IP Addressing, Subnets, DHCP

application
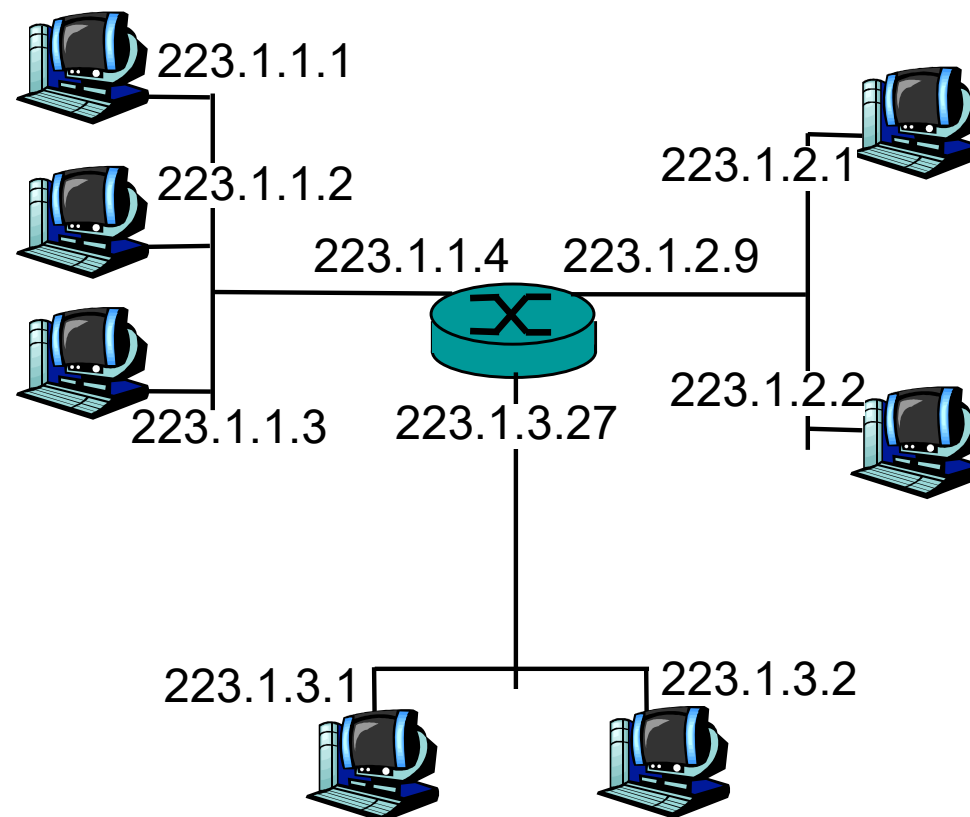
transport

network

link

physical

- **IP address**: 32-bit identifier for host, router *interfaces*

- **interface**: connection between host/router and physical link

  - routers typically have multiple interfaces

  - hosts typically have one or two interfaces

 - **IP addresses** are associated with each interface

223.1.1.1

223.1.2.1

223.1.1.2

223.1.1.4   223.1.2.9

223.1.1.3   223.1.3.27

223.1.2.2

223.1.3.1   223.1.3.2

Dotted-decimal notation

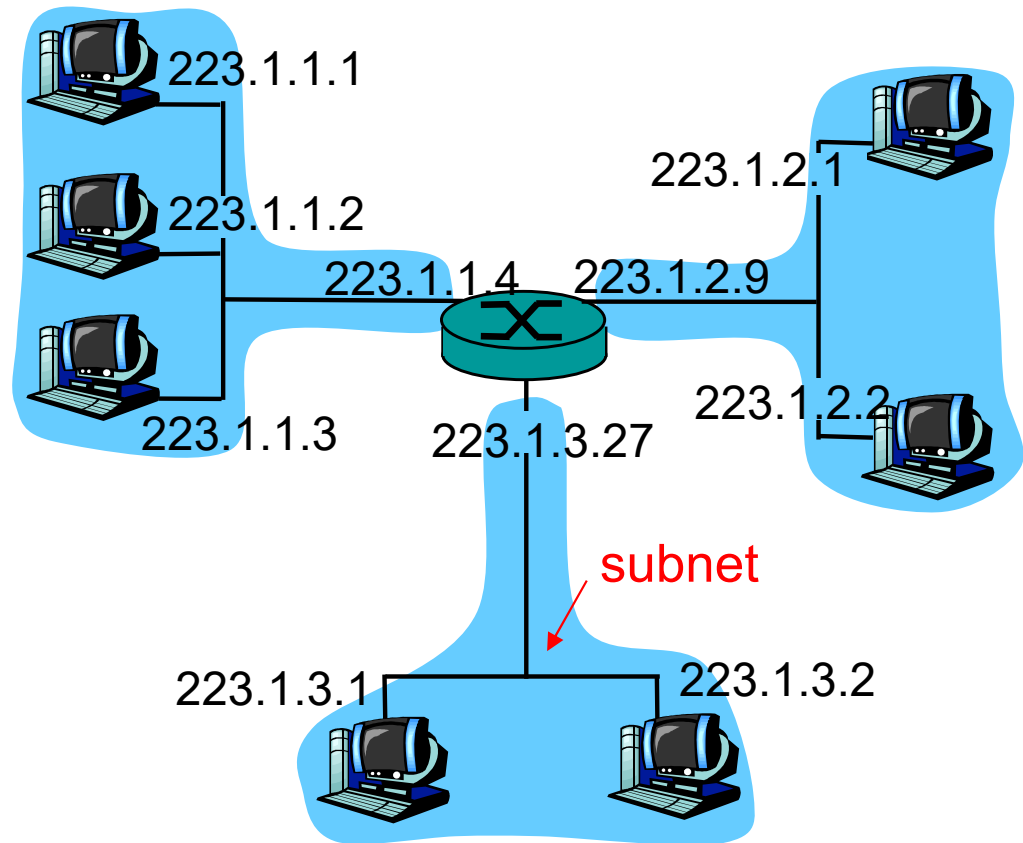223.1.1.1 = 11011111 00000001 00000001 00000001

223   1   1   1

Suppose there are three routers between a source host and a destination host.

- Ignoring fragmentation, an IP datagram sent from the source host to the destination host will travel over how many interfaces?

