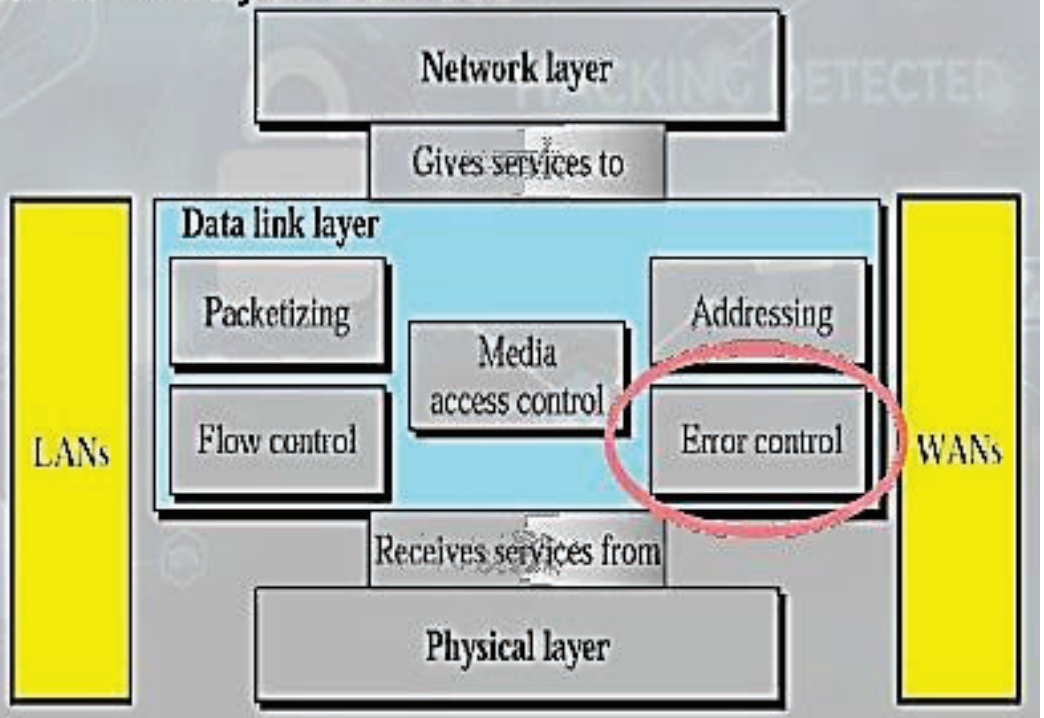
Data Link Layer

Data Link (Layer 2)

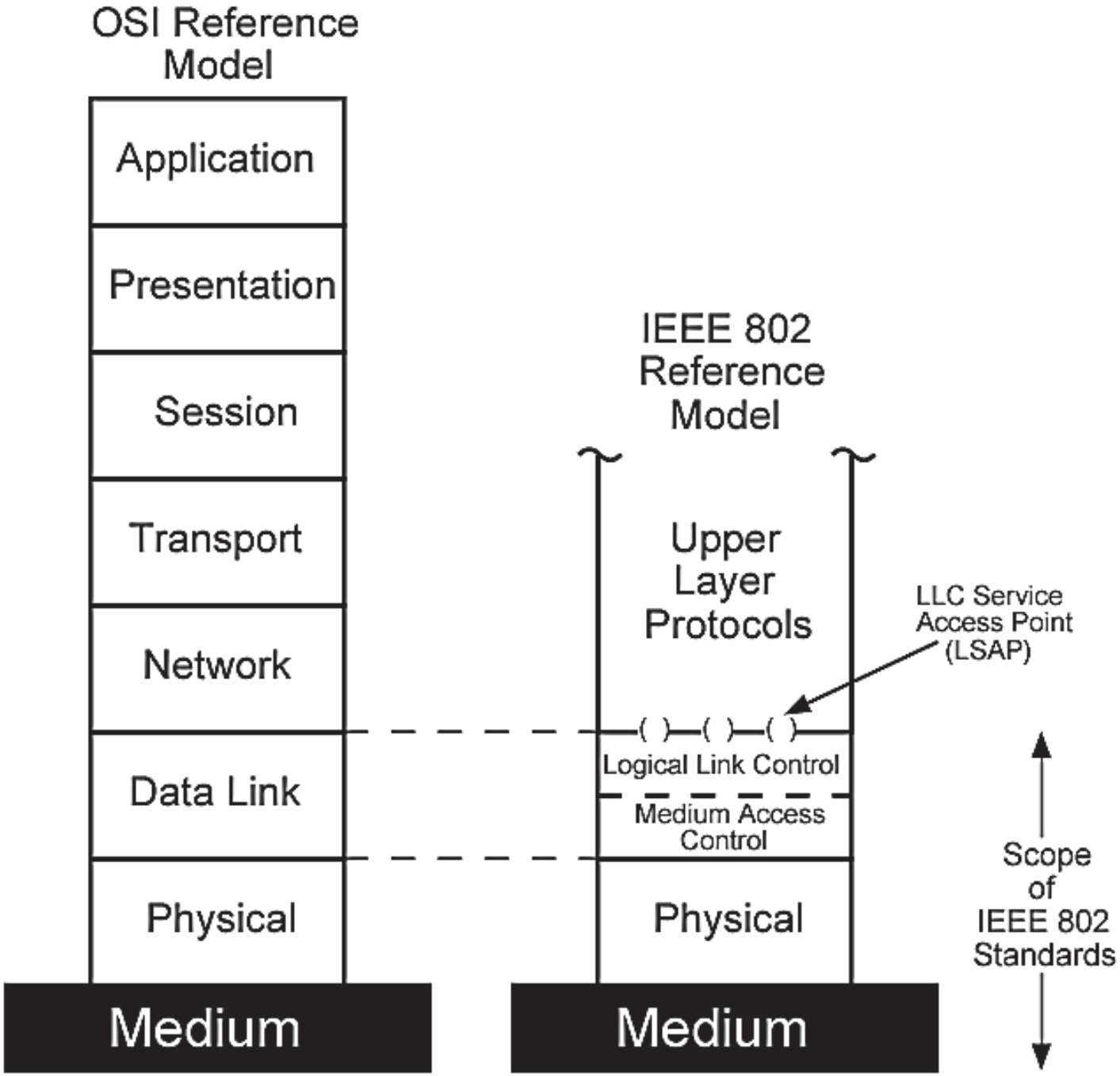
Responsible for delivery of data between two systems on network.

Switch & Bridge are Data Link Layer devices

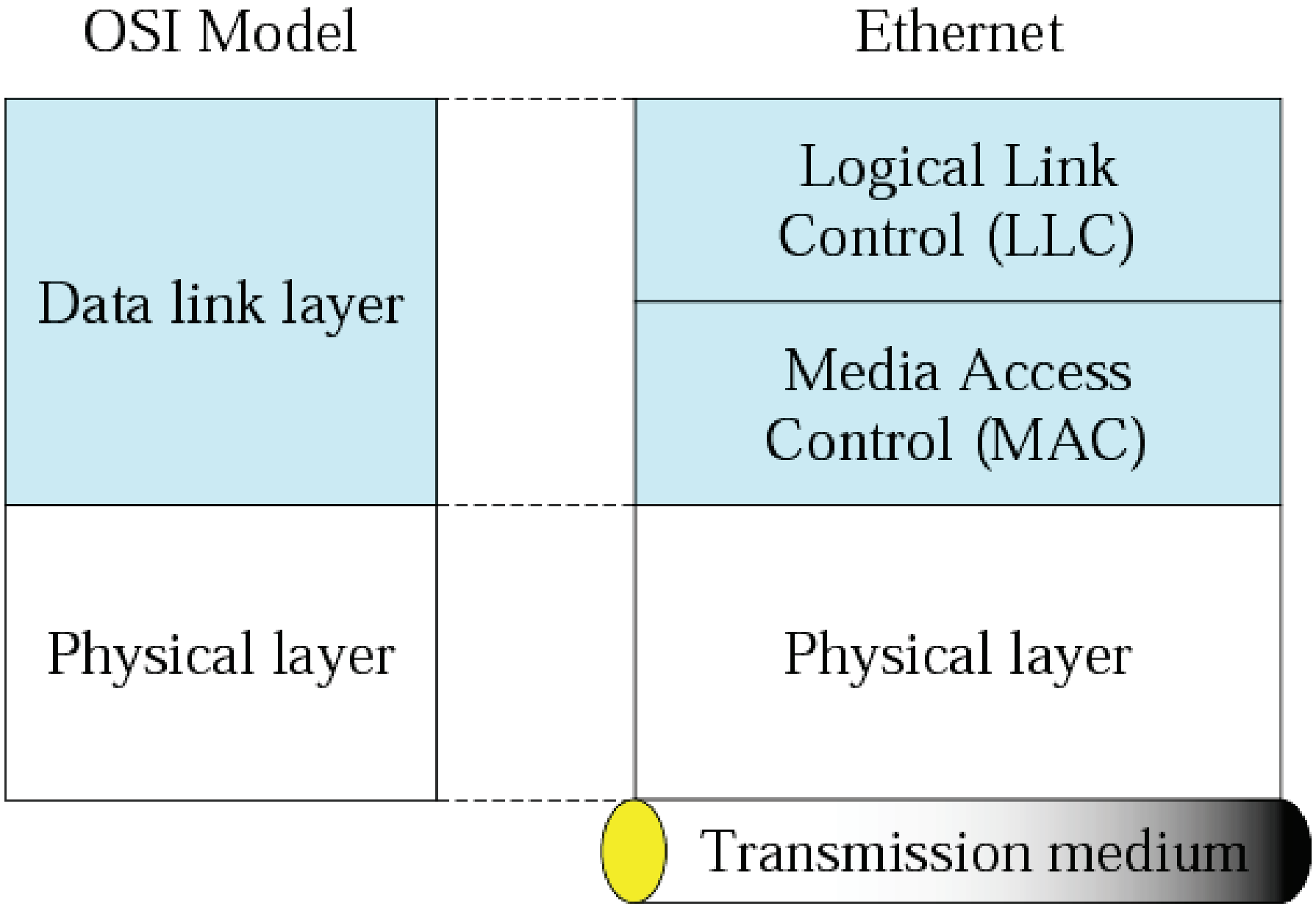
- Framing
- Physical Addressing
- Synchronization.
- Error Control.
- Flow Control.
- Multi-Access.



