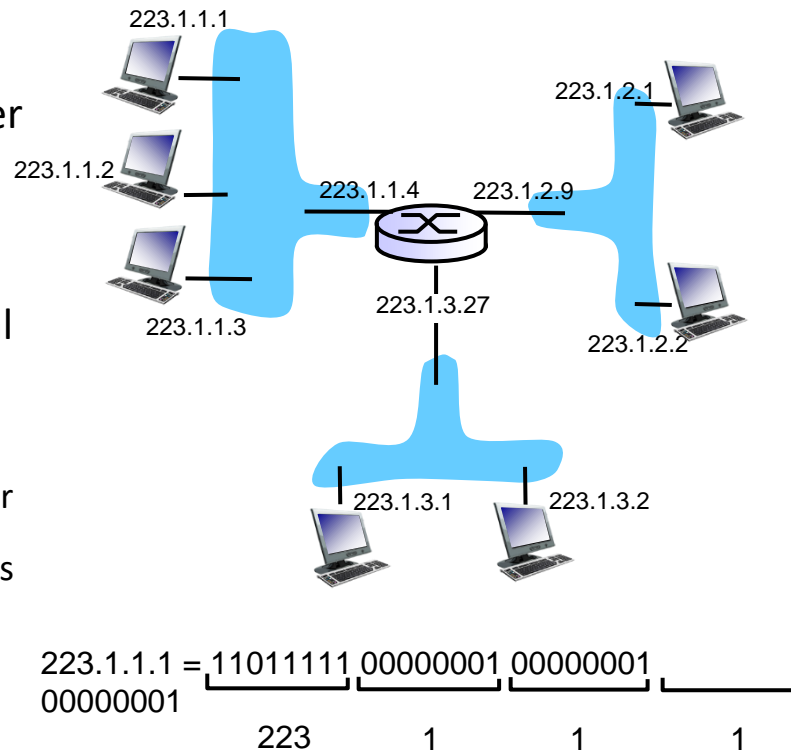


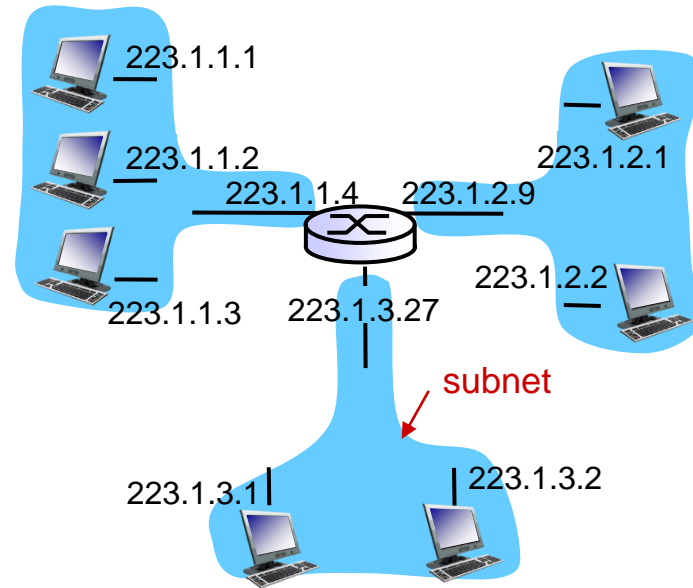
# IP addressing: introduction

- **IP address:** 32-bit identifier for host, router *interface*
- **interface:** connection between host/router and physical link
  - router's typically have multiple interfaces
  - host typically has one or two interfaces (e.g., wired Ethernet, wireless 802.11)
- **IP addresses associated with each interface**



# Subnets

- IP address:
  - subnet part - high order bits
  - host part - low order bits
- *what's a subnet ?*
  - device interfaces with same subnet part of IP address
  - can physically reach each other *without intervening router*

