

IPV4



IPv4

IPv6

IP Address \Rightarrow xxx.xxx.xxx.xxx or

xxxx.xxxxx.xxxxx.xxxx

2^{32} or 4,398,969,264 addresses



13/9/16 @ 23:00 World Population
was

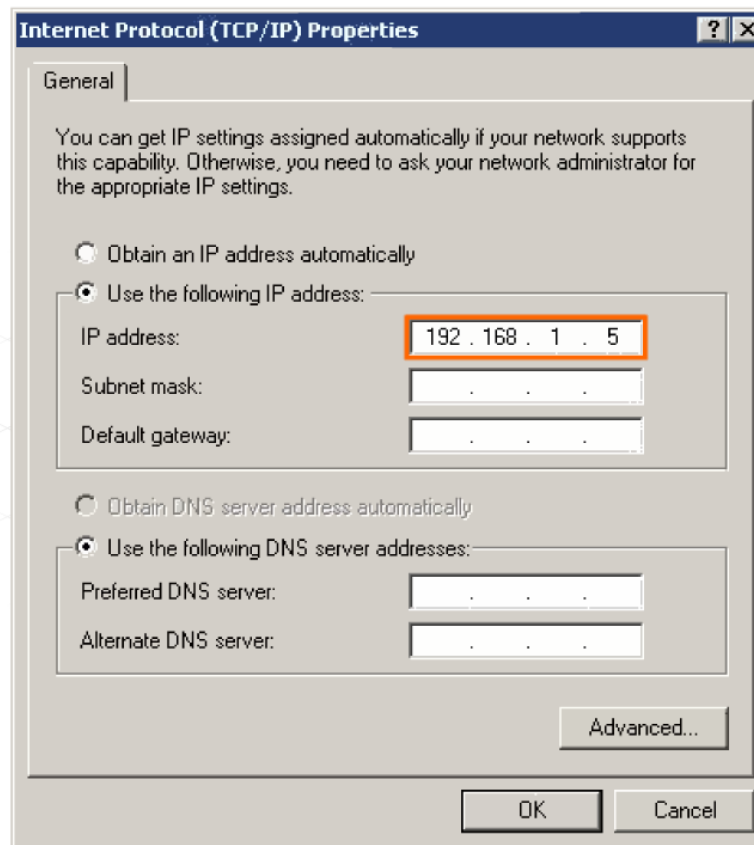
7,450,169,240

Number of IP
Addresses
World Population

$= 4.7 \times 10^{28}$ IP
Addresses each

IP Addressing Structure

- Describe the dotted decimal structure of a binary IP address and label its parts



I see you have
assigned me
an IP address
**11000000.1010
1000.00000001.
00000101**
Now other
hosts can find
me!



IP version 4 (IPv4) is the current form of addressing used on the Internet.

IP Addressing Structure

- Describe the general role of 8-bit binary in network addressing and convert 8-bit binary to decimal

IPv4 Addresses

192	.	168	.	10	.	1
11000000		10101000		00001010		00000001

The computer using this IP address is on network 192.168.10.0.

Dotted Decimal Address

Network

Host

Octet

32-Bit Address

Roll over a label to see the parts of an IP address.

IP Addressing Structure

- Practice converting 8-bit binary to decimal

Binary To Decimal Conversion

Exponent	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Position	128	64	32	16	8	4	2	1
Bits	1	1	1	1	0	1	0	1
1 BYTE / 1 Octet								
Add these numbers together	128 + 64 + 32 + 16 + 0 + 4 + 0 + 1							
Decimal	245							

A 1 in this position means 64 is added to the total.

A 0 in any position means that 0 is added to the total.

11110101 in Binary = Decimal Number 245


IP Addressing Structure

- Practice converting decimal to 8-bit binary

Decimal to Binary Conversion Activity

Given a decimal value, enter the correct binary values for each position.

Decimal Value	209							
Exponent	2^{7th}	2^{6th}	2^{5th}	2^{4th}	2^{3rd}	2^{2nd}	2^{1st}	2^0
Position	128	64	32	16	8	4	2	1
Bit	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>


Enter numbers for these 8 positions.

