

Networking Essentials

ITC 2243

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Internet Protocol (IP)

- An IP address is an identifier (numerical label) for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address to the destination.
- The IP address space is managed globally by the Internet Assigned Numbers Authority (IANA)
- IP address versions :
 - ❑ **IP Version 4 (IPv4)** defines a 32-bit number, written as four numbers separated by dots. Each number can be 0 to 255.

Example - **192.168.10.15**

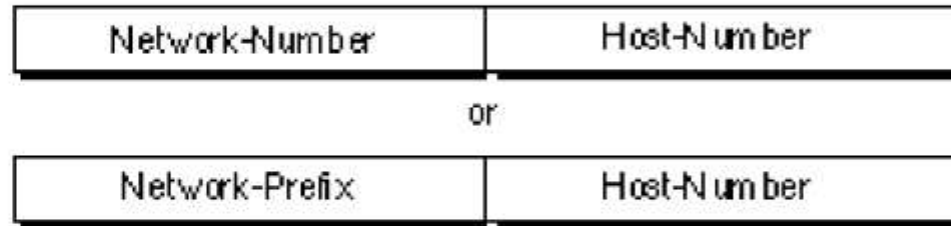
- ❑ **IP Version 6 (IPv6)** defines a 128-bit number, they are written as eight groups of four hexadecimal digits with colons between the groups.

Example - **2001:0db8:0000:1234:0000:0567:8000:0001**

Internet Protocol Version 4 (IPv4)

- An IP Address consists of two parts:

The first part of an Internet address identifies the network on which the host resides, while the second part identifies the particular host on the given network.



Every machine on the same network shares the same network address as part of its IP address. In the IP address 192.168.10.15, for example, 192.168.10. is the network address. The Host address is assigned to uniquely identify each machine on a network. In this example 15 is the host address.

IPv4 Classes

- IP Address classes and ranges :

Address Class	RANGE	Default Subnet Mask
A	1.0.0.0 to 126.255.255.255	255.0.0.0
B	128.0.0.0 to 191.255.255.255	255.255.0.0
C	192.0.0.0 to 223.255.255.255	255.255.255.0
D	224.0.0.0 to 239.255.255.255	Reserved for Multicasting
E	240.0.0.0 to 254.255.255.255	Experimental

Note: addresses 127.0.0.0 to 127.255.255.255
is reserved for loopback testing.

IPv4 Subnet Mask

Subnet Mask

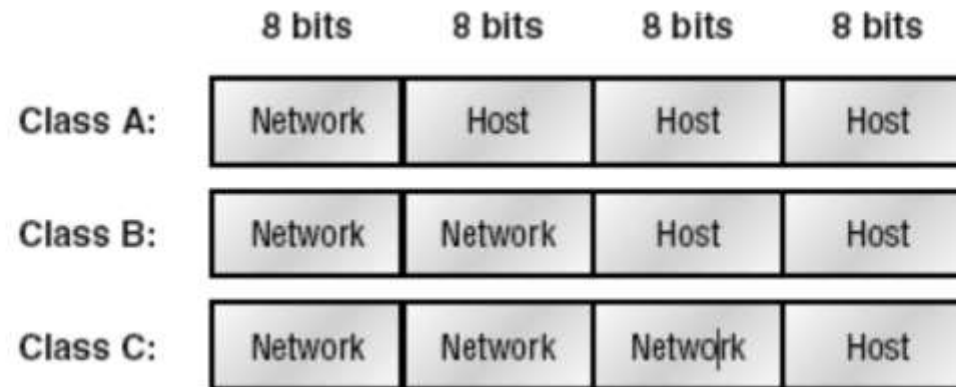
- Blocks part of the IP address to distinguish the network ID from the Host ID. This will determine if the TCP/IP clients are on the same network or on a remote/different network. An improper Subnet mask can cause connectivity problems.

Default Subnet Mask

Class	Format	Default Subnet Mask
A	<i>network.node.node.node</i>	255.0.0.0
B	<i>network.network.node.node</i>	255.255.0.0
C	<i>network.network.network.node</i>	255.255.255.0

IPv4

For the small number of networks possessing a very large number of nodes, they created the Class A network. At the other extreme is the Class C network, which is reserved for the many networks with a small number of nodes. The class distinction for networks between very large and very small is predictably called the Class B network



126 Class A networks total, each with 16,777,214 hosts ($256^3 - 2$).

16,382 Class B networks total, each with 65,534 hosts ($256^2 - 2$).

2,097,150 Class C networks total, each with 254 hosts ($256 - 2$).

