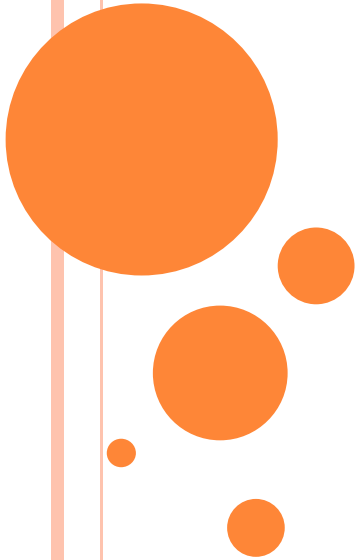
LAN PROTOCOLS



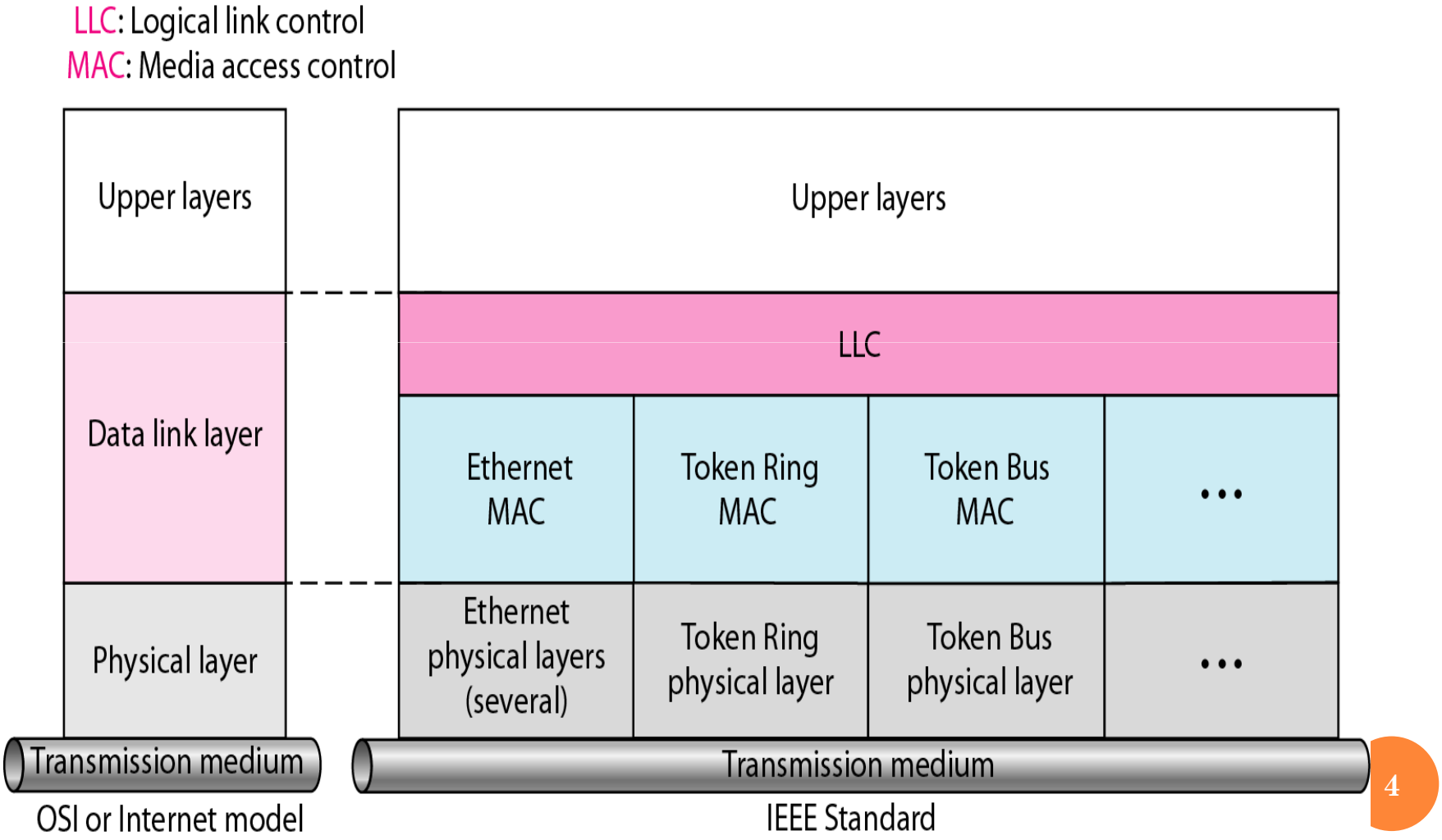
IEEE STANDARDS

- In 1985, the Computer Society of the IEEE started a project, called Project 802, to set standards to enable intercommunication among equipment from a variety of manufacturers. Project 802 is a way of specifying functions of the physical layer and the data link layer of major LAN protocols.

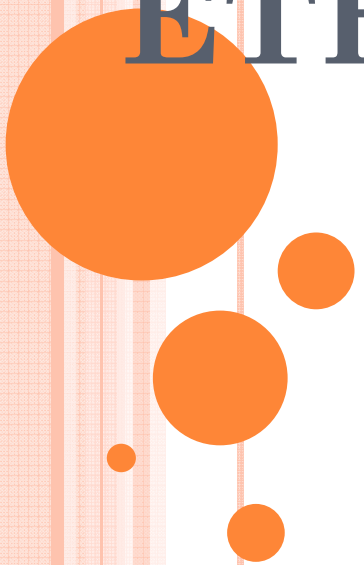
IEEE STANDARDS

- IP → IEEE 802.1
- LLC → IEEE 802.2
  - Hides the difference between various LAN protocols to the network layer.
- ETHERNET → IEEE 802.3
- TOKEN BUS → IEEE 802.4
- TOKEN RING → IEEE 802.5

IEEE STANDARD FOR LANs



ETHERNET IEEE 802.3



INTRODUCTION

- Most widely used LAN protocol
- Used with Bus or Star topology
- Access Method is CSMA/CD

