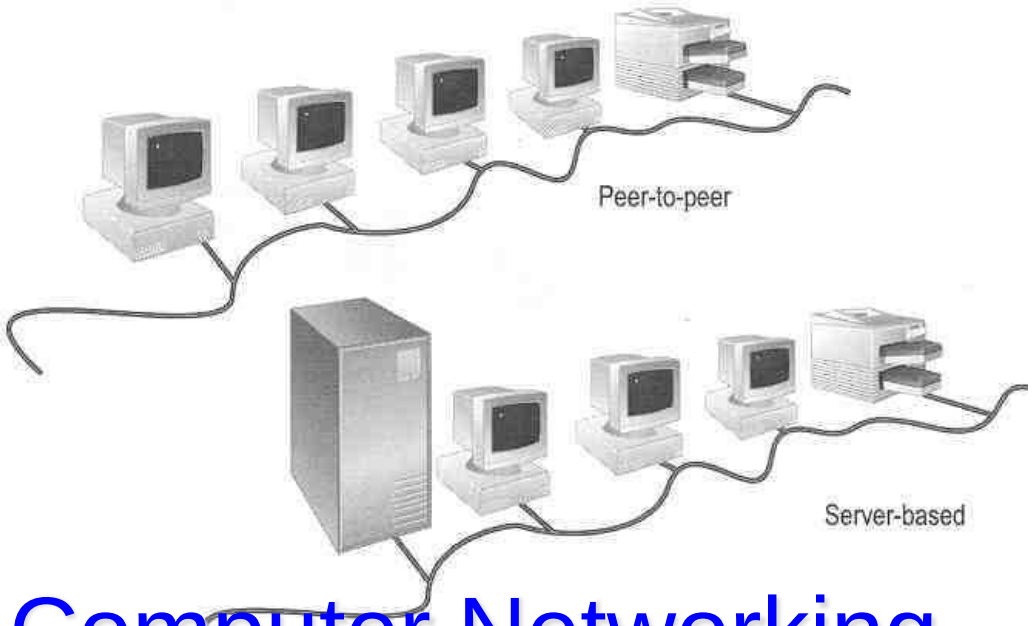


Computer Networking
Lecture 5
Hassan Alamri

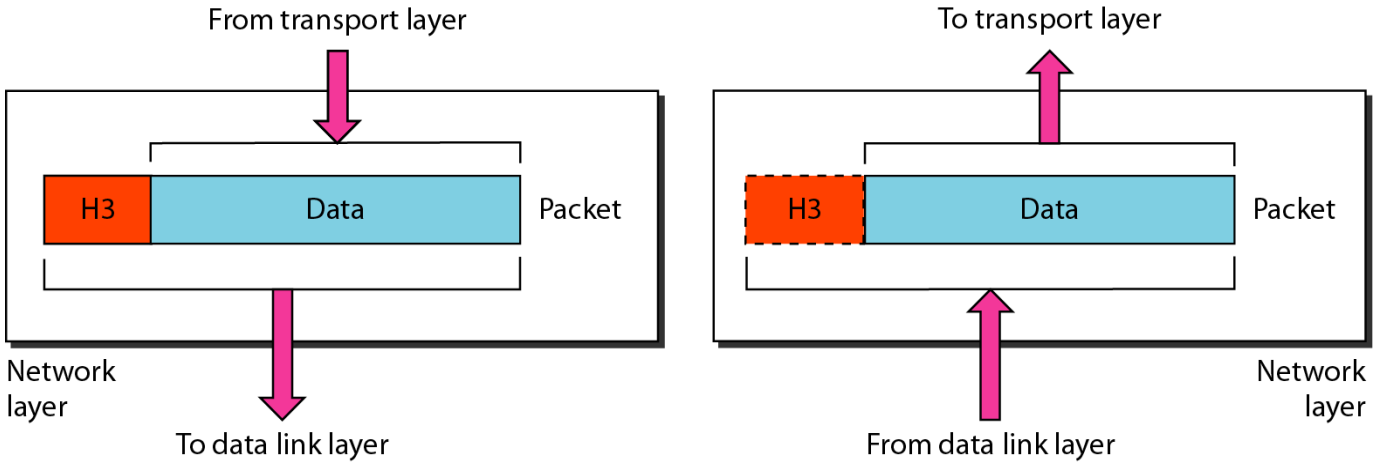
Agenda:

Network Layer (3)

- Network Layer principles
- Network Layer protocols
- Addressing
- IP
- Routing Protocols

Network (Layer3)

The network layer is responsible for the delivery of individual packets from the source host to the destination host , possibly across multiple networks (links).