Change the following IPv4 addresses from binary notation to dotted-decimal notation.

a. 10000001 00001011 00001011 11101111

b. 11000001 10000011 00011011 11111111

c. 11100111 11011011 10001011 01101111

d. 11111001 10011011 11111011 00001111

Change the following IPv4 addresses from dotted-decimal notation to binary notation.

a. 111.56.45.78

b. 221.34.7.82

c. 241.8.56.12

d. 75.45.34.78

Classify and Define IPv4 Addresses

- Name the three types of addresses in the network and describe the purpose of each type

	Address Types			
	Network			Host
Network Address	10	0	0	0
	00001010	00000000	00000000	00000000
Broadcast Address	10	0	0	255
	00001010	00000000	00000000	11111111
Host Address	10	0	0	1
	00001010	00000000	00000000	00000001

Classify and Define IPv4 Addresses

- Determine the network, broadcast and host addresses for a given address and prefix

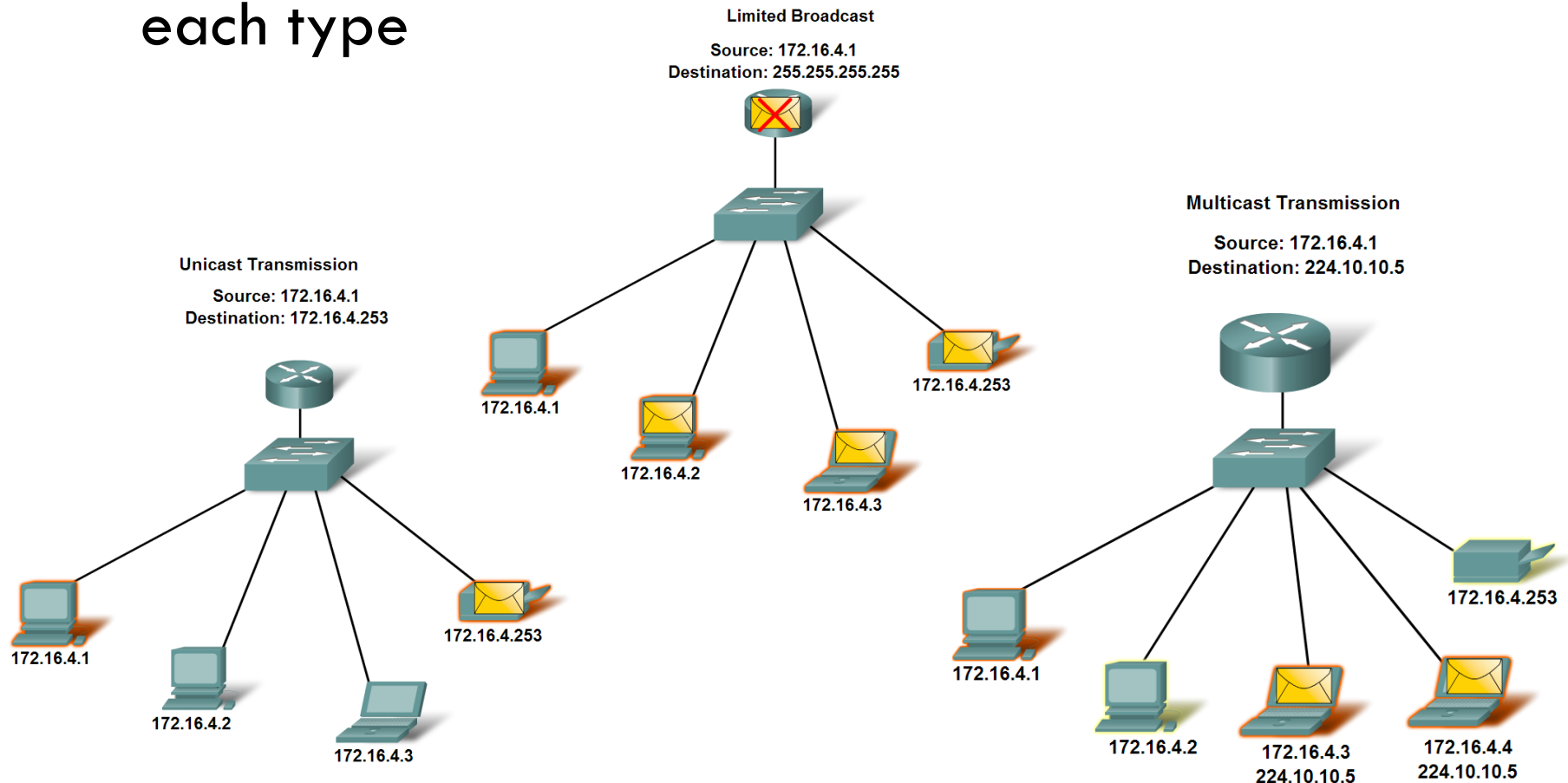
Given address/prefix of 144.83.250.97 /17

For each row, enter the values for that type of address.