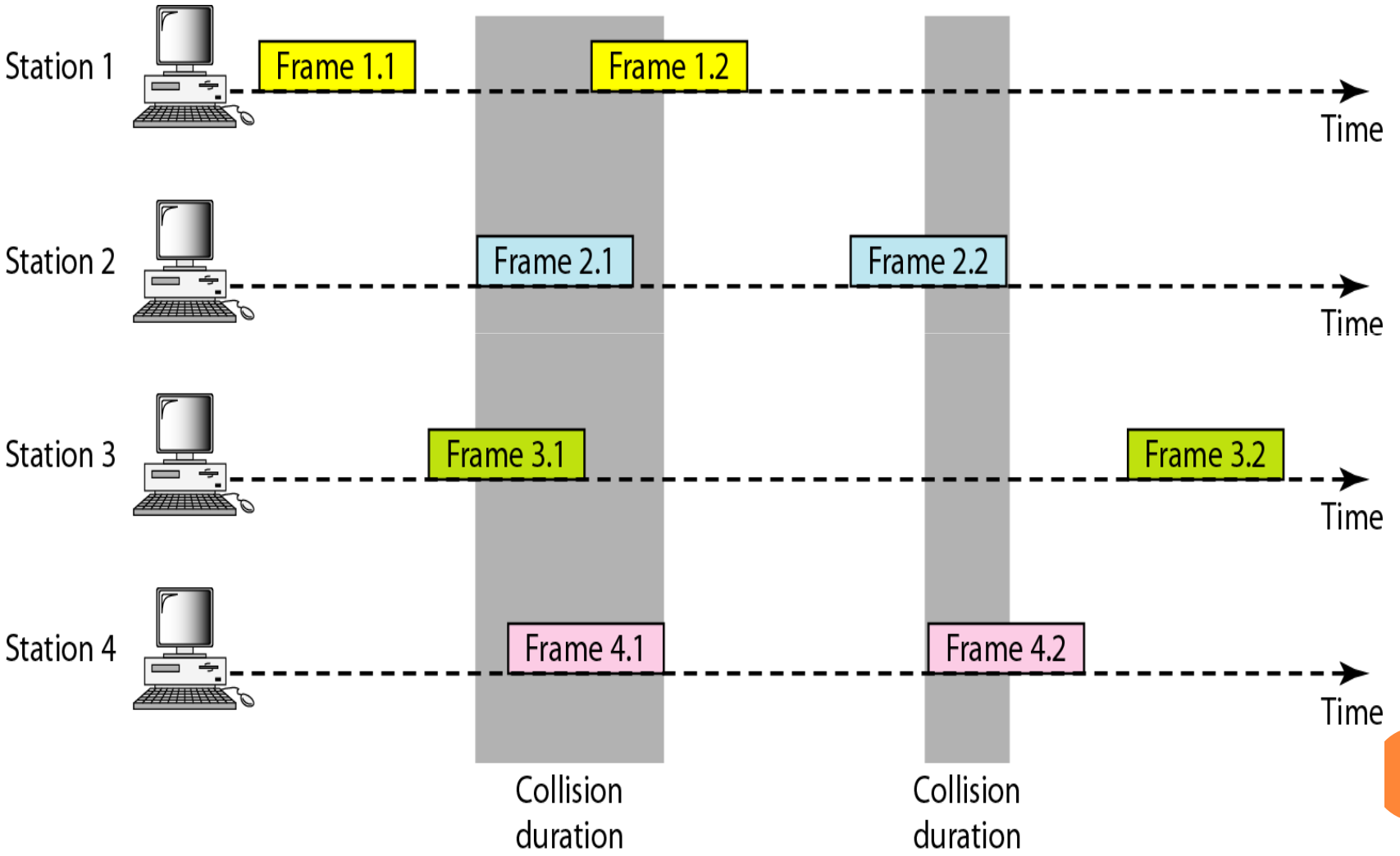
Topics discussed in this section:

ALOHA
Carrier Sense Multiple Access
Carrier Sense Multiple Access with Collision Detection

ALOHA

- Free for all
- Any station has a frame to transmit, it transmits.
- Contention occurs when more than one station transmits.

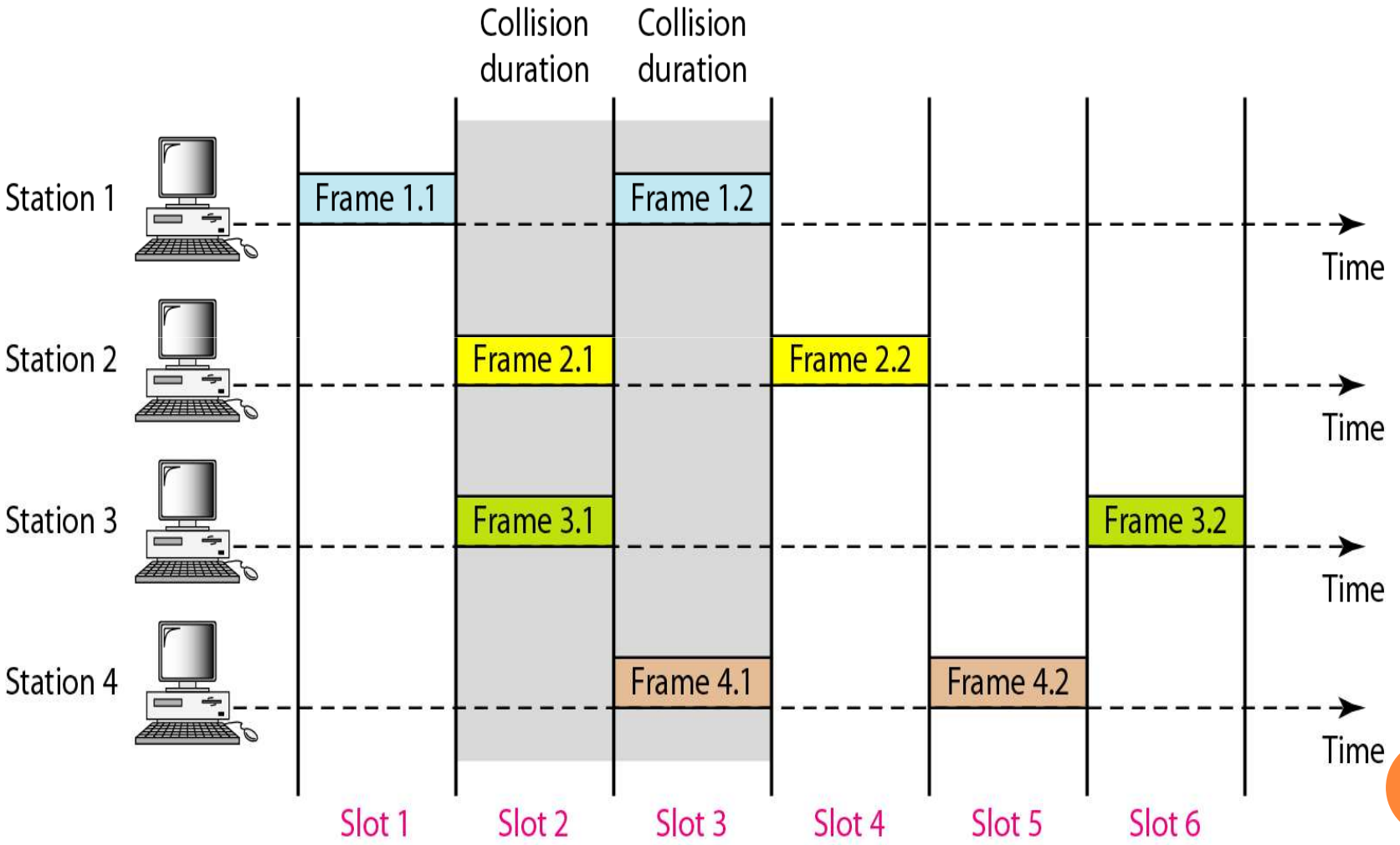
ALOHA CONT…


Station 1
Frame 1.1
Frame 1.2
Time
Station 2
Frame 2.1
Frame 2.2
Time
Station 3
Frame 3.1
Frame 3.2
Time
Station 4
Frame 4.1
Frame 4.2
Time
Collision duration
Collision duration

SLOTTED ALOHA

- Time divided into slots
- Slot size is equal.
- Therefore fixed time for frame transmission.
- If a station is ready with a frame, it waits until start of next transmission time.
- Contention occurs at time slots.