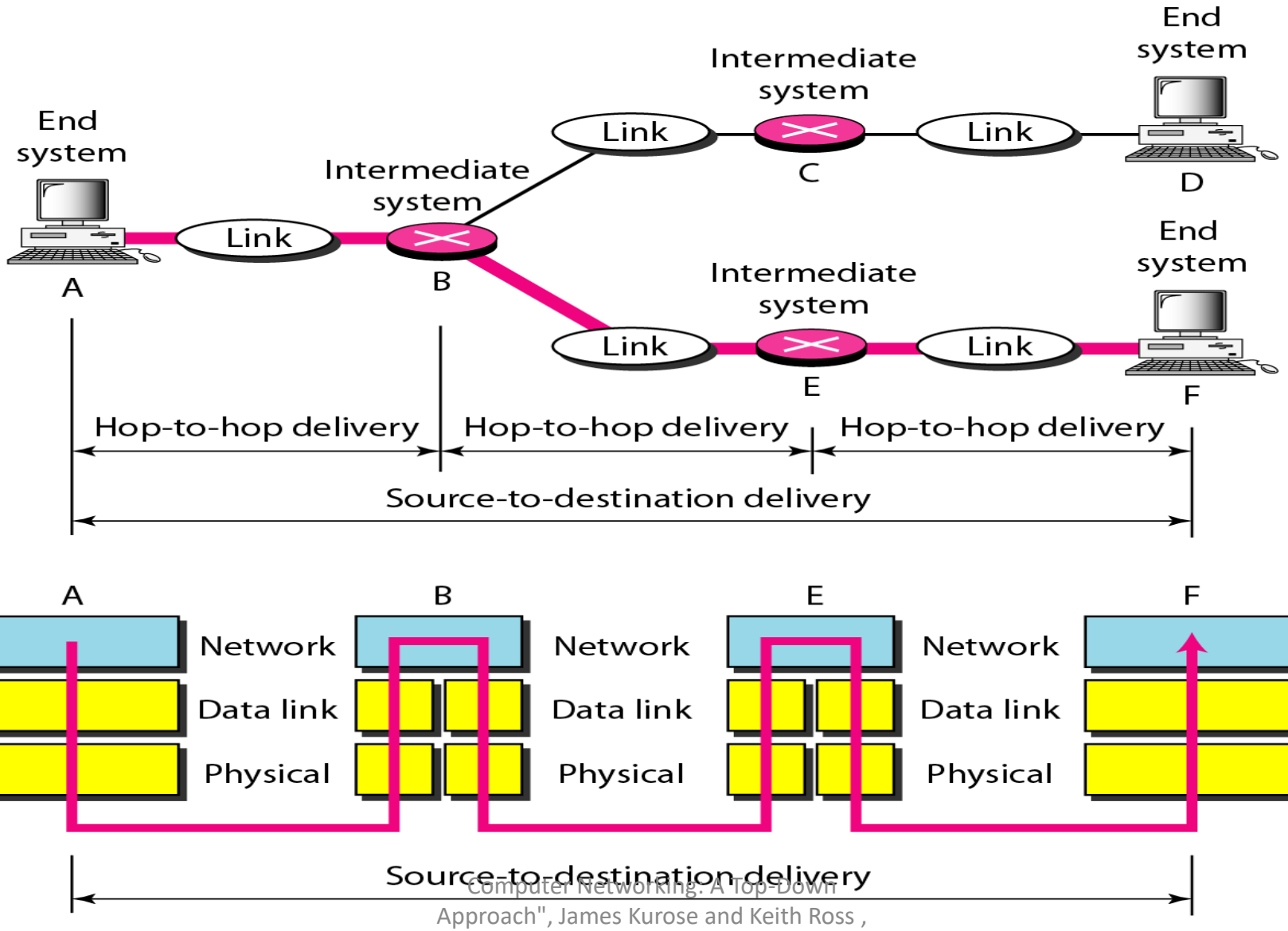


Network (Layer3) responsibilities

➢**Logical addressing**. The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary, we need another addressing system to help distinguish the source and destination systems. The network layer adds a header to the packet coming from the upper layer that, among other things, includes the logical addresses of the sender and receiver.

➢**Routing.** When independent networks or links are connected to create *internetworks* (network of networks) or a large network, the connecting devices (called *routers* or *switches) route or switch the packets to their final destination. One of the functions* of the network layer is to provide this mechanism.

Source-to-destination delivery



Network Layer Protocols

1. Address Resolution Protocol(ARP)

It is a protocol used by the Internet Protocol (IP) specifically IPv4, to map IP network addresses to the hardware addresses used by a data link protocol

2. Internet Control Message Protocol (ICMP)

ICMP (Internet Control Message Protocol) is an error-reporting protocol network devices.