IPv4 Public and Private Range

Public and Private IP addresses

IANA has reserved the following three blocks of the IP address space for private networks (local networks):

Reserved IP Address Space

Address Class	Reserved address space
Class A	10.0.0.0 through 10.255.255.255
Class B	172.16.0.0 through 172.31.255.255
Class C	192.168.0.0 through 192.168.255.255

IPv4

IPv4 address in dotted-decimal notation

172 . 16 . 254 . 1

↓ ↓ ↓ ↓
10101100.00010000.11111110.00000001

8 bits

32 bits (4 bytes)

Dotted
Decimal

Maximum

Binary

Value of
Binary

Example
Binary

← 32 Bits →			
Network		Host	
255	255	255	255
1	8 9	16 17	24 25 32
11111111	11111111	11111111	11111111
128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1
172	16	122	204
10101100	00010000	01111010	11001100

IPv4

IPv4 address in dotted-decimal notation

172 . 16 . 254 . 1

↓ ↓ ↓ ↓
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8 bits

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Example
Binary

← 32 Bits →			
Network		Host	
255	255	255	255
1	8 9	16 17	24 25 32
11111111	11111111	11111111	11111111
128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1
172	16	122	204
10101100	00010000	01111010	11001100

IPv4 CIDR Notation

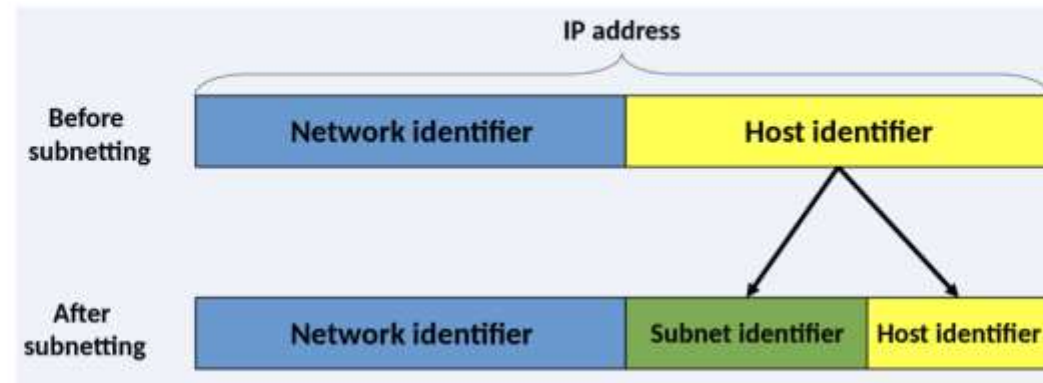
CIDR notation - The size of the routing prefix of the address is designated in CIDR notation by suffixing the address with the number of significant bits, e.g., 192.168.1.15/24, which is equivalent to the historically used subnet mask 255.255.255.0

Fill in the blanks:

IP Address	Class	Private/Public	Default Subnet mask	Network portion	Host portion
192.168.50.20					
180.56.70.20					
123.78.55.11					
10.1.1.10					

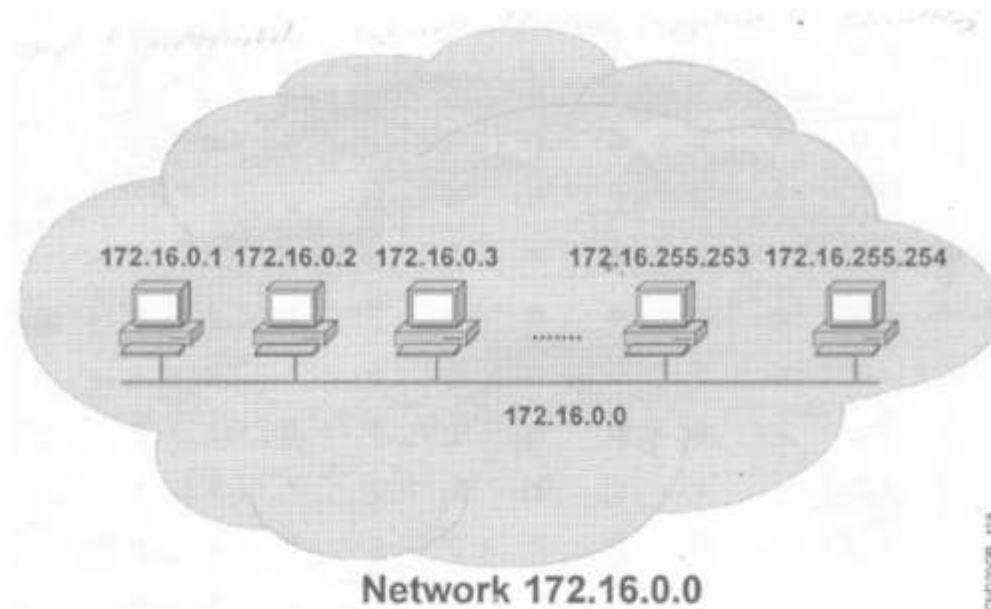
IPv4 Subnetting

- Subnetting allows you to create multiple logical networks that exist within a single Class A, B, or C network. If you do not subnet, you will only be able to use one network from your Class A, B, or C network, which is unrealistic.
- If you break a major network (Class A, B, or C) into smaller subnetworks, it allows you to create a network of interconnecting subnetworks. Each network would then have a unique network ID.