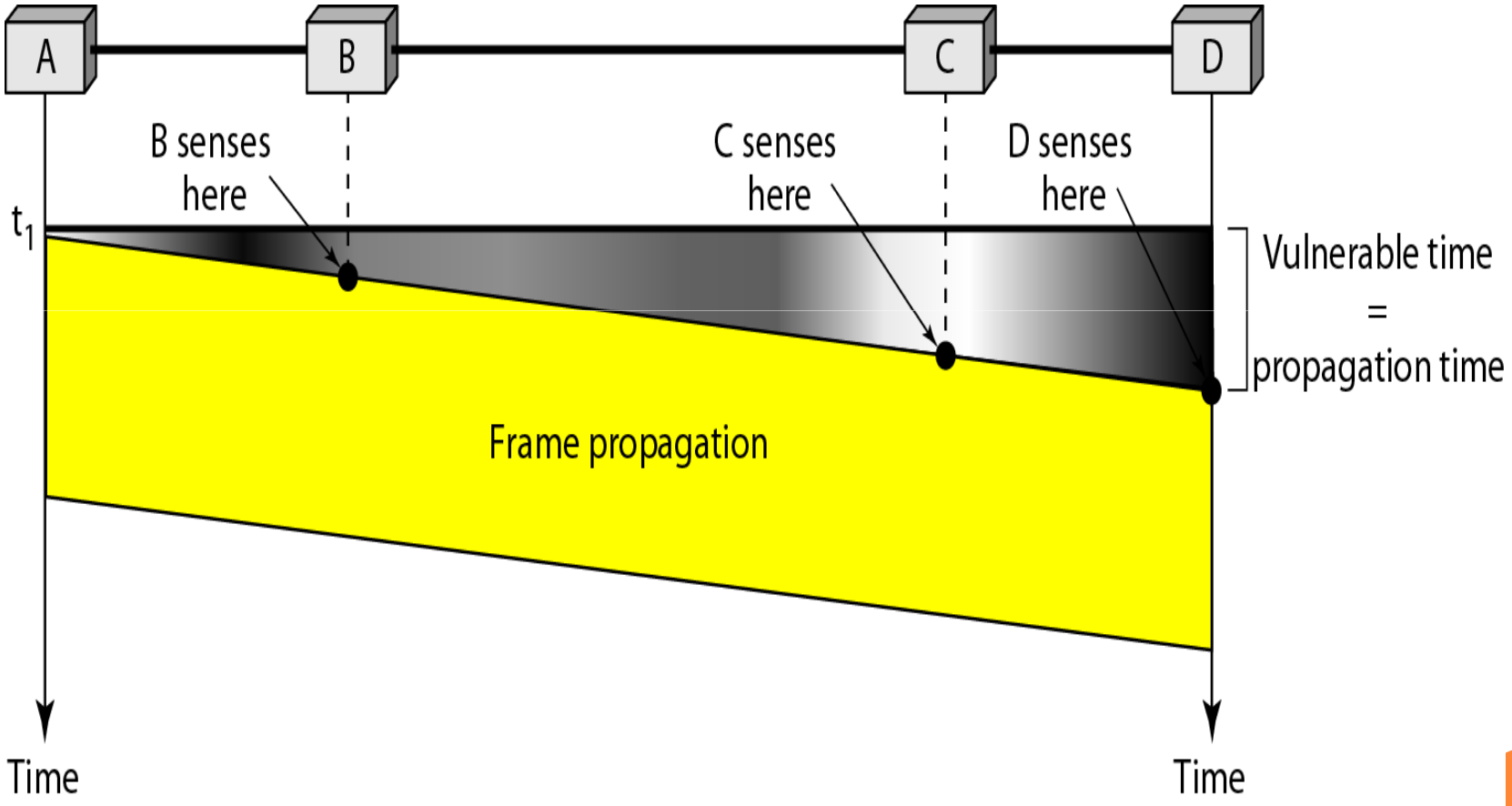
SLOTTED ALOHA CONT…



Carrier Sense Multiple Access

- Before transmitting the data listens the medium
- If medium is idle then transmit else wait and try again.
- How to identify collision occurs?
- 2 stations senses and transmit at time t.
- No ack for some amount of time.
- Assume collision and retransmit.

CSMA Cont…


A
B
C
D
B senses here
C senses here
D senses here
t_1
Vulnerable time
=
propagation time
Frame propagation
Time
Time

NON – PERSISTENT CSMA

1. If idle transmit.
2. If busy wait for random time
   i. Random generator is used to generate random time.
3. On timer expire do step 1

- Collision is reduced
- Idle time is increased

1 – Persistent CSMA

1. If idle transmit.
2. If busy continue to listen until channel is idle
3. If collision, wait a random time and do step 1.

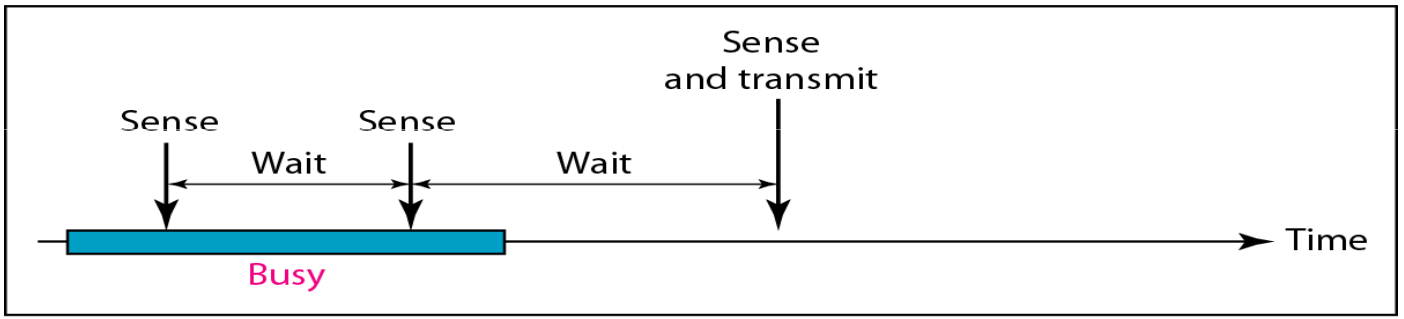
- Collision is increased.