Type of Address	Enter LAST octet in binary	Enter LAST octet in decimal	Enter full address in decimal
Network	<input type="text" value="00000000"/>	<input type="text" value="0"/>	<input type="text" value="144.83.128.0"/>
Broadcast	<input type="text" value="11111111"/>	<input type="text" value="255"/>	<input type="text" value="144.83.255.255"/>
First Usable Host Address	<input type="text" value="00000001"/>	<input type="text" value="1"/>	<input type="text" value="144.83.128.1"/>
Last Usable Host Address	<input type="text" value="11111110"/>	<input type="text" value="254"/>	<input type="text" value="144.83.255.254"/>

Classify and Define IPv4 Addresses

- Name the three types of communication in the Network Layer and describe the characteristics of each type



Classify and Define IPv4 Addresses

- Identify the address ranges reserved for these special purposes in the IPv4 protocol

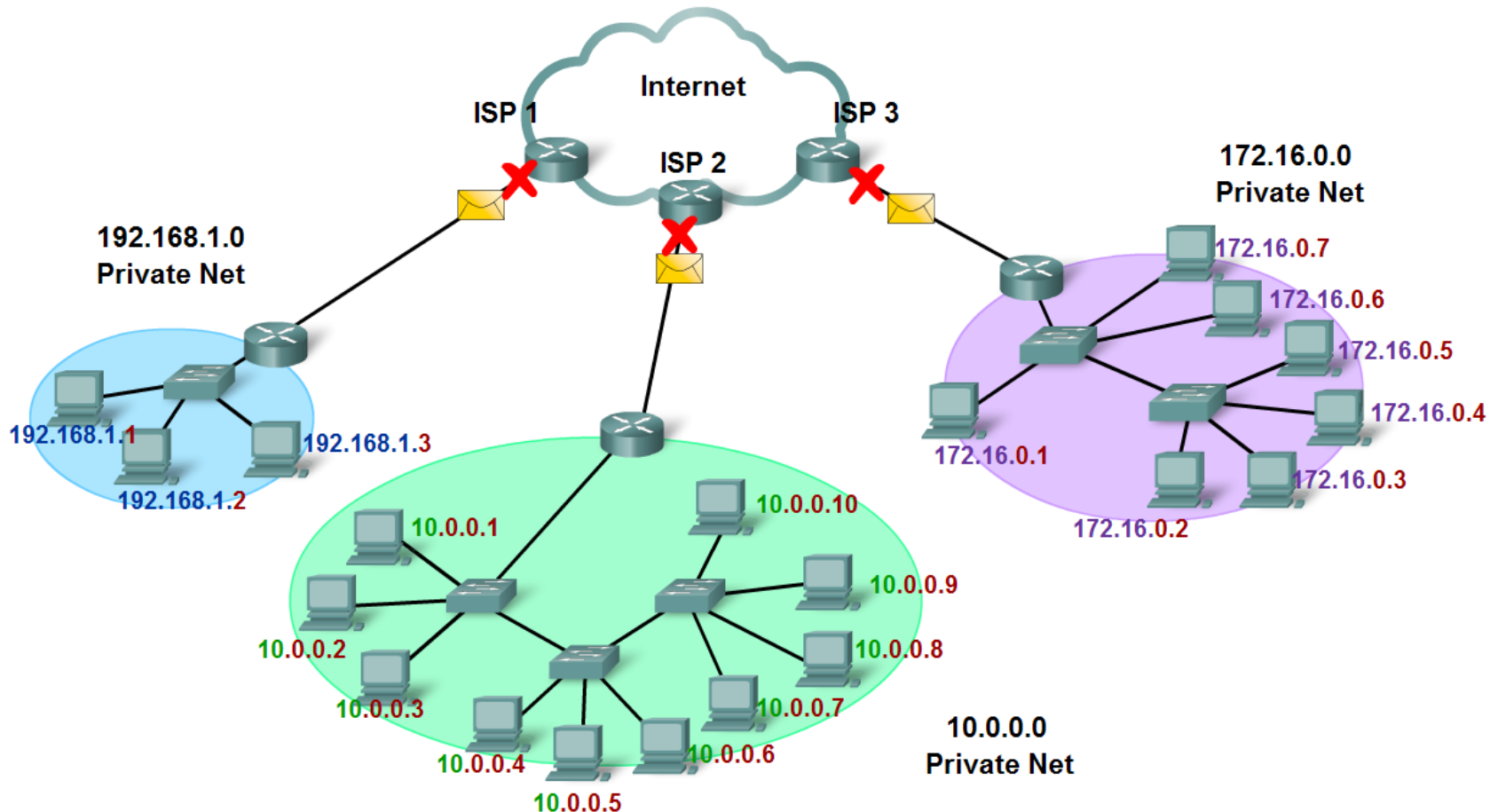
Reserved IPv4 Address Ranges

Type of Address	Usage	Reserved IPv4 Address Range	RFC
Host Address	used for IPv4 hosts	0.0.0.0 to 223.255.255.255	790
Multicast Addresses	used for multicast groups on a local network	224.0.0.0 to 239.255.255.255	1700
Experimental Addresses	<ul style="list-style-type: none">• used for research or experimentation• cannot currently be used for hosts in IPv4 networks	240.0.0.0 to 255.255.255.254	1700 3330