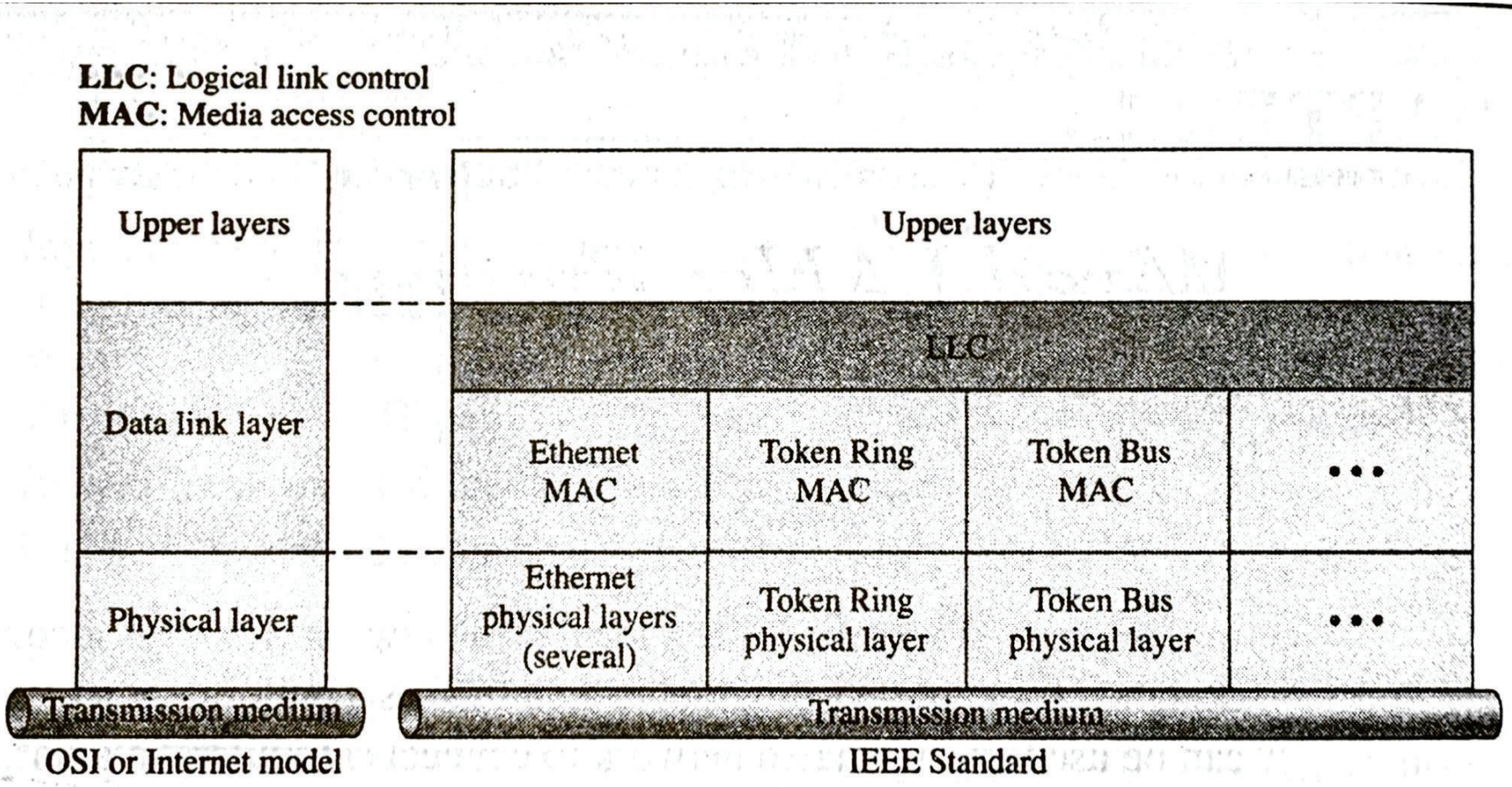
IEEE 802 v OSI



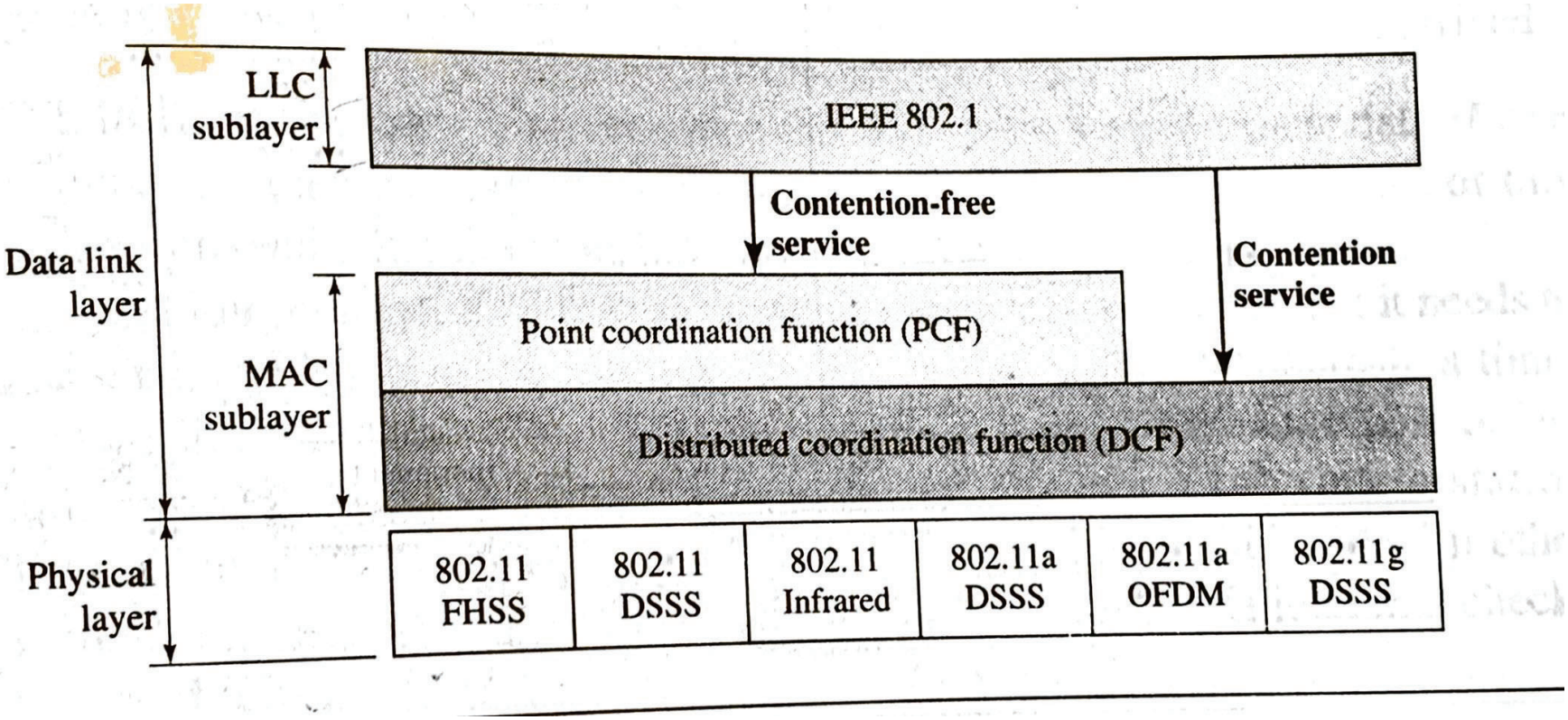
IEEE 802 Standard for LAN



IEEE 802 Standard for LAN



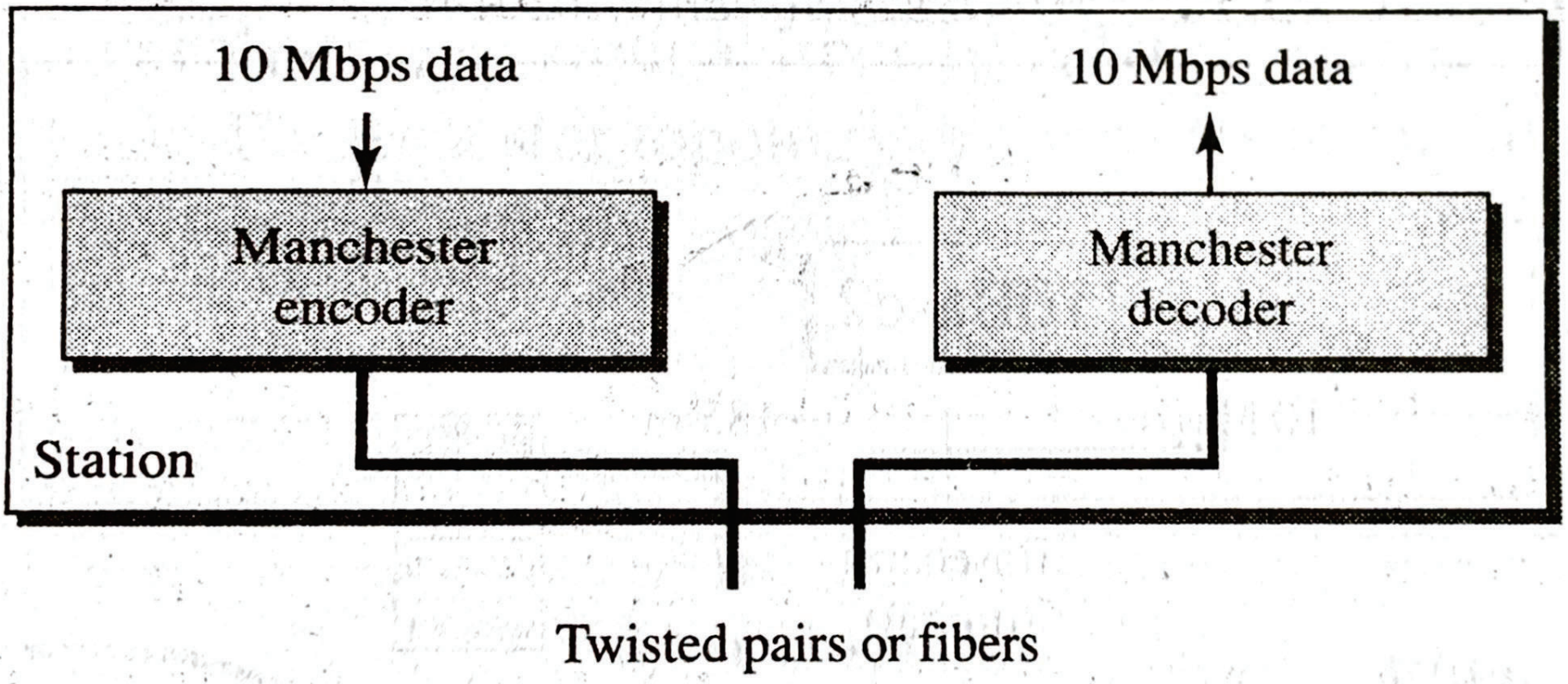
IEEE 802 Standard for WLAN



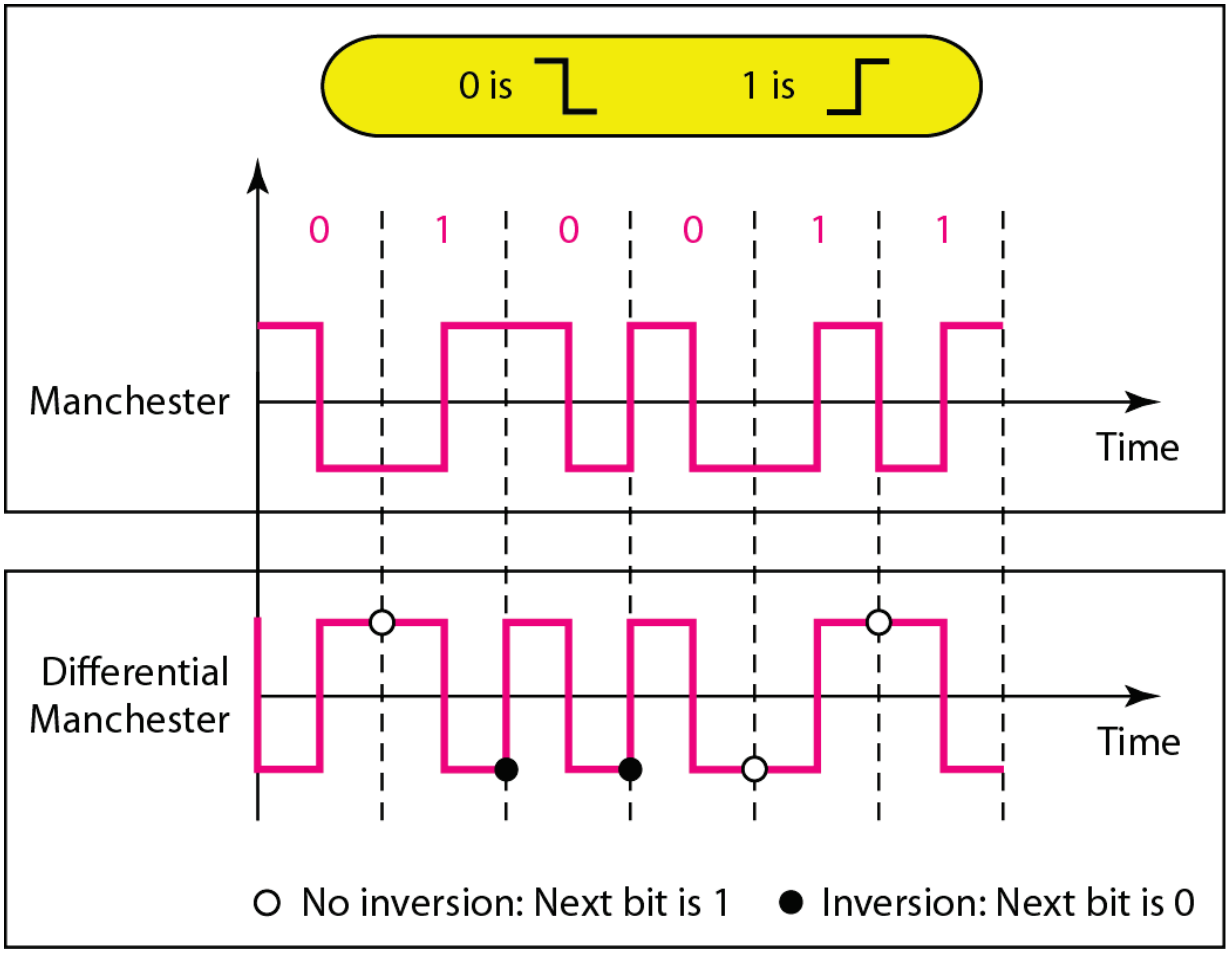
802 Layers - Physical

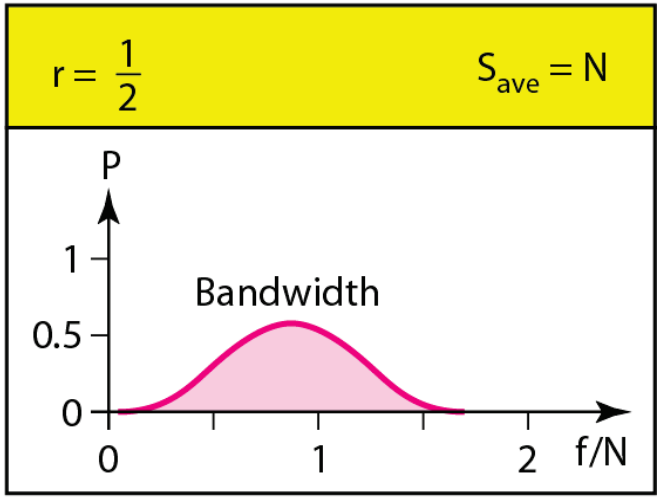
- Encoding/decoding
- Preamble generation/removal
- Bit transmission/reception
- Transmission medium and topology

