Chapter 6A: IPv4 Addressing (I)

IPv4 Addresses

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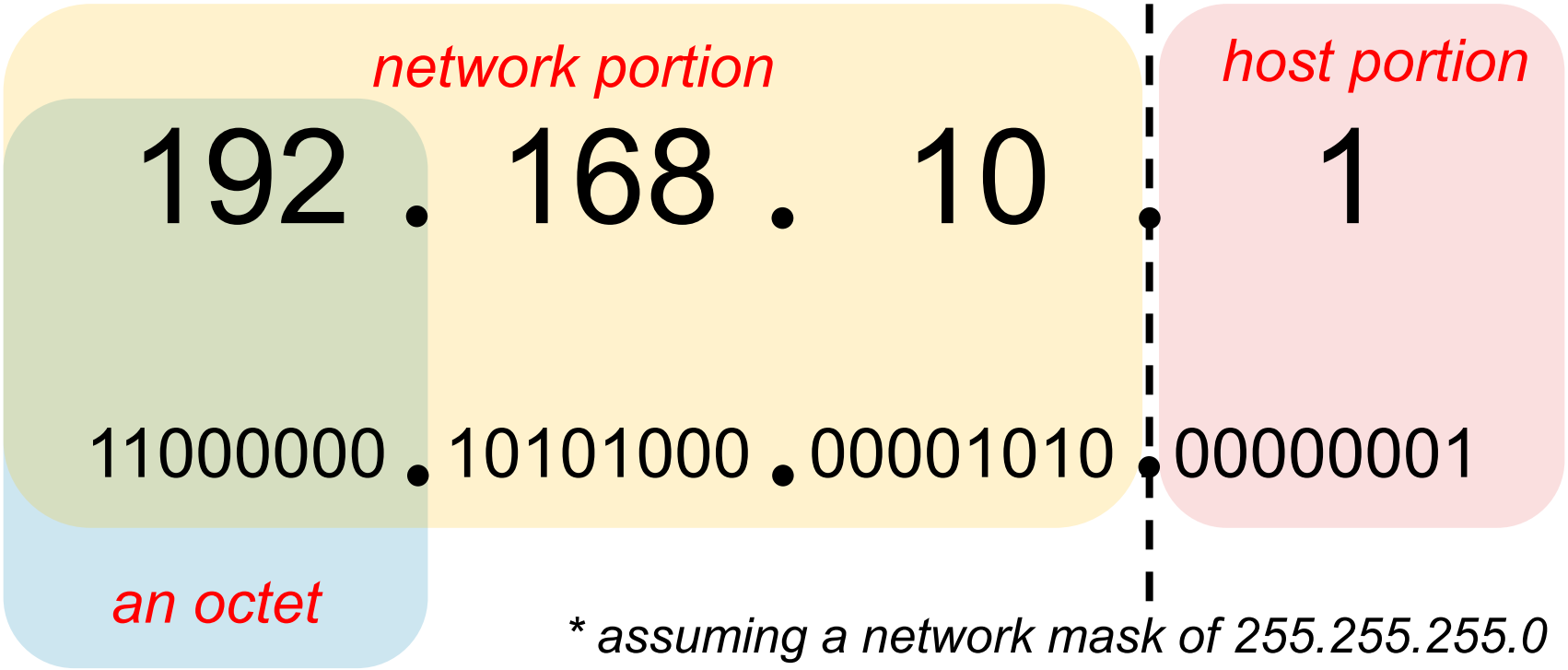
Represented in Dotted Decimal Format



a. How many bits in an IPv4 address? _____

b. How many octets are there? _____

c. How many bits are there in an octet? _____

d. What is the decimal range of each octet? _____

Binary Number System

The Binary number system (or Base 2)

- only two digits: 0 and 1
- let's examine 1 octet in an IPv4 address, 1 1 0 0 0 0 0 0:-

Radix	2	2	2	2	2	2	2	2
Exponent	7	6	5	4	3	2	1	0
Octet Bit Values	128	64	32	16	8	4	2	1
Binary Address	1	1	0	0	0	0	0	0
Binary Bit Values	128	64	0	0	0	0	0	0