Classify and Define IPv4 Addresses

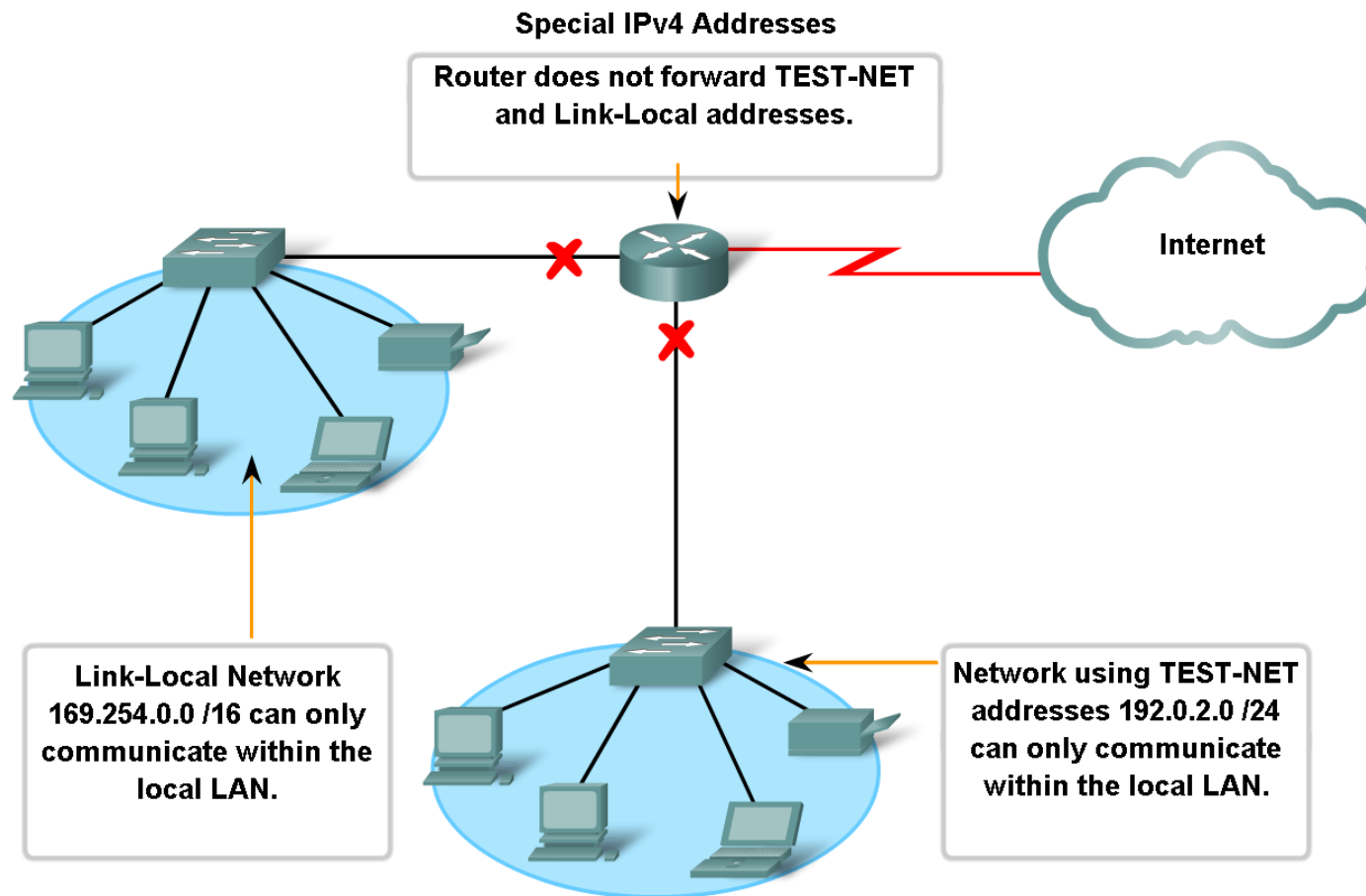
- Define public address and private address