Encoding in standard Ethernet LANs

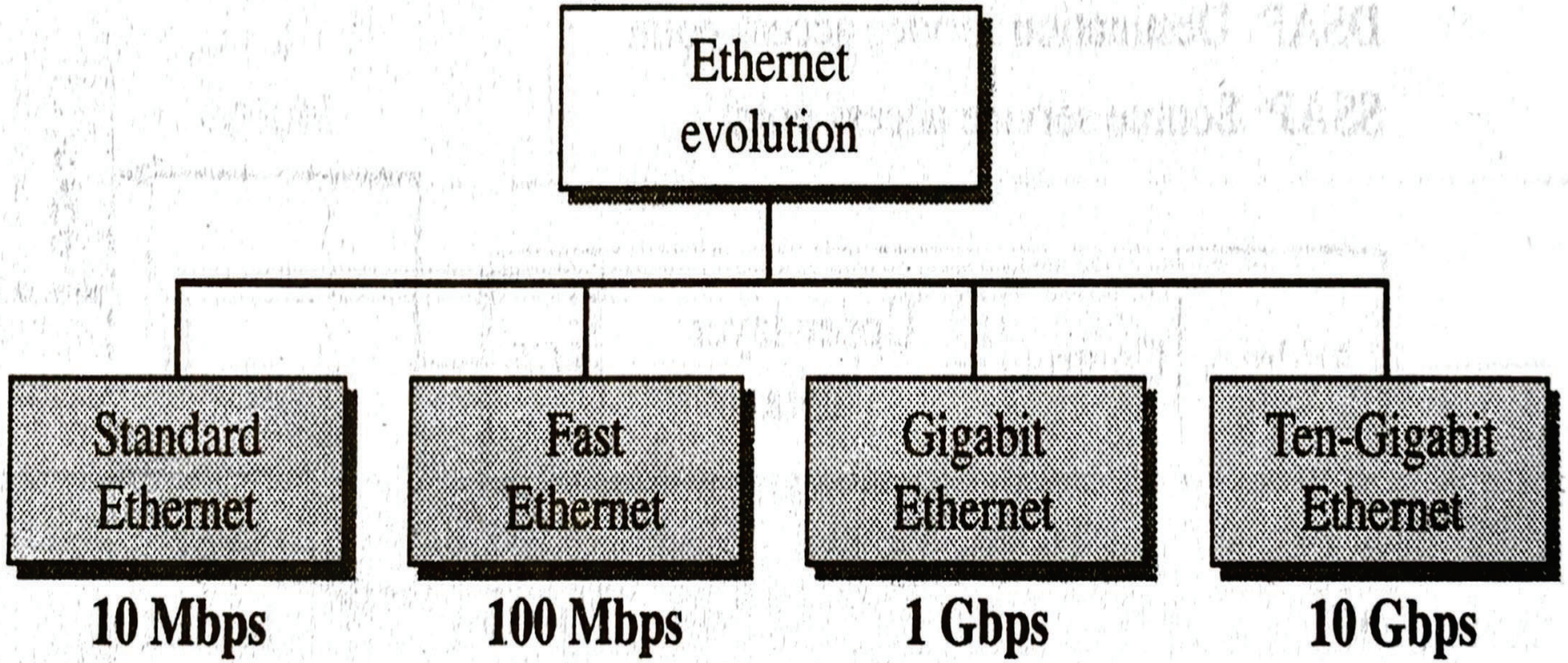


Polar biphase: Manchester and differential Manchester schemes

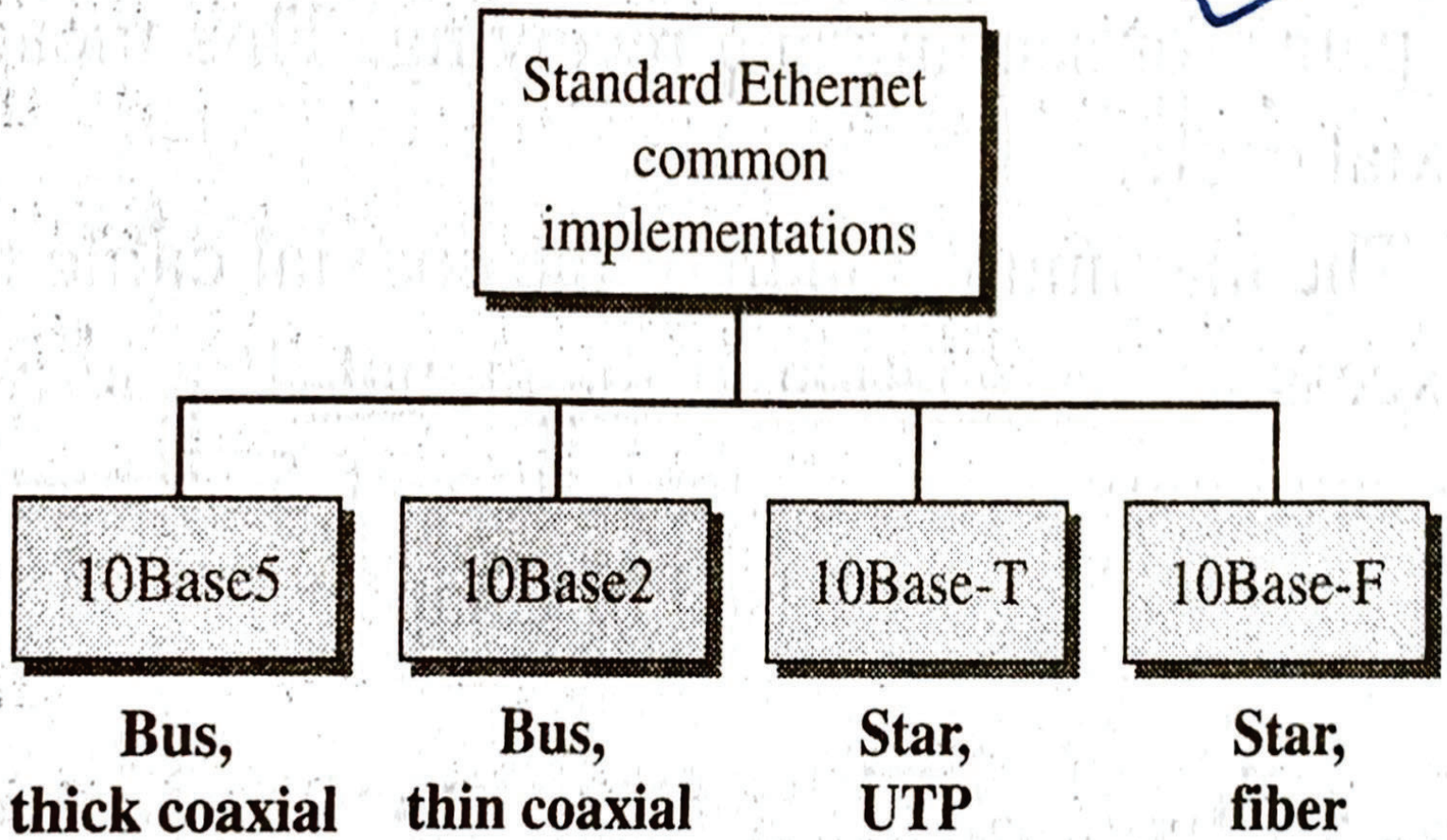




IEEE 802.3 Ethernet evolution through four generations



Categories for Standard Ethernet



Ethernet frame

Preamble 56 bits of alternating 1s and 0s.
SFD Start field delimiter, flag (10101011)

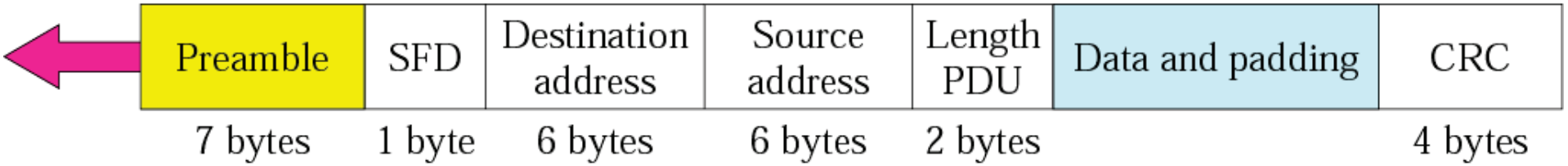
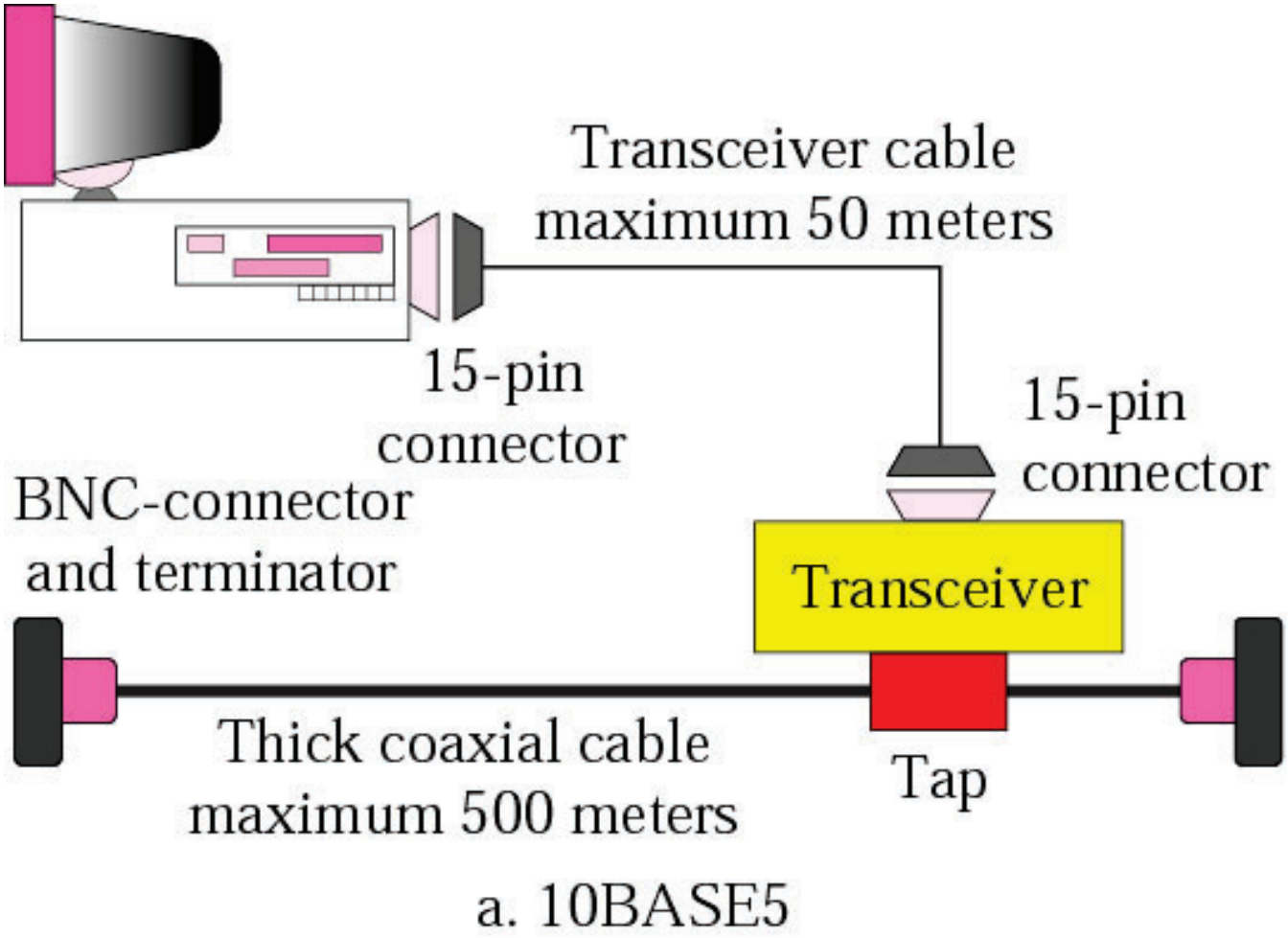
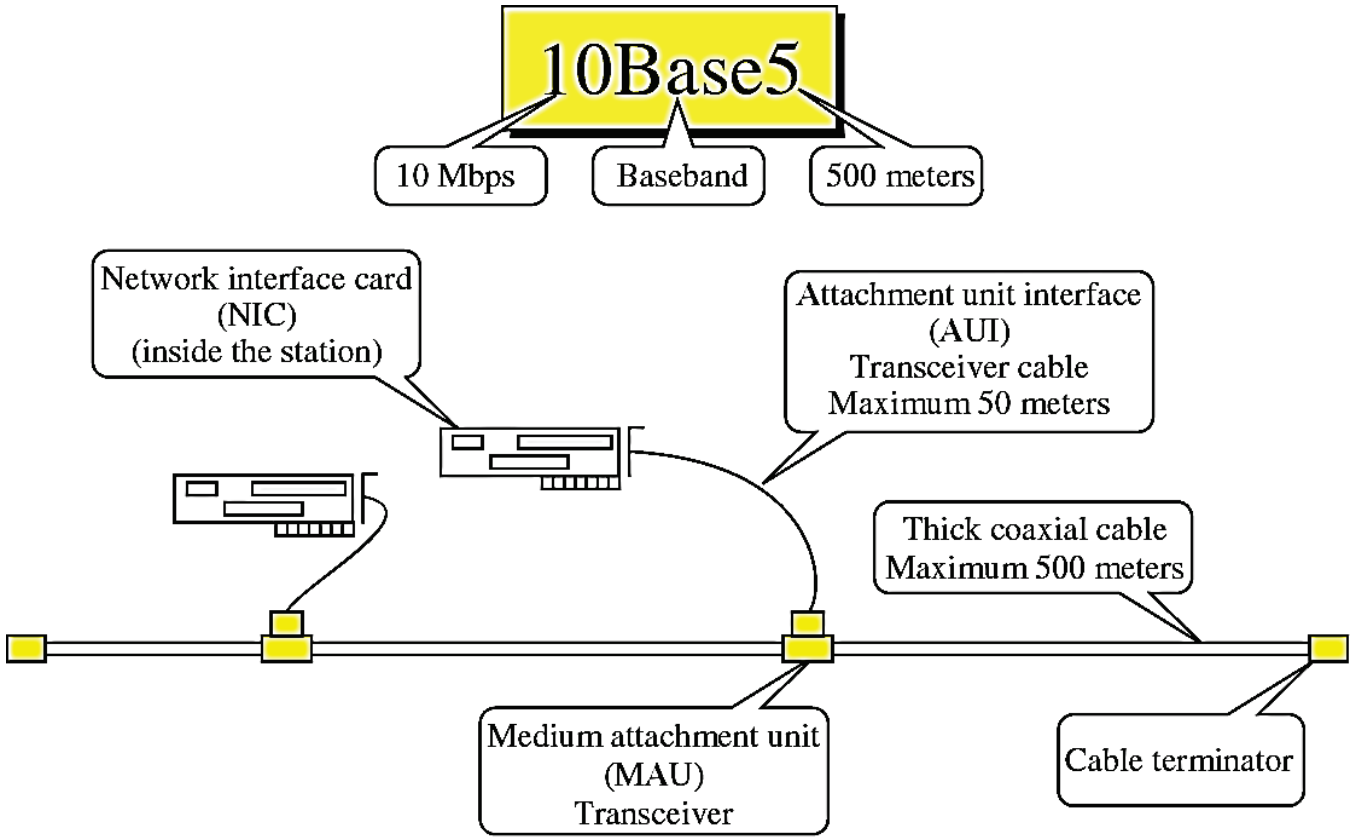


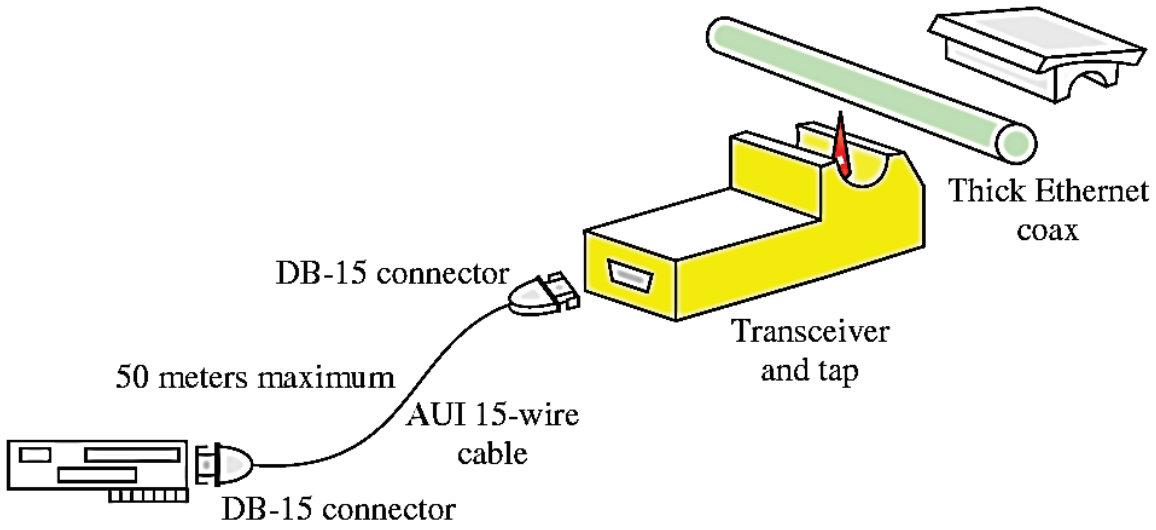
Figure 3-5:a

Ethernet implementation

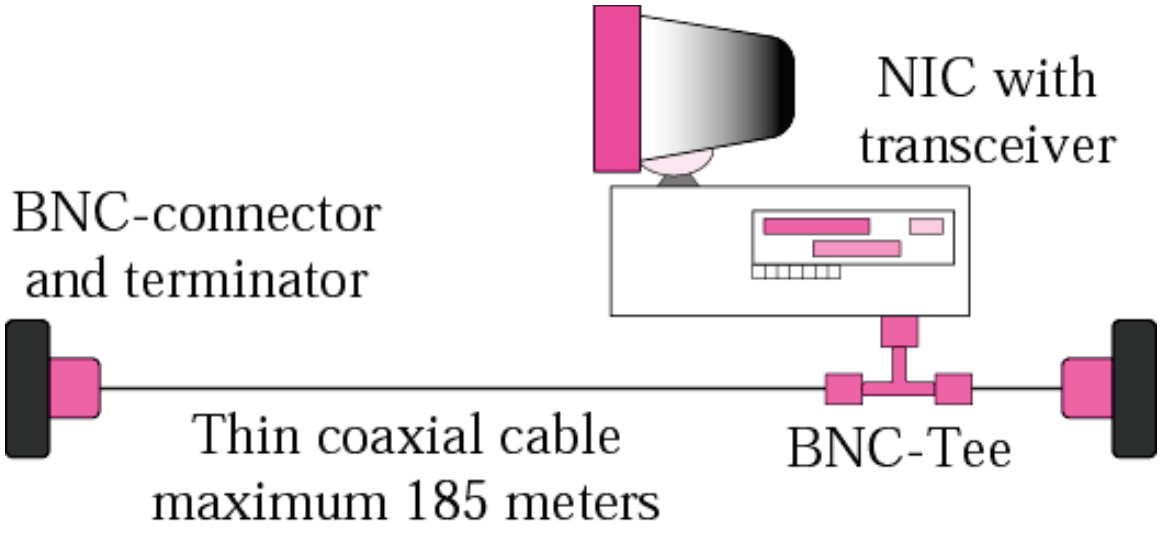


Bayonet Neill–Concelman") is a miniature quick connect/disconnect radio frequency **connector** used for coaxial cable