- How many forwarding tables will be indexed to move the datagram from the source to the destination?
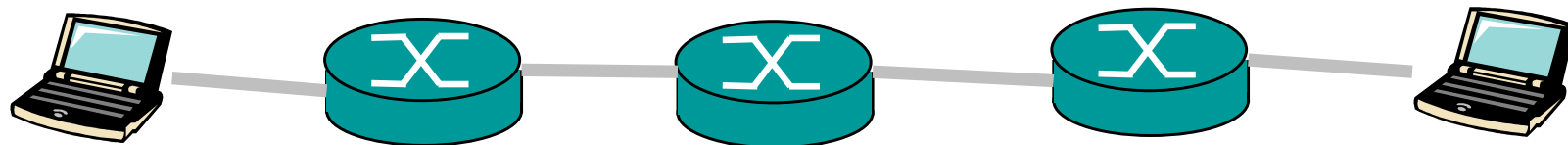
- ## IP address:
  - subnet part (**high order bits**)
  - host part (**low order bits**)

- ## *What is a subnet ?*
  - device interfaces with same subnet part of IP address
 - **can physically reach each other without intervening router** (e.g. can be connected by an Ethernet switch).

223.1.1.1

223.1.1.2

223.1.1.4   223.1.2.9

223.1.1.3   223.1.3.27

223.1.2.1

223.1.2.2

subnet

223.1.3.1   223.1.3.2

network consisting of 3 subnets

Note*: High order = leftmost = most significant* **bits** *in an address!*

Recipe:

- To **determine the subnets**, detach each interface from its host or router, creating islands of isolated networks (disconnected graphs).

- Each isolated network is called a subnet.

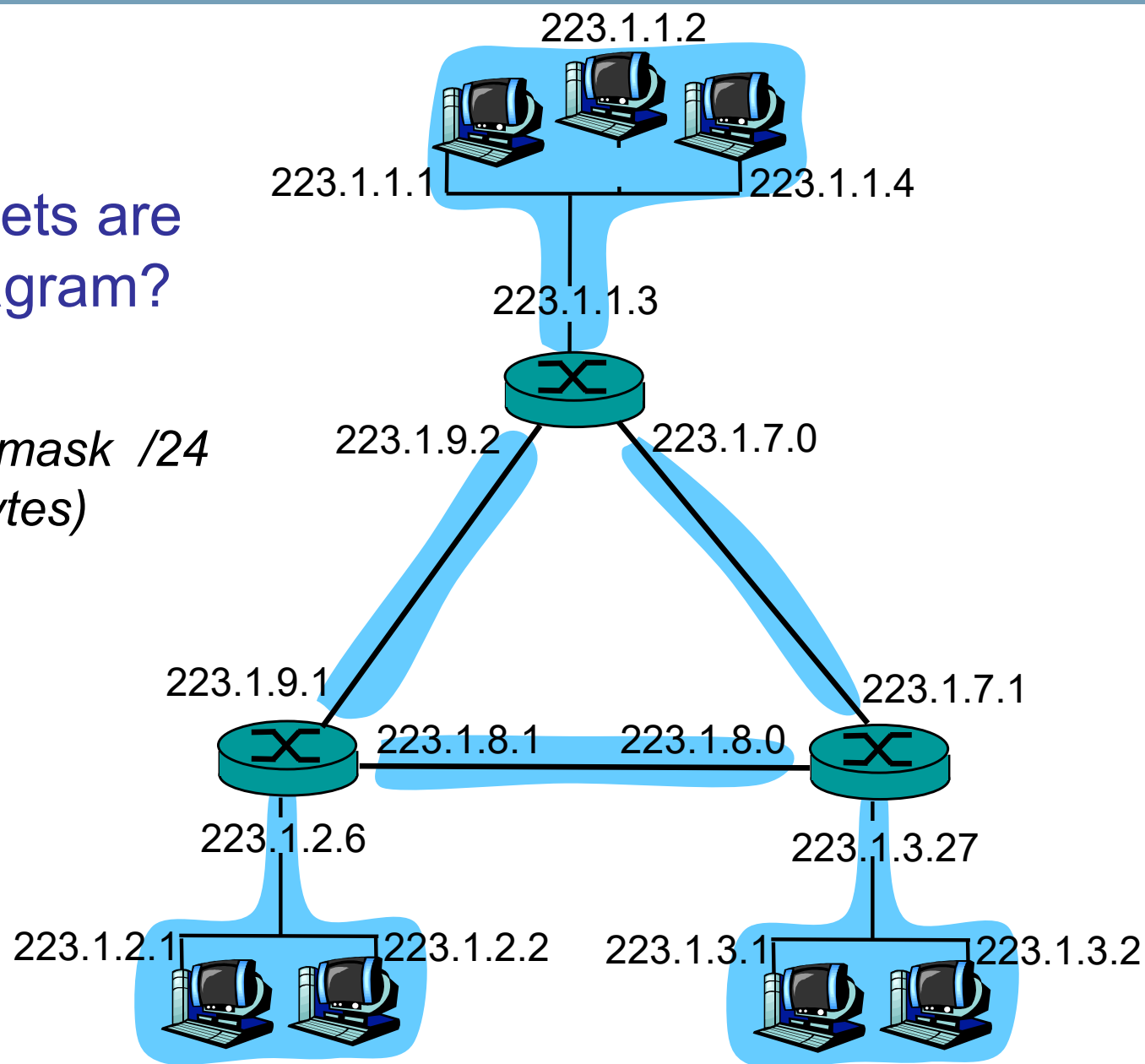223.1.1.0/24   223.1.2.0/24

223.1.3.0/24   Subnet mask: /24
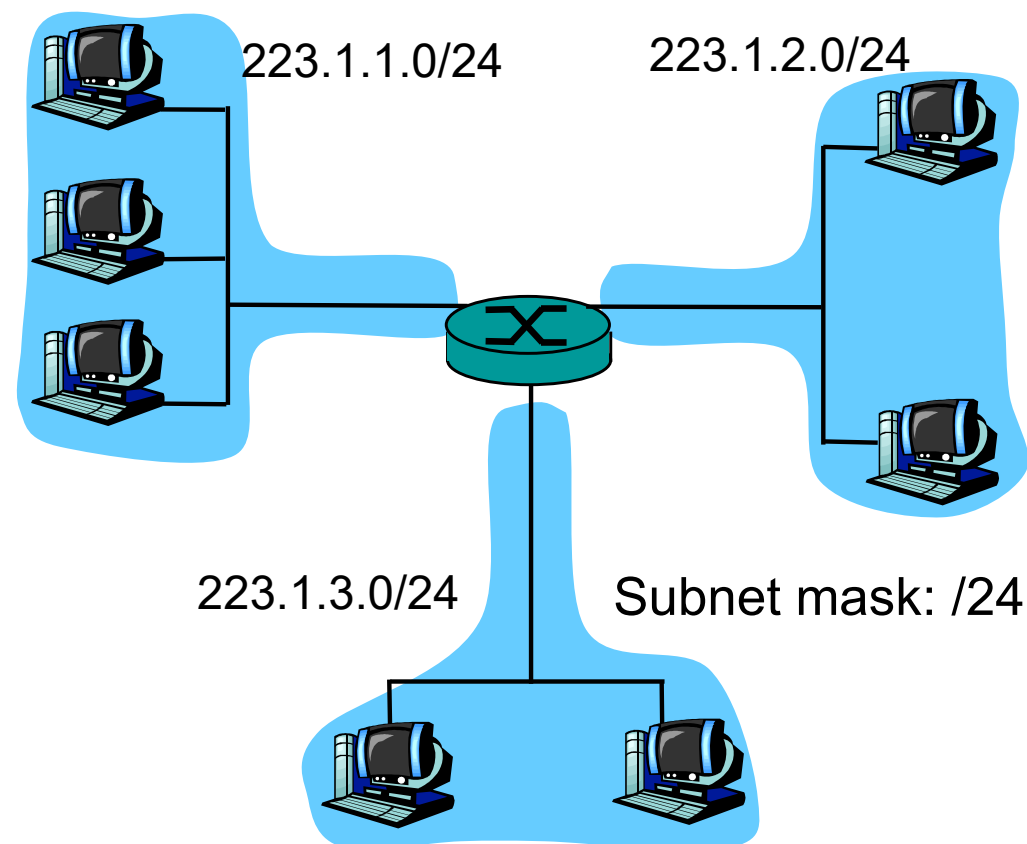
Leftmost *(most significant) X bits* out of *32 bit* defines the subnet address:

Here: **223.1.1**.xxx   ⟺   **11011111.00000001.00000001**.xxxxxxxx

Question:

How many subnets are shown in the diagram?

Hint: consider subnet mask /24 (i.e. fix first three bytes)

223.1.1.2

223.1.1.1

223.1.1.4

223.1.1.3

223.1.9.2

223.1.7.0

223.1.9.1

223.1.7.1

223.1.8.1

223.1.8.0

223.1.2.6

223.1.3.27

223.1.2.1

223.1.2.2

223.1.3.1

223.1.3.2

CIDR: Classless InterDomain Routing (cider)

– flexible subnet addressing: subnet portion of address of arbitrary length

– address format: a.b.c.d/x, where **x is # bits in subnet portion** (leftmost bits) of the address

$\longleftarrow$ prefix $\longrightarrow$ | $\leftarrow$ host $\longrightarrow$

11001000 00010111_0001000 0 00000000

200.23.16.0/23
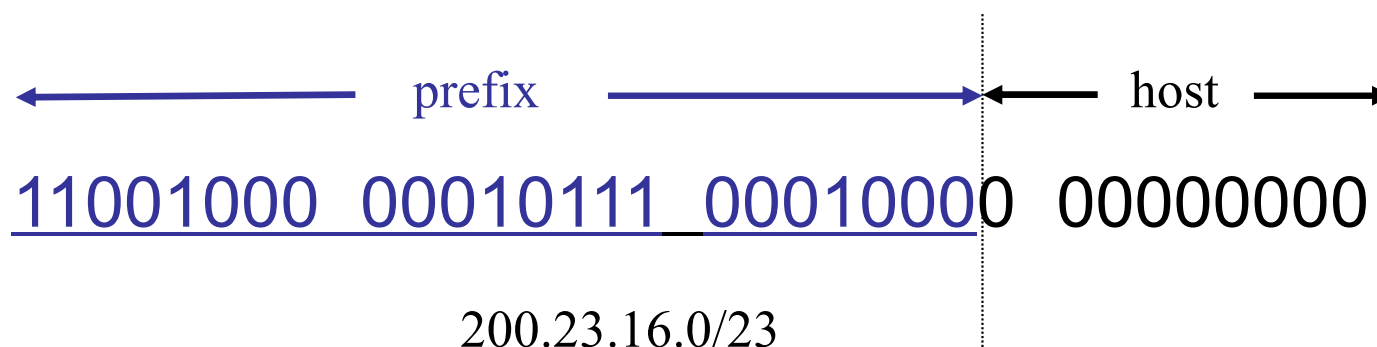
- **Classful addressing**: Class A, B, C networks with (8, 16, 24 bit prefixes) – historical, inflexible…

- **Broadcast address**: 255.255.255.255, all datagrams are delivered to all hosts on the same subnet.

- **Subnet (network) mask** designates a subnetwork.

For example:
192.168.0.0 with netmask 255.255.255.0 corresponds to:
192.168.0.0/24 in CIDR notation,
i.e. leftmost 24 bits determine the specific subnetwork which can have up to 256 hosts.

Q: How does a *host* get its IP address?

- *Manual entry* (rare but possible via config or control panel of operating system)
- DHCP: Dynamic Host Configuration Protocol: dynamically get address from a DHCP server
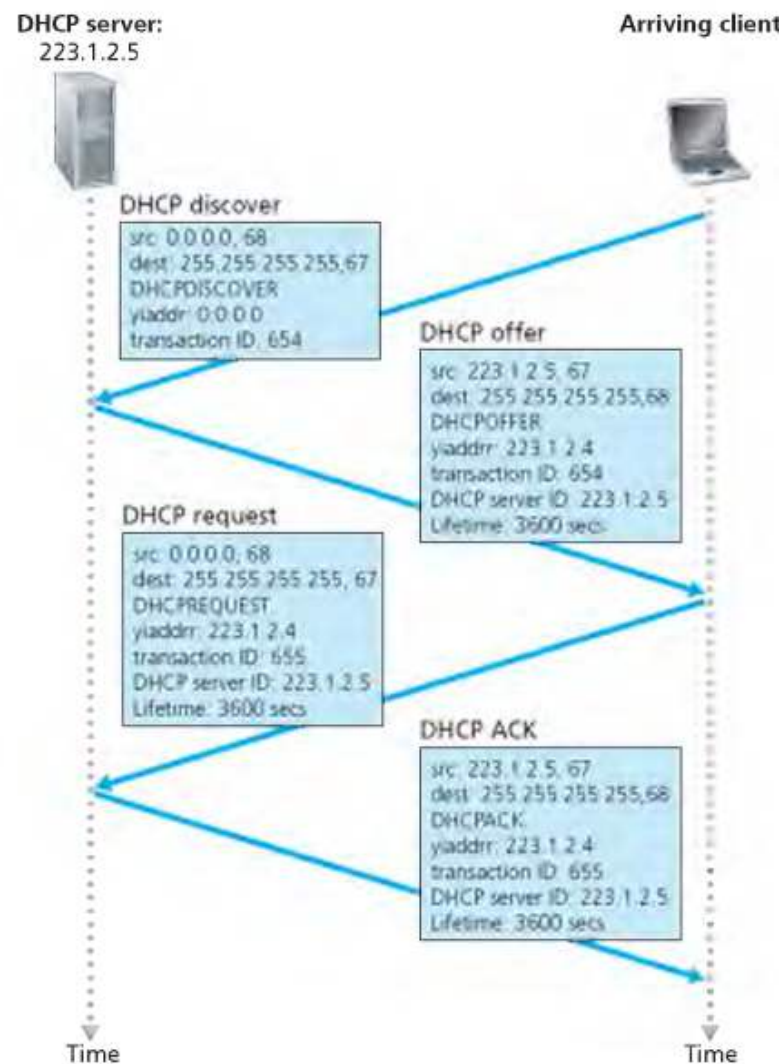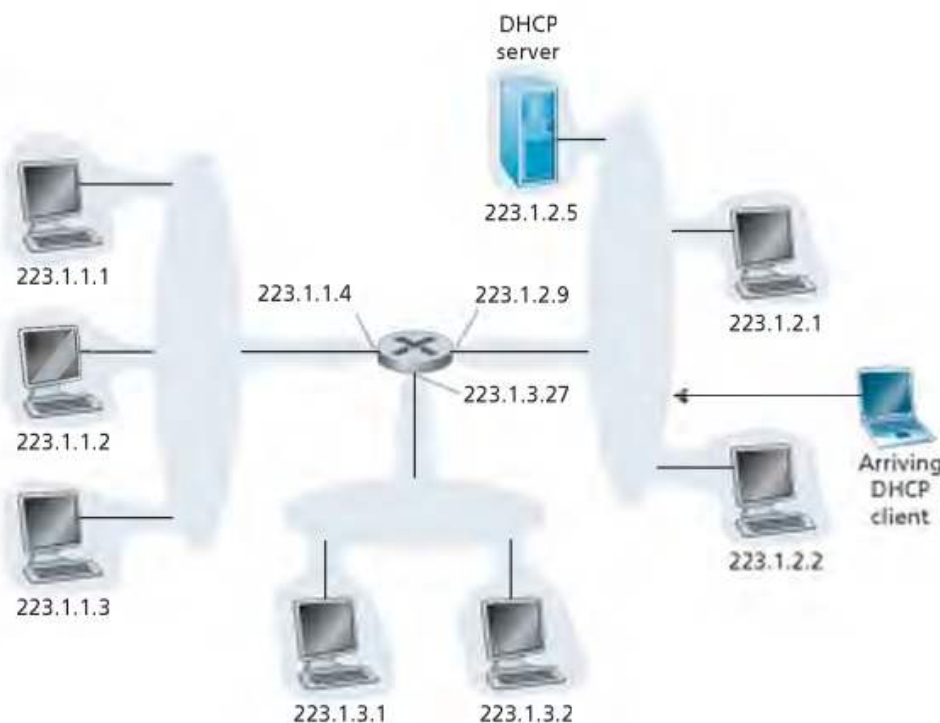 - "plug-and-play"

<u>Goal:</u> allow host to *dynamically* obtain its IP address from a network server when it joins network

- Can renew its lease on address in use

- Allows reuse of addresses (only hold address while connection is "on")

- Support for mobile users who want to join network

DHCP overview:

– host broadcasts "DHCP discover" msg

– DHCP server responds with "DHCP offer" msg

– host requests IP address: "DHCP request" msg

– DHCP server sends address: "DHCP ack" msg

Questions:
1. Why use broadcast in the DHCP protocol?
2. What if the DHCP server is not in the subnet?

yiaddr: your internet addr