Private Addresses used in Networks without NAT



Classify and Define IPv4 Addresses

- Describe the purpose of several special addresses



Classify and Define IPv4 Addresses

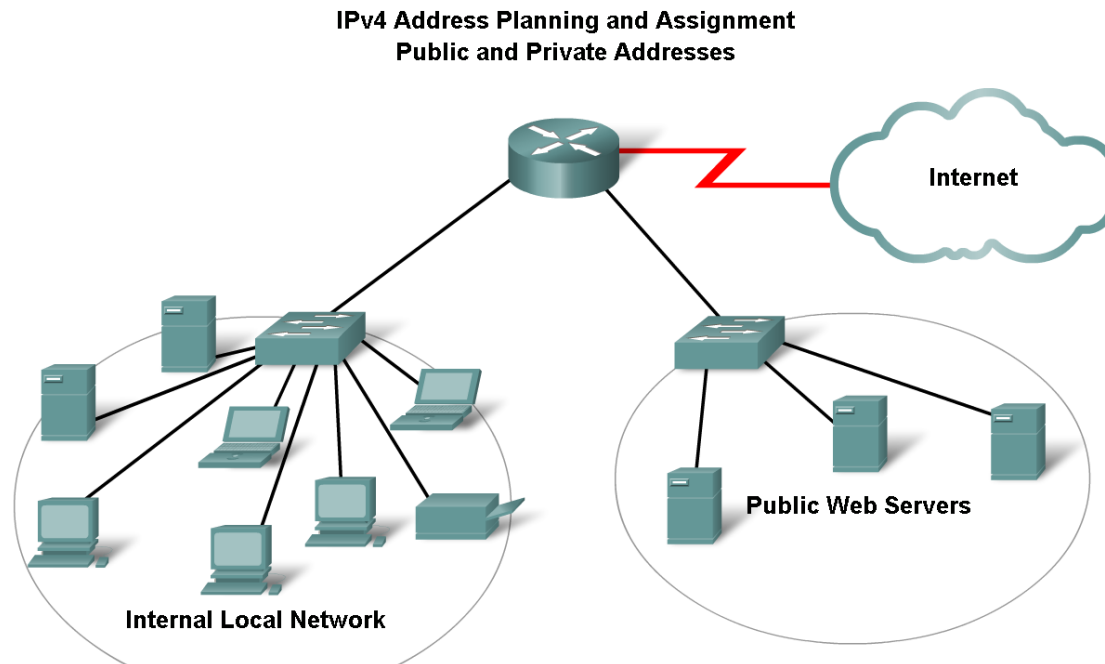
IP Address Classes

Address Class	1st octet range (decimal)	1st octet bits (green bits do not change)	Network(N) and Host(H) parts of address	Default subnet mask (decimal and binary)	Number of possible networks and hosts per network
A	1-127**	00000000-01111111	N.H.H.H	255.0.0.0	128 nets (2^7) 16,777,214 hosts per net (2^{24-2})
B	128-191	10000000-10111111	N.N.H.H	255.255.0.0	16,384 nets (2^{14}) 65,534 hosts per net (2^{16-2})
C	192-223	11000000-11011111	N.N.N.H	255.255.255.0	2,097,150 nets (2^{21}) 254 hosts per net (2^{8-2})
D	224-239	11100000-11101111	NA (multicast)		
E	240-255	11110000-11111111	NA (experimental)		

** All zeros (0) and all ones (1) are invalid hosts addresses.

Assigning Addresses

- Explain the importance of using a structured process to assign IP addresses to hosts and the implications for choosing private vs. public addresses



Assigning Addresses

- Explain how end user devices can obtain addresses either statically through an administrator or dynamically through DHCP

Assigning Dynamic Addresses

The image displays two side-by-side windows from a Windows XP system. The left window is titled 'Internet Protocol (TCP/IP) Properties' and shows the 'General' tab. The 'Obtain an IP address automatically' radio button is selected. The right window is a 'Command Prompt' showing the output of the 'ipconfig /all' command. A yellow box highlights the DHCP configuration details in the command prompt output, which are also pointed to by arrows from a text box.

Using DHCP
These addresses are assigned dynamically:

- IP Address
- Subnet mask
- Default gateway
- DHCP server

Internet Protocol (TCP/IP) Properties - General Tab

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☒ Obtain an IP address automatically

☐ Use the following IP address:

IP address:

Subnet mask:

Default gateway:

☐ Obtain IP address automatically

☐ Use the following IP address:

Preferred IP address:

Alternate IP address:

Command Prompt Output

```
C:\>ipconfig /all

Windows IP Configuration

Host Name . . . . . : Host-1
Primary Dns Suffix . . . . . :
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : woh.rr.com

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . : woh.rr.com
Description . . . . . : Intel(R) PRO/100 VE Network Connection
Physical Address. . . . . : 80-07-E9-63-CE-53
Dhcp Enabled. . . . . : Yes
Autoboot Enabled. . . . . : Yes
IP Address. . . . . : 192.168.1.100
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
DHCP Server . . . . . : 192.168.1.1
Lease Obtained. . . . . : Thursday, December 28, 2006 10:50:49 AM
Lease Expires . . . . . : Friday, December 29, 2006 10:50:49 AM
```