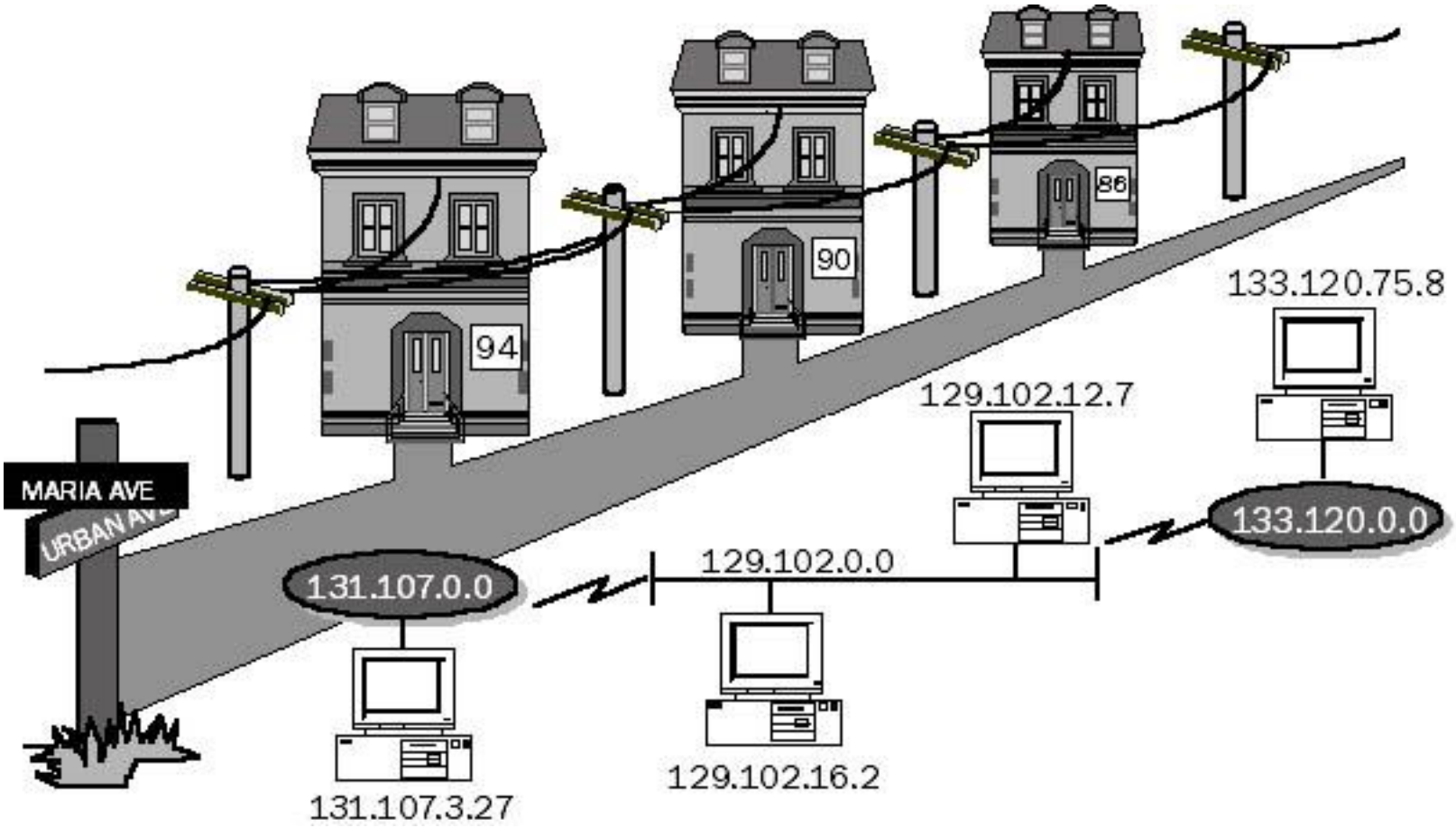
3. Internet Protocol Version 4 (IPv4)

IPv4 which has ruled the world for decades but now is running out of address space.