P – PERSISTENT CSMA

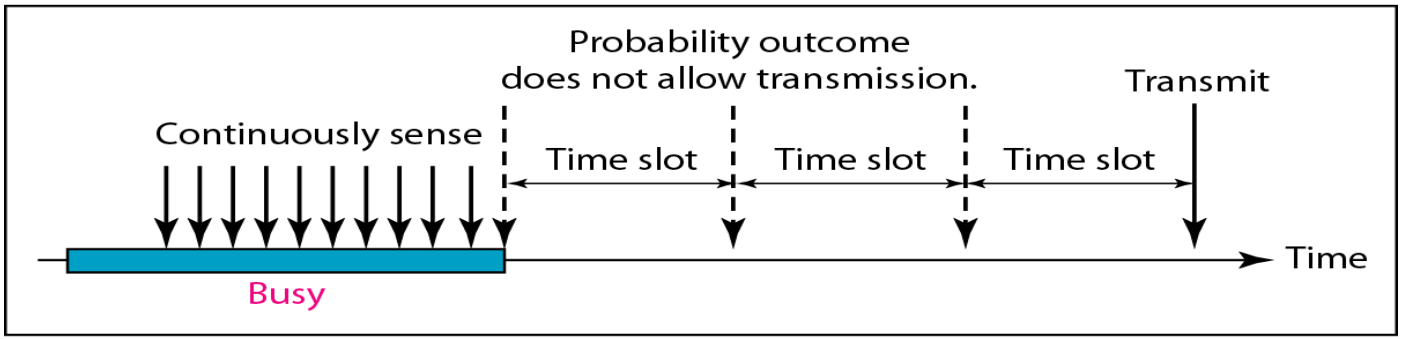
1. If busy continue to listen until channel is idle
2. If channel is idle transmit with a probability p.

COMPARISON OF CSMA'S

a. 1-persistent



b. Nonpersistent



c. p-persistent

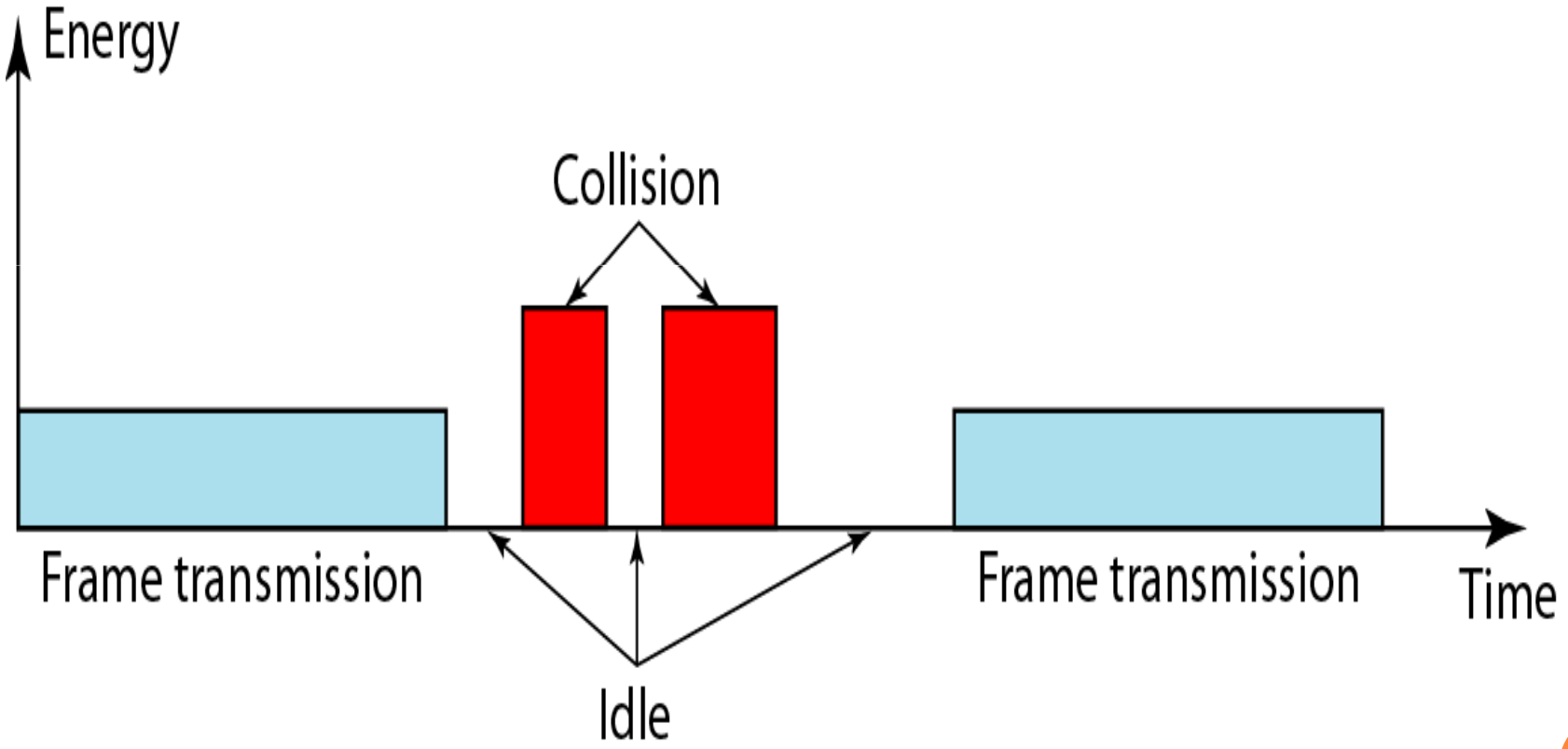
CSMA/CD

- CSMA wastes bandwidth
- Some mechanism is needed to detect collision
- Listen the medium continuously when the medium is transmitting
  1. If idle transmit
  2. If collision stop transmission
     1. Then transmit jamming signal.
  3. Wait a random time and then try to transmit again.
- Improves performance by terminating transmission ie avoiding collision

