP address using a DNS server and Microsoft-supported methods

**Estimated lesson time: 20 minutes**

## Understanding Host Names

A host name is an alias assigned to an IP node to identify it as a TCP/IP host. The host

name can be up to 255 characters long and can contain alphabetic and numeric characters and the "-" and "." characters. Multiple host names can be assigned to the same host. For computers running Windows 2000, the host name does not have to match the Windows 2000 computer name.

Windows Sockets (WinSock) applications, such as Microsoft Internet Explorer and the File Transfer Protocol (FTP) utility, can use one of two values for the destination to be connected: the IP address or a host name. When the IP address is specified, name resolution is not needed. When a host name is specified, the host name must be resolved to an IP address before IP-based communication with the desired resource can begin.

Host names can take various forms. The two most common forms are a nickname and a domain name. A nickname is an alias to an IP address that individual people can assign and use. A domain name is a structured name that follows Internet conventions.

## Purpose of Host Names

A host name is an alias assigned to a computer by an administrator to identify a TCP/IP host. The host name does not have to match the NetBIOS computer name, and can be a 255-character alphanumeric value. Multiple host names can be assigned to the same host.

A host name simplifies the way a user references other TCP/IP hosts. Host names are easier to remember than IP addresses. In fact, a host name can be used in place of an IP address when using PING or other TCP/IP applications.

A host name always corresponds to an IP address that is stored in a HOSTS file or in a database on a DNS server. Windows clients can translate between host names and NetBIOS names in many cases, allowing a WINS server or the LMHOSTS file to perform resolution for a host name.

The hostname utility will display the host name assigned to your system. By default, the host name is the computer name of your computer running Windows 2000.

## Host Name Resolution

Host name resolution is the process of mapping a host name to an IP address. Before the IP address can be resolved to a hardware address, the host name must be resolved to an IP address.

Windows 2000 can resolve host names using several methods including:

- **NetBIOS name resolution.** NetBIOS defines a session-level interface and a session management/data transport protocol. NetBIOS uses name registration, name release, and name discovery for interacting with NetBIOS hosts. NetBIOS name resolution is the process of mapping a computer's NetBIOS name to an IP address. There are several methods available for resolving NetBIOS names, each depending on your network configuration. The methods are NetBIOS name cache, NetBIOS name server, local broadcast, LMHOSTS file, HOSTS file, and DNS.
- **Resolving names with a HOSTS file.** The HOSTS file is a text file stored

locally on a system that contains host names and associated IP addresses. The HOSTS file is discussed in more detail in the next lesson.

- **Resolving names with a DNS server.** A DNS server is a centralized online database that is used in IP networks to resolve fully qualified domain names (FQDNs) and other host names to IP addresses. Windows 2000 can use a DNS server and provides DNS server service. DNS is explained in [Chapter 7](#), "Implementing Domain Name System (DNS)."

Microsoft TCP/IP can use any of the methods shown in Tables 6.1 and 6.2 to resolve host names. The methods that Windows 2000 can use to resolve a host name are configurable.

**Table 6.1** *Standard Host Name Resolution Methods*

<b>Standard Methods of Resolution</b>	<b>Description</b>
Local host name	The configured host name for the computer. This name is compared to the destination host name.
HOSTS file	A local text file in the same format as the 4.3 Berkeley Software Distribution UNIX\Etc\HOSTS file. This file maps host names to IP addresses. This file is typically used to resolve host names for TCP/IP applications.
DNS server	A server that maintains a database of IP address/computer name (host name) mappings.

**Table 6.2** *Microsoft Host Name Resolution Methods*

<b>Microsoft Methods of Resolution</b>	<b>Description</b>
NetBIOS Name Server	A server implemented under Requests for Comment (RFCs) 1001 and 1002 to provide name resolution of NetBIOS computer names. The Microsoft implementation of this is WINS.
Local broadcast	A broadcast on the local network for the IP address of the destination NetBIOS name.
LMHOSTS file	A local text file that maps IP addresses to the NetBIOS computer names of Windows hosts.

## **NetBIOS Name Resolution**

A NetBIOS name is a unique, 16-byte address used to identify a NetBIOS resource on the network. The NetBIOS name resolution process converts a NetBIOS name to an IP address. An example of a process that uses a NetBIOS name is the File and Printer Sharing for Microsoft Networks service on a computer running Windows 2000. When your computer starts, File and Printer Sharing for Microsoft Networks registers a

unique NetBIOS name based on the name of your computer. Computers running Microsoft TCP/IP can use local broadcast name resolution, which is a NetBIOS-over-TCP/IP mode of operation. This method relies on a computer making IP-level broadcasts to register its name by announcing it on the network. Each computer in the broadcast area is responsible for challenging attempts to register a duplicate name and for responding to name queries for its registered name.

