Computer Techniques Engineering Department
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Networks Simulation

IP addressing & IP Subnetting

Topic 5

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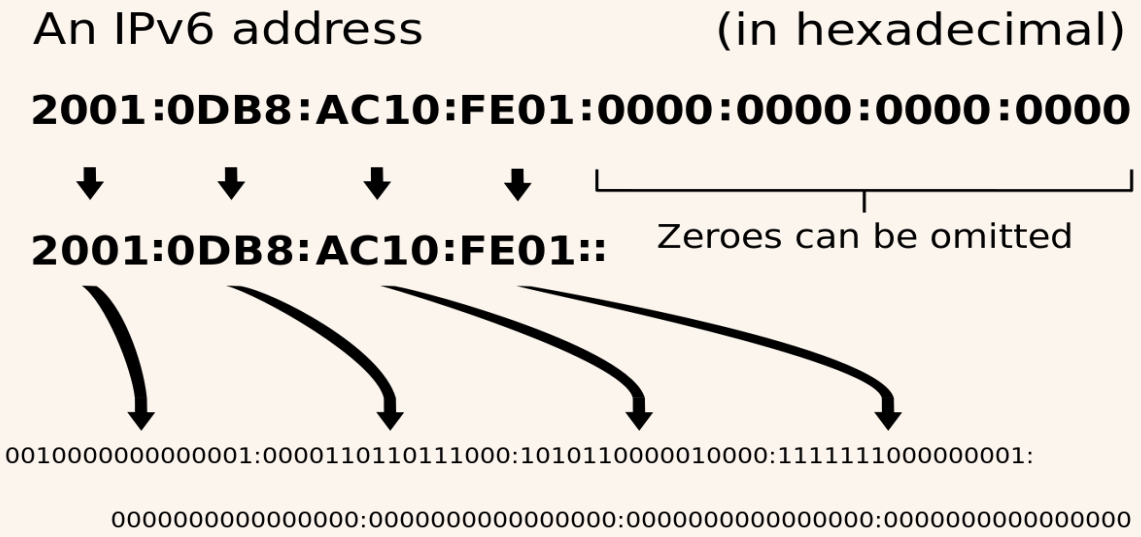
IP version 4 (IPv4) and IP version 6 (IPv6)

- The identifier used the IP in the Network Layer of the TCP/IP protocol suite to identify the connection of each device to the Internet.
- The Internet is in transition between **IP version 4 (*IPv4*) and IP version 6 (*IPv6*).**

  - An IPv4 address is a **32-bit address** = 2^{32} **or 4,294,967,296** addresses.
  - An IPv6 address is a **128-bit address = 2^{128} or 3.403 x 10^{38}** addresses.



How Many Subnets

$2^n = 2^2$= 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.

How many Hosts Per Subnet?

2^n-2 = number of hosts per subnet.

- Y is the number of unmasked bits, or the 0s.
- For example, in 11000000, the number of zeros gives us 2^6-2 hosts. In this example, there are 62 hosts per subnet.

Homework As a Group: Find the Range of IP address

IP Address	Length (CIDR)
192.168.1.35	/27

$$2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0$$

128 64 32 16 8 4 2 1

11000000.10101000.00000001.00100011

192 (Octet, 8 bits) + **168** (Octet, 8 bits) + **1** (Octet, 8 bits) + **35** (Octet, 3 bits) **/27**

