

IP Addressing II

Course Code: CSC 3116

Course Title: Computer Networks



Dept. of Computer Science
Faculty of Science and Technology

| | | | | | |
|---------------------|---|-----------------|---|------------------|--------------|
| Lecturer No: | Lab 2 | Week No: | 2 | Semester: | Spring 22-23 |
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Lecture Outline

- Classful Address
- Network and Host Address
- Broadcast

Classful Addressing

□ Address

1. Class A
2. Class B
3. Class C
4. Class D
5. Class E

Recognizing Class

| | Octet 1 | Octet 2 | Octet 3 | Octet 4 |
|----------------|----------|---------|---------|---------|
| Class A | 0..... | | | |
| Class B | 10..... | | | |
| Class C | 110..... | | | |
| Class D | 1110.... | | | |
| Class E | 1111.... | | | |

Binary notation

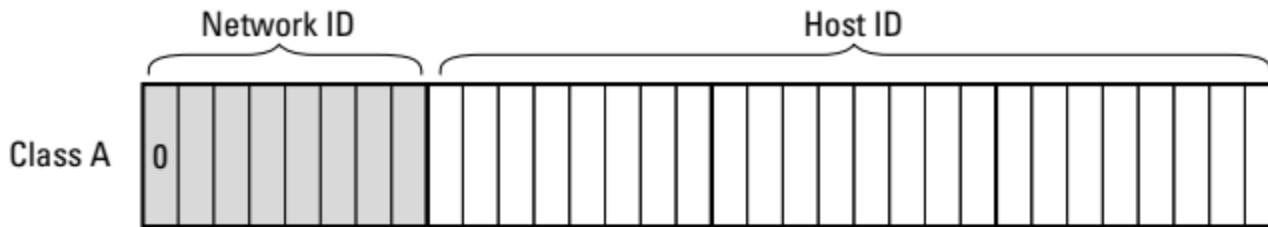
| | Byte 1 | Byte 2 | Byte 3 | Byte 4 |
|----------------|---------|--------|--------|--------|
| Class A | 0-127 | | | |
| Class B | 128-191 | | | |
| Class C | 192-223 | | | |
| Class D | 224-239 | | | |
| Class E | 240-255 | | | |

Dotted-decimal notation

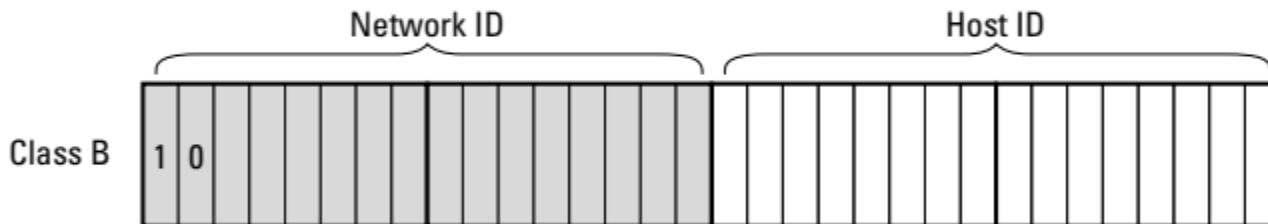
Recognizing Class (cont....)

| <i>Class</i> | <i>Address Number Range</i> | <i>Starting Bits</i> | <i>Length of Network ID</i> | <i>Number of Networks</i> | <i>Hosts</i> |
|--------------|-----------------------------|----------------------|-----------------------------|---------------------------|--------------|
| A | 1-126 .x.y.z | 0 | 8 | 126 | 16,777,214 |
| B | 128-191 .x.y.z | 10 | 16 | 16,384 | 65,534 |
| C | 192-223 .x.y.z | 110 | 24 | 2,097,152 | 254 |

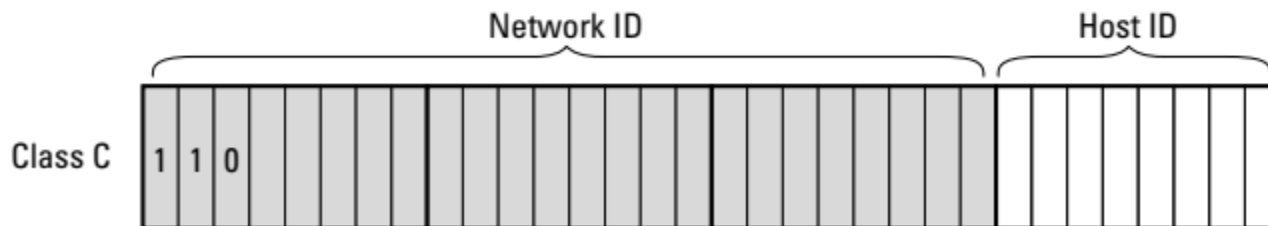
Network address and Host address (cont....)