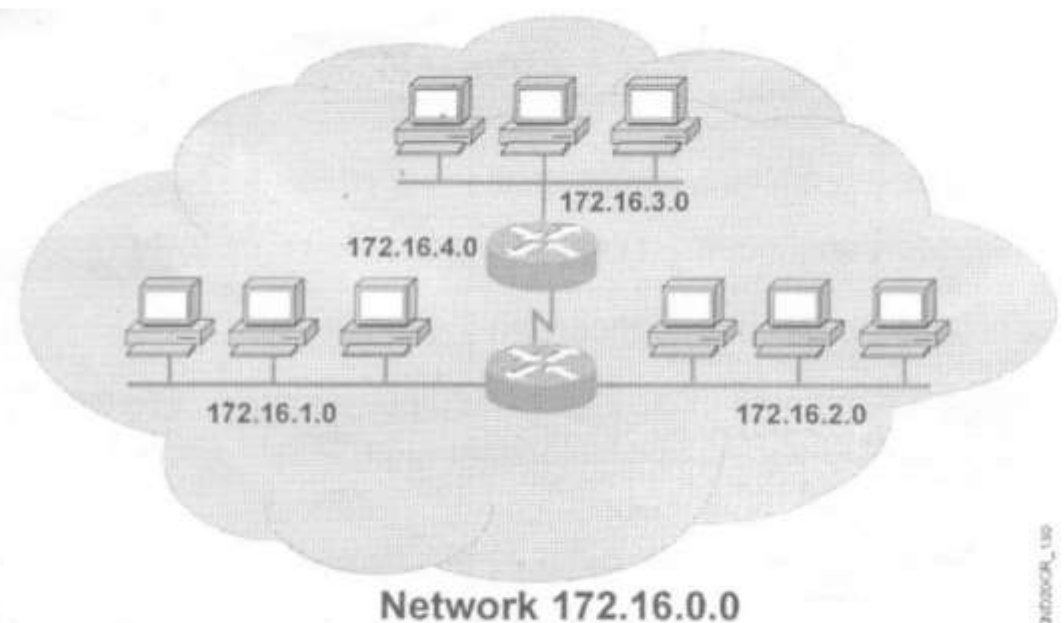


IPv4 Subnetting

IP Addressing without Subnets



IP Addressing with Subnets



IPv4 Subnetting

To subnet a network, extend the natural mask using some of the bits from the host ID portion of the address to create a subnetwork ID.

For example, given a Class C network of 204.15.5.0 which has a natural mask of 255.255.255.0, you can create subnets in this manner:

```
204.15.5.0      -11001100.00001111.00000101.00000000
255.255.255.0   -11111111.11111111.11111111.00000000
                -11111111.11111111.11111111.11100000   (255.255.255.224)
                -----|sub|-----
```

With these three bits, it is possible to create 8 subnets and each subnet have a total of 32 host IPs.

IPv4 Subnetting

Example1

You have a Class-C network as 192.168.50.0/24 in your organization. You want to create 12 subnets.

```
255.255.255.0  11111111.11111111.11111111.00000000
                11111111.11111111.11111111.11110000  (255.255.255.240)
```

With these four bits, it is possible to create 16 subnets and each subnet have a total of 16 host IPs.

1st Network	2nd Network	3rd Network	4th Network	
192.168.50.0	192.168.50.16	192.168.50.32	192.168.50.48
192.168.50.15	192.168.50.31	192.168.50.47	192.168.50.63

IPv4 Subnetting

Example2

If a router on a network has the address 203.189.78.10/30, What is the network address and broadcast address of that subnetwork?

11111111.11111111.11111111.11111100

203.189.78.0

203.189.78.4

203.189.78.8

203.189.78.12

203.189.78.3

203.189.78.7

203.189.78.11

Network address - 203.189.78.8

Broadcast address - 203.189.78.11

IPv4 Subnetting

Example3

The network 220.100.40.0 is sub-netted with the subnet mask 255.255.255.192

What is the maximum number of networks possible and what is the maximum number of hosts usable on each subnet?

255.255.255.192 -> 11111111.11111111.11111111.11000000

Maximum number of networks possible - 4

Maximum number of hosts usable on each subnet - 62

IPv4 Subnetting

Example3

The network 220.100.40.0 is sub-netted with the subnet mask 255.255.255.192

What is the maximum number of networks possible and what is the maximum number of hosts usable on each subnet?

255.255.255.192 -> 11111111.11111111.11111111.11000000

Maximum number of networks possible - 4

Maximum number of hosts usable on each subnet - 62



Thank you!!!