## Resolving Names with a Hosts File

As shown in Figure 6.1, the process of resolving a host name using the HOSTS file is as follows:

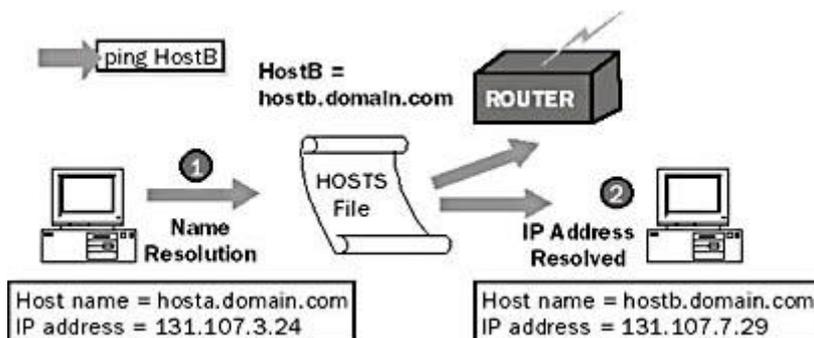
1. Name resolution begins when a user calls a WinSock-based application referencing a host name rather than an IP address.
2. Windows 2000 checks to see if the host name is the same as the local host name. If the two names are different, the HOSTS file is parsed. If the host name is found in the HOSTS file, it is resolved to an IP address.

If the host name cannot be resolved and no other resolution methods—such as DNS, a NetBIOS name server, or the LMHOSTS file—are configured, the process stops and the user receives an error message.

3. After the host name is resolved to an IP address, an attempt is made to resolve the destination host's IP address to its hardware address.

If the destination host is on the local network, ARP obtains its hardware address by consulting the ARP cache or by broadcasting the destination host's IP address.

If the destination host is on a remote network, ARP obtains the hardware address of a router and the request is routed to the destination host.



**Figure 6.1** Resolving a destination host's IP address to its hardware address

## Resolving Names with a DNS Server

A DNS server is a centralized online database that is used in IP networks to resolve host names to IP addresses. Windows 2000 can act as a DNS client and the Windows 2000 Server family provides DNS server services. Resolving a domain name using a DNS server is very similar to using a HOSTS file.

If Windows 2000 is configured to resolve host names using a DNS server, it uses two steps to resolve a host name, as shown in the following process and illustrated in Figure

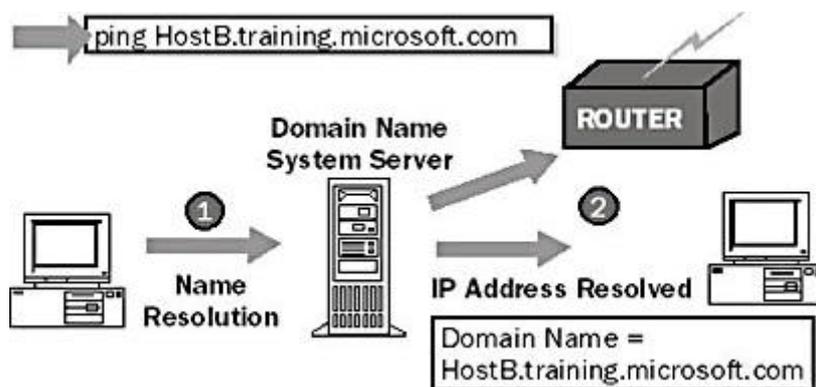
6.2:

1. When a user types a command using an FQDN or a host name, the process for resolving the name using the HOSTS file is followed first. If the IP address cannot be resolved using the HOSTS file, a request is sent to the DNS server to look up the name in its database and resolve it to an IP address.

If the DNS server does not respond to the request, additional attempts are made at intervals of 1, 2, 2, and 4 seconds. If the DNS server does not respond to these five attempts, and there are no other resolution methods configured such as a NetBIOS name server or LMHOSTS, the process stops and an error is reported.

2. After the host name is resolved, ARP obtains the hardware address. If the destination host is on the local network, ARP obtains its hardware address by consulting the ARP cache or by broadcasting the IP address. If the destination host is on a remote network, ARP obtains the hardware address of a router that can deliver the request.