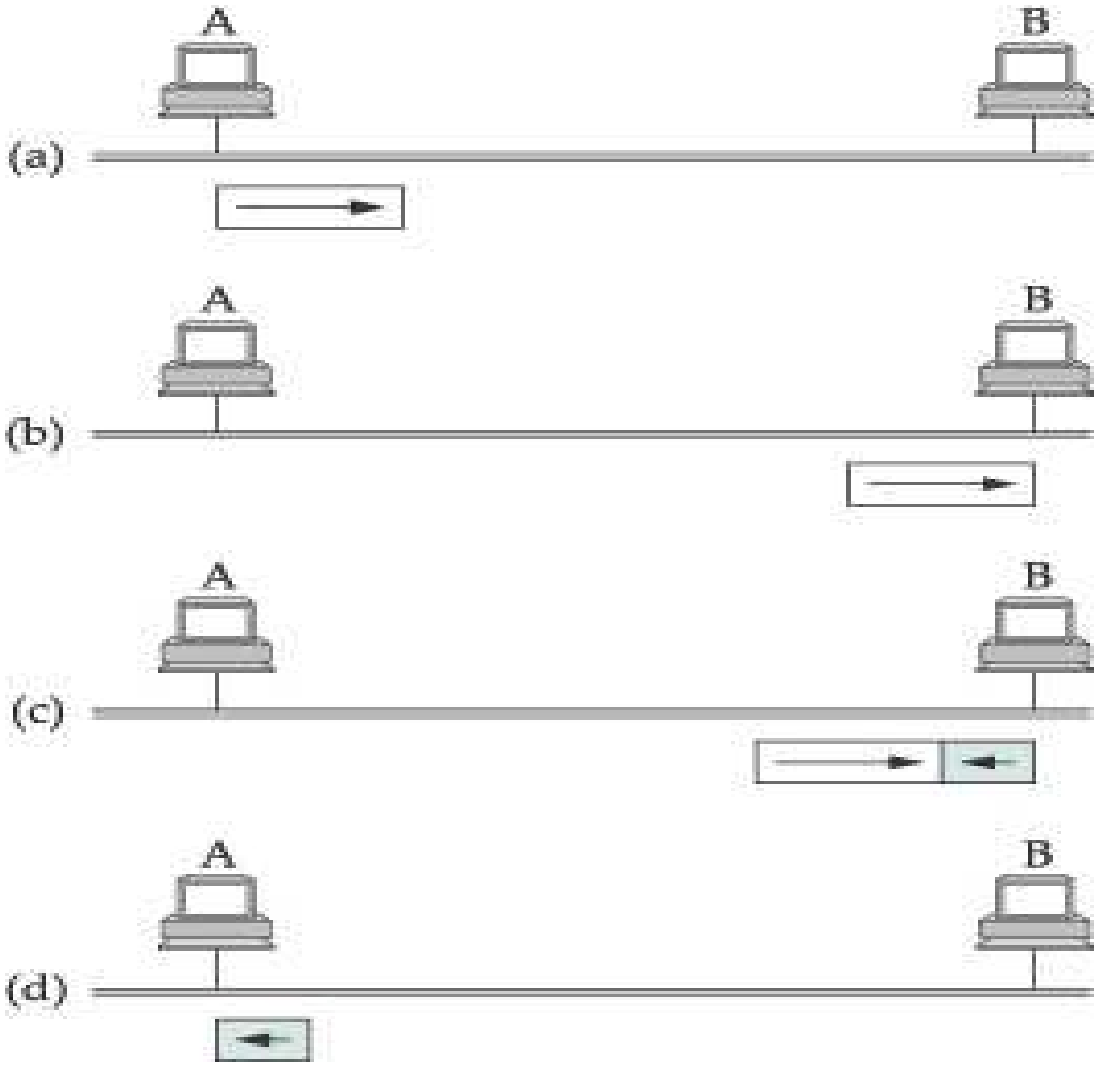
Carrier Sensing

- No voltage → Medium idle
- Current flows → some station is transmitting
- Voltage for each bit → 18-20 mA
- Excess current flows → collision
- When collision each bit is > 24mA

CSMA/CD


Energy
Collision
Frame transmission
Frame transmission
Time
Idle

CSMA/CD



- A sends a frame at time t
- A's frame arrives at B at time t+d
- B begins transmitting at time t+d and collides with A's frame
- B send jamming signal (runt frame) to A at t+2d

EXPONENTIAL BACKOFF ALG.

- The retransmission is delayed by an amount of time derived from the slot time and the number of attempts to retransmit.
- After *c* collisions, a random number of slot times between 0 and 2^c - 1 is chosen.
- For the first collision, each sender will wait 0 or 1 slot times.
- After the second collision, the senders will wait anywhere from 0 to 3 slot times inclusive.

Exponential Backoff Alg.

- After the third collision, the senders will wait anywhere from 0 to 7 slot times (inclusive), and so forth.
- As the number of retransmission attempts increases, the number of possibilities for delay increases exponentially.

Exponential Backoff Alg.

- The 'truncated' simply means that after a certain number of increases, the exponentiation stops; i.e. the retransmission timeout reaches a ceiling, and thereafter does not increase any further.
- For example, if the ceiling is set at $i = 10$ (as it is in the IEEE 802.3 CSMA/CD standard), then the maximum delay is 1023 slot times.

Frame Format

- Preamble → Alert and Synchronization for timing
- Signal for beginning of frame
- Destination Address
  - Within a single network →Destination Address
  - Another network → Router's Address

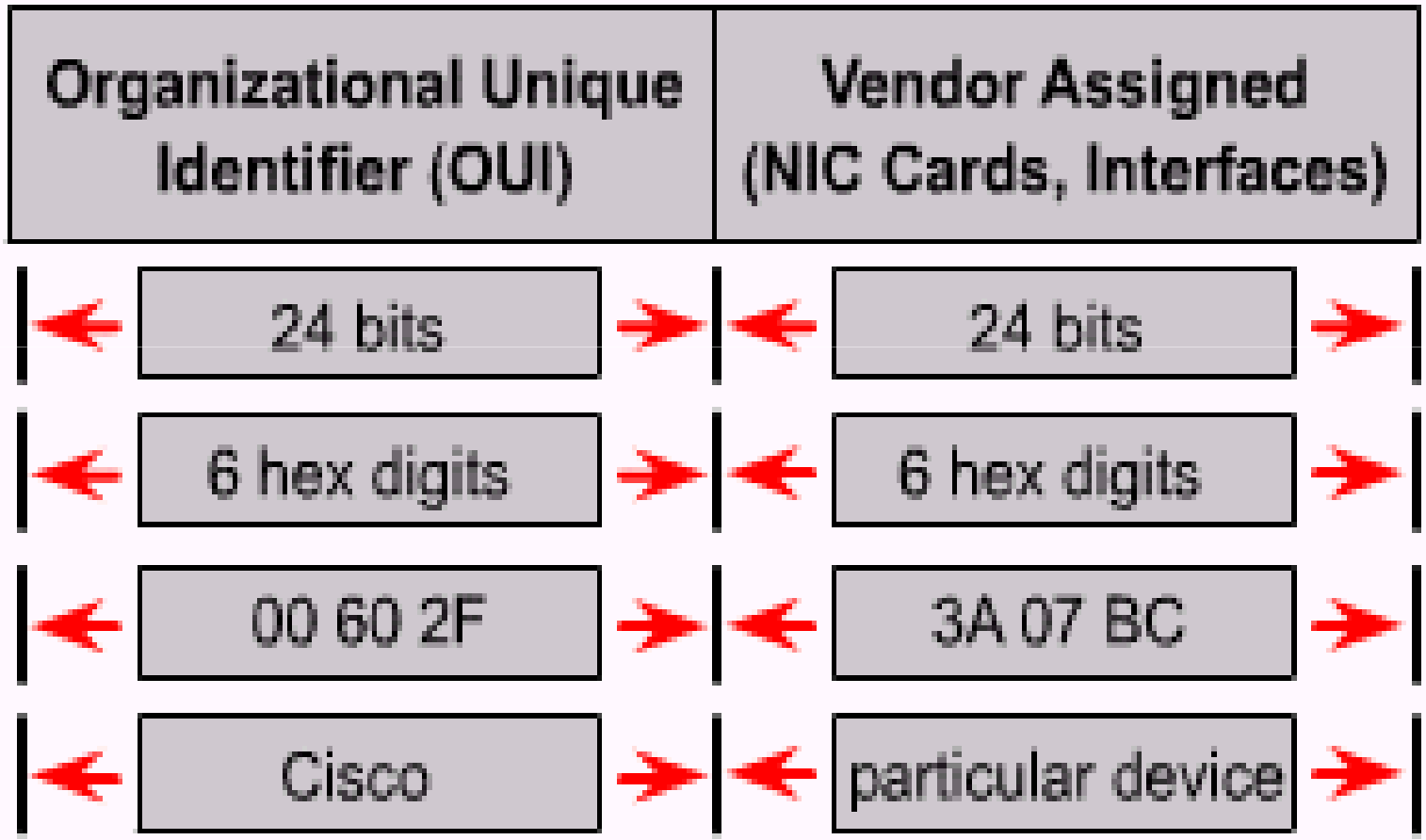
Frame Format

- Source Address
  - Single Network→ Source Address
  - Different Network → Last device which forwards the packet.
- Type/ Length
  - Length of the data from LLC
- CRC
  - Error checking methods