Network ID length: 8 bits
Host ID length: 24 bits

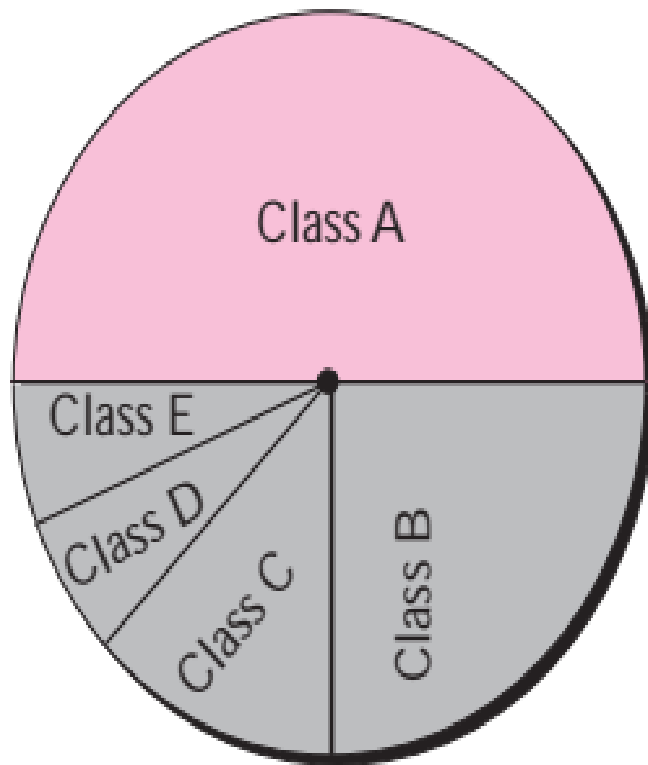


Network ID length: 16 bits
Host ID length: 16 bits



Network ID length: 24 bits
Host ID length: 8 bits

Address Space



Class A: 2^{31} = 2,147,483,648 addresses, 50%

Class B: 2^{30} = 1,073,741,824 addresses, 25%

Class C: 2^{29} = 536,870,912 addresses, 12.5%

Class D: 2^{28} = 268,435,456 addresses, 6.25%

Class E: 2^{28} = 268,435,456 addresses, 6.25%

Address Space (cont....)

Problem

Find the class of each address:

a. 00000001 00001011 00001011 11101111

b. 11000001 10000011 00011011 11111111

Solution

a. The first bit is 0. This is a class A address.

b. The first 2 bits are 1; the third bit is 0. This is a class C address.

Address Space (cont....)

Find the class of each address:

- a.** 227.12.14.87
- b.** 193.14.56.22
- c.** 14.23.120.8
- d.** 252.5.15.111

Solution

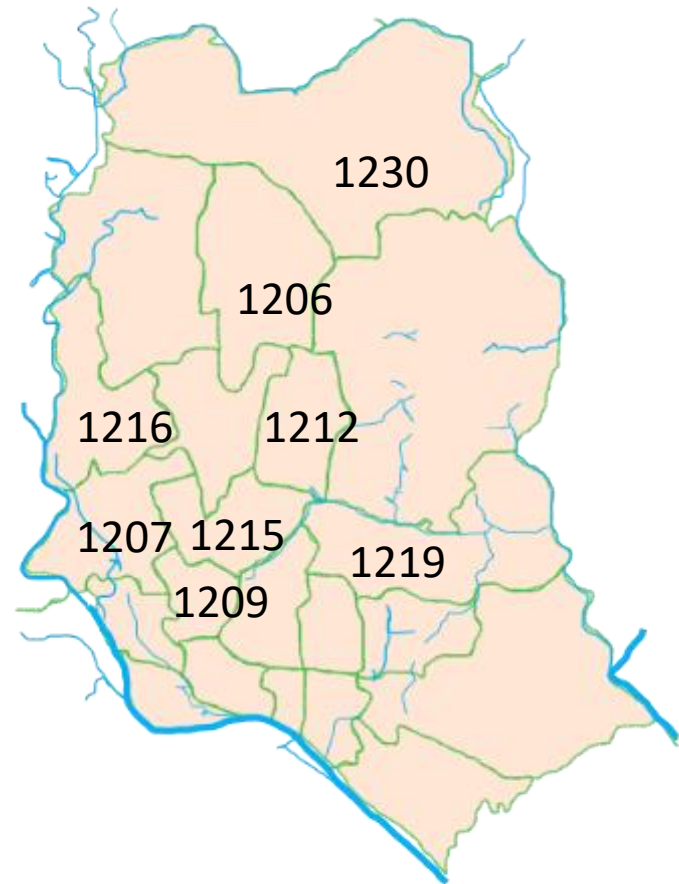
- a.** The first byte is 227 (between 224 and 239); the class is D.
- b.** The first byte is 193 (between 192 and 223); the class is C.
- c.** The first byte is 14 (between 0 and 127); the class is A.
- d.** The first byte is 252 (between 240 and 255); the class is E.