Add the binary bit values. 128 + 64 = 192

Converting a Binary Address to Decimal

Practice

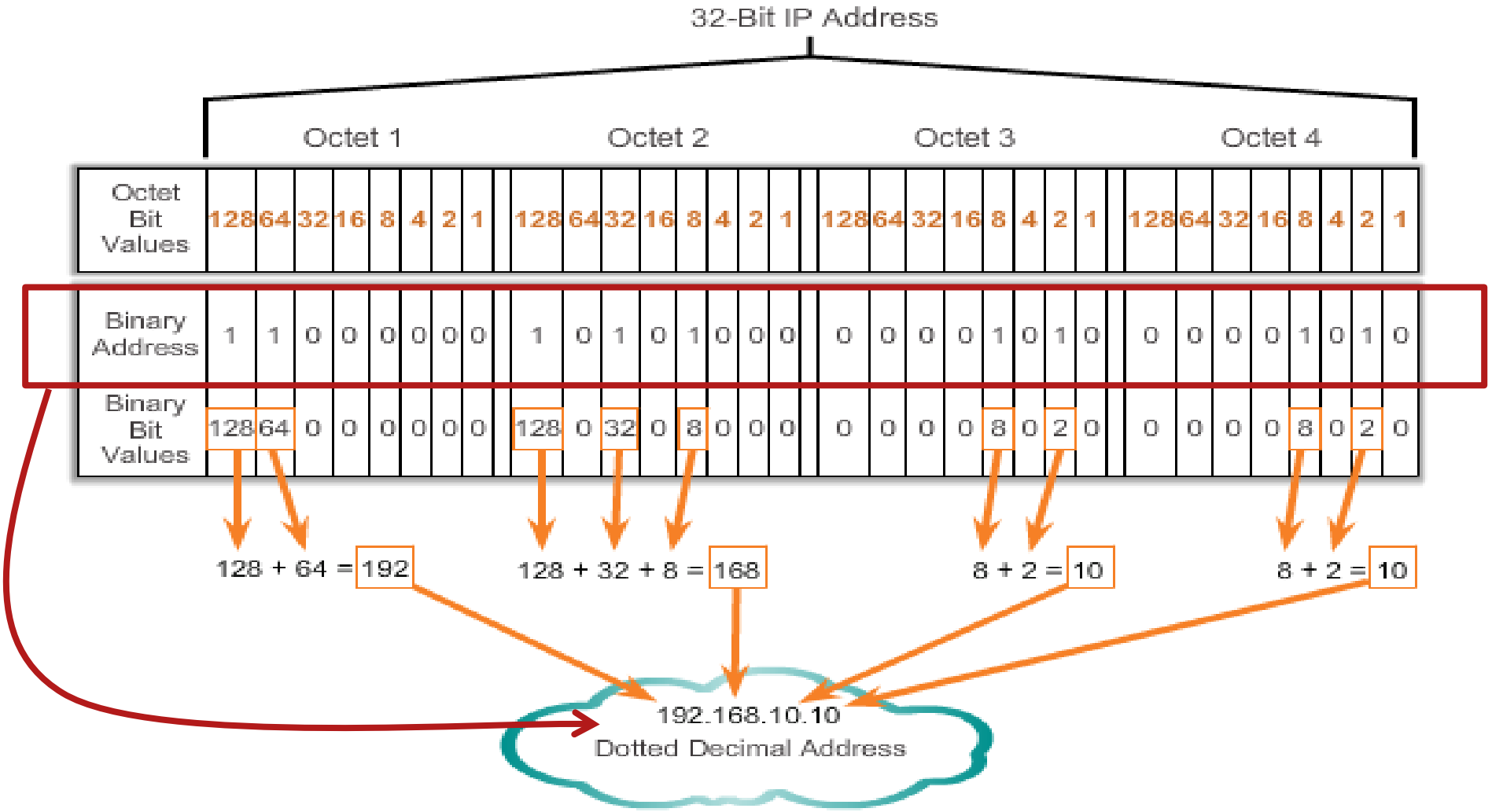
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	0	1	1	0	0	0	0