MAC Address

- 48 bit address
- The first six hexadecimal digits, which are administered by the IEEE, identify the manufacturer or vendor.
- This portion of the MAC address is known as the Organizational Unique Identifier (OUI).
- The remaining six hexadecimal digits represent the interface serial number, or another value administered by the specific equipment manufacturer.

MAC Address Format



Addressing

- Unicast : The 8th bit is set as 0 if the address is unicast

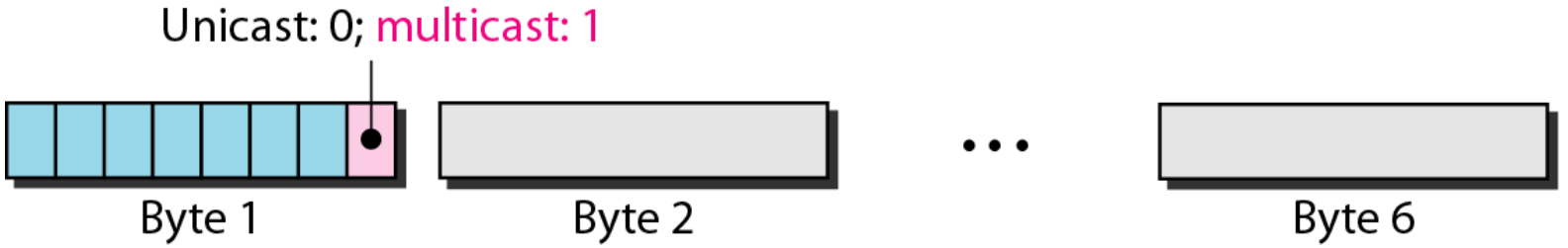
  (Ex : Source or one destination address)

- Multicast : The 8th bit of the Ethernet address is set as 1, if the address is multicast

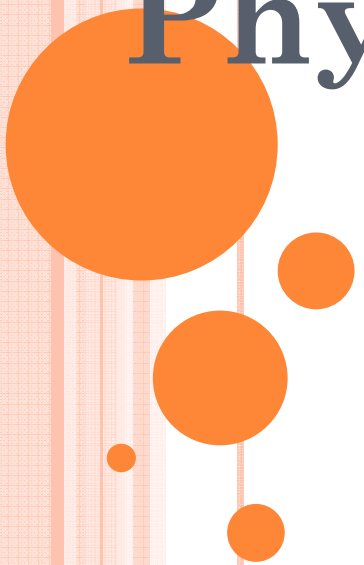
  (Ex : group of destination)

- Broadcast : All the 48 bits of the Ethernet address are 1's if the address is broadcast.

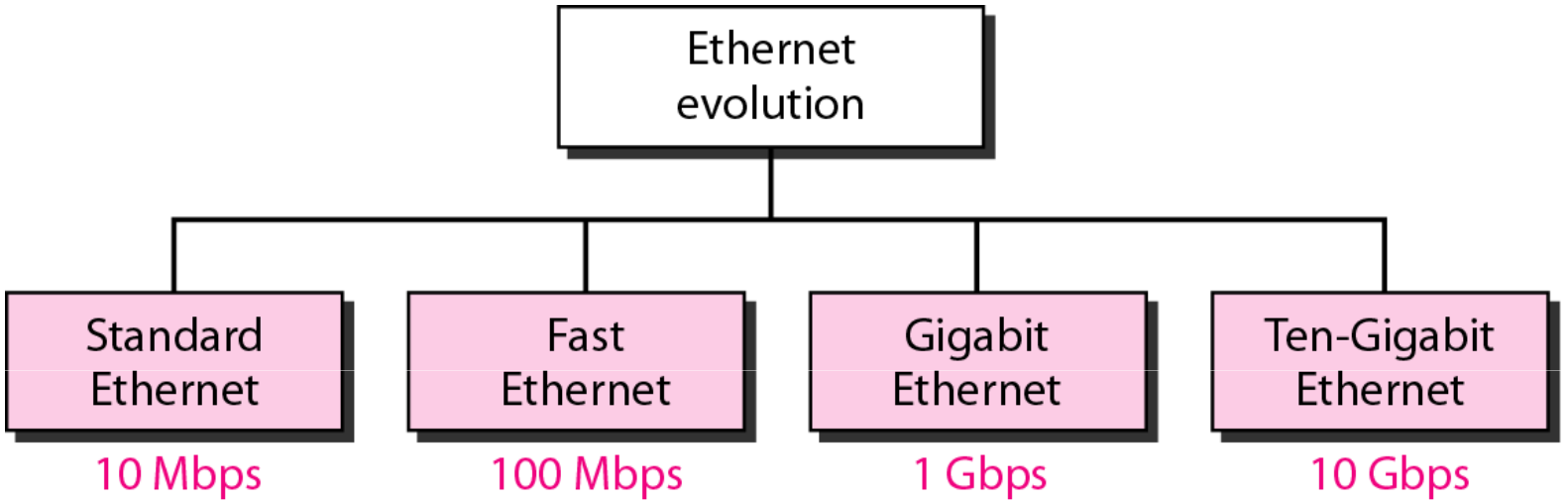
  (Ex : All stations in the network are destinations)