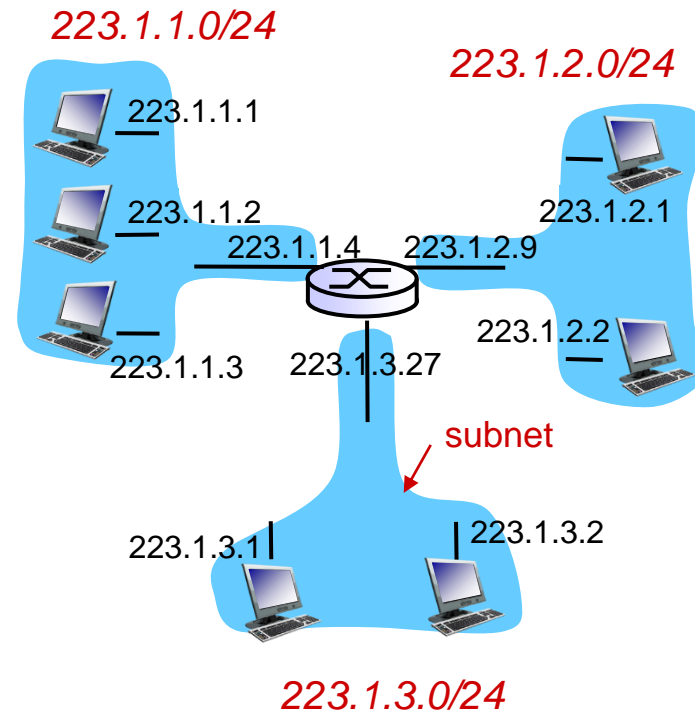


network consisting of 3 subnets

# Subnets

## *recipe*

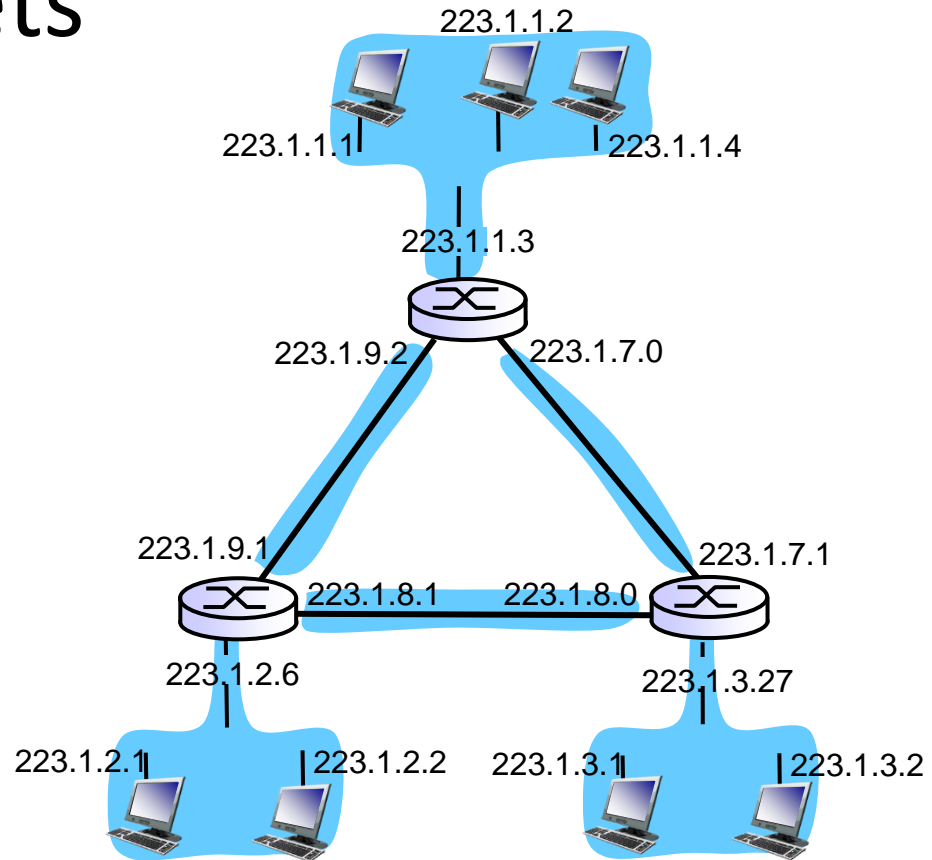
- ❖ to determine the subnets, detach each interface from its host or router, creating islands of isolated networks
- ❖ each isolated network is called a *subnet*



subnet mask: /24

# Subnets

how many?