Few of the special purpose IP addresses

| IP address | Purpose |
|--|------------------------------|
| 0.0.0.0 | For several reasons* |
| 10.0.0.0 to 10.255.255.255, 8-bits mask | Private IP address |
| 172.16.0.0 to 172.31.255.255, 12-bits mask | Private IP address |
| 192.168.0.0 to 192.168.255.255, 16-bits mask | Private IP address |
| 255.255.255.255 | Limited Broadcast IP address |
| 127.0.0.0 | Loopback address |
| | |

- Automatically temporarily assigned to host for DHCP discovery
- If a host has two IP addresses, 192.168.1.1 and 10.1.2.1, and a server running on the host is configured to listen on 0.0.0.0, it will be reachable at both of those IP addresses.

Network address and Host address



Network address and Host address (cont....)

- **The network ID (or network address)**
 - Identifies the network on which a host computer can be found
- **The host ID (or host address)**
 - Identifies a specific device on the network indicated by the network ID

Analogy:

- network address----->Postcode of an area
- Host address-----> House number of a person in that area

Network address and Host address (cont....)

➤ No. of Networks= $2^{\text{No.of bits in the network ID}}$

➤ No. of hosts= $2^{\text{No.of bits in the host ID}} - 2$

Extracting Information in a Block

How many addresses are there in a block?

What is the first address?

What is the last address?

1. The number of addresses in the block, N , can be found using $N = 2^{32-n}$.
2. To find the first address, we keep the n leftmost bits and set the $(32 - n)$ rightmost bits all to 0s.
3. To find the last address, we keep the n leftmost bits and set the $(32 - n)$ rightmost bits all to 1s.

Broadcast

❖ Broadcast¹

- Sending packet to all hosts of a network
 - Limited Broadcast
 - When a host of a network sends packet to all hosts of the same network
 - Sends packet to 255.255.255.255 IP address
 - Direct Broadcast
 - When a host of a network sends packet to all hosts of another network.
 - If the network address of the target network is 20.0.0., the packet is sent to 20.255.255.255

Broadcast (cont....)

- A network has three kinds of IP addresses
 - Network IP address
 - Lowest IP address of the network
 - Broadcast IP address
 - Highest IP address of the network
 - Host IP addresses
 - All IP addresses of the network except the lowest and highest IP address

Broadcast (cont....)

- How to get network IP address and broadcast IP address?
- **Network IP address:** Replace all host bits by zeroes (0) of any IP address of the network
- **Broadcast IP address:** Replace all host bits by ones of any IP address of the network

Broadcast (cont....)

What is the network and broadcast IP addresses of the network which uses 192.100.12.110 as a host address?

- 192.100.12.110 is a class C address
- 192.100.12 is the network part and 110 is the host part
- Network IP address: 192.100.12.0
- Broadcast IP address: 192.100.12.255