Physical Properties



Ethernet evolution through four generations

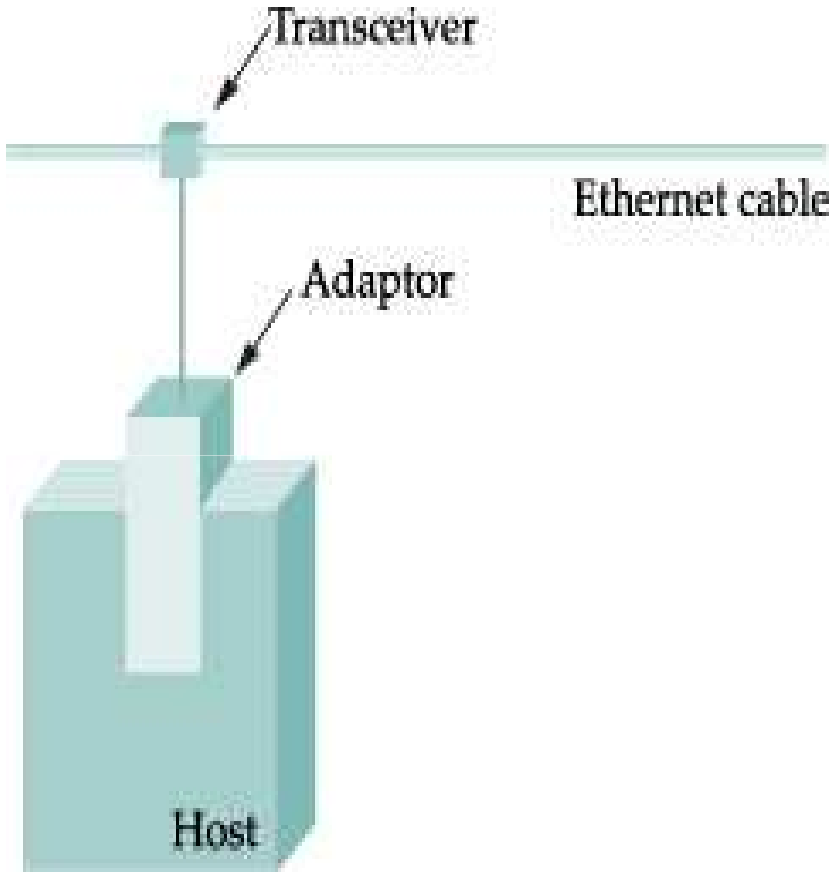


Fast Ethernet, Gigabit Ethernet and Ten Gigabit Ethernet are designed to be used in full duplex, point to point configurations.

Typically they are used in Switched networks

Transceiver

- In early stage An Ethernet segment is implemented on a coaxial cable of upto 500m.
- Cable is similar to TV cable. Instead of 75 ohms impedance, this cable use 50 ohms.
- A transceiver is attached to the cable and also to the adapter.
- The transceiver receives and sends signal.

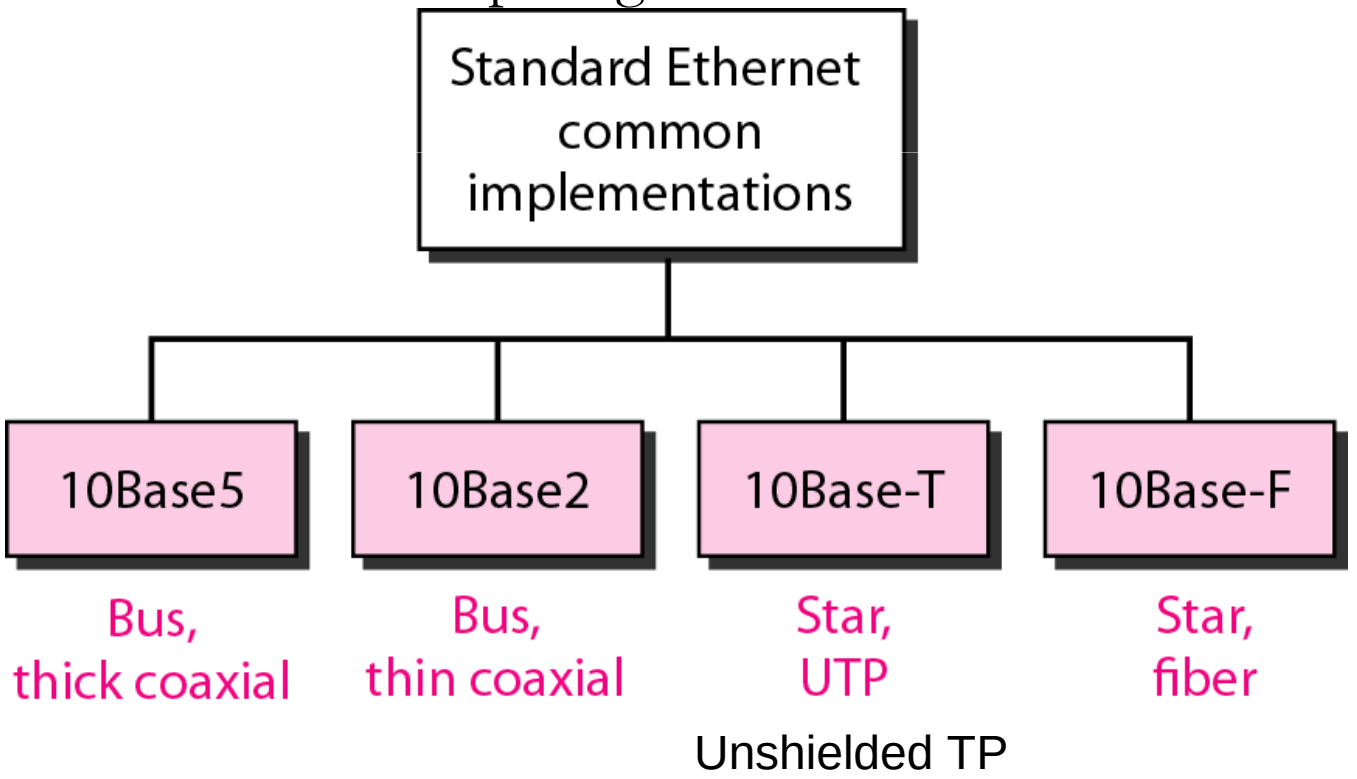


Repeater

- Multiple Ethernet can be joined together by repeaters.
- Repeater forwards analog signals.
- More than 4 repeaters can not be positioned between any pair of hosts.
- Therefore Total length of Ethernet is 2500m.
- Distance between two host must be 2.5m

Categories of standard Ethernet

- 10Base5 →10 Mbps, baseband segment length 500m
- Baseband → Single signal send over the cable.
- Broadband → Multiple signal send over the cable.