# What is Subnet Mask?

**IPv4 address** has two components, the network part and the host part.

In fact **IPv4 address** , is a combination of IPv4 address and Subnet mask

**The purpose of subnet mask** is to identify which part is the **network part** and which part is the **host part**.

**Subnet mask** is a 32 bit number where all the bits of the network part are represented as **1** and all the bits of the host part are represented as **0**.

For example, for a **Class C Network**, 192.168.10.0, the address part and the subnet mask is **255.255.255.0**

# Subnet and Subnetting

- A logical, visible subdivision of an IP network is called **subnet** or **subnetwork**.
  - It is created by dividing the host identifier
- **Subnetting** is the practice of dividing a network into two or more networks.
- **In subnetting**, a class A or class B or class C block is divided into several subnets (each subnet with larger prefix length than the original network).
- **For example**, divide the **class A** into **four subnets**, then each subnet will have prefix length as 10 (take two bits from host id part in order to obtain subnets).

# Subnetting

**Subnetting is done by taking the bits from host part and adding it to the network part**

**Remember the following [as already covered]**

If all the bits in the host part are "0", that represents the network id (network address)

If all the bits in the host part are "0" except the last bit, it is the first usable IPv4 address

If all the bits in the host part are "1" except the last bit, it is the last usable IPv4 address

If all the bits in the host part are "1", that represents the broadcast

# Class C – 1 bit subnetting

Consider class c network 192.168.10.0 (subnet mask is 255.255.255.0)

- ❖ If we include one bit from the host part to the network part, the **subnet mask** changes into 255.255.255.128.
- ❖ The single bit can have two values in last octet, either 0 or 1 (so we can get **two subnets with a single bit subnetting**)
- ❖ 11000000.10101000.00001010.**0** | 00000000  
11111111.11111111.11111111.**1** | 00000000
- ❖ So the network 192.168.10.0 is divided into two networks,
  - ❖ each network has 128 total addresses of which 126 are usable
    - ❖ two are used in each subnet to represent the network address and broadcast address.



# Class C – 1 bit subnetting

SN No.	Description	Binaries	Decimal
1	Network Address	11000000.10101000.00001010. <b>0</b> 0000000	192.168.10.0
	First usable address	11000000.10101000.00001010.00000001	192.168.10.1
	Last usable address	11000000.10101000.00001010.01111110	192.168.10.126
	Broadcast Address	11000000.10101000.00001010. <b>0</b> 1111111	192.168.10.127
2	Network Address	11000000.10101000.00001010. <b>1</b> 0000000	192.168.10.128
	First usable address	11000000.10101000.00001010.10000001	192.168.10.129
	Last usable address	11000000.10101000.00001010.11111110	192.168.10.254
	Broadcast Address	11000000.10101000.00001010. <b>1</b> 1111111	192.168.10.255

# Class C – 2 bit subnetting

SN No.	Description	Binaries	Decimal
1	NA	11000000.10101000.00001010. <b>00</b> 000000	192.168.10.0
	1st	11000000.10101000.00001010.00000001	192.168.10.1
	Last	11000000.10101000.00001010.00111110	192.168.10.62
	BA	11000000.10101000.00001010. <b>00</b> 111111	192.168.10.63
2	NA	11000000.10101000.00001010. <b>01</b> 000000	192.168.10.64
	1st	11000000.10101000.00001010.01000001	192.168.10.65
	Last	11000000.10101000.00001010.01111110	192.168.10.126
	BA	11000000.10101000.00001010. <b>01</b> 111111	192.168.10.127
3	NA	11000000.10101000.00001010. <b>10</b> 000000	192.168.10.128
	1st	11000000.10101000.00001010.10000001	192.168.10.129
	Last	11000000.10101000.00001010.10111110	192.168.10.190
	BA	11000000.10101000.00001010. <b>10</b> 111111	192.168.10.191
4	NA	11000000.10101000.00001010. <b>11</b> 000000	192.168.10.192
	1st	11000000.10101000.00001010.11000001	192.168.10.193
	Last	11000000.10101000.00001010.11111110	192.168.10.254
	BA	11000000.10101000.00001010. <b>11</b> 111111	192.168.10.255