So 10110000 = 176

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1

So 11111111 = 255

Converting a Binary Address to Decimal

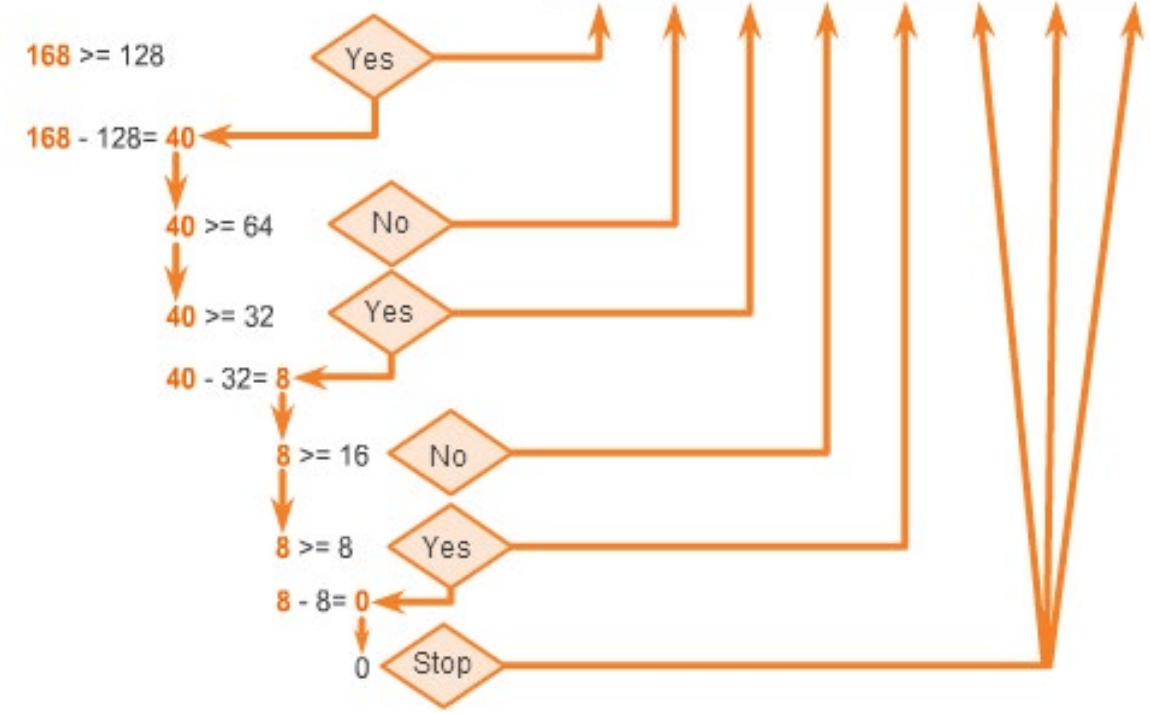


Converting from Decimal to Binary

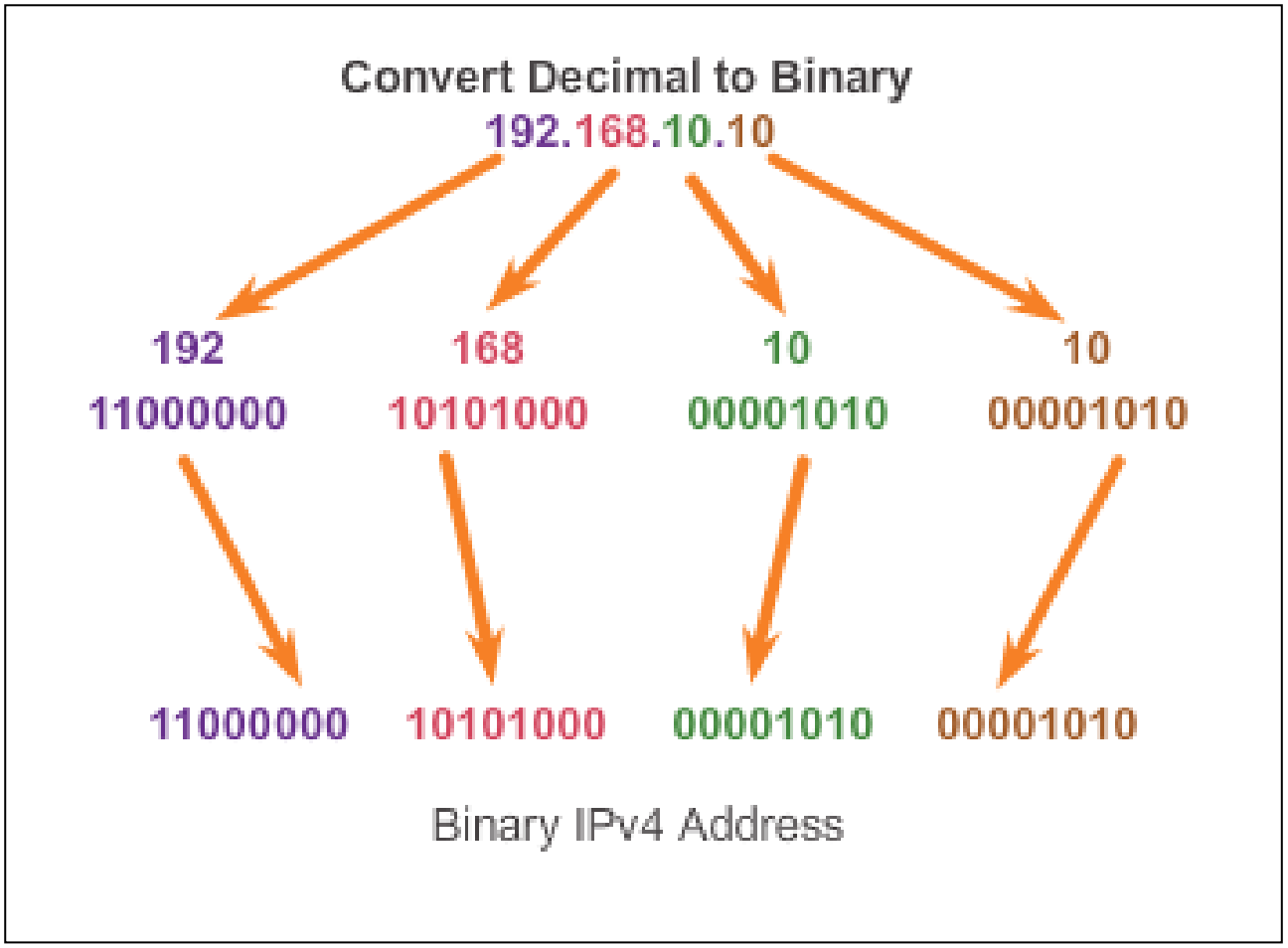
Converting decimal to binary is a series of steps starting from the leftmost bit of the octet