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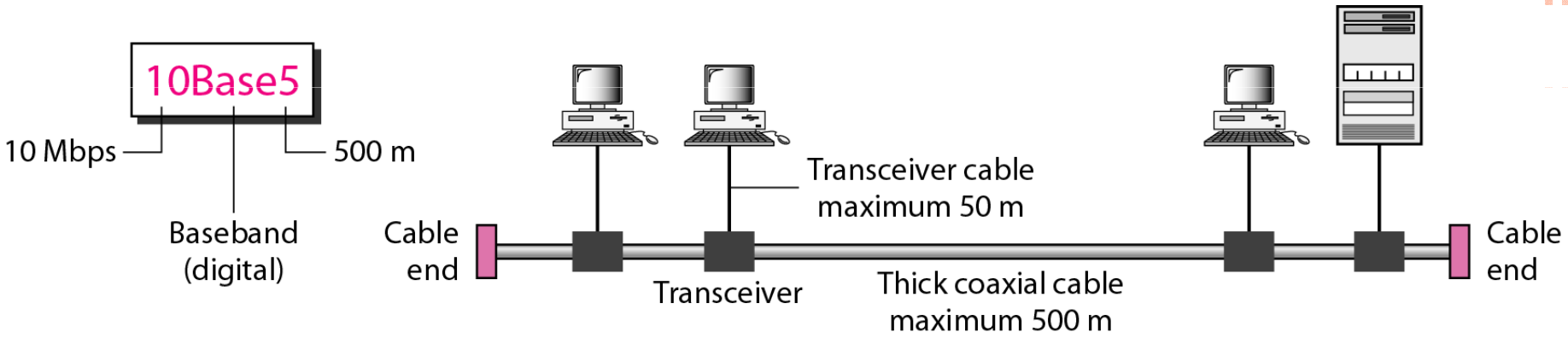
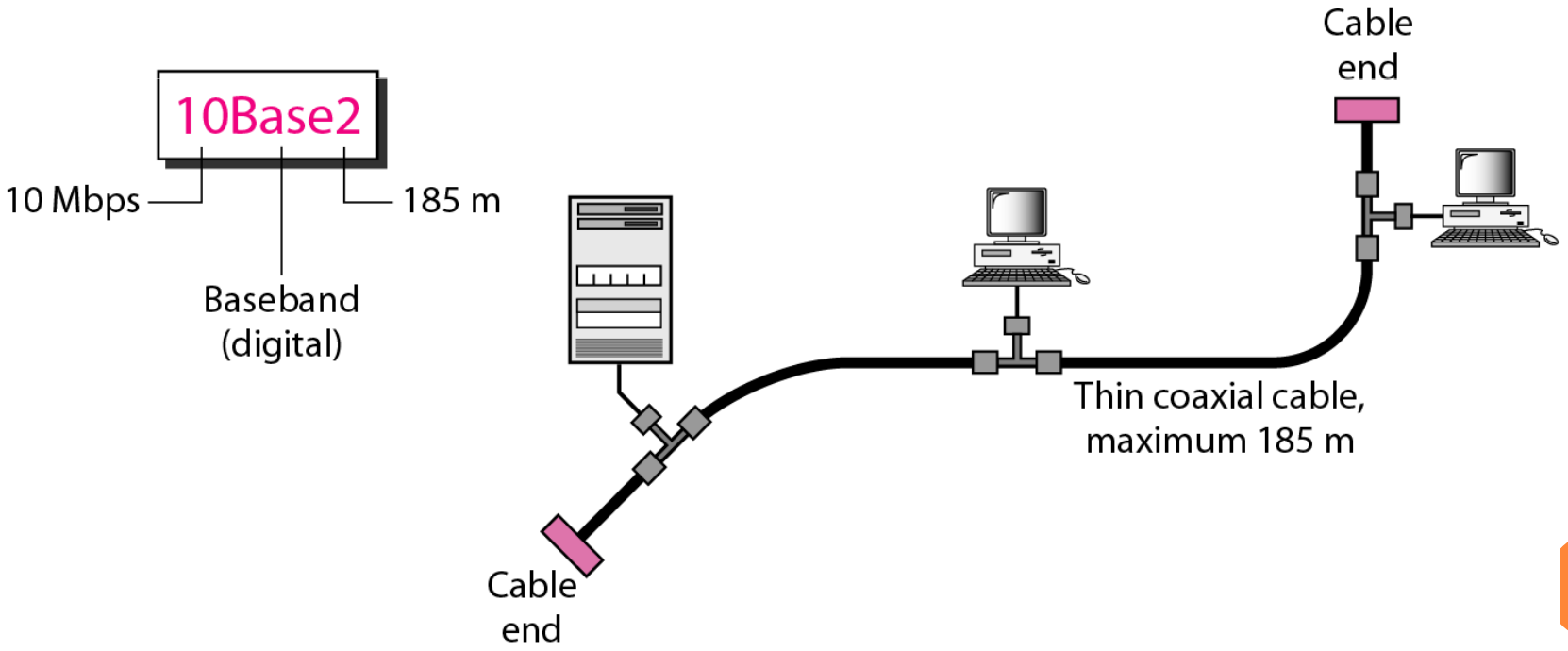
10Base5 Implementation

- Bus topology
- Size of a garden hose, hard to handle
- Maximum 5 segments, repeaters can be used



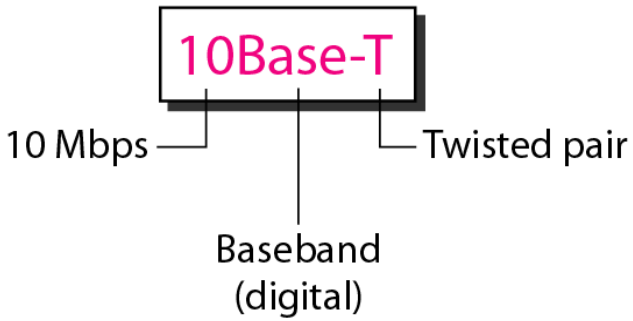
10Base2 Implementation

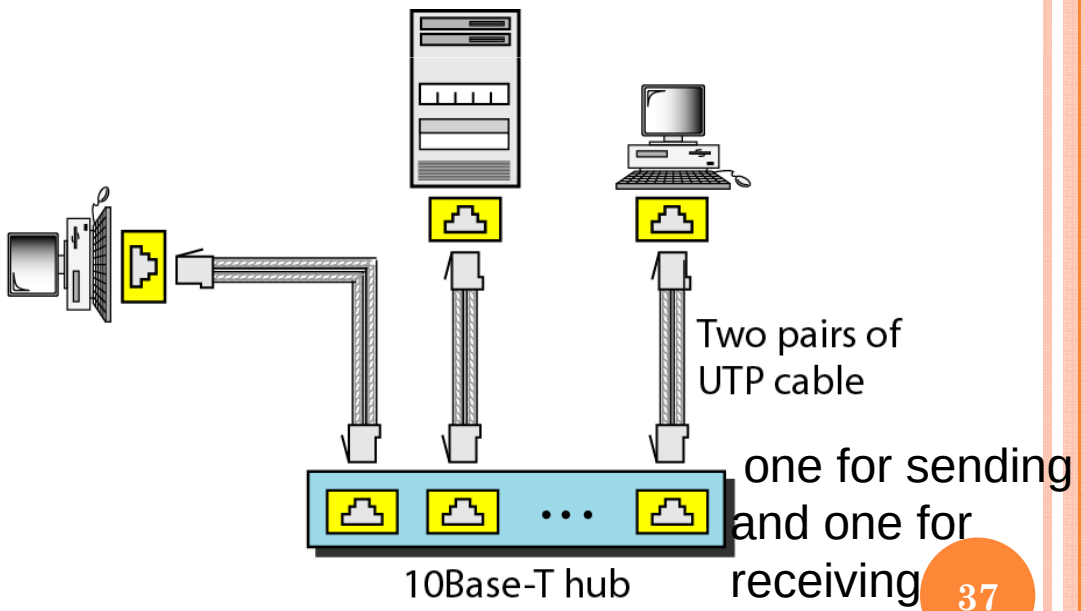
- Bus topology
- Thinner and more flexible
- Tee connection is used. Cheaper than 10Base5



10BaseT Implementation

- Star topology
- Hub is used
- Segment length 100m





one for sending and one for receiving

10BaseF Implementation

- Star topology
- Hub is used