CM1604Computer Systems Fundamentals

IP Addressing

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IP Addressing

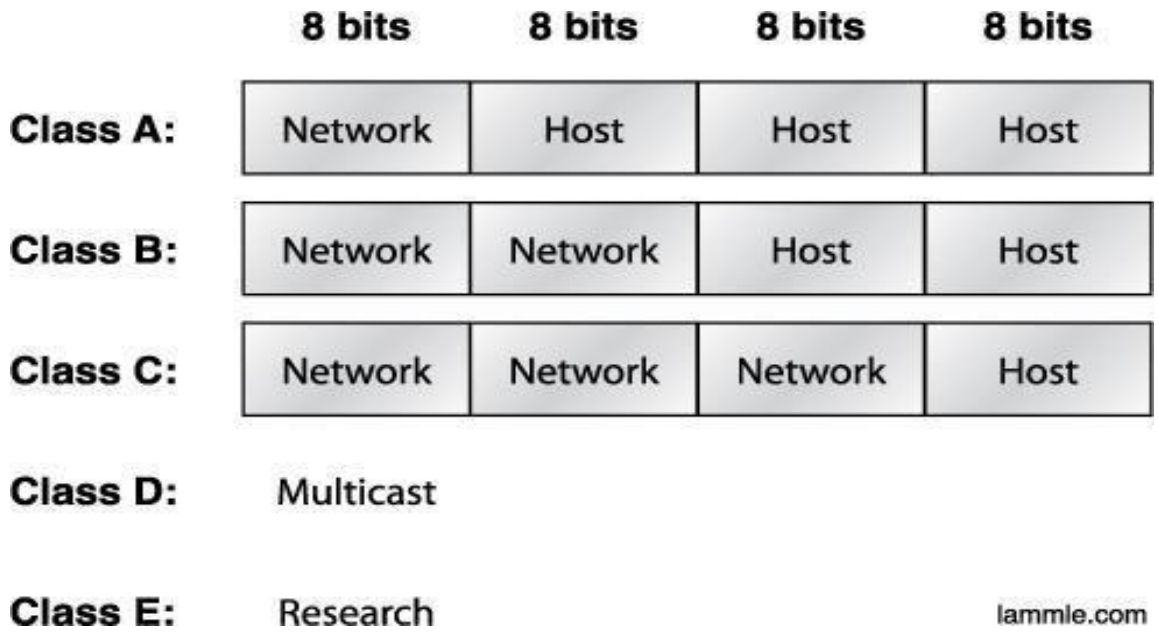
- An IP address is a numeric identifier assigned to each machine on an IP network.
- It designates the specific location of a device on the network.
- IP addressing was designed to allow hosts on one network to communicate with a host on a different network regardless of the type of LANs the hosts are participating in.

IP Terminology

- BIT: A bit is one digit, either a 1 or a 0.
- BYTE: A byte is 7 or 8 bits, depending on whether parity is used.
- For the rest of this chapter, always assume a byte is 8 bits.
- OCTET: An octet, made up of 8 bits, is just an ordinary 8-bit binary number. In this chapter, the terms byte and octet are completely interchangeable.
- Network address: This is the designation used in routing to send packets to a remote network—for example, 10.0.0.0, 172.16.0.0, and 192.168.10.0.
- Broadcast address: The address used by applications and hosts to send information to all nodes on a network is called the broadcast address.

Network Addressing

- Subdividing an IP address into a network and node address is determined by the class designation of one's network. This figure summarizes the three classes of networks



Reserved Addressing

Address	Function
Network 127.0.0.1	Reserved for loopback tests.
Node address of all 0s	Interpreted to mean “network address” or any host on specified network.
Node address of all 1s	Interpreted to mean “all nodes” on the specified network

Private Addressing

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

Subnetting Basics

- Benefits of subnetting include:
  - Reduced network traffic
  - Optimized network performance
  - Simplified management
  - Facilitated spanning of large geographical distances.

Subnet Masks

- Used to define which part of the host address will be used as the subnet address.