168 = ? In binary

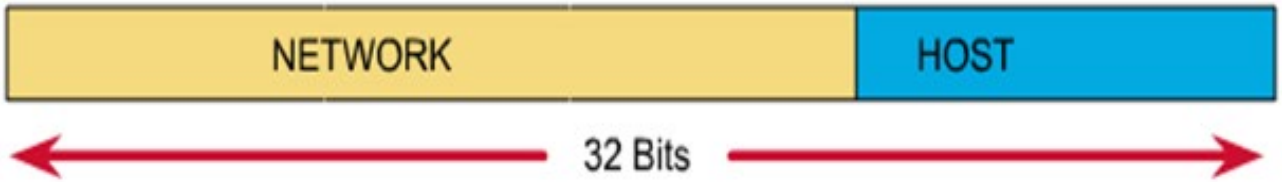
Exponent	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Octet Bit Values	128	64	32	16	8	4	2	1
Binary Address	1	0	1	0	1	0	0	0



Converting from Decimal to Binary (Cont.)



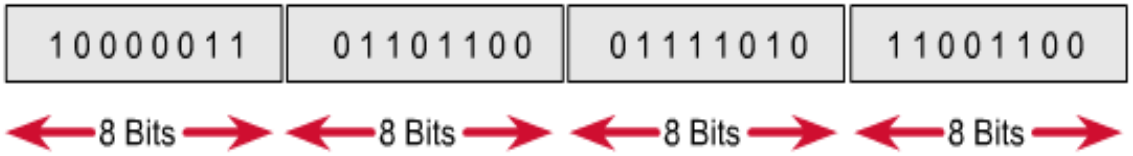
The Anatomy of an IPv4 Address



IP Addresses are 32 bits.

Where the network part ends and the host part begins depends on the subnet mask.