If the DNS server is on a remote network, ARP must obtain the hardware address of a router before the name can be resolved.



**Figure 6.2** Resolving a host name with a DNS server

## Microsoft Methods of Resolving Host Names

Windows 2000 can be configured to resolve host names using a NetBIOS name server, broadcast, and LMHOSTS in addition to the HOSTS file and DNS server. If one of these methods fails, the other methods provide a backup, as shown in the following example and illustrated in Figure 6.3. If WINS and LMHOSTS are configured, the order of resolution is as follows:

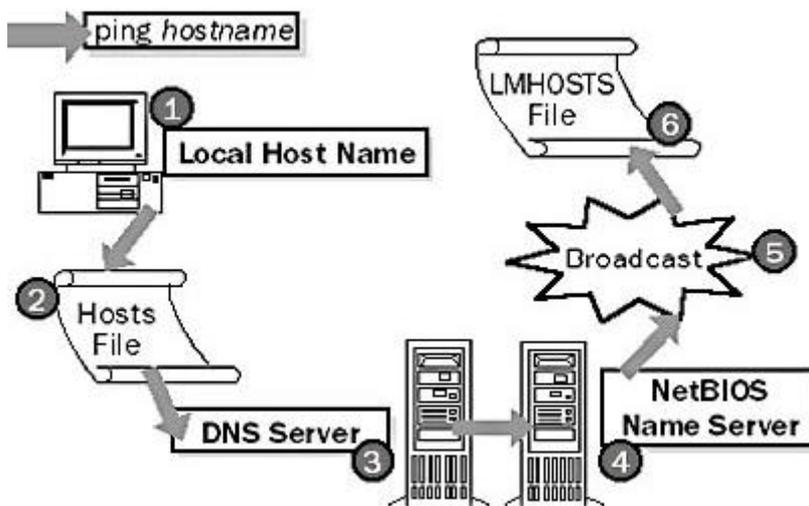
1. When a user types a command referencing a host name, Windows 2000 checks to see if the host name is the same as the local host name. If they are the same, the name is resolved and the command is carried out without generating network activity.
2. If the host name and local host name are not the same, the HOSTS file is parsed. If the host name is found in the HOSTS file, it is resolved to an IP address and address resolution occurs.
3. If the host name cannot be resolved using the HOSTS file, the source host sends a request to its configured domain name servers. If the host name is found by a

DNS server, it is resolved to an IP address and address resolution occurs.

If the DNS server does not respond to the request, additional attempts are made at intervals of 1, 2, 2, and 4 seconds.

4. If the DNS server cannot resolve the host name, the source host checks its local NetBIOS name cache before it makes three attempts to contact its configured NetBIOS name servers. If the host name is found in the NetBIOS name cache or by a NetBIOS name server, it is resolved to an IP address and address resolution occurs.
5. If the host name is not resolved by the NetBIOS name server, the source host generates three broadcast messages on the local network. If the host name is found on the local network, it is resolved to an IP address and address resolution occurs.
6. If the host name is not resolved using broadcasts, the local LMHOSTS file is parsed. If the host name is found in the LMHOSTS file, it is resolved to an IP address and address resolution occurs.

If none of these methods resolves the host name, the only way to communicate with the other host is to specify the IP address.



**Figure 6.3** Backup methods for resolving host names

## Lesson Summary

A host name is used to identify a TCP/IP host or default gateway. Host name resolution is the process of mapping a host name to an IP address. This is necessary before ARP can resolve the IP address to a hardware address.

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## Lesson 3: The Hosts File

Now that you have learned the concepts of how host names are resolved using different methods, you will look at the HOSTS file. In this lesson, you modify the HOSTS file

so that host names are resolved correctly.

**After this lesson, you will be able to**

- Configure and use the HOSTS file

**Estimated lesson time: 15 minutes**

## Understanding the Hosts File

The HOSTS file is a static file used to map host names to IP addresses. This file provides compatibility with the UNIX HOSTS file. The HOSTS file is used by PING and other TCP/IP applications to resolve a host name to an IP address. The HOSTS file can be used to resolve NetBIOS names (Microsoft TCP/IP-32-specific).