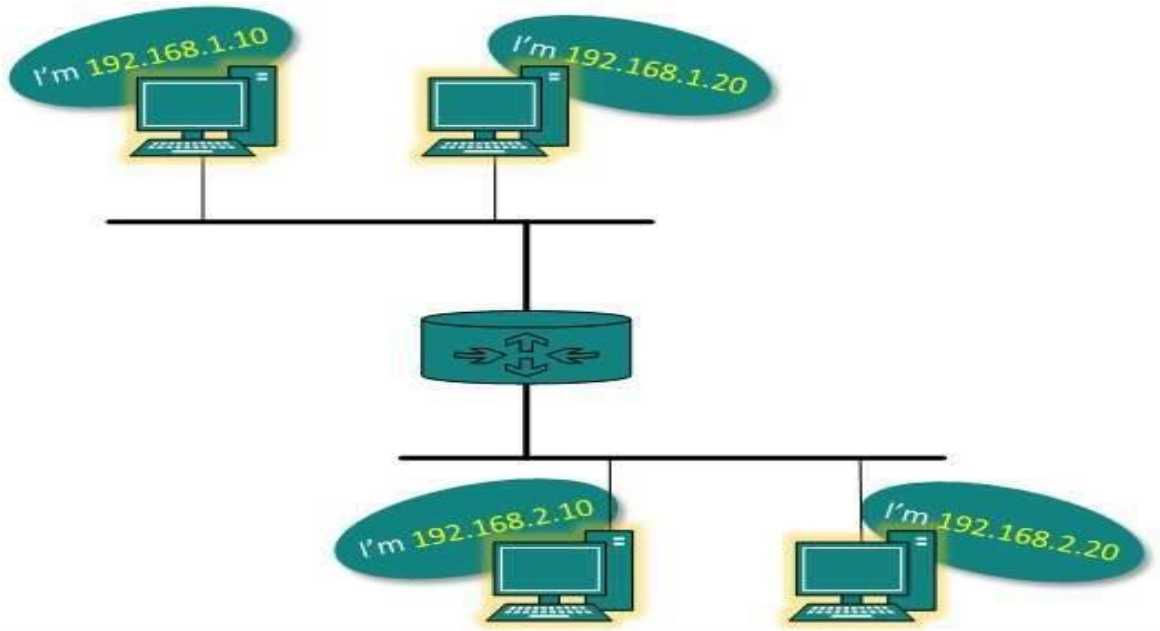
4. Internet Protocol Version 6 (IPv6)

IPv6 is created to replace IPv4 and hopefully mitigates limitations of IPv4 too.

Network Addressing



Network Addressing



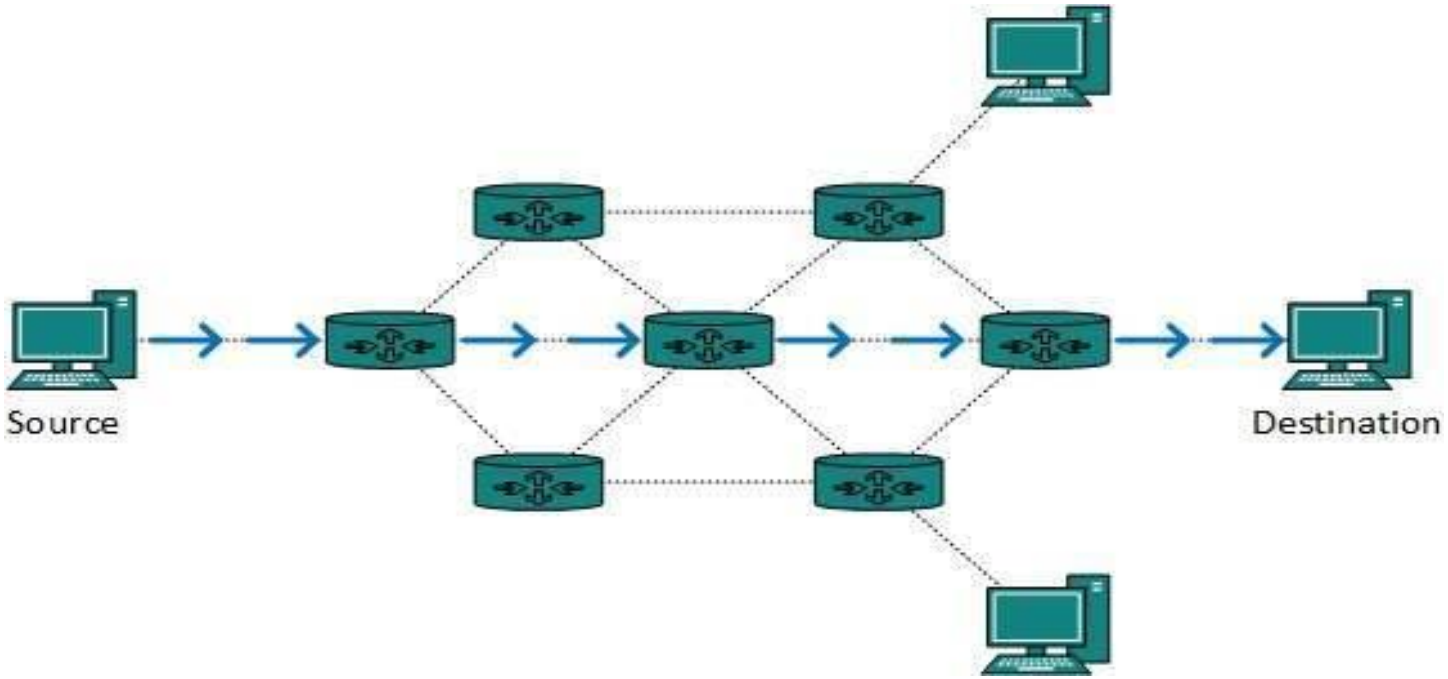
IP addressing provides mechanism to differentiate between hosts and network. Because IP addresses are assigned in hierarchical manner, a host always resides under a specific network. The host which needs to communicate outside its subnet, needs to know destination network address, where the packet/data is to be sent