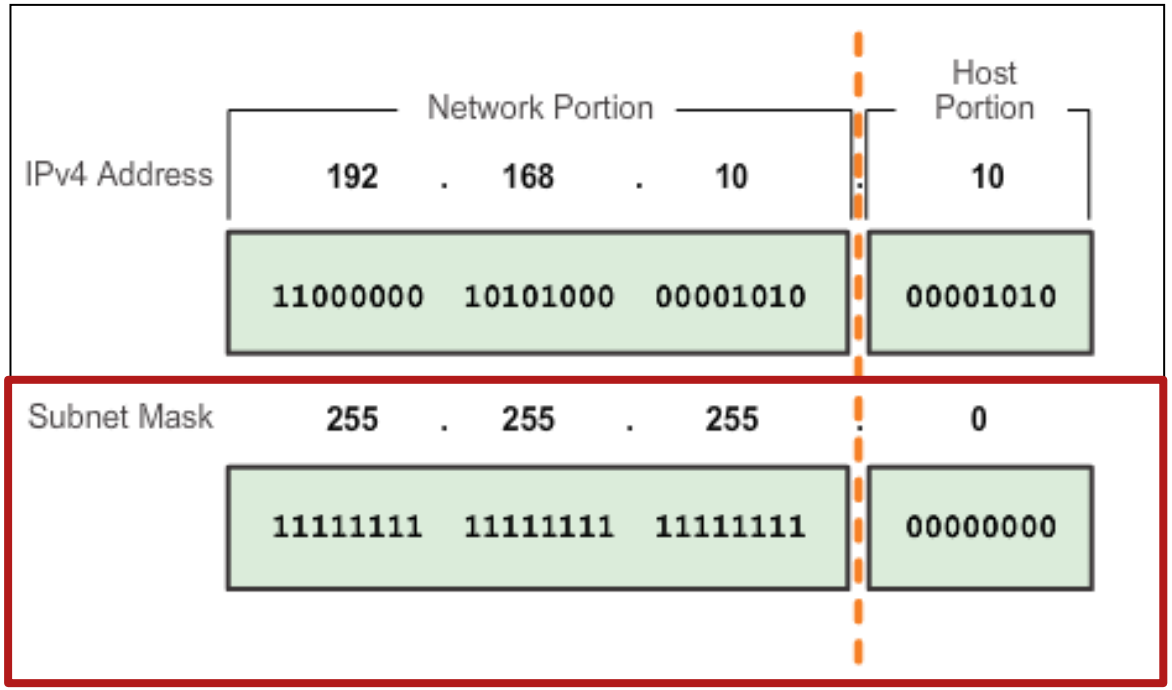
Divide into four 8 bit sections (bytes or octets).



Convert from binary to dotted decimal.

Network Portion and Host Portion of an IPv4 Address

- To define the network and host portion of an address, a separate 32-bit pattern called a subnet mask is used.
- The subnet mask does not actually contain the network or host portion of an IPv4 address, it just tells you where to look for these portions in a given IPv4 address



- Subnet mask appears in binary as a series of 1s followed by a series of 0s.
- The network divide (dash line) for the IP address is where the series of 1s meet the 0s in the subnet mask.

IPv4 Subnet Mask

Network Portion and Host Portion of an IPv4 Address

Example 1: IPv4 address: 10.20.30.40
Subnet mask: 255.255.0.0 (or /16)

Network portion ← → Host portion

IPv4 address:	**10.**	**20.**	**30.**	**40**
(in binary):	00001010.	00010100.	00011110.	00101000
Subnet mask:	**255.**	**255.**	**0.**	**0**
(in binary):	11111111.	11111111.	00000000.	00000000

Representing the subnet mask as a subnet prefix:

- Subnet mask is in dotted decimal format
- It can also be represented in a prefix format such as /16 as in this example above by counting the number of 1s in the binary form of the subnet mask

Network Portion and Host Portion of an IPv4 Address

Example 2: IPv4 address: 10.20.30.40
Subnet mask: 255.255.240.0 (or /20)