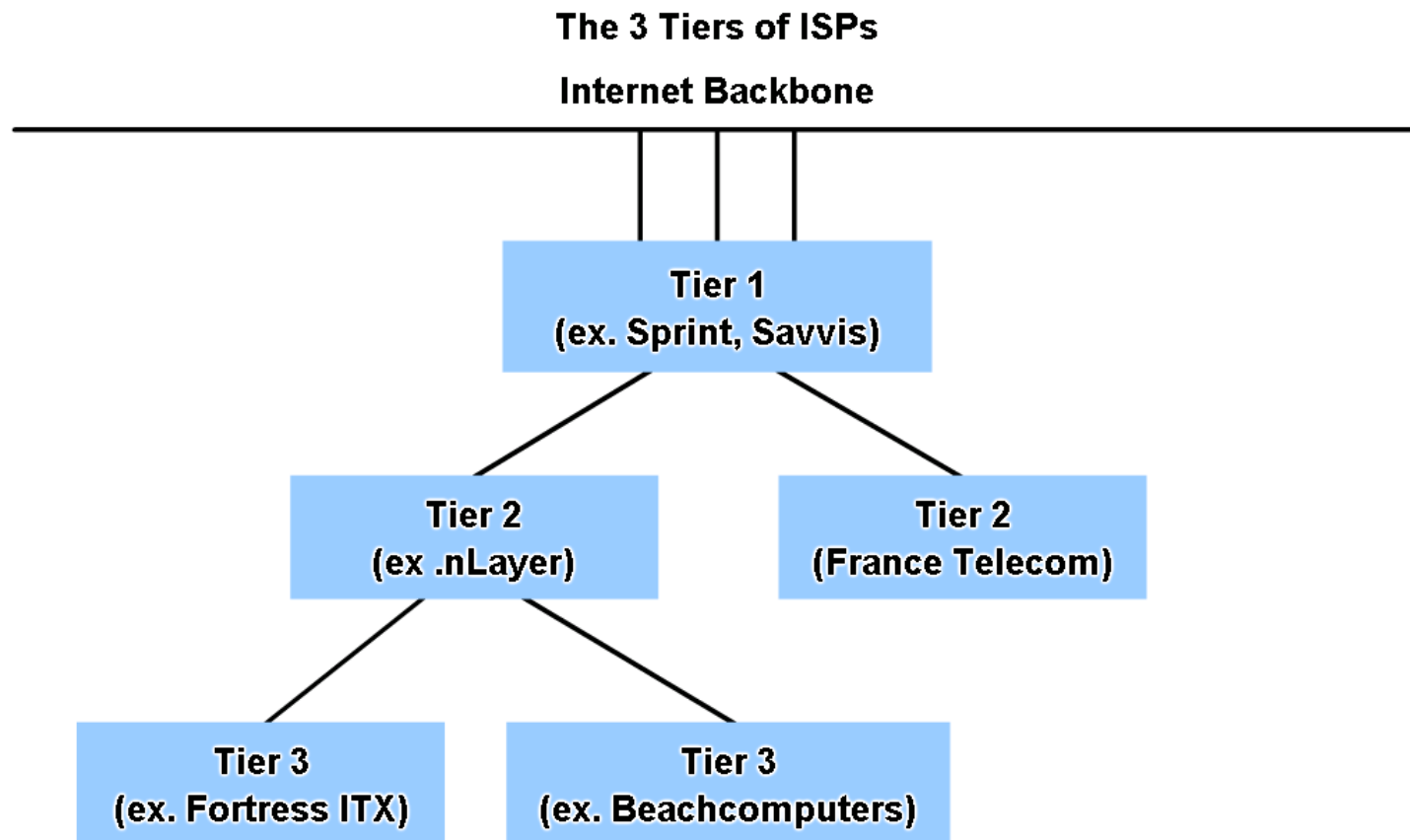
Assigning Addresses

- Describe the process for requesting IPv4 public addresses, the role ISPs play in the process, and the role of the regional agencies that manage IP address registries.