11111111. 11111111.11111111.11100000

27 bits for network

5 bits = host = 64 hosts

64 – 2 = 62 Usable IPs

The range of IP addresses: -

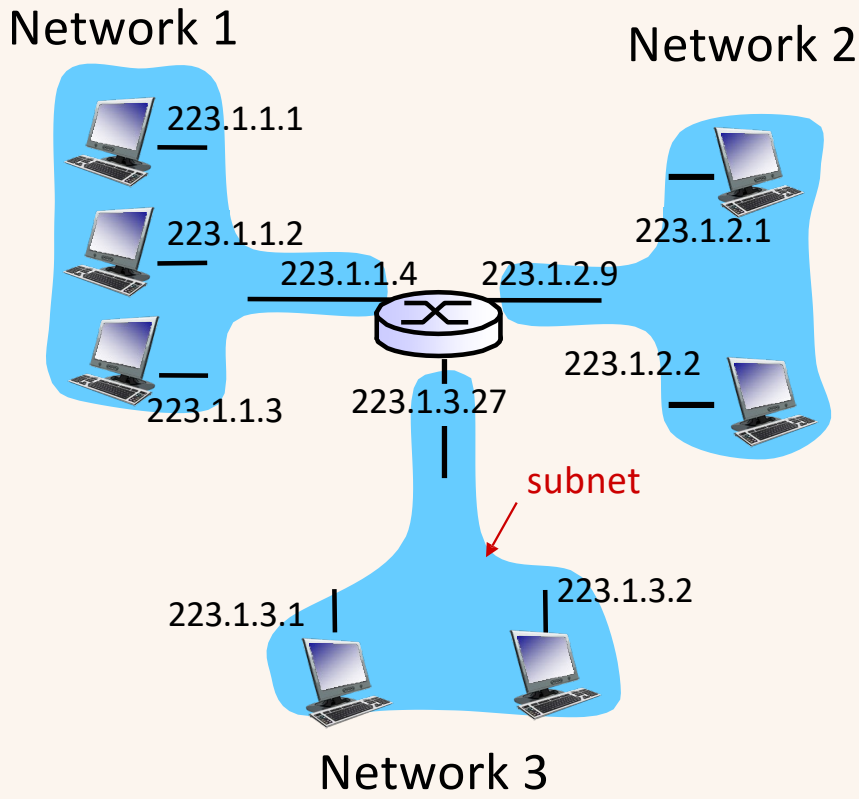
First IP : 192.168.1.32 to Last IP 192.168.1.63

Subnets

- **Subnetting** is allow the block of addresses to be split into several parts for internal use as multiple networks.

- **IP address:**
  - Subnet part - high-order bits
  - Host part - low-order bits

- *What's a subnet?*
  - Device interfaces with the same subnet part of the IP address
  - Can physically reach each other *without intervening router*

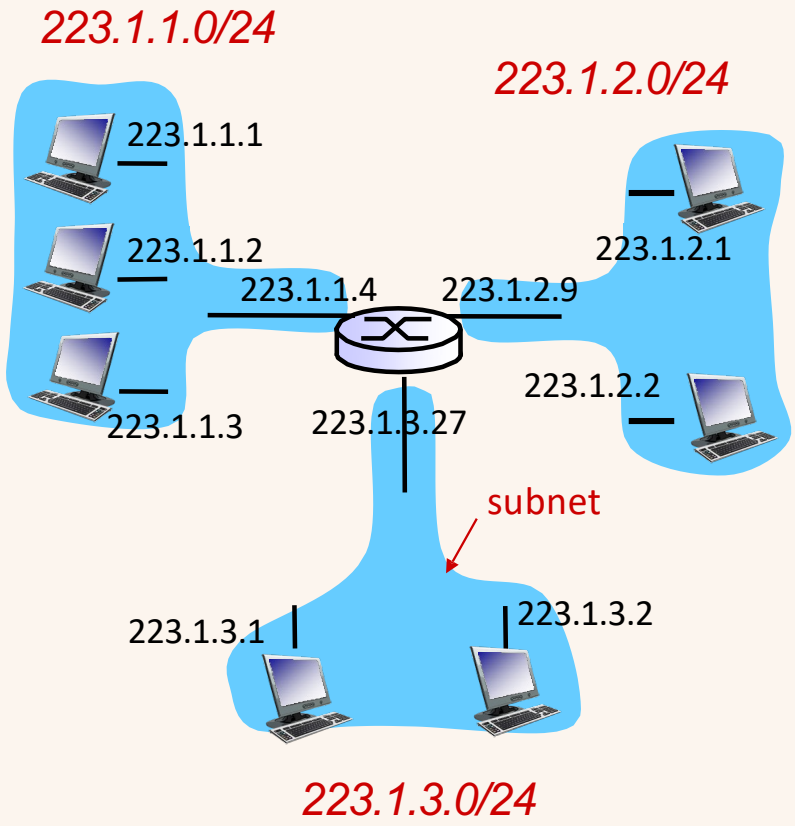


Network consisting of 3 subnets

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*

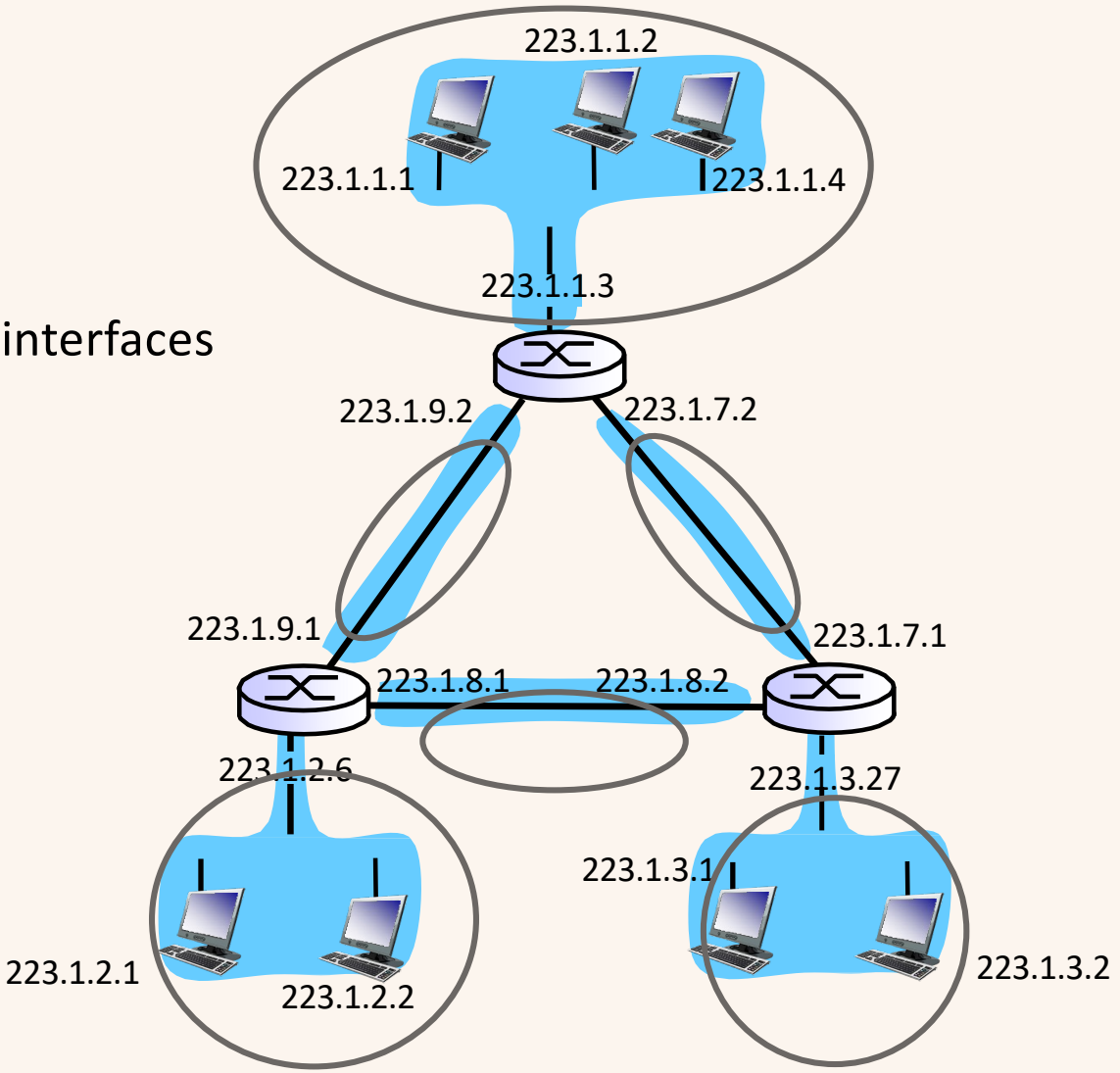


subnet mask: /24

How many Networks?

6 Networks

Each Router has 3 interfaces



Subnets

Benefits of subnetting include:

- Reduced network traffic
- Optimized network performance
- Simplified management
- Facilitated spanning of large geographical distances.

Subnet work

Subnets

The Internet is running out of IP addresses. One solution is to subnet a network address.

This is done by borrowing host bits to be used as network bits.

Example:

- IP address: 190.150.10.2
- Class B mask 255.255.0.0

Borrowing 1 bit gives a subnet mask of 255.255.128.0
Borrowing 2 bits gives a subnet mask of 255.255.192.0
Borrowing 3 bits gives a subnet mask of 255.255.224.0
Borrowing 4 bits gives a subnet mask of 255.255.240.0

Subnet work

Example 1:

Given an IP address of 180.200.0.0, subnet by borrowing 4 bits.
Mask is 255.255.0.0. then:

Subnet mask = 255.255.240.0
The 4 bits borrowed are value 128, 64, 32, 16. This will create 16 sub-networks, where the first and last will be unusable. Where 2^4

Subnetwork address:

180.200.0.0
180.200.16.0
180.200.32.0
180.200.48.0
180.200.64.0
etc…

Subnet work

The first 3 useable subnetworks are:

1- 180.200.16.0
2- 180.200.32.0
3- 180.200.48.0

For sub-network 180.200.16.0, the valid IP address are:

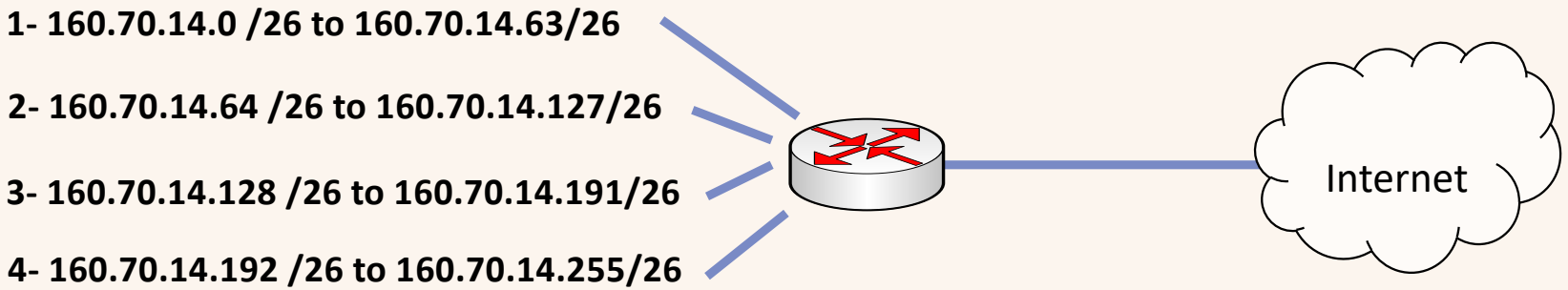
First IP Address 180.200.16.1 to **Last IP address** 180.200.31.254

Directed broadcast address is:

180.200.31.255

Exercise 1

An organization is granted a block of addresses with the beginning address **160.70.14.0/26.** The organization needs to have 3 subblocks of addresses to use in its three subnets: each subblock of 60 addresses, **Design the subblocks.**



Exercise 2

Q1: Your company has been given a 200.10.57.0 network address. You need to divide your network into two subnets (X and Y) using a router, Answer the following questions.

1- What is the network class?

2- How many bits need to be borrowed from the host field to the subnet field?

3- What is the actual number of hosts per subnet ?

4- What is the usable number of hosts per subnet ?

5- What is the subnet mask?

6- What are the IP addresses of the router's NICs at both subnets? Assuming that routers NICs at subnets X and Y take the first usable host IP addresses at the first and second usable subnets respectively.

Exercise 2

1- What is the network class? Class C

2- How many bits need to be borrowed from the host field to the subnet field?

- 1 bits borrow for the Subnet and 7 bits for the hosts

3- What is the actual number of hosts per subnet? 128

4- What is the usable number of hosts per subnet? 128 - 2 = 126

5- What is the subnet mask? 255.255.255.128

6- What are the IP addresses of the router's NICs at both subnets? Assuming that routers NICs at subnets X and Y take the first usable host IP addresses at the first and second usable subnets respectively

Exercise 2

- **Subnet X**: 200.10.57.0/25 Network Address: 200.10.57.0
  - First usable IP address: 200.10.57.1 (used by the router's NIC for Subnet X)
  - Last usable IP address: 200.10.57.126
  - Broadcast Address: 200.10.57.127
- **Subnet Y**: 200.10.57.128/25 Network Address: 200.10.57.128
  - First usable IP address: 200.10.57.129 (used by the router's NIC for Subnet Y)
  - Last usable IP address: 200.10.57.254
  - Broadcast Address: 200.10.57.255

Thank you!

Do you have any questions?

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