Network Address Types

Network address can be of one of the following:

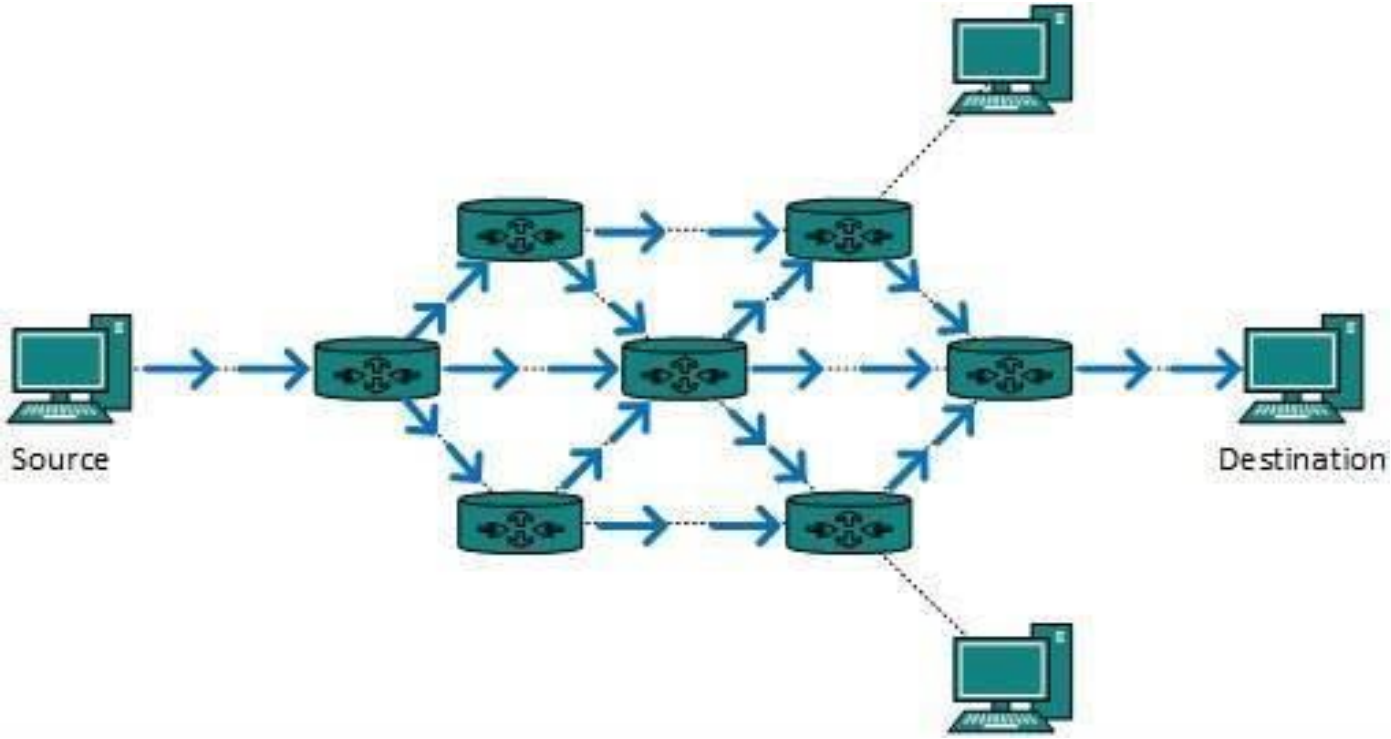
1. **Unicast** (destined to one host)
2. **Multicast** (destined to group)
3. **Broadcast** (destined to all)
4. **Anycast** (destined to nearest one)