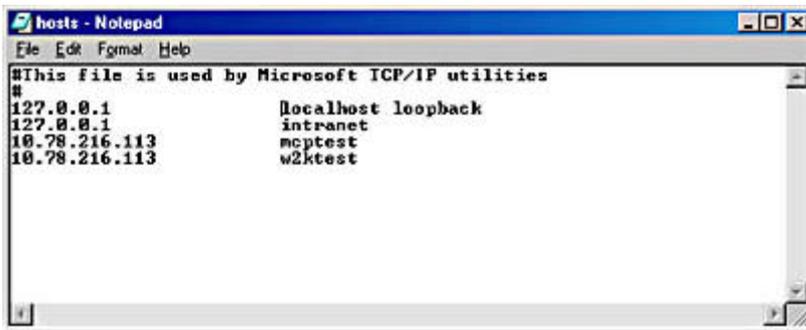
A HOSTS file must reside on each computer. A single entry consists of an IP address corresponding to one or more host names. By default, the host name localhost is an entry in the HOSTS file. The HOSTS file is parsed whenever a host name is referenced. Names are read in a linear fashion. The most commonly used names should be near the beginning of the file.

### NOTE

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The HOSTS file can be edited with any text editor. It is located in the `\systemroot\System32\Drivers\Etc` directory. Each host entry is limited to 255 characters, and entries in the HOSTS file are not case-sensitive.

Figure 6.4 shows an example of the contents of the HOSTS file.



**Figure 6.4** A HOSTS file

Within the HOSTS file

- Multiple host names can be assigned to the same IP address. Note that the server at the IP address 172.16.94.97 can be referred to by its fully qualified domain name (rhino.microsoft.com) or a nickname (rhino). This allows the user at this computer to refer to this server using the nickname rhino rather than typing the entire FQDN.
- Entries can be case-sensitive depending on the platform. Entries in the HOSTS file for some UNIX operating systems are case-sensitive. Entries in the HOSTS file for Windows 2000 and Windows 2000-based computers are not case-sensitive.

# Advantage of Using a Hosts File

The advantage of using a HOSTS file is that it is customizable for the user. Each user can create whatever entries he or she wants, including easy-to-remember nicknames for frequently accessed resources. However, the individual maintenance of the HOSTS file does not scale well to storing large numbers of FQDN mappings.



## Practice: Working with the HOSTS File and DNS

In this procedure, you configure and use the HOSTS file, configure Windows 2000 to use DNS, and identify problems associated with host name and domain name resolution. In the first part of the procedure, you add host name/IP address mappings to your HOSTS file and then use the file to resolve host names.

In this procedure, you determine the local host used for TCP/IP applications, such as PING.

- **To determine the local host name**

1. Open a command prompt.
2. Type **hostname** and then press the Enter key.

The local host name is displayed.

In this procedure, you PING the name of the local host to verify that your system can resolve local host names without entries in the HOSTS file.

- **To ping your local host name**

1. Type **ping Server1** (where Server1 is the name of your computer) and then press the Enter key.

What was the response?

Perform the following procedure from Server1 to attempt to ping a local computer name.

- **To ping a local computer name**

1. Type **ping computertwo** and then press the Enter key.

What was the response?

- **To add an entry to the HOSTS file on Server1**

1. Change to the following directory by typing:

```
cd %systemroot%\system32\drivers\etc
```

2. Use a text editor to modify a file called HOSTS by typing:

```
notepad hosts
```

3. Add an entry in the HOSTS file for computertwo. This will be the IP address, followed by a space, and then the host name.
4. Save the file, then exit Edit.

- **To use the HOSTS file for name resolution**

1. Type **ping computertwo** and then press the Enter key.

What was the response?

[Answers](#)

## Lesson Summary

The HOSTS file is a text file that you can edit with any text editor (such as Notepad). The HOSTS file maps host names to IP addresses and provides compatibility with the UNIX HOSTS file. If your network uses HOSTS files for host name resolution and you cannot connect to the other computer using its host name, there may be an invalid entry in your HOSTS file. Search your HOSTS file for the host name of the other computer, verify that there is only one entry per host name, and then verify that the entry for the host name of the other computer is valid. For more information on the HOSTS file, see the sample HOSTS file in the %SystemRoot%\System32\Drivers\Etc folder.

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## Review



Answering the following questions will reinforce key information presented in this chapter. If you are unable to answer a question, review the appropriate lesson and then try the question again. Answers to the questions can be found in [Appendix A](#), "Questions and Answers."

1. What is a host name?
2. What is the purpose of a host name?
3. What does a HOSTS file entry consist of?
4. During the name resolution process, what occurs first: ARP resolution or host name resolution?

## Answers