IANA					
Global	IANA				
Regional Internet Registries	AfriNIC Africa Region	APNIC Asia/ Pacific Region	LACNIC Latin America And Caribbean Region	ARIN North America Region	RIPE NCC Europe, Middle East, Central Asia Region

Assigning Addresses

- Identify different types of ISPs and their roles in providing Internet connectivity



Role of the Subnet Mask

- Describe how the subnet mask is used to create and specify the network and host portions of an IP address

Network and Host Portions of an IP Address							
IP Address	172	.	16	.	4	.	1
	10101100		00010000		00000100		00000001
Subnet Mask	255	.	255	.	255	.	0
	11111111		11111111		11111111		00000000
Prefix /24 (24 high order bits)							

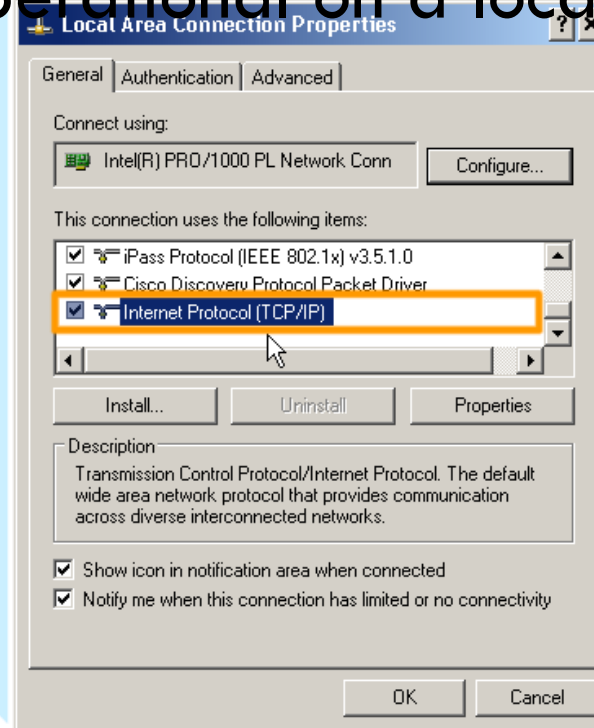
Testing the Network Layer

- Describe the general purpose of the ping command, trace the steps of its operation in a network, and use the ping command to determine if the IP protocol is operational on a local host

Pinging the local host confirms that TCP/IP is installed and working on the local host.

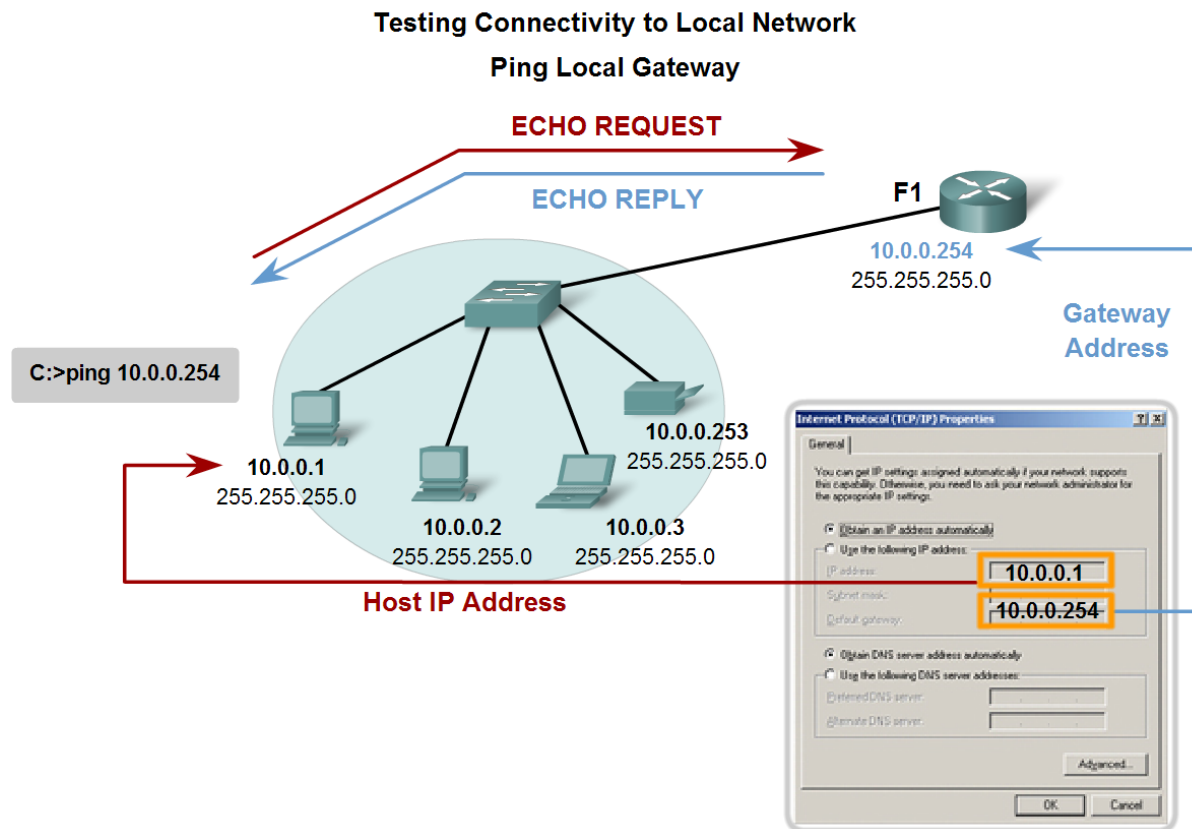


Pinging **127.0.0.1** causes a device to ping itself.