# Class C – 3 bit subnetting

SN No.	Description	Binaries	Decimal
1	NA	11000000.10101000.00001010. <b>000</b> 00000	192.168.10.0
	1st	11000000.10101000.00001010.00000001	192.168.10.1
	Last	11000000.10101000.00001010.00011110	192.168.10.30
	BA	11000000.10101000.00001010. <b>000</b> 11111	192.168.10.31
2	NA	11000000.10101000.00001010. <b>001</b> 00000	192.168.10.32
	1st	11000000.10101000.00001010.00100001	192.168.10.33
	Last	11000000.10101000.00001010.00111110	192.168.10.62
	BA	11000000.10101000.00001010. <b>001</b> 11111	192.168.10.63
.....			
8	NA	11000000.10101000.00001010. <b>111</b> 00000	192.168.10.224
	1st	11000000.10101000.00001010.11100001	192.168.10.225
	Last	11000000.10101000.00001010.11111110	192.168.10.254
	BA	11000000.10101000.00001010. <b>111</b> 11111	192.168.10.255

# **ASSIGNMENT 3**

# Task-C

- Apply 1 bit subnetting to
  - 201.65.71.0
  - What is Network Address?
  - What is broadcast address?
  - No. of blocks?

# Task-A

- Apply 2 bit subnetting to
  - 219.30.5.27
  - No. of blocks?
  - What is Network Address?
  - What is 1st usable address?
  - What is last usable address?
  - What is broadcast address?

# Solution- Task A

IP Address:	219.30.5.27
Network Address:	219.30.5.0
Usable Host IP Range:	219.30.5.1 - 219.30.5.62
Broadcast Address:	219.30.5.63
Total Number of Hosts:	64
Number of Usable Hosts:	62

219.30.5.0	219.30.5.1 - 219.30.5.62	219.30.5.63
219.30.5.64	219.30.5.65 - 219.30.5.126	219.30.5.127
219.30.5.128	219.30.5.129 - 219.30.5.190	219.30.5.191
219.30.5.192	219.30.5.193 - 219.30.5.254	219.30.5.255

# Class B – 1 bit subnetting

Consider class B network 172.16.0.0 (subnet mask is 255.255.0.0)

- ❖ If we include one bit from the host part to the network part, the **subnet mask** changes into 255.255.128.0.
- ❖ The single bit can have two values in last octet, either 0 or 1 (so we can get **two subnets with a single bit subnetting**)
- ❖ 10101100.00010000.**0** | 00000000.00000000  
11111111.11111111.**1** | 00000000.00000000
- ❖ So the network 172.16.0.0 is divided into two networks,
  - ❖ each network has 32768 total addresses of which 32766 are usable
    - ❖ two are used in each subnet to represent the network address and broadcast address.
  - ❖ The subnet mask for one bit subnetting is **255.255.128.0**.



# Class B – 1 bit subnetting

SN No.	Description	Binaries	Decimal
1	Network Address	10101100.00010000. <b>0</b> 0000000.00000000	172.16.0.0
	First address	10101100.00010000.00000000.00000001	172.16.0.1
	Last address	10101100.00010000.01111111.11111110	172.16.127.254
	Broadcast Address	10101100.00010000. <b>0</b> 1111111.11111111	172.16.127.255
2	Network Address	10101100.00010000. <b>1</b> 0000000.00000000	172.16.128.0
	First address	10101100.00010000.10000000.00000001	172.16.128.1
	Last address	10101100.00010000.11111111.11111110	172.16.255.254
	Broadcast Address	10101100.00010000. <b>1</b> 1111111.11111111	172.16.255.255