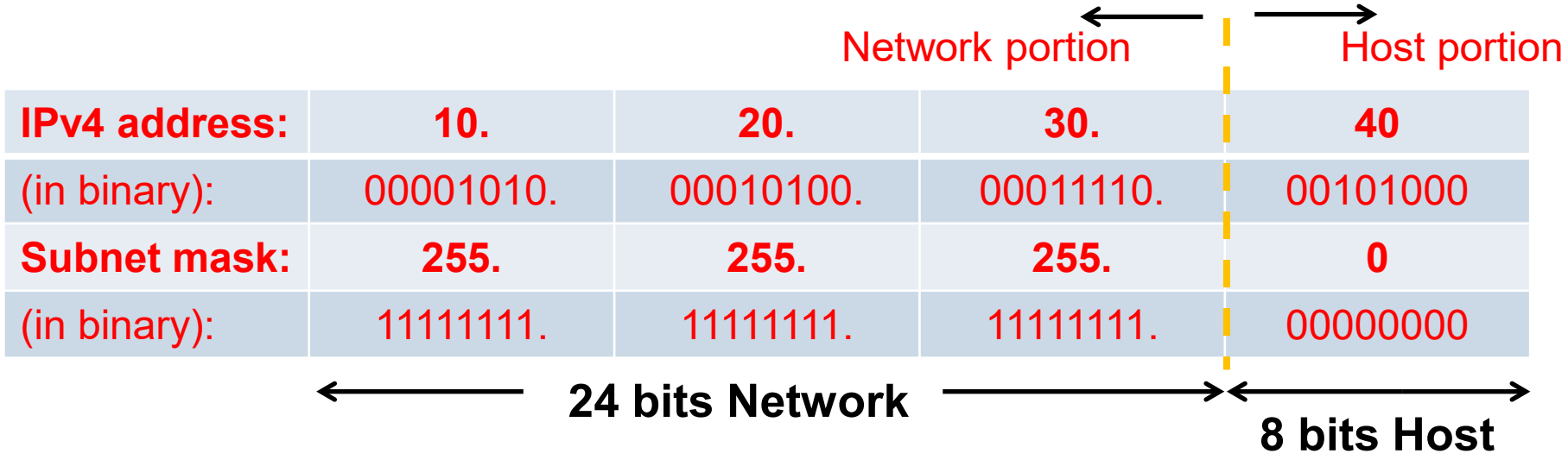
Network portion ← → Host portion

IPv4 address:	**10.**	**20.**	**30.**	**40**
(in binary):	00001010.	00010100.	0001 1110.	00101000
Subnet mask:	**255.**	**255.**	**240.**	**0**
(in binary):	11111111.	11111111.	1111 0000.	00000000

20 bits Network **12 bits Host**

Network Portion and Host Portion of an IPv4 Address

Example 3: IPv4 address: 10.20.30.40 **/24**
Subnet mask: 255.255.255.0



IPv4 address:	**10.**	**20.**	**30.**	**40**
(in binary):	00001010.	00010100.	00011110.	00101000
Subnet mask:	**255.**	**255.**	**255.**	**0**
(in binary):	11111111.	11111111.	11111111.	00000000

The Subnet Mask – Network and Host Portions

	1st octet	2nd octet	3rd octet	4th octet
172.0.0.0	Network	Host	Host	Host
Subnet Mask	11111111	00000000	00000000	00000000
192.4.0.0	Network	Network	Host	Host
Subnet Mask	11111111	11111111	00000000	00000000
192.168.1.0	Network	Network	Network	Host
Subnet Mask	11111111	11111111	11111111	00000000

- A “1” bit in the subnet mask means that the corresponding bit in the IP address should be read as a network number
- A “0” bit in the subnet mask means that the corresponding bit in the IP address should be read as a host bit.

The Subnet Mask – Network and Host Portions

	1st octet	2nd octet	3rd octet	4th octet
172.0.0.0	Network	Host	Host	Host
Subnet Mask: 255.0.0.0 or /8	255	0	0	0
192.4.0.0	Network	Network	Host	Host
Subnet Mask: 255.255.0.0 or /16	255	255	0	0
192.168.1.0	Network	Network	Network	Host
Subnet Mask: 255.255.255.0 or /24	255	255	255	0

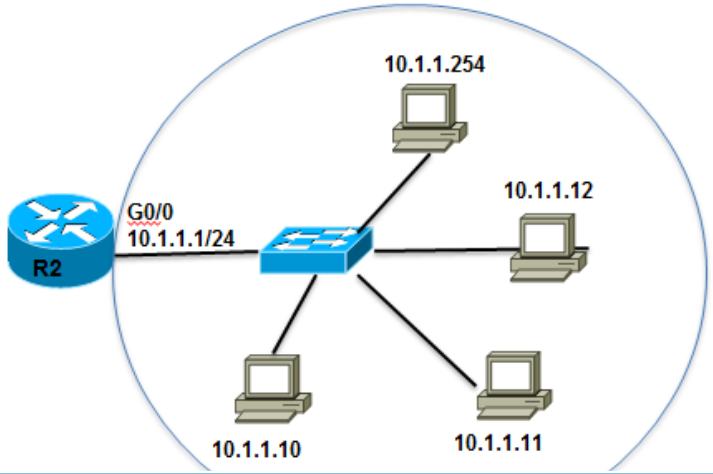
- /n "slash" tells us how many "1" bits are in the subnet mask.
- Subnet masks do not have to end on "natural octet boundaries"
- **Network Addresses have all zeros in the host portion of the address.**

Why the mask matters: Number of hosts!