Unicast Routing



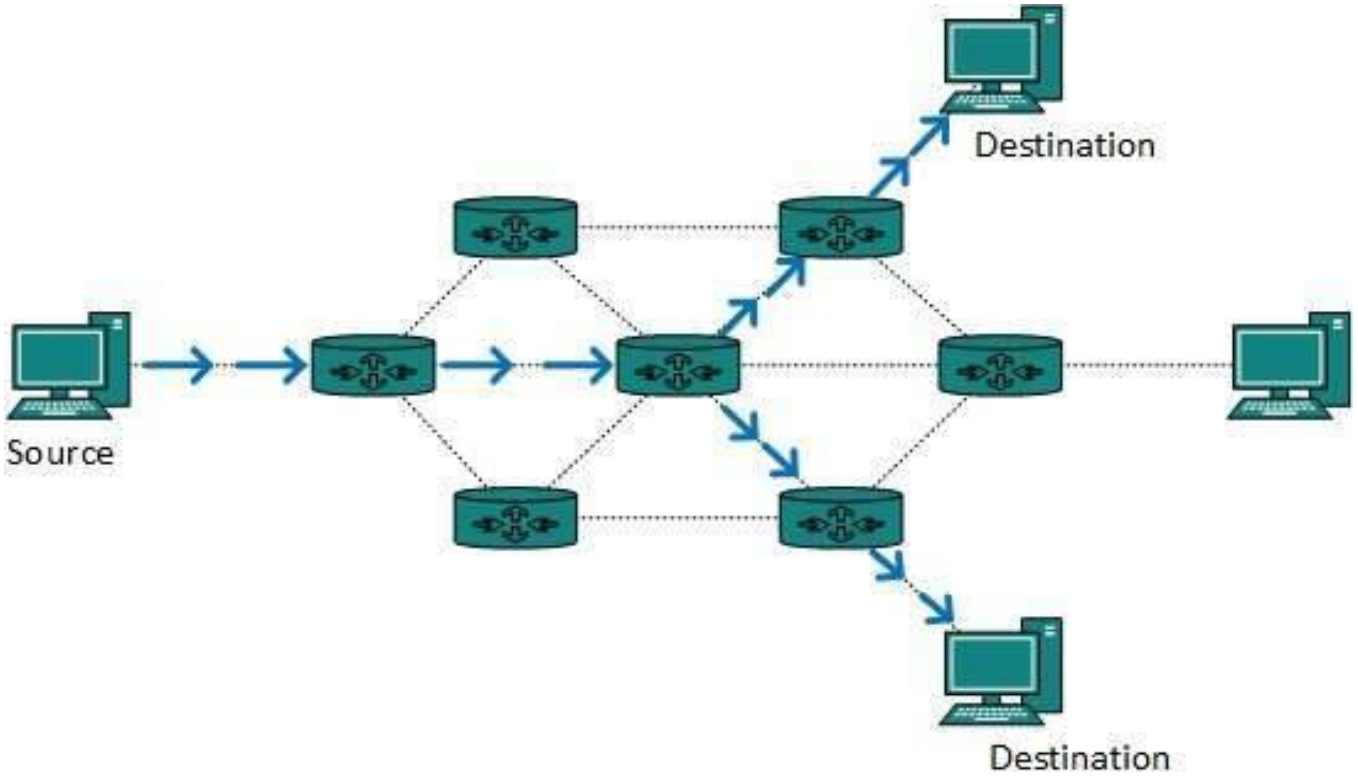
It is the simplest form of routing because the destination is already known. In this mode, data is sent only to one destined host

Broadcast Routing



A broadcast message is destined to all network devices. The Destination Address field contains a special broadcast address, i.e. **255.255.255.255**

Multicast Routing



In multicast routing, the data is sent to only nodes which wants to receive the packets.

IP Address

A network address consists of two parts:

(i) Address of the LAN and

(ii) Device or host address on that LAN

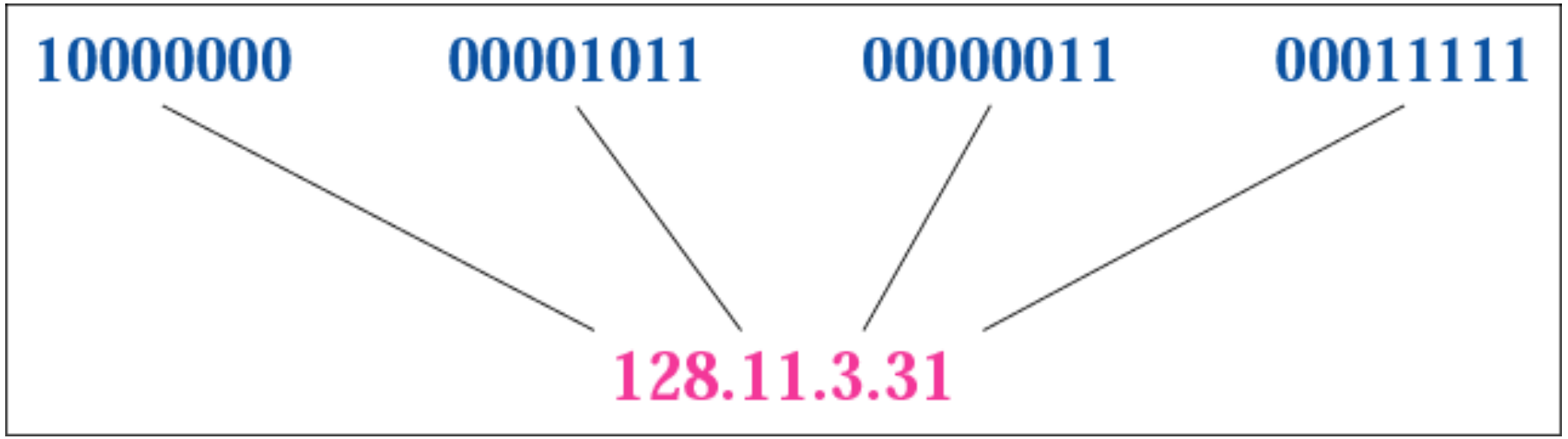
What is an IP Address?