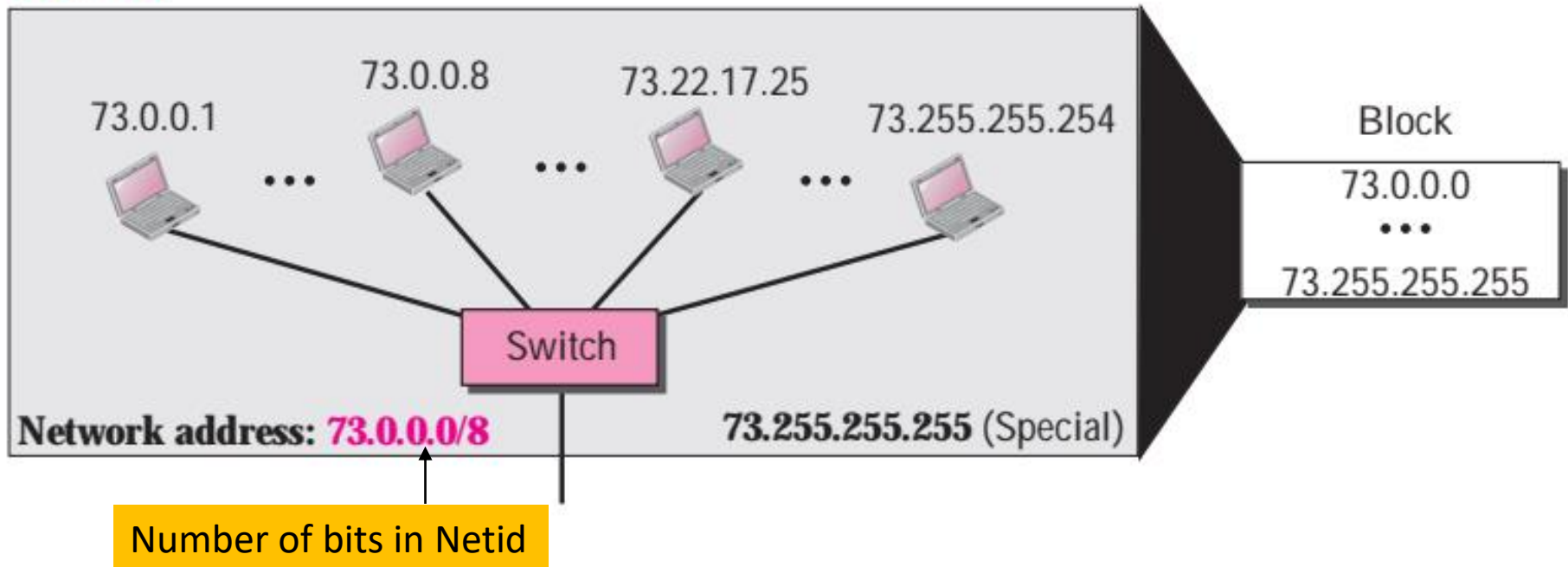
No. of usable host IP address: No. of addresses-2

Broadcast (cont....)

Example

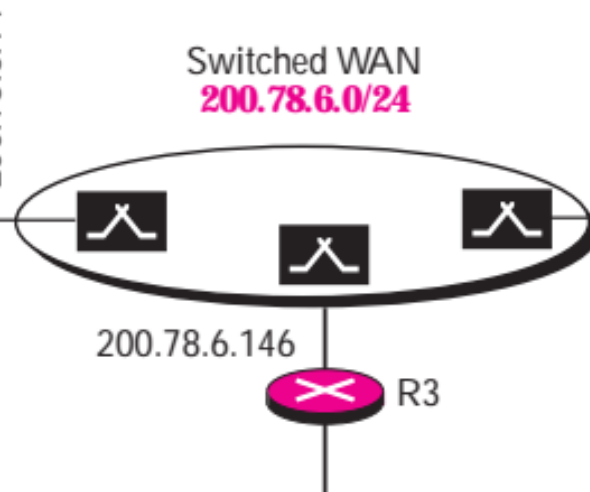
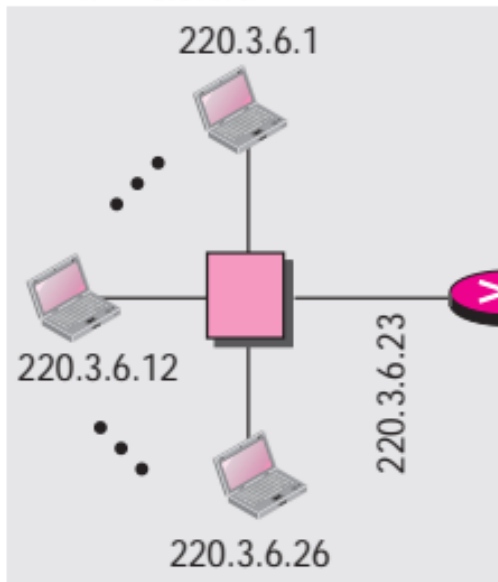
An address in a block is given as 73.22.17.25. Find the number of addresses in the block, the first address, and the last address.