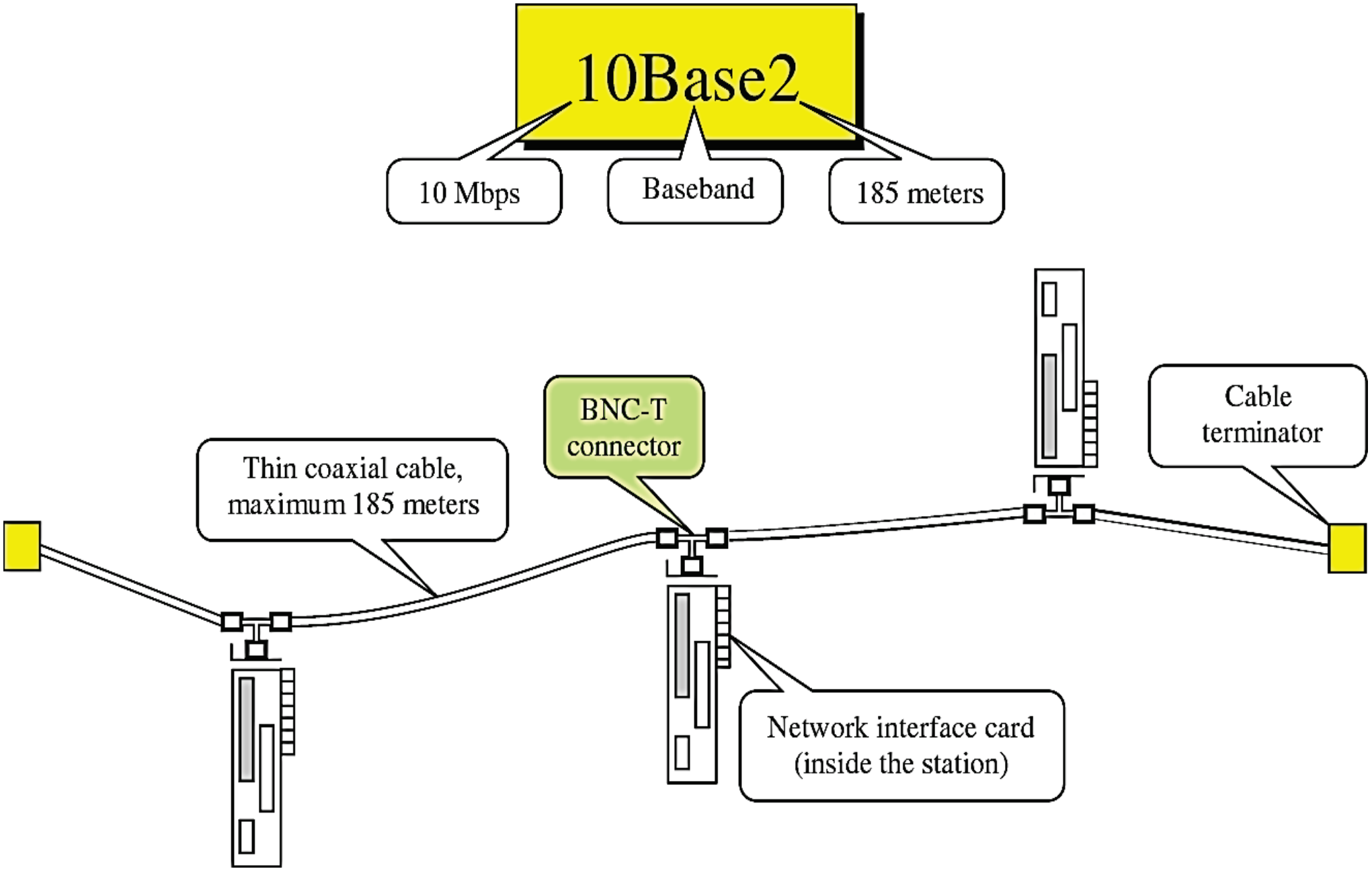




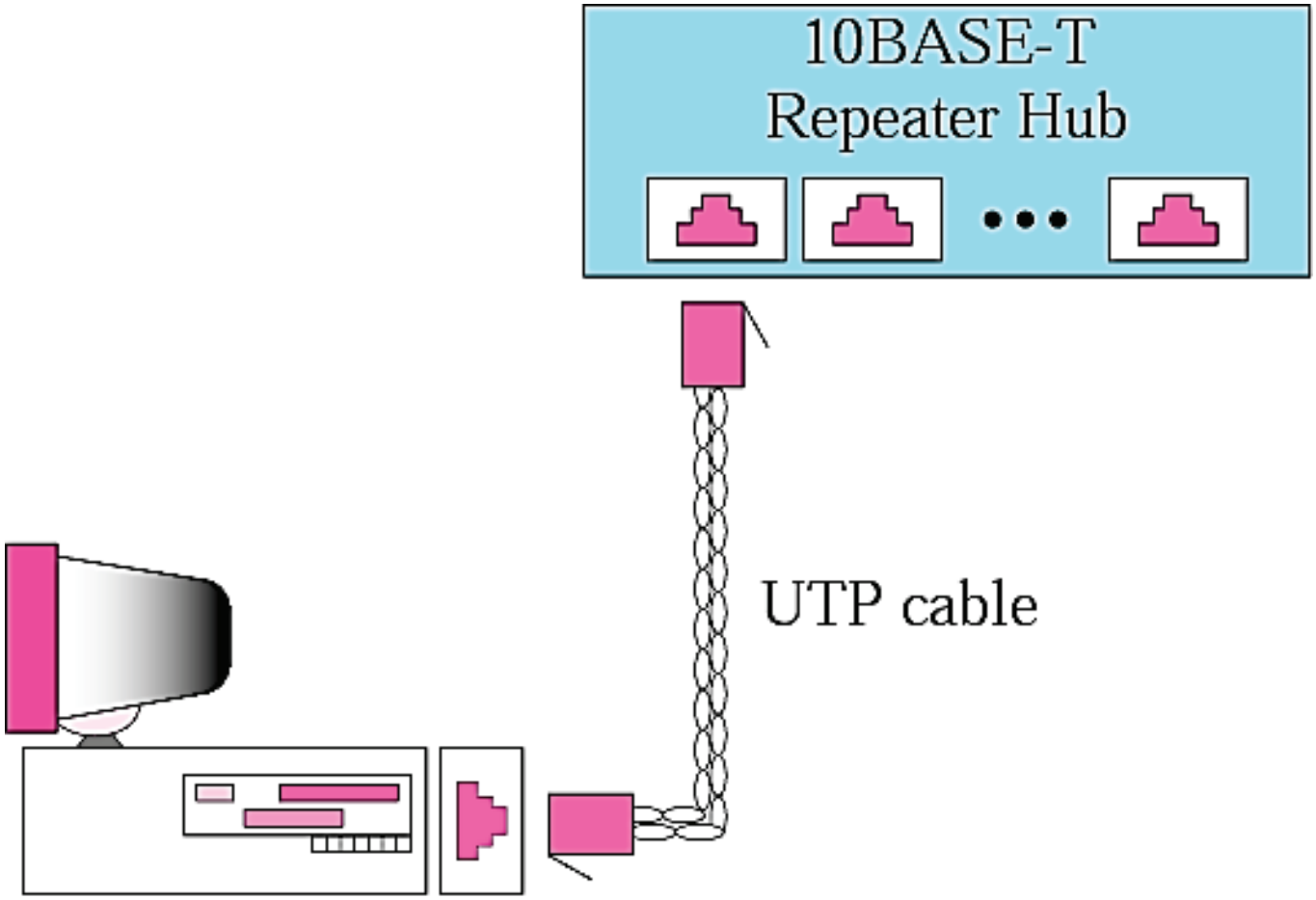
Ethernet implementation



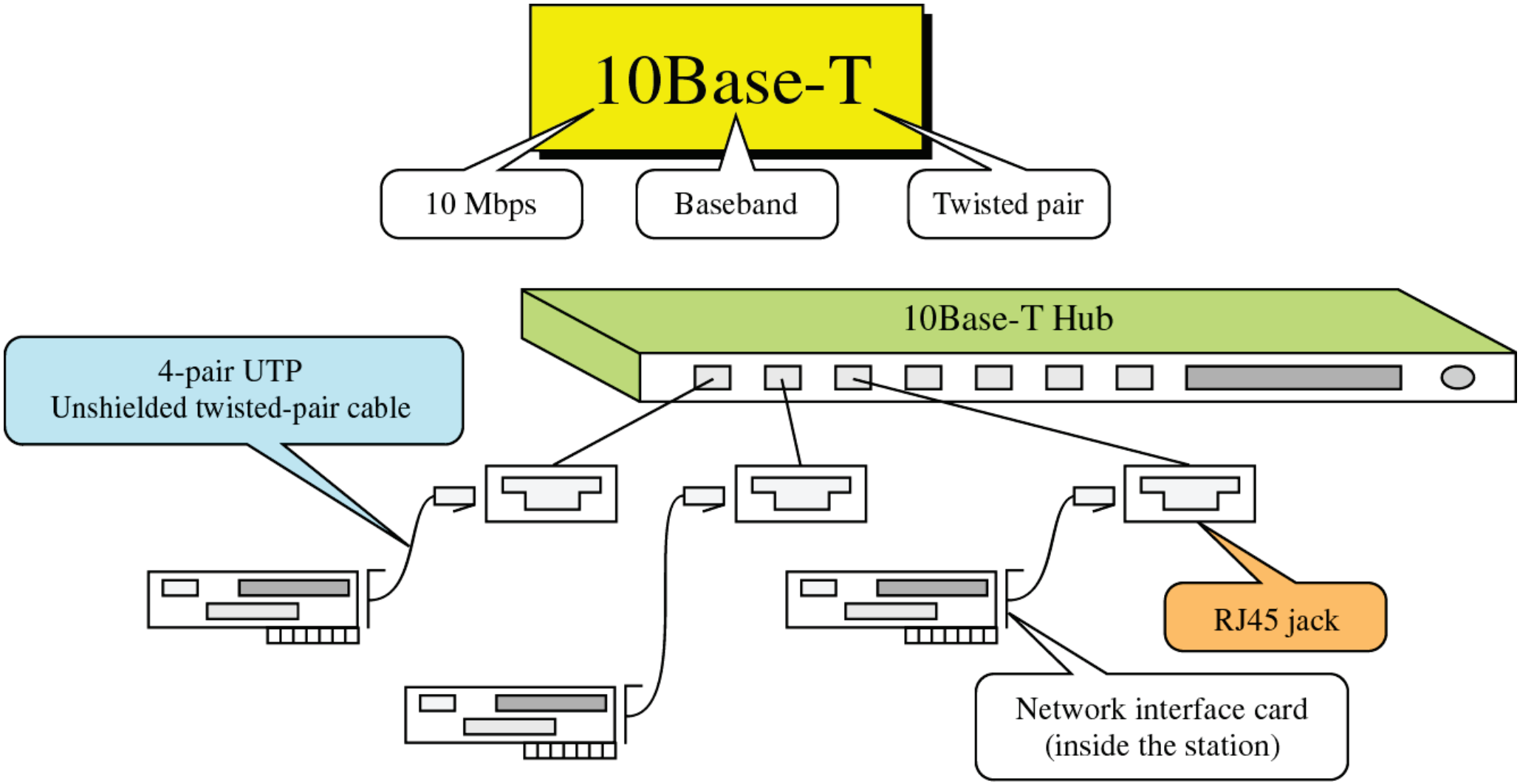
b. 10BASE2



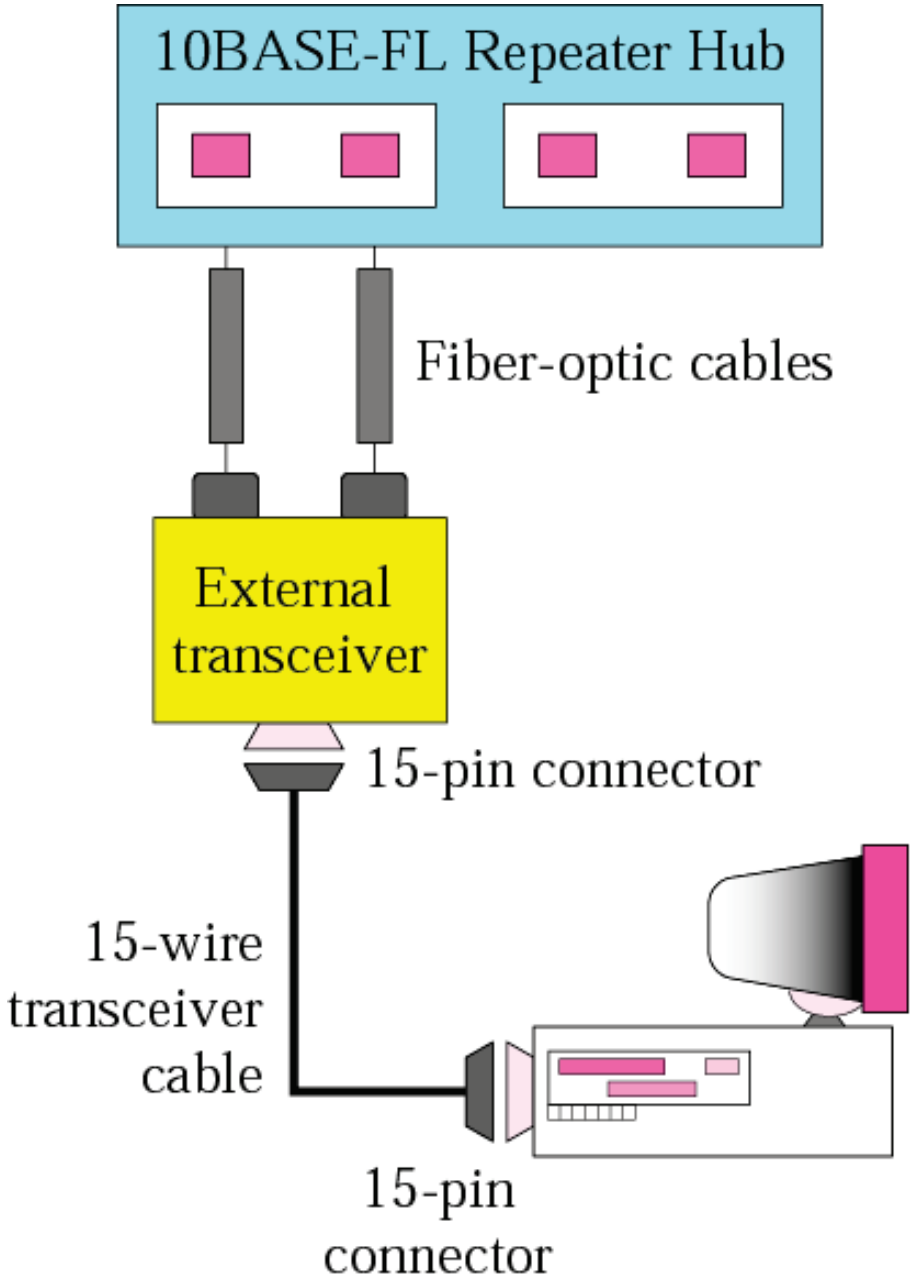
Ethernet implementation



c. 10BASE-T

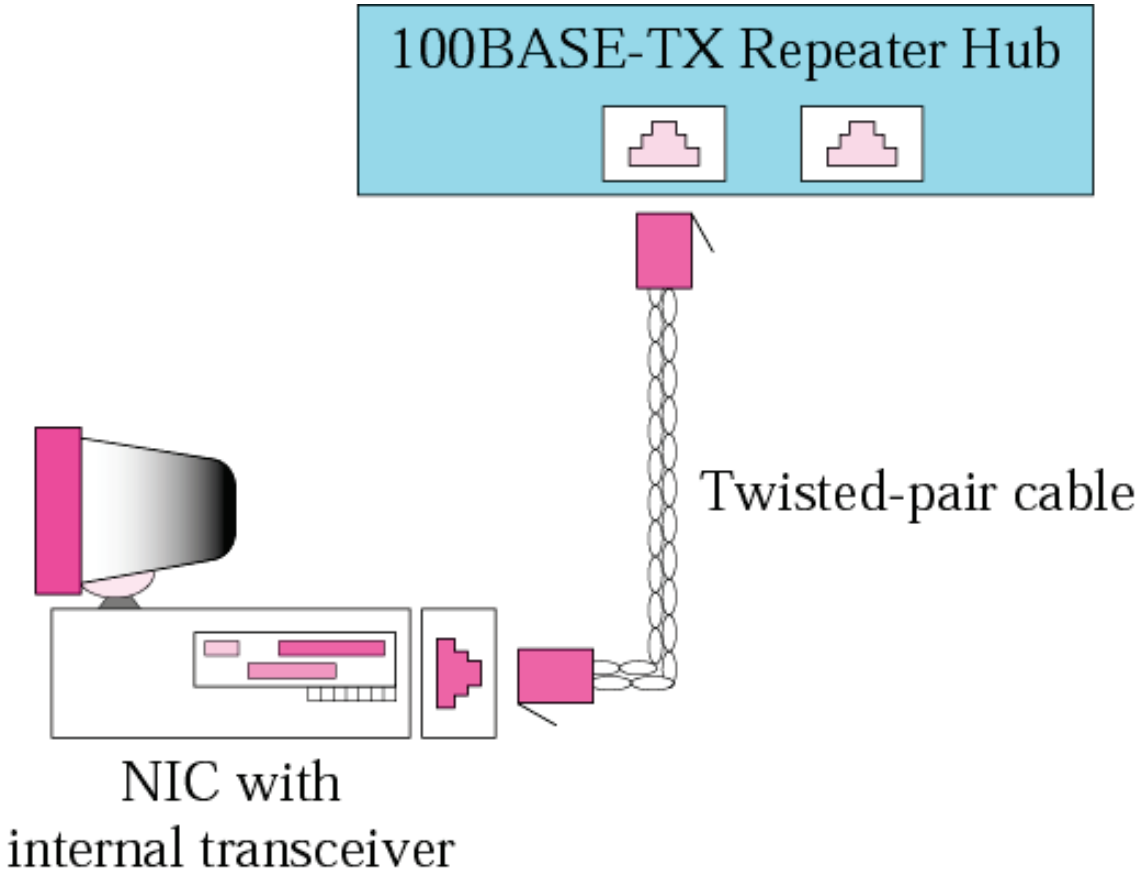


Ethernet implementation



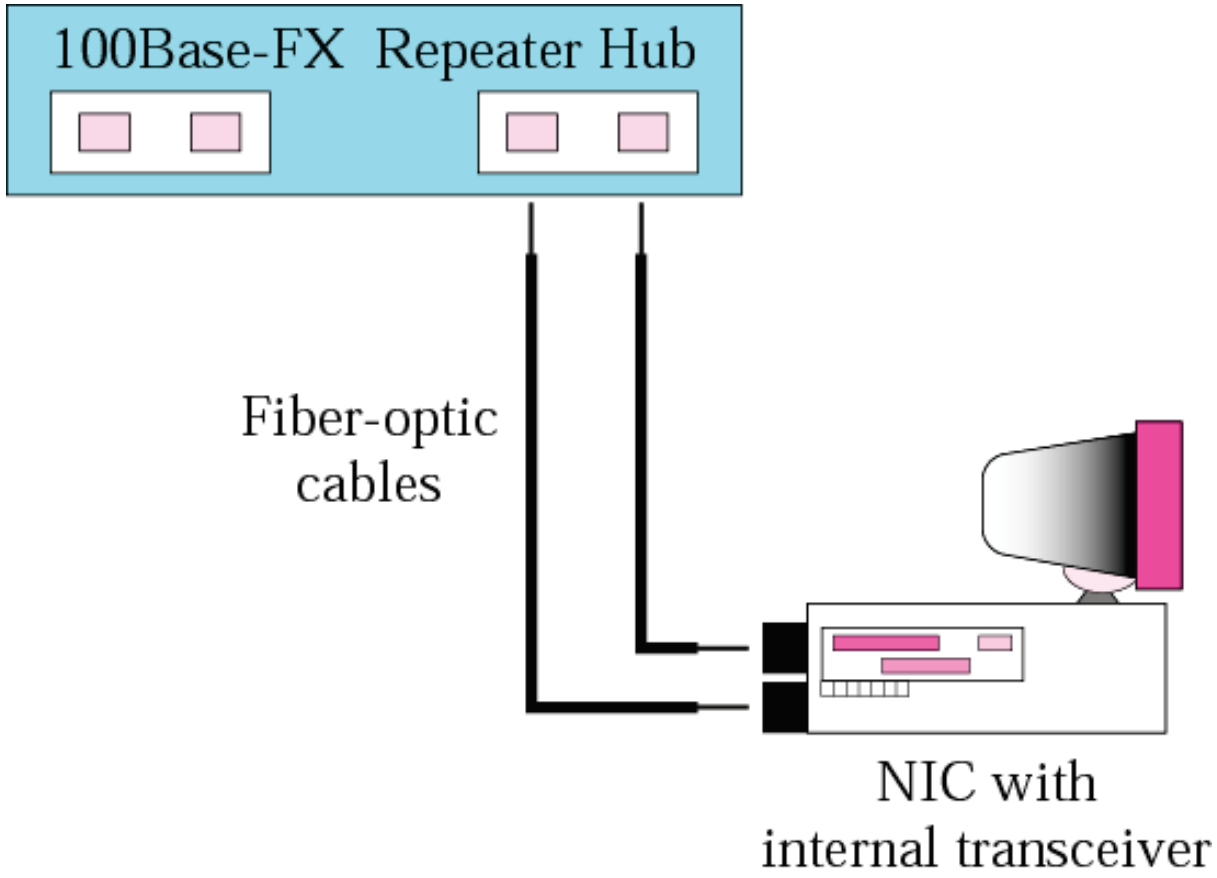
d. 10BASE-FL

Fast Ethernet implementation



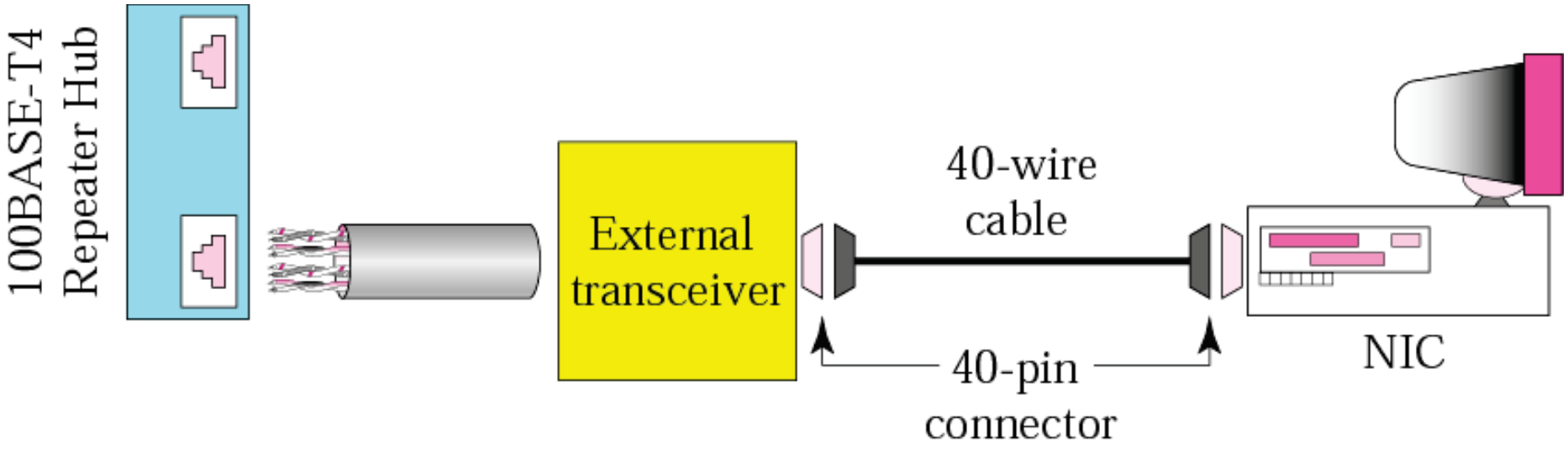
a. 100BASE-TX

Fast Ethernet implementation



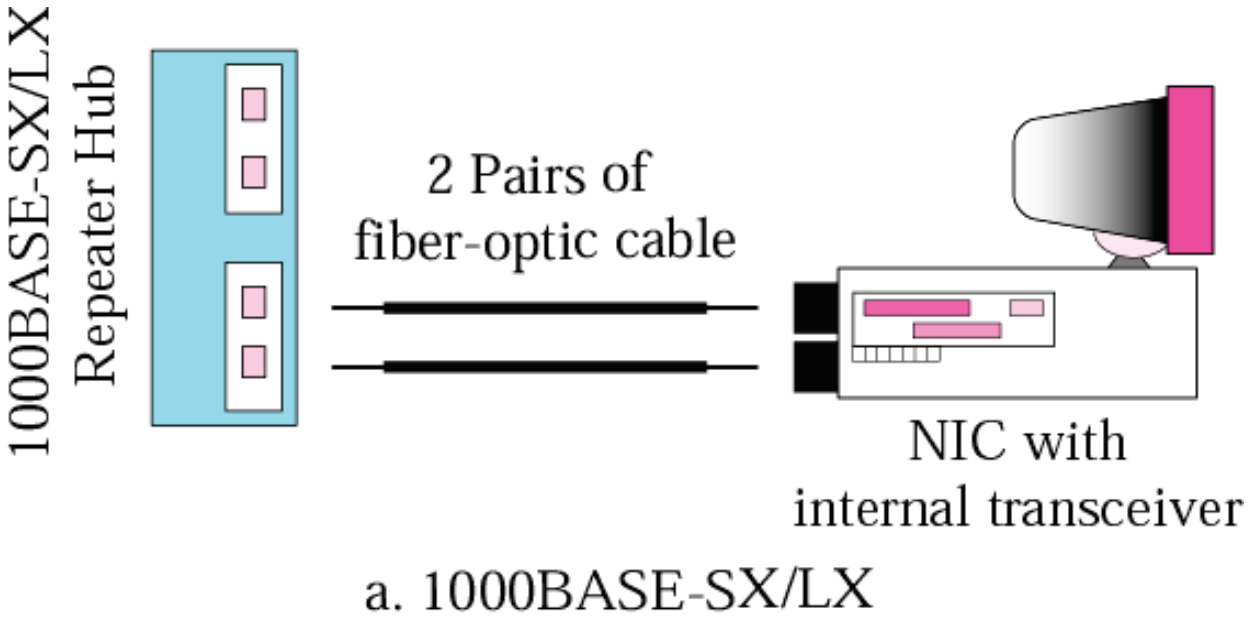
b. 100BASE-FX

Fast Ethernet implementation



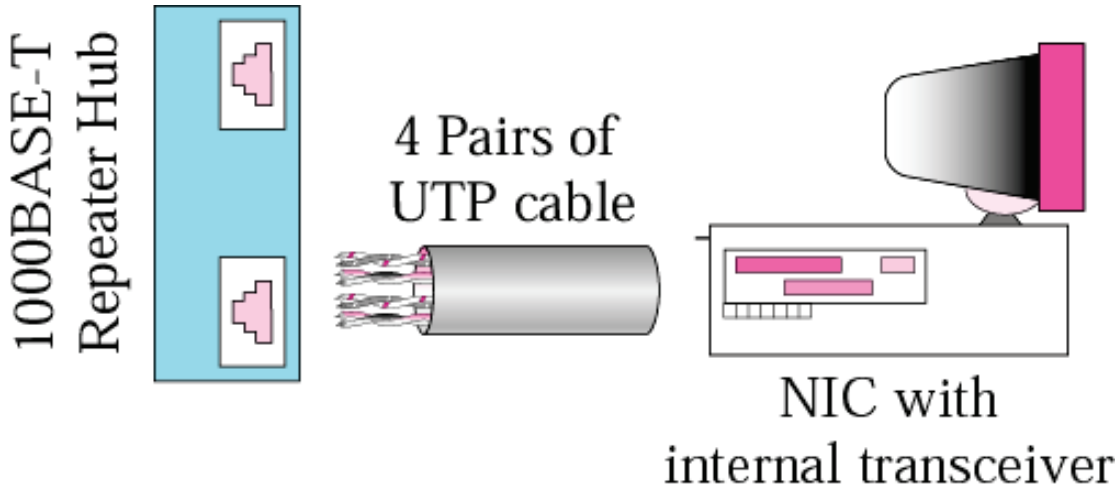
c. 100BASE-T4

Gigabit Ethernet implementation



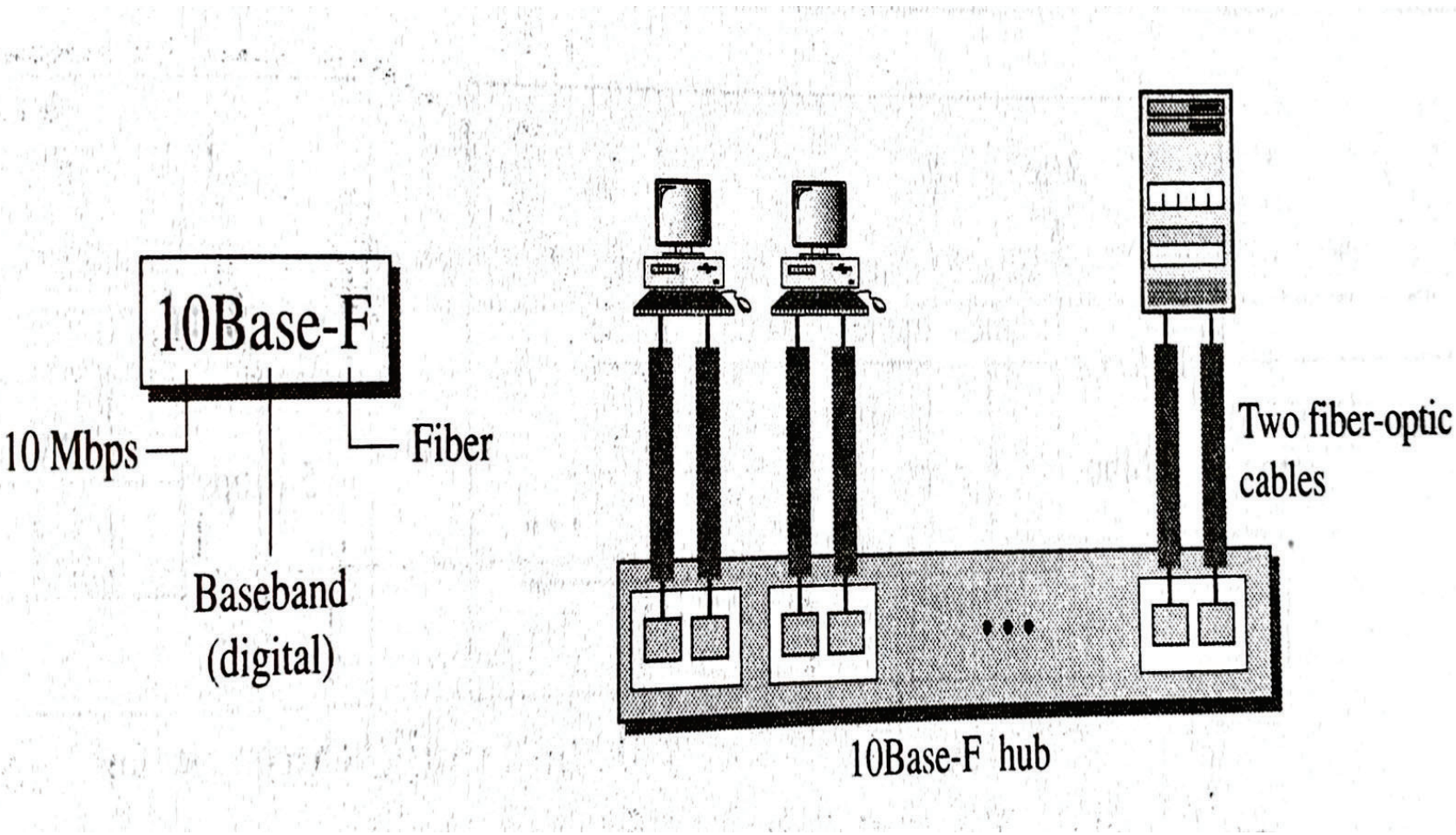
a. 1000BASE-SX/LX

Gigabit Ethernet implementation



b. 1000BASE-T

10 Base-Fiber Implementation



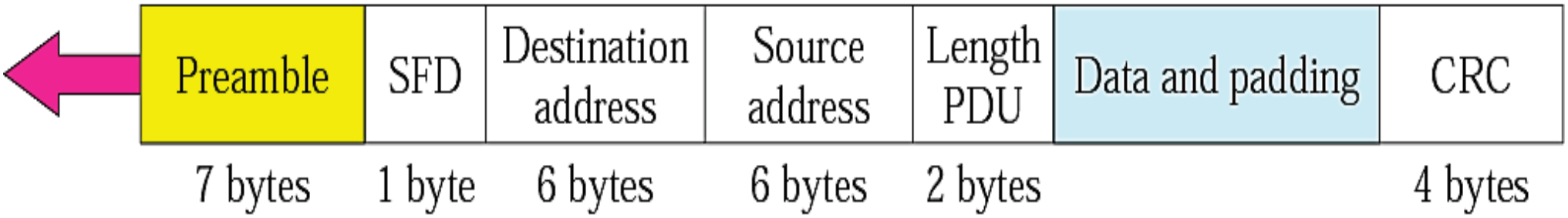
Summary of standard Ethernet Implementation

Characteristics	*10Base5*	*10Base2*	*10Base-T*	*10Base-F*
Media	Thick coaxial cable	Thin coaxial cable	2 UTP	2 Fiber
Maximum length	500 m	185 m	100 m	2000 m
Line encoding	Manchester	Manchester	Manchester	Manchester

*Topology
*Diagram

IEEE 802.3 MAC Ethernet frame

Preamble 56 bits of alternating 1s and 0s.
SFD Start field delimiter, flag (10101011)



PDU:Stands for "Protocol **Data** Unit." A **PDU** is a specific block of information transferred over a network. It is often used in reference to the OSI model, since it describes the different types of **data** that are transferred from each **layer. At Data link layer it's a frame**

Ethernet Quiz

1. This set of Computer Networks Multiple Choice Questions & Answers (MCQs) focuses on “Ethernet”.

1. Ethernet frame consists of _____

a) MAC address
b) IP address