An IP address is a 32-bit address.

The IP addresses are unique.

The address space of IPv4 is 2^{32} or 4,294,967,296.

Dotted-decimal notation



Example 1

Change the following IP address from binary notation to dotted-decimal notation.

10000001 00001011 00001011 11101111

Solution

129.11.11.239

Example 2

Change the following IP address from dotted-decimal notation to binary notation:

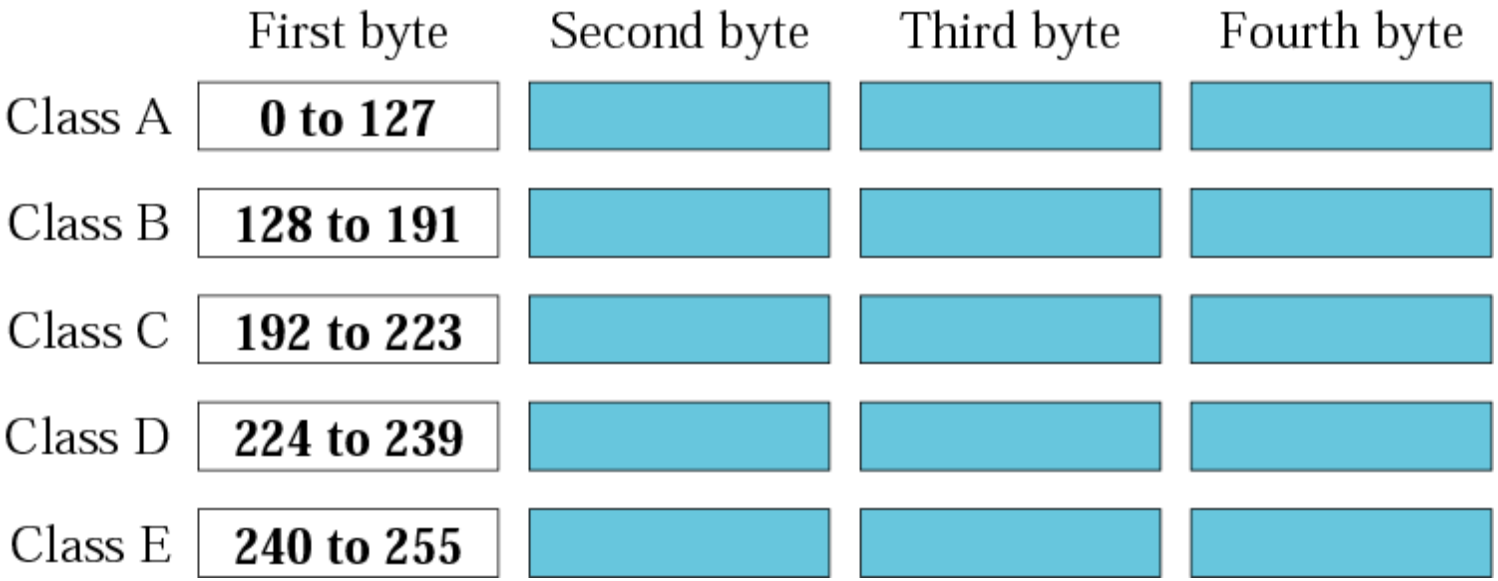
111.56.45.78

Solution

01101111 00111000 00101101 01001110

Figure 4-3

IP Classes



Example 7

Find the class of the following addresses

158.223.1.108

227.13.14.88

Solution

- 158.223.1.108

1st byte = 158 (128<158<191) class B

- 227.13.14.88

1st byte = 227 (224<227<239) class D

Example:

- You been given this IP Address: 50.60.70.80 , Find out the following:
- 1- Which Class is this IP Address?
- 2- What is the Network Address?
- 3- What is the first Host IP Address?
- 4- What is the Last Host IP Address?
- 5- What is the Broadcast IP Address?
- 6- What is the Subnet mask for this IP Address?

Example:

- You been given this IP Address: 50.60.70.80 , Find out the following:
- 1- Which Class is this IP Address? **Class A**
- 2- What is the Network Address? **50.0.0.0**
- 3- What is the first Host IP Address? **50.0.0.1**
- 4- What is the Last Host IP Address? **50.255.255.254**
- 5- What is the Broadcast IP Address? **50.255.255.255**
- 6- What is the Subnet mask for this IP Address? **255.0.0.0**

Routing Protocol

A **routing protocol** specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network.