- A 32-bit value that allows the recipient of IP packets to distinguish the network ID portion of the IP address from the host ID portion.

Understanding the Powers of 2

Understanding the Powers of 2

Powers of 2 are important to understand and memorize for use with IP subnetting. To review powers of 2, remember that when you see a number with another number to its upper right (called an exponent), this means you should multiply the number by itself as many times as the upper number specifies. For example, 2^3 is $2 \times 2 \times 2$, which equals 8. Here's a list of powers of 2 you should commit to memory:

$2^1 = 2$	$2^3 = 8$	$2^5 = 32$	$2^7 = 128$
$2^2 = 4$	$2^4 = 16$	$2^6 = 64$	$2^8 = 256$

Default Subnet Masks

Class	Format	Default Subnet Mask
A	*network.node.node.node*	255.0.0.0
B	*network.network.node.node*	255.255.0.0
C	*network.network.network.node*	255.255.255.0

Classless Inter-Domain Routing (CIDR)

- **Used to allocate an amount of IP address space to a given entity (company, home, customer, etc).**
- Example: 192.168.10.32/28

- **The slash notation (/) means how many bits are turned on (1s) and tells you what your subnet mask is.**

CIDR Values

Subnet Mask	CIDR Value
255.0.0.0	/8
255.128.0.0	/9
255.192.0.0	/10
255.224.0.0	/11
255.240.0.0	/12
255.248.0.0	/13
255.252.0.0	/14
255.254.0.0	/15
255.255.0.0	/16
255.255.128.0	/17
255.255.192.0	/18
255.255.224.0	/19
255.255.240.0	/20
255.255.248.0	/21

Subnet Mask	CIDR Value
255.255.252.0	/22
255.255.254.0	/23
255.255.255.0	/24
255.255.255.128	/25
255.255.255.192	/26
255.255.255.224	/27
255.255.255.240	/28
255.255.255.248	/29
255.255.255.252	/30

Subnetting Class C Addresses

- **In a Class C address, only 8 bits are available for defining the hosts. Remember that subnet bits start at the left and go to the right, without skipping bits. This means that the only Class C subnet masks can be the following:**

- Binary Decimal CIDR

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- 10000000 = 128 /25
- 11000000 = 192 /26
- 11100000 = 224 /27
- 11110000 = 240 /28
- 11111000 = 248 /29
- 11111100 = 252 /30

Class C 192 mask examples

Subnet	Host	Meaning
00	000000 = 0	The network (do this first)
00	000001 = 1	The first valid host
00	111110 = 62	The last valid host
00	111111 = 63	The broadcast address (do this second)

Subnet	Host	Meaning
01	000000 = 64	The network
01	000001 = 65	The first valid host
01	111110 = 126	The last valid host
01	111111 = 127	The broadcast address

Class C 192 mask examples

Subnet	Host	Meaning
10	000000 = 128	The subnet address
10	000001 = 129	The first valid host
10	111110 = 190	The last valid host
10	111111 = 191	The broadcast address

Subnet	Host	Meaning
11	000000 = 192	The subnet address
11	000001 = 193	The first valid host
11	111110 = 254	The last valid host
11	111111 = 255	The broadcast address

Subnetting Class C Addresses – Fast Method

- **Answer Five Simple Questions:**
  - How many subnets does the chosen subnet mask produce?
  - How many valid hosts per subnet are available?
  - What are the valid subnets?
  - What's the broadcast address of each subnet?
  - What are the valid hosts in each subnet?

How Many Subnets?

2^x = number of subnets.

- X is the number of masked bits, or the 1s.

- For example, in 11000000, the number of ones gives us 2^2 subnets. In this example there are 4 subnets.

What Are The Valid Subnets?

- 256-subnet mask = block size, or base number.

- For example 256-192=64. 64 is the first subnet. The next subnet would be the base number plus itself or 64+64=128, (the second subnet).

What's The Broadcast Address For Each Subnet?

- The broadcast address is all host bits turned on, which is the number immediately preceding the next subnet.

What Are The Valid Hosts?

- Valid hosts are the number between the subnets, omitting all 0s and all 1s.