# Class B – 2 bit subnetting

SN No.	Description	Binaries	Decimal
1	NA	10101100.00010000. <b>00</b> 000000.00000000	172.16.0.0
	1st	10101100.00010000. <b>00</b> 000000.00000001	172.16.0.1
	Last	10101100.00010000. <b>00</b> 111111.11111110	172.16.63.254
	BA	10101100.00010000. <b>00</b> 111111.11111111	172.16.63.255
2	NA	10101100.00010000. <b>01</b> 000000.00000000	172.16.64.0
	1st	10101100.00010000. <b>01</b> 000000.00000001	172.16.64.1
	Last	10101100.00010000. <b>01</b> 111111.11111110	172.16.127.254
	BA	10101100.00010000. <b>01</b> 111111.11111111	172.16.127.255
3	NA	10101100.00010000. <b>10</b> 000000.00000000	172.16.128.0
	1st	10101100.00010000. <b>10</b> 000000.00000001	172.16.128.1
	Last	10101100.00010000. <b>10</b> 111111.11111110	172.16.191.254
	BA	10101100.00010000. <b>10</b> 111111.11111111	172.16.191.255
4	NA	10101100.00010000. <b>11</b> 000000.00000000	172.16.192.0
	1st	10101100.00010000. <b>11</b> 000000.00000001	172.16.192.1
	Last	10101100.00010000. <b>11</b> 111111.11111110	172.16.192.254
	BA	10101100.00010000. <b>11</b> 111111.11111111	172.16.192.255

# Class A – 1 bit subnetting

Consider class A network 10.0.0.0 (subnet mask is 255.0.0.0)

- ❖ If we include one bit from the host part to the network part, the **subnet mask** changes into 255.128.0.0.
- ❖ The single bit can have two values in second octet, either 0 or 1 (so we can get **two subnets with a single bit subnetting**)
- ❖ 00001010.**0** | 00000000.00000000.00000000  
11111111.**1** | 00000000.00000000.00000000
- ❖ The network 10.0.0.0 is divided into two networks, each network has 8388608 total IPv4 Addresses and 8388606 usable IPv4 Addresses (two IPv4 Addresses are used in each subnet to represent the network address and the directed broadcast address).

# Class A – 1 bit subnetting

SN No	Description	Binaries	Decimal
1	Network Address	00001010. <b>0</b> 0000000.00000000.00000000	10.0.0.0
	First IPv4 address	00001010.00000000.00000000.00000001	10.0.0.1
	Last IPv4 address	00001010.01111111.11111111.11111110	10.127.255.254
	Broadcast Address	100001010. <b>0</b> 1111111.11111111.11111110	10.127.255.255
2	Network Address	00001010. <b>1</b> 0000000.00000000.00000000	10.128.0.0
	First IPv4 address	00001010.10000000.00000000.00000001	10.128.0.1
	Last IPv4 address	00001010.11111111.11111111.11111110	10.255.255.254
	Broadcast Address	00001010. <b>1</b> 1111111.11111111.11111111	10.255.255.255

# Class A – 2 bit subnetting

N No	Description	Binaries	Decimal
1	Network Address	00001010. <b>00</b> 000000.00000000.00000000	10.0.0.0
	First IPv4 address	00001010.00000000.00000000.00000001	10.0.0.1
	Last IPv4 address	00001010.00111111.11111111.11111110	10.63.255.254
	Broadcast Address	00001010. <b>00</b> 111111.11111111.11111111	10.63.255.255
2	Network Address	00001010. <b>01</b> 000000.00000000.00000000	10.64.0.0
	First IPv4 address	00001010.01000000.00000000.00000001	10.64.0.1
	Last IPv4 address	00001010.01111111.11111111.11111110	10.127.255.254
	Broadcast Address	00001010. <b>01</b> 111111.11111111.11111111	10.127.255.255
3	Network Address	00001010. <b>10</b> 000000.00000000.00000000	10.128.0.0
	First IPv4 address	00001010.10000000.00000000.00000001	10.128.0.1
	Last IPv4 address	00001010.10111111.11111111.11111110	10.191.255.254
	Broadcast Address	00001010. <b>10</b> 111111.11111111.11111111	10.191.255.255
4	Network Address	00001010. <b>11</b> 000000.00000000.00000000	10.192.0.0
	First IPv4 address	00001010.11000000.00000000.00000001	10.192.0.1
	Last IPv4 address	00001010.11111111.11111111.11111110	10.255.255.254
	Broadcast Address	00001010. <b>11</b> 111111.11111111.11111111	10.255.255.255