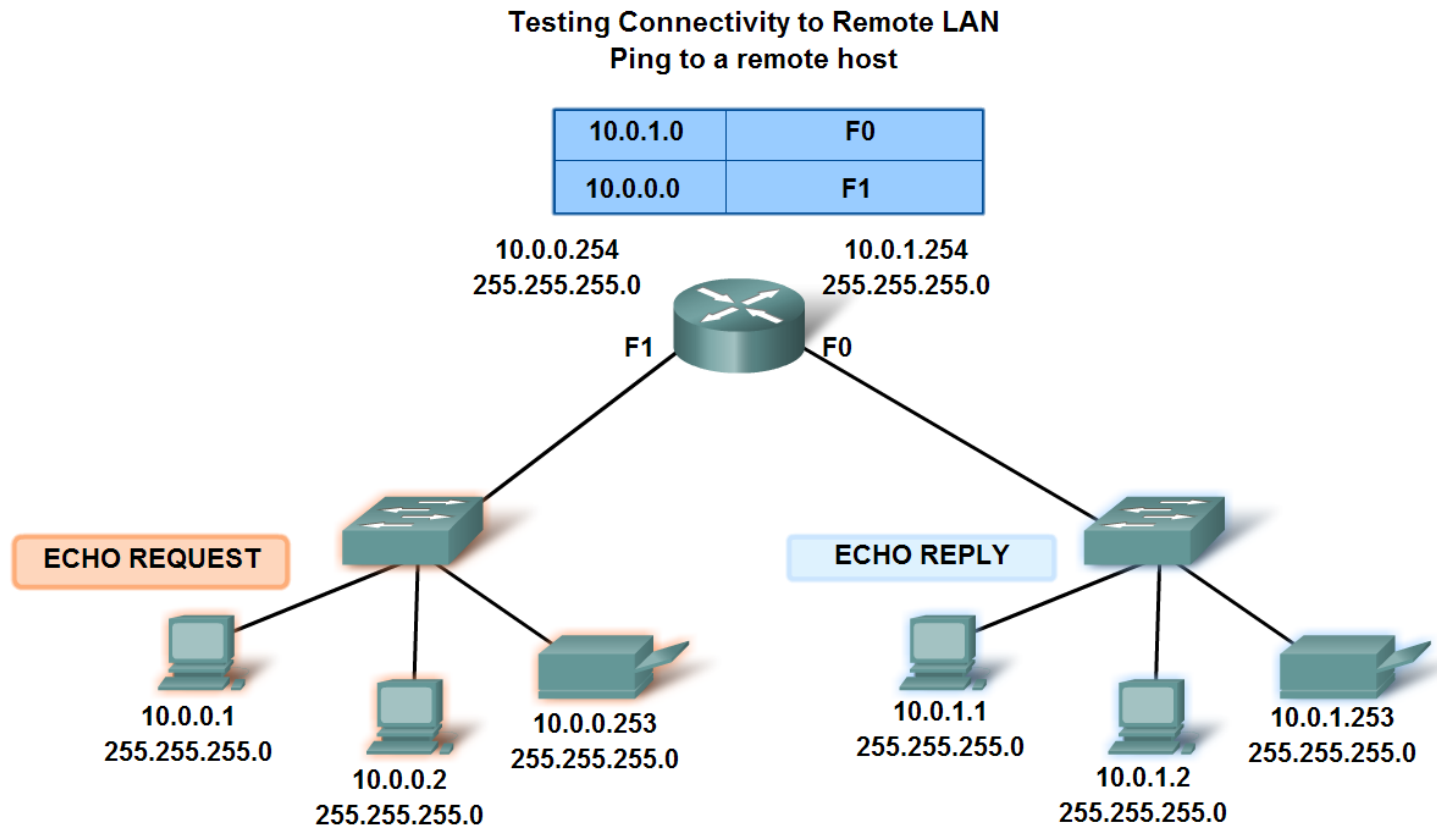
Testing the Network Layer

- Use ping to verify that a local host can communicate with a gateway across a local area network



Testing the Network Layer

- Use ping to verify that a local host can communicate via a gateway to a device in remote network



Testing the Network Layer

- Use `tracert`/`traceroute` to observe the path between two devices as they communicate and trace the steps of `tracert`/`traceroute`'s operation