Netid 73: common in all addresses

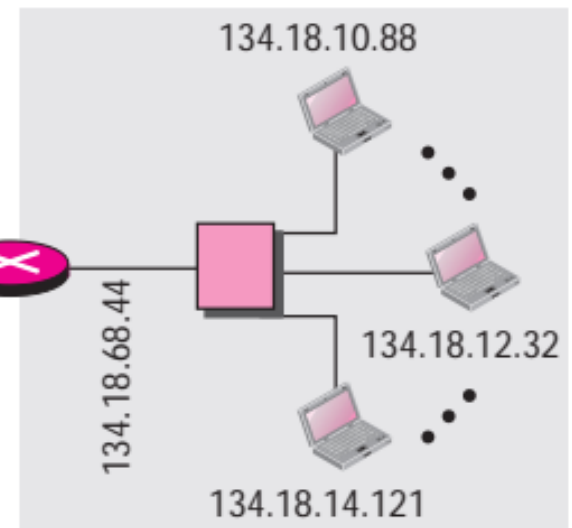


Interconnections of multiple networks

LAN: 220.3.6.0/24



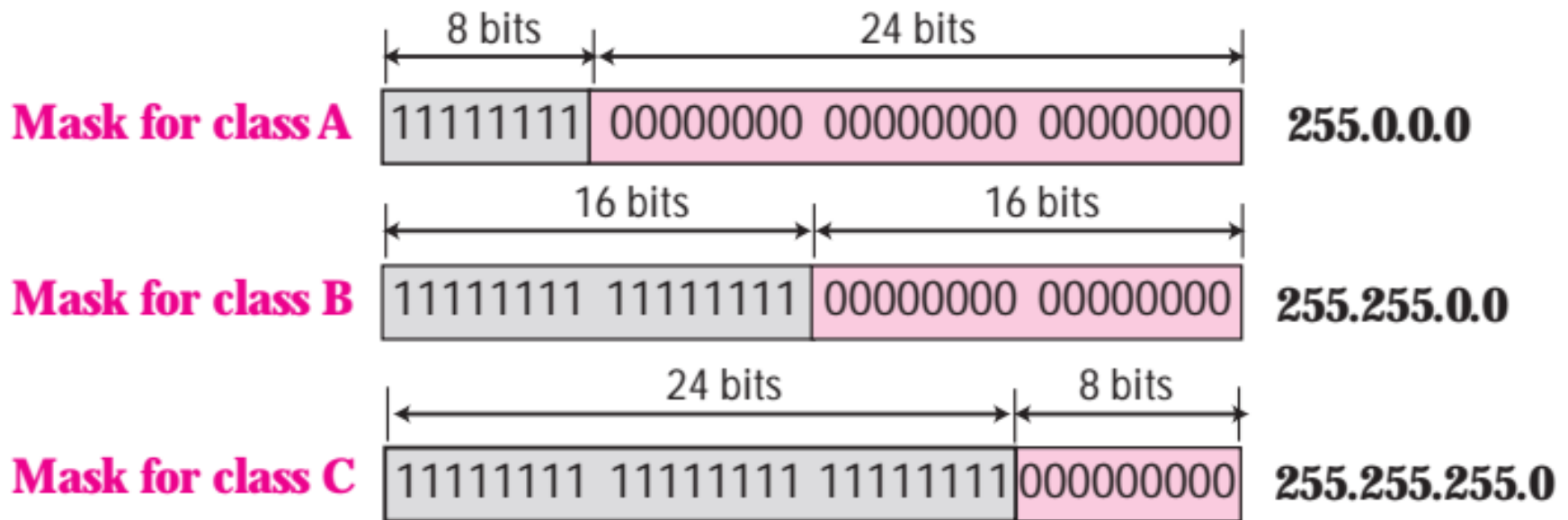
LAN: 134.18.0.0/16



Rest of the Internet

Network Mask/Subnet Mask

A **network mask** or a **default mask** in classful addressing is a 32-bit number with n leftmost bits all set to 1s and $(32 - n)$ rightmost bits all set to 0s



Network Mask/Subnet Mask

| Class | n | k | No. of Networks (Blocks) 2^{n-k} | No. of Host in each Network 2^{32-n} |
|---------|-----|-----|--|--|
| Class A | 8 | 1 | 128 | 16,777,216 |
| Class B | 16 | 2 | 16,384 | 65,536 |
| Class C | 24 | 3 | 2,097,152 | 256 |

Huge wastage of IP addresses
Wastage of IP addresses
No enough for all organizations



References

1. **Official Cert Guide CCNA 200-301 , vol. 1**, *W. Odom*, Cisco Press, First Edition, 2019, USA.
2. **CCNA Routing and Switching**, *T. Lammle*, John Wily & Sons, Second Edition, 2016, USA.
3. Cisco IOS Configuration Fundamentals Command Reference.
<http://www.cisco.com>



Books

1. **Official Cert Guide CCNA 200-301 , vol. 1**, *W. Odom*, Cisco Press, First Edition, 2019, USA.
2. **CCNA Routing and Switching**, *T. Lammle*, John Wily & Sons, Second Edition, 2016, USA.