Subnet Mask:	1st octet	2nd octet	3rd octet	4th octet
255.0.0.0 or /8	Network	Host	Host	Host
255.255.0.0 or /16	Network	Network	Host	Host
255.255.255.0 or /24	Network	Network	Network	Host

- Subnet masks do not have to end on “natural octet boundaries”

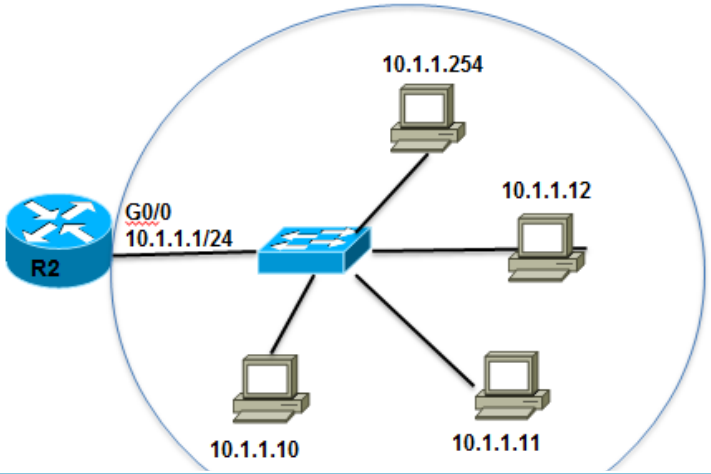
IPv4 Network, Host, and Broadcast Address



10.1.1.0/24

Network Portion			Host portion	Type of Address
10	1	1	0	
00001010	00000001	00000001	00000000	All 0s -> Network Address
10	1	1	10	
00001010	00000001	00000001	00001010	0s and 1s in host portion -> Host Address
10	1	1	255	
00001010	00000001	00000001	11111111	All 1s -> Broadcast Address