Routing Protocols Types:

- There are two kinds of routing protocols available to route unicast packets:

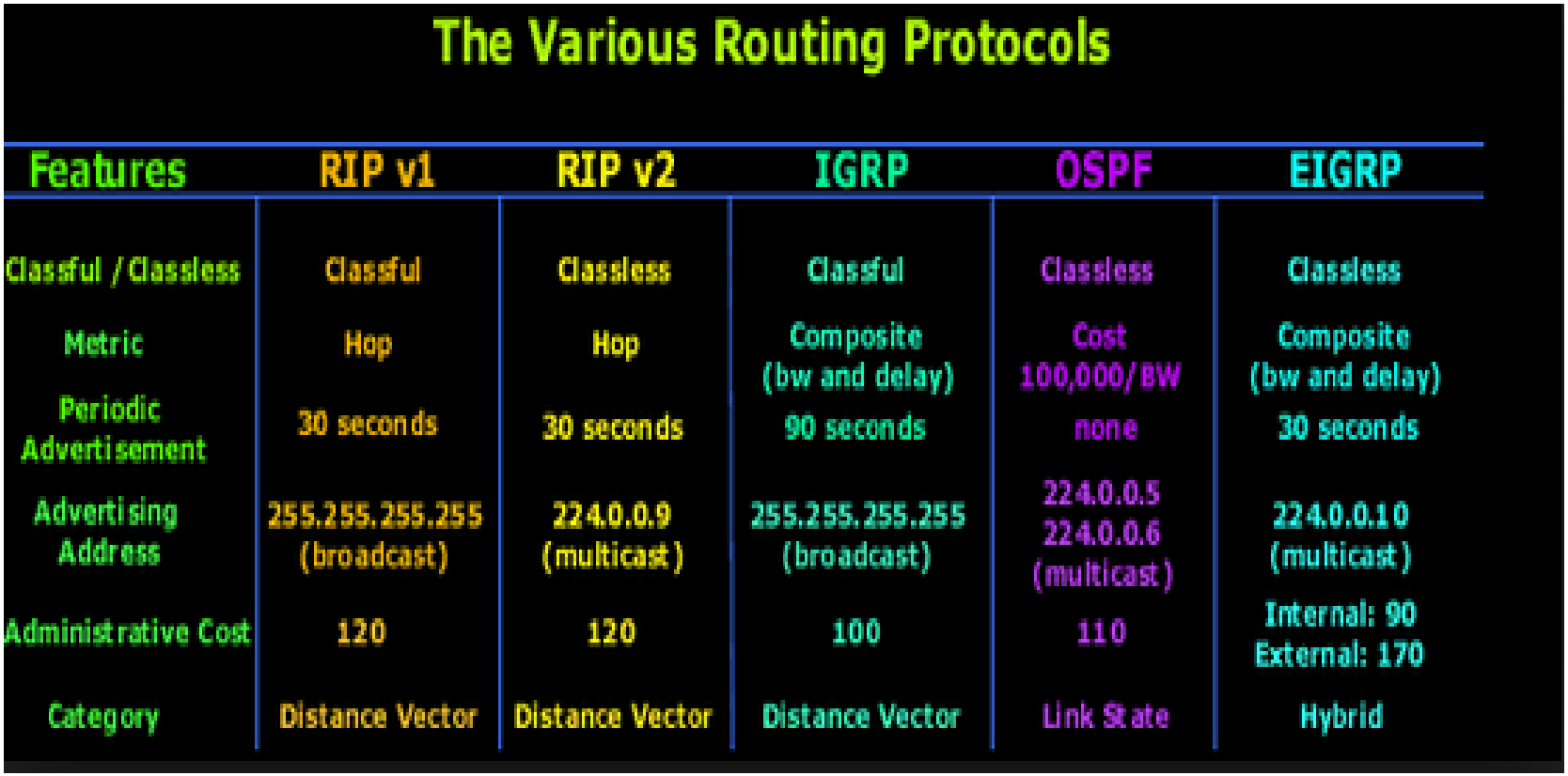
1. **Distance Vector Routing Protocol**

- Distance Vector is simple routing protocol which takes routing decision on the number of hops between source and destination. For example Routing Information Protocol (RIP).

2. **Link State Routing Protocol**

- Link State protocol is slightly complicated protocol than Distance Vector. It takes into account the states of links of all the routers in a network. For example, Open Shortest Path First (OSPF).

Routing Protocols Summary



The Various Routing Protocols

Features	RIP v1	RIP v2	IGRP	OSPF	EIGRP
Classful / Classless	Classful	Classless	Classful	Classless	Classless
Metric	Hop	Hop	Composite (bw and delay)	Cost 100,000/BW	Composite (bw and delay)
Periodic Advertisement	30 seconds	30 seconds	90 seconds	none	30 seconds
Advertising Address	255.255.255.255 (broadcast)	224.0.0.9 (multicast)	255.255.255.255 (broadcast)	224.0.0.5 224.0.0.6 (multicast)	224.0.0.10 (multicast)
Administrative Cost	120	120	100	110	Internal: 90 External: 170
Category	Distance Vector	Distance Vector	Distance Vector	Link State	Hybrid

Reference

- Computer Networking: A Top-Down Approach", James Kurose and Keith Ross , 5th edition