c) Default mask
d) Network address

Answer: a
Explanation: The Ethernet frame has a header that contains the source and destination MAC address. Each MAC address is of 48 bits.

Ethernet Quiz

2. What is start frame delimeter (SFD) in ethernet frame?
a) 10101010
b) 10101011
c) 00000000
d) 11111111

Answer: b
Explanation: The start frame delimiter is a 1 byte field in the Ethernet frame that indicates that the preceding bits are the start of the frame. It is always set to 10101011.

Ethernet Quiz

3. MAC address is of _____
a) 24 bits
b) 36 bits
c) 42 bits
d) 48 bits

Answer: d
Explanation: MAC address is like a local address for the NIC that is used to make a local Ethernet (or wifi) network function. It is of 48 bits.

Ethernet Quiz

4. What is autonegotiation?
a) a procedure by which two connected devices choose common transmission parameters
b) a security algorithm
c) a routing algorithm
d) encryption algorithm

Answer: a
Explanation: autonegotiation is a procedure by which two connected devices choose common transmission parameters. It is a signaling mechanism used in Ethernet over Twisted pair cables.

Ethernet Quiz

5. Ethernet in metropolitan area network (MAN) can be used as _____

a) pure ethernet
b) ethernet over SDH
c) ethernet over MPLS
d) all of the mentioned

Answer: d
Explanation: A metropolitan area network (MAN) that is based on Ethernet standards is called an Ethernet MAN. It is commonly used to connect nodes to the Internet. Businesses also use Ethernet MANs to connect their own offices to each other.

Ethernet Quiz

6. A point-to-point protocol over Ethernet is a network protocol for _____

a) encapsulating PPP frames inside ethernet frames
b) encapsulating ehternet framse inside PPP frames
c) for security of ethernet frames
d) for security of PPP frames

Answer: a
Explanation: PPoE or Point-to-Point protocol over Ethernet was first introduced in 1999. It is popularly used by modern day Internet Service Providers for Dial-up connectivity.

Ethernet Quiz

7. High speed Ethernet works on _____
a) coaxial cable
b) twisted pair cable
c) optical fiber
d) unshielded twisted pair cable

Answer: c
Explanation: Fast Ethernet is mostly used in networks along with Category 5 (Cat-5) copper twisted-pair cable, but it also works with fiber-optic cable. Based on the cable being used, There can be three types of Fast Ethernet.

Ethernet Quiz

8. The maximum size of payload field in Ethernet frame is _____

a) 1000 bytes
b) 1200 bytes
c) 1300 bytes
d) 1500 bytes

Answer: d
Explanation: The minimum size of the payload field is 40 bytes and the maximum size is 1500 bytes. If the payload size exceeds 1500 bytes, the frame is called a jumbo frame.

Ethernet Quiz

9. What is interframe gap?
a) idle time between frames
b) idle time between frame bits
c) idle time between packets
d) idle time between networks

Answer: a
Explanation: The inter-frame gap is the idle time for the receiver between the incoming frame flow. The inter-frame gap must be as low as possible for idle connections.

Ethernet Quiz

10. An Ethernet frame that is less than the IEEE 802.3 minimum length of 64 octets is called _____

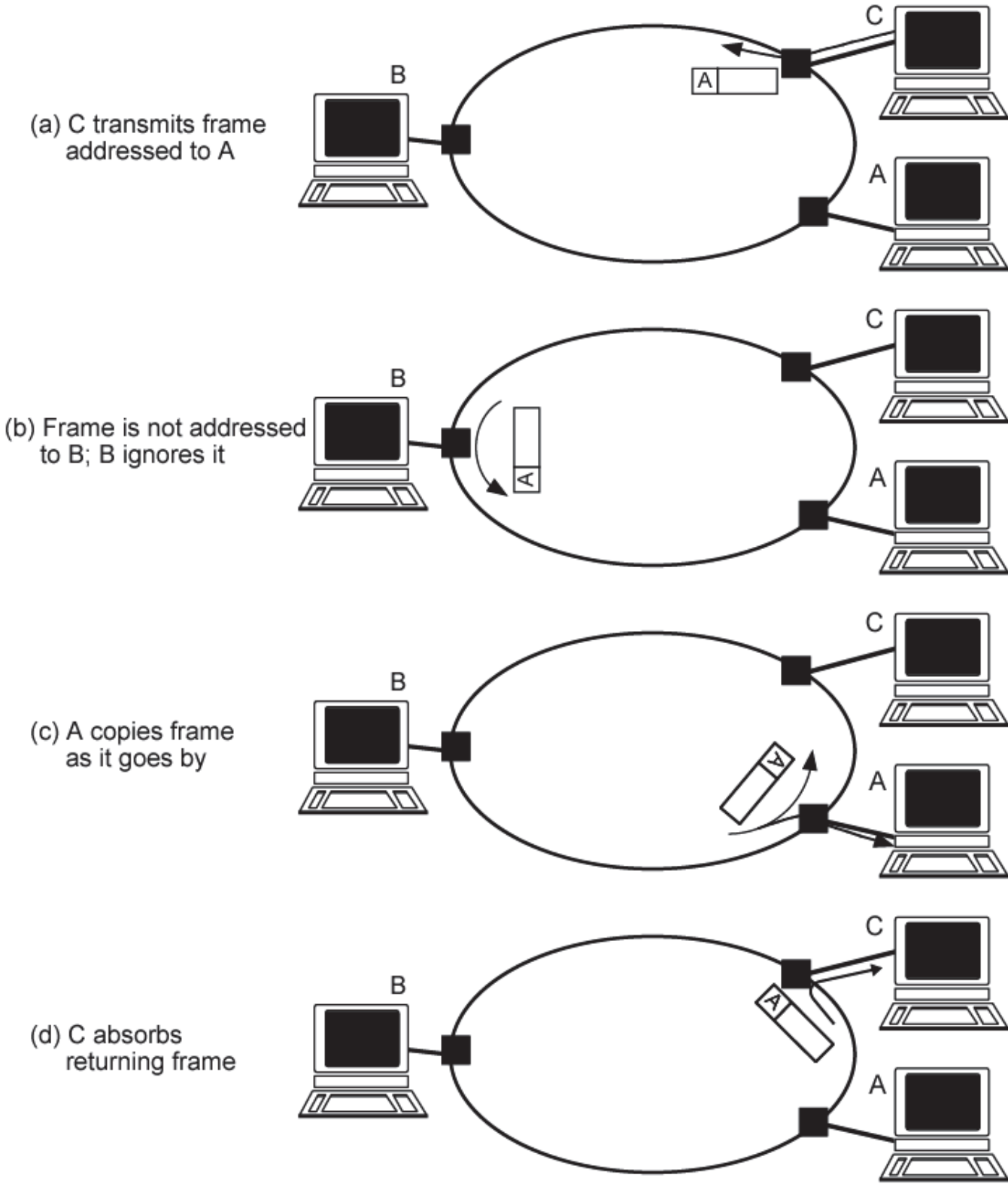
a) short frame
b) runt frame
c) mini frame
d) man frame

Answer: b
Explanation: An ethernet frame that is less than the IEEE 802.3 minimum length of 64 octets is called a runt frame. Such frames are a result of collisions or software malfunctions

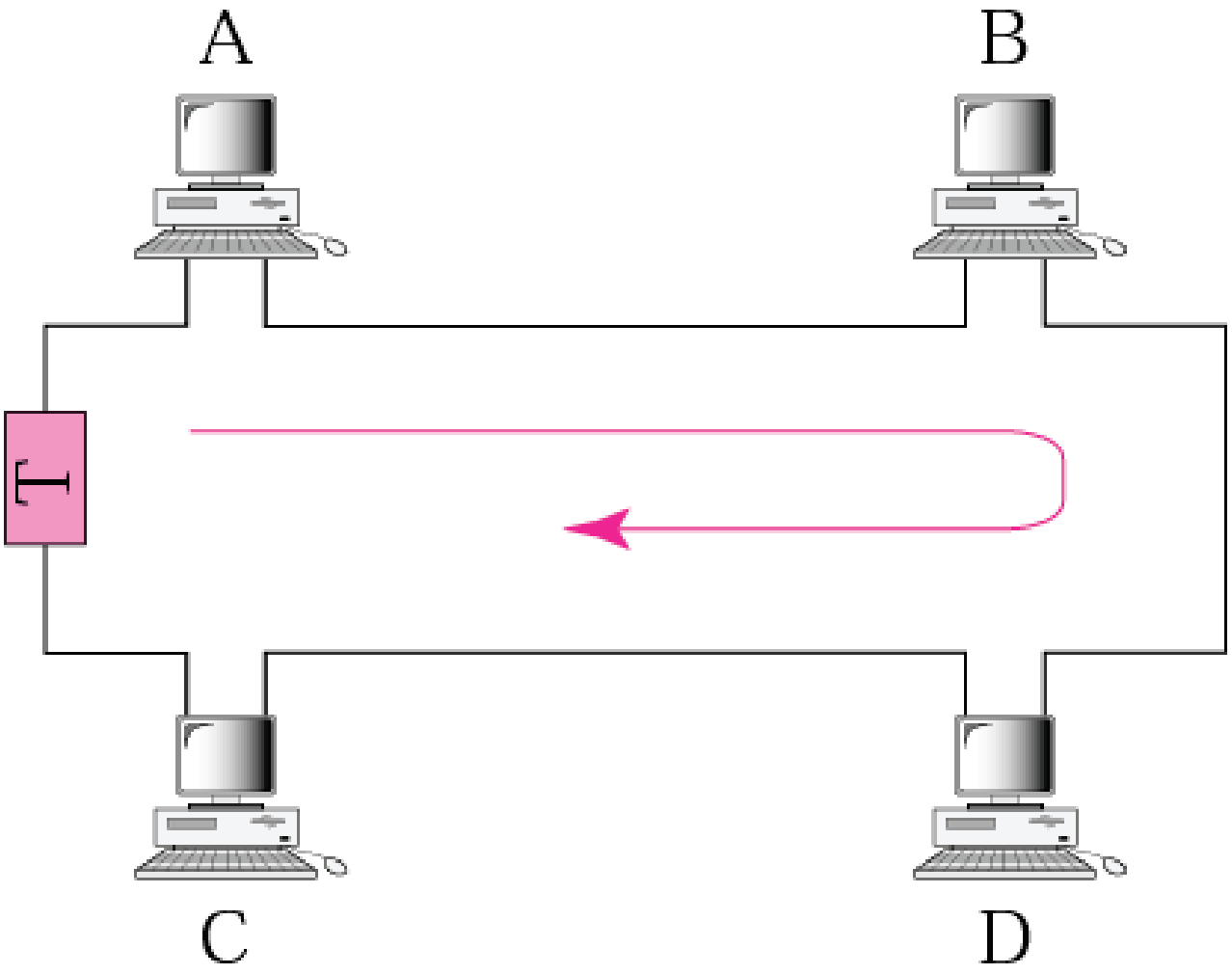
IEEE 802.4 Token Ring

- Repeaters joined by point to point links in closed loop
  - Receive data on one link and retransmit on another
  - Links unidirectional
  - Stations attach to repeaters
- Data in frames
  - Circulate past all stations
  - Destination recognizes address and copies frame
  - Frame circulates back to source where it is removed
- Media access control determines when station can insert frame

Frame Transmission Ring LAN

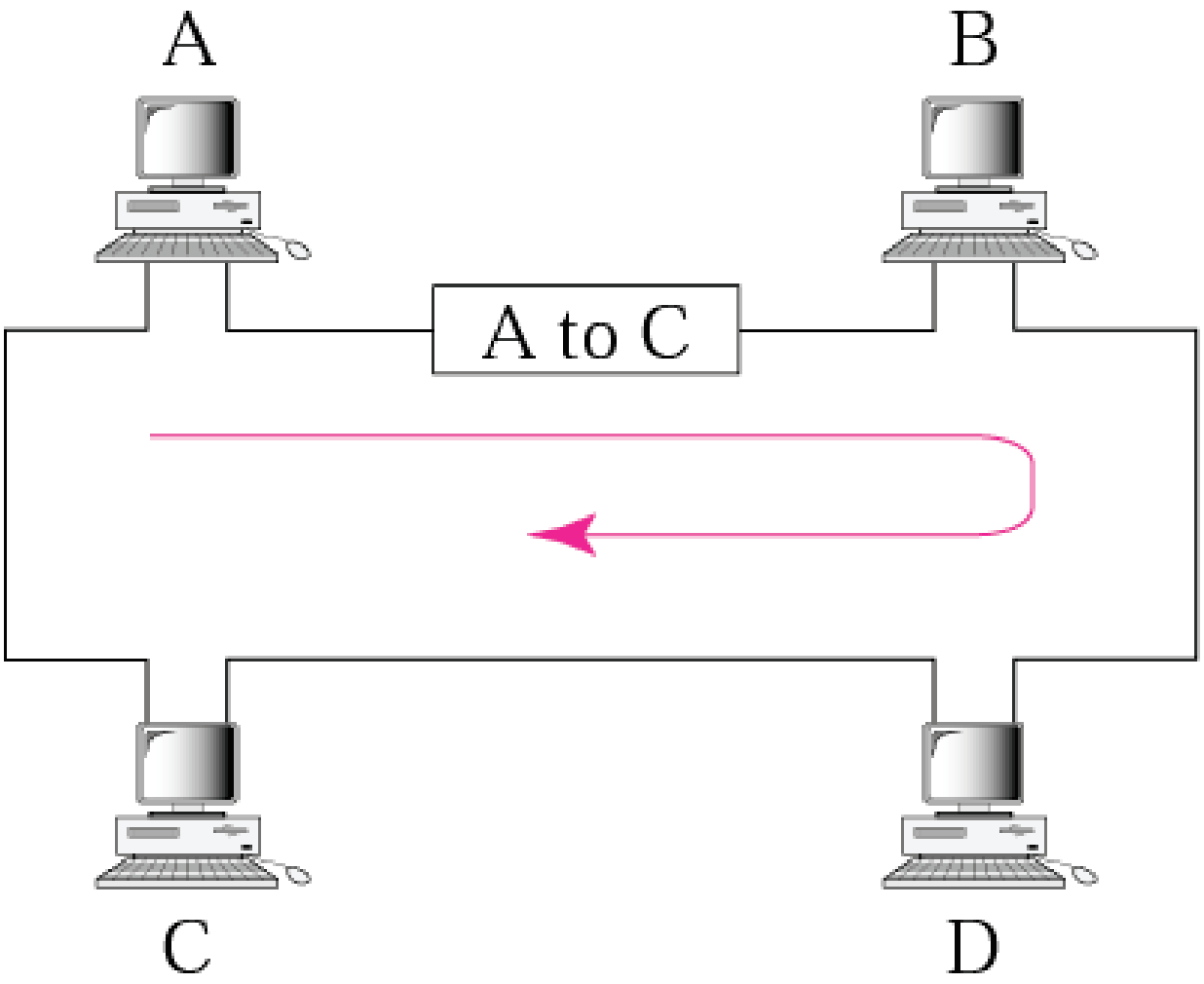


IEEE 802.4 Token Ring



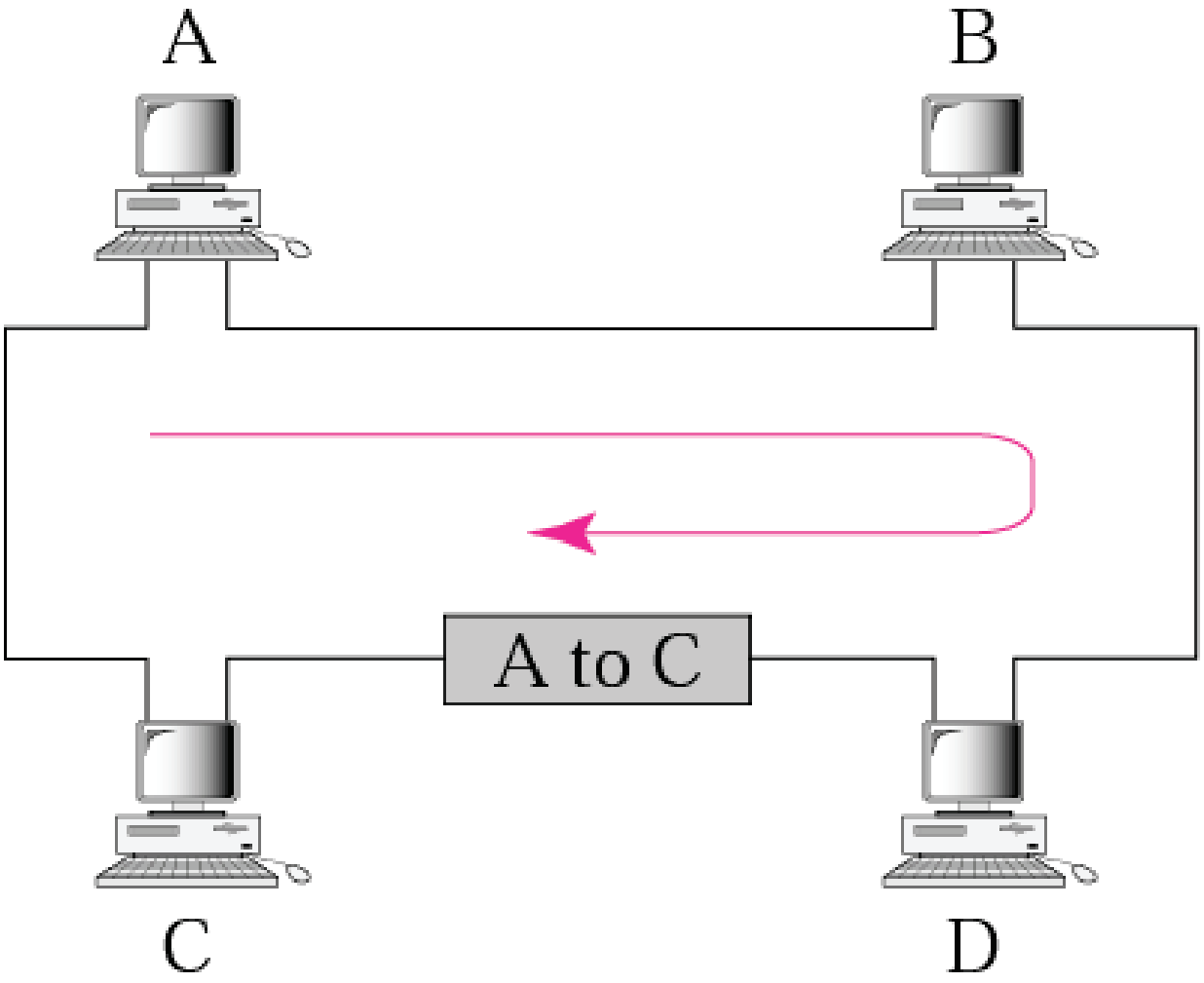
a. Station A captures the token

Token passing



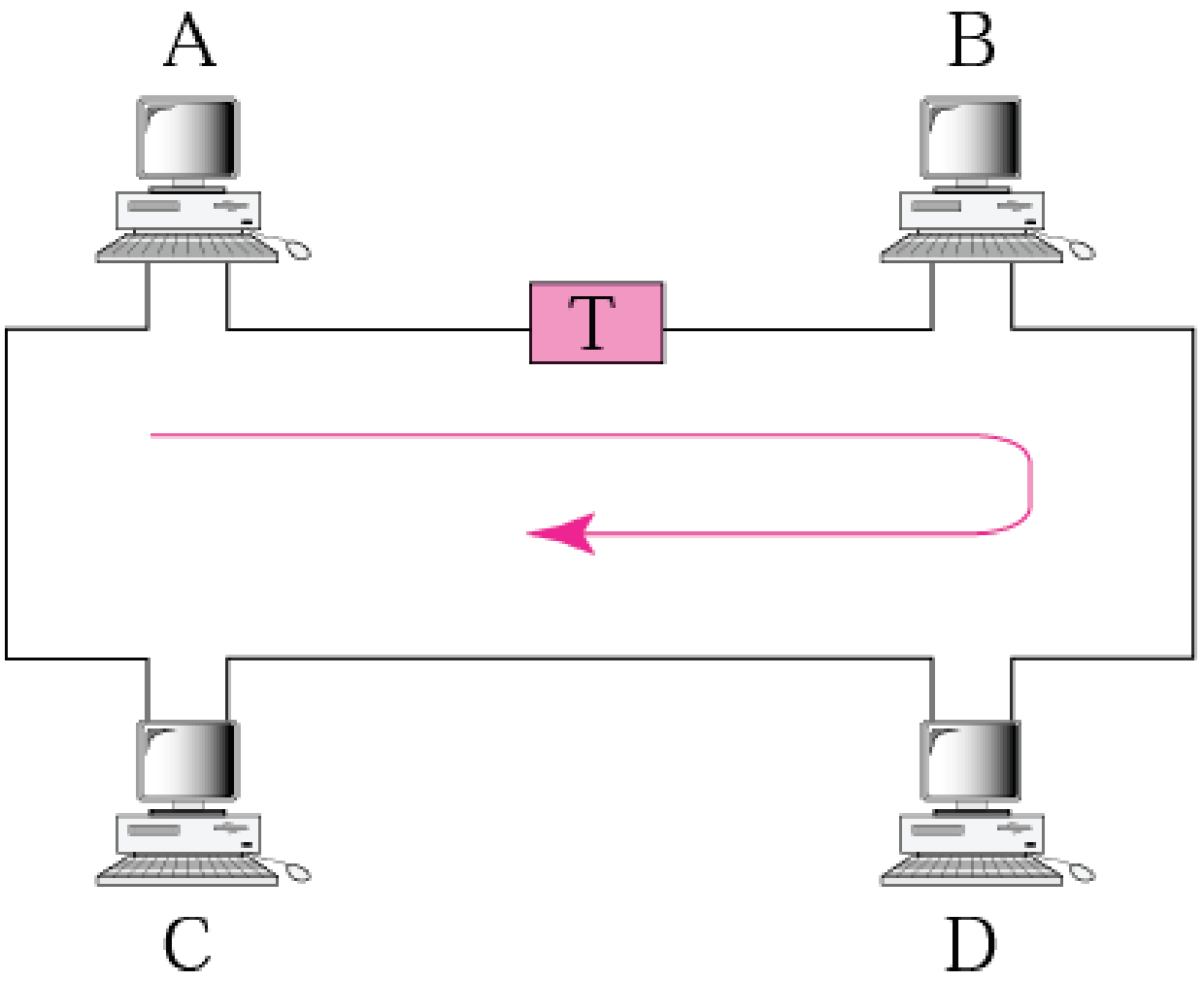
b. Station A sends data to station C

Token passing

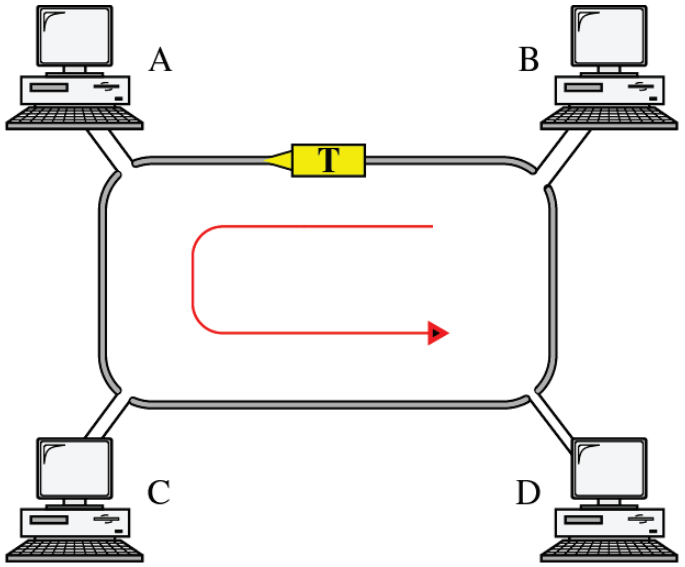


c. Station C copies data and sends frame back to A

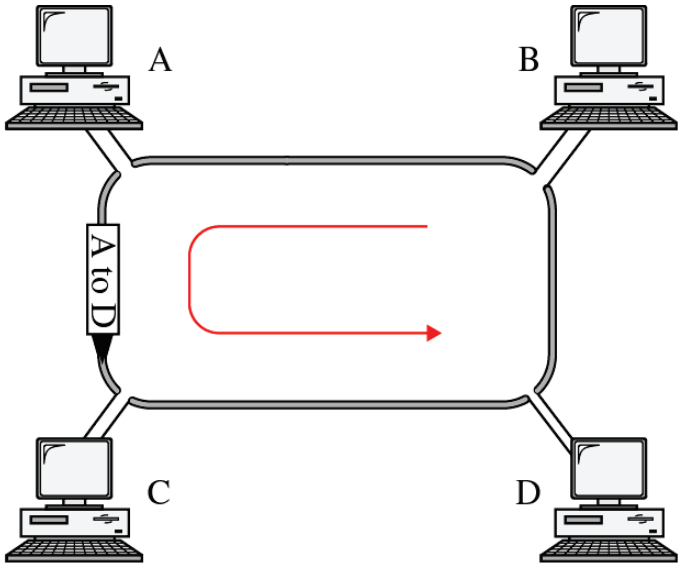
Token passing



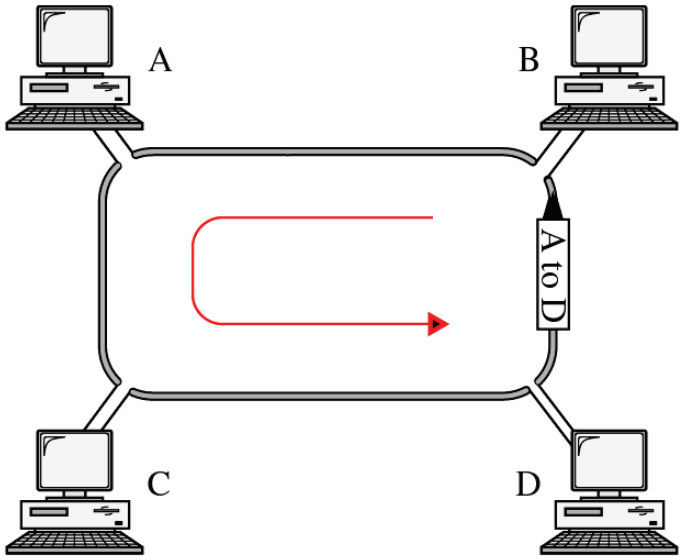
d. Station A releases the token



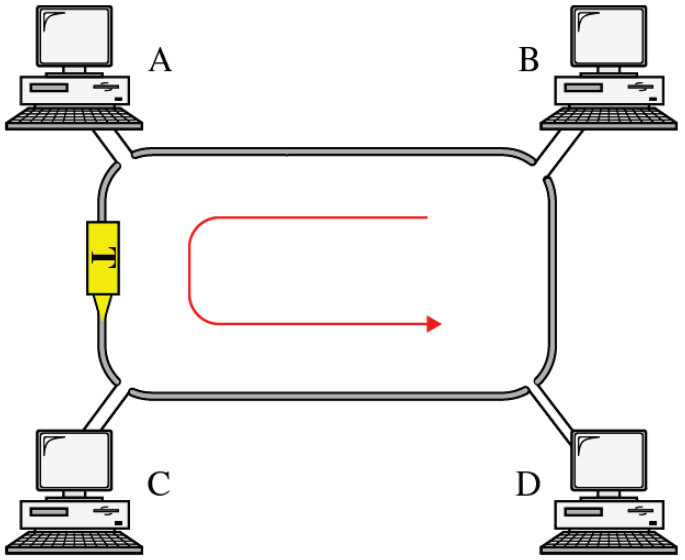
a. Token is traveling along the ring.



b. Station A captures the token and sends its data to D.

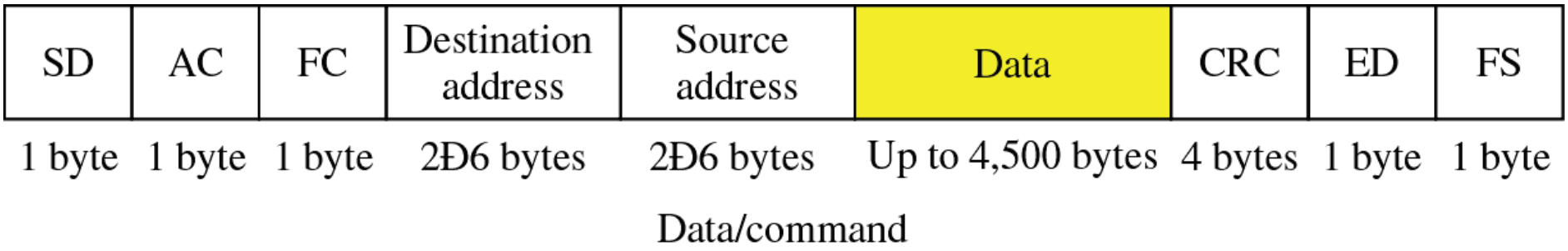


c. Station D copies the frame and sends the data back to the ring.

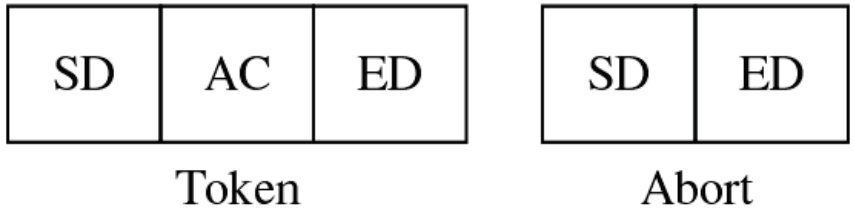


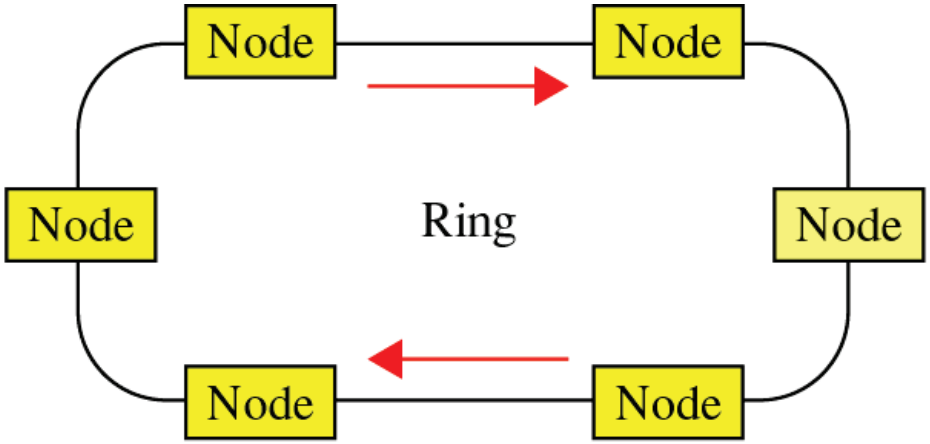
d. Station A receives the frame and releases the token.

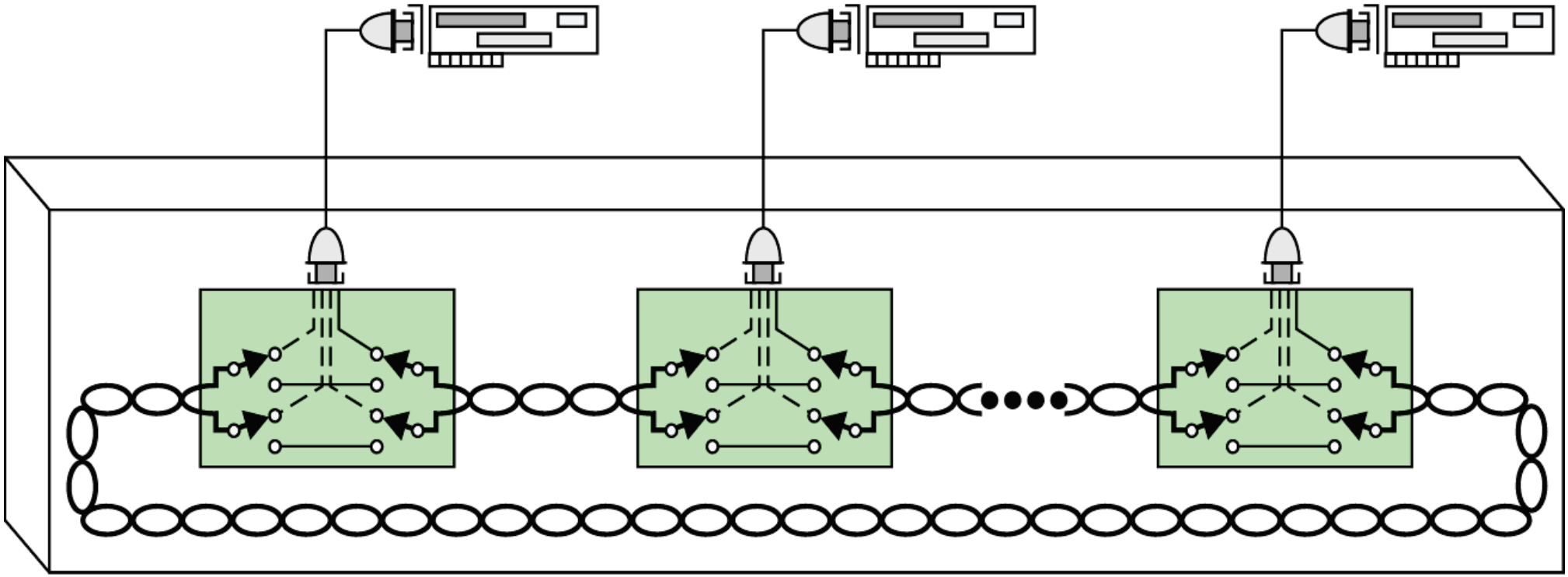
IEEE 802.4 Token Ring Frame



SD Start delimiter (flag)
AC Access control (priority)
FC Frame control (frame type)
ED End delimiter (flag)
FS Frame status

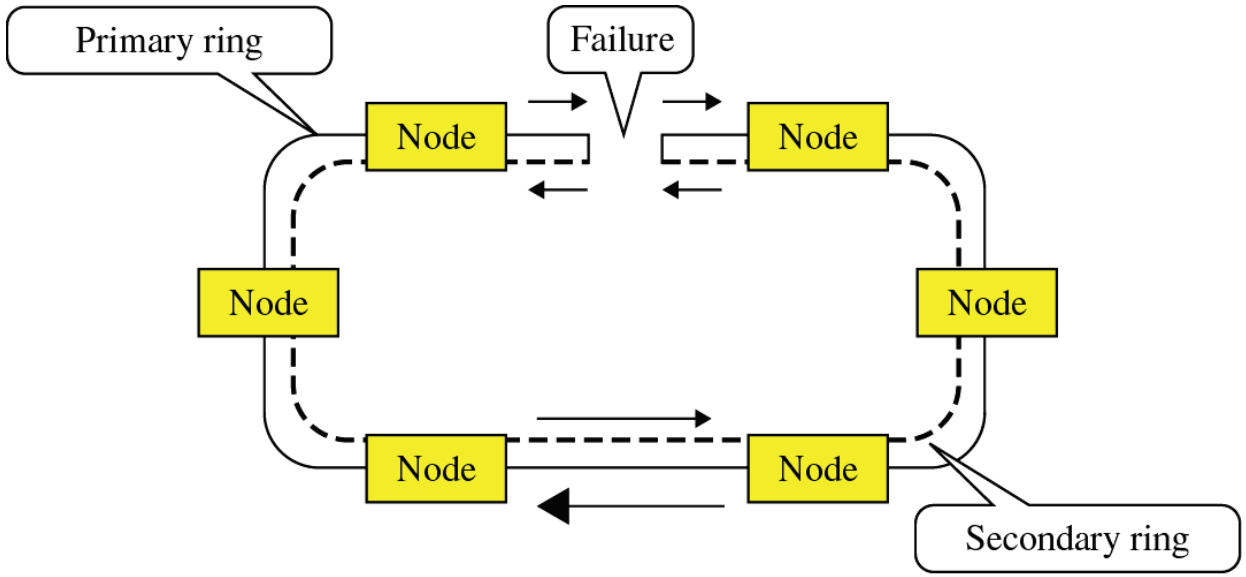