IPv4 Network, Host, and Broadcast Address

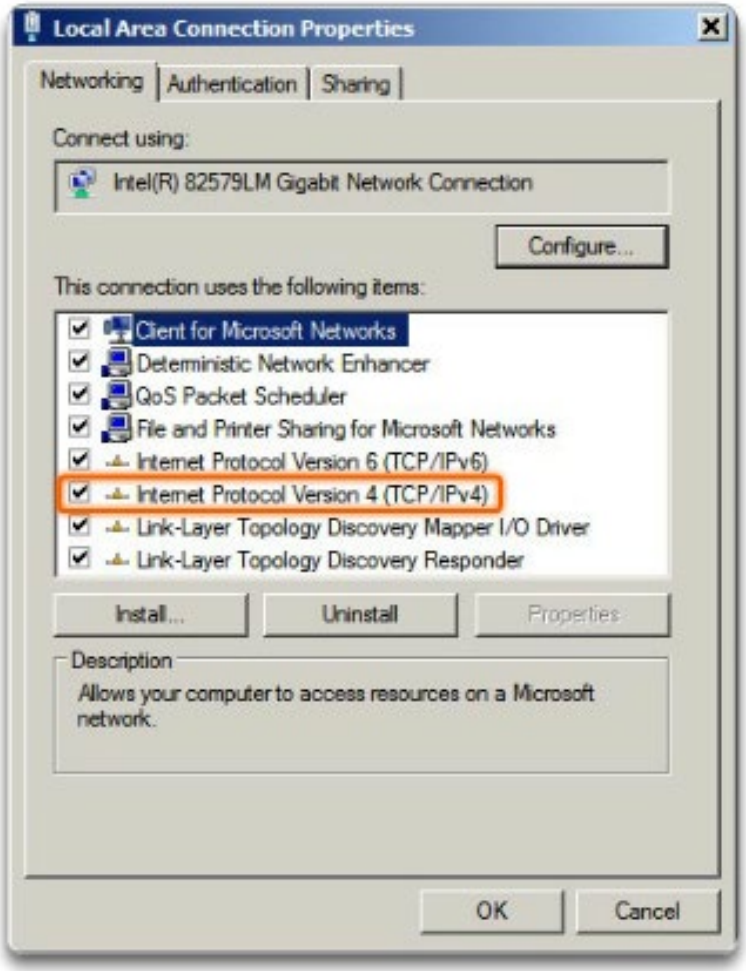


10.1.1.0/24

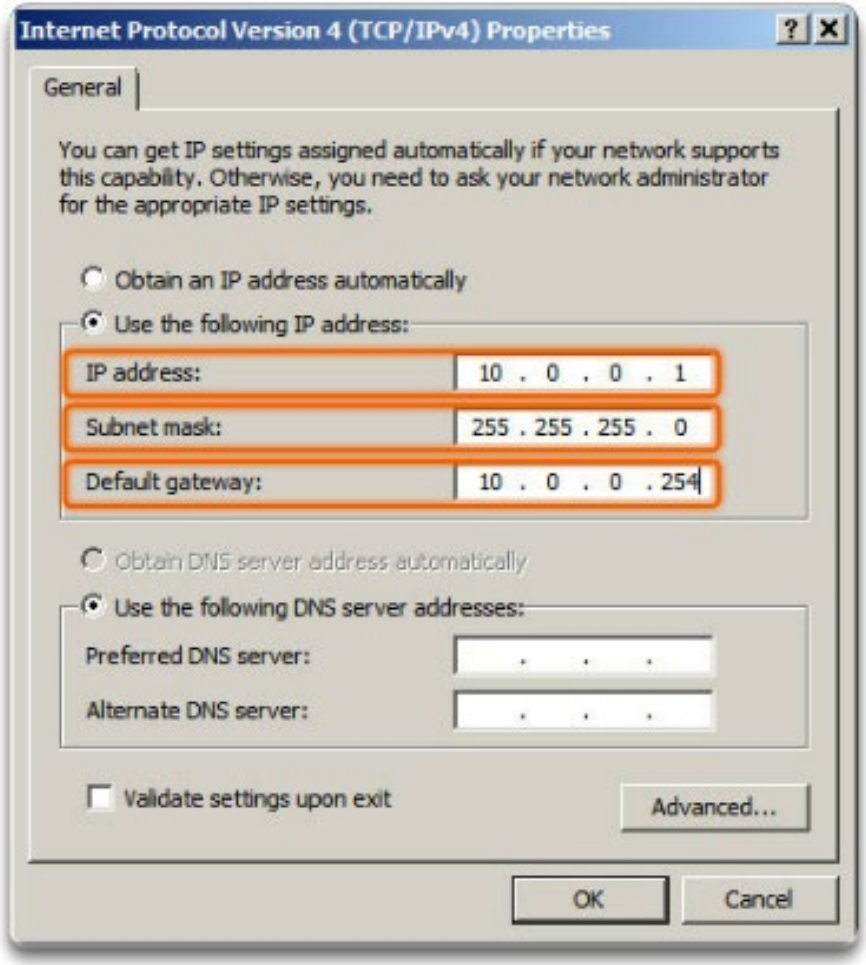
Network Portion			Host portion	Type of Address
10	1	1	1	
00001010	00000001	00000001	00000001	1st host address
10	1	1	254	
00001010	00000001	00000001	11111110	Last host address

Assigning a Static IPv4 Address to a Host

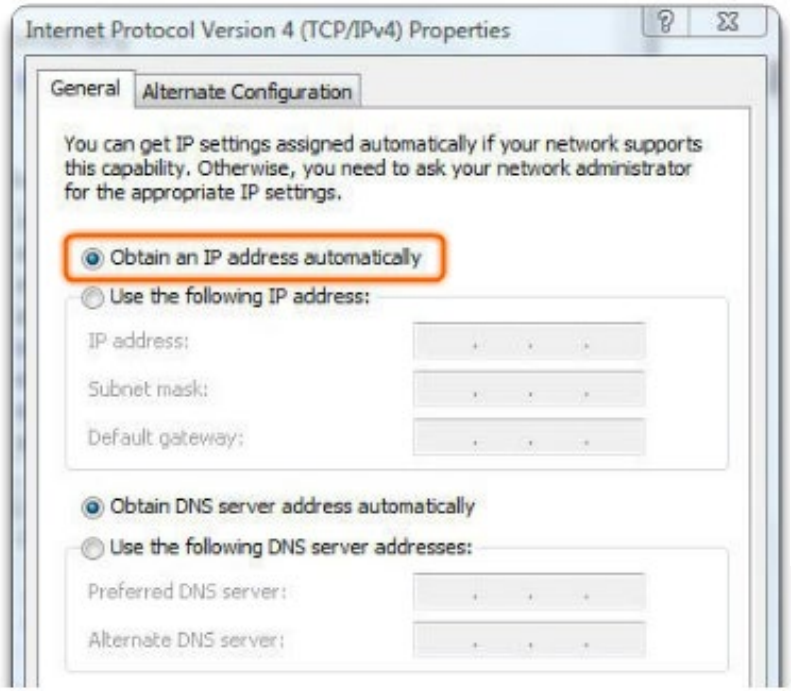
LAN Interface Properties



Configuring a Static IPv4 Address



Assigning a Dynamic IPv4 Address to a Host



DHCP – The preferred method of assigning IPv4 addresses to hosts on large networks because it reduces the burden on network support staff and virtually eliminates entry errors.

Summary

- IP addresses are hierarchical with network, subnetwork, and host portions.
- An IP address can represent a complete network, a host, or the broadcast address of the network.
- The subnet mask or prefix is used to determine the network portion of an IP address.
- DHCP enables the automatic assignment of addressing information such as IP address, subnet mask, default gateway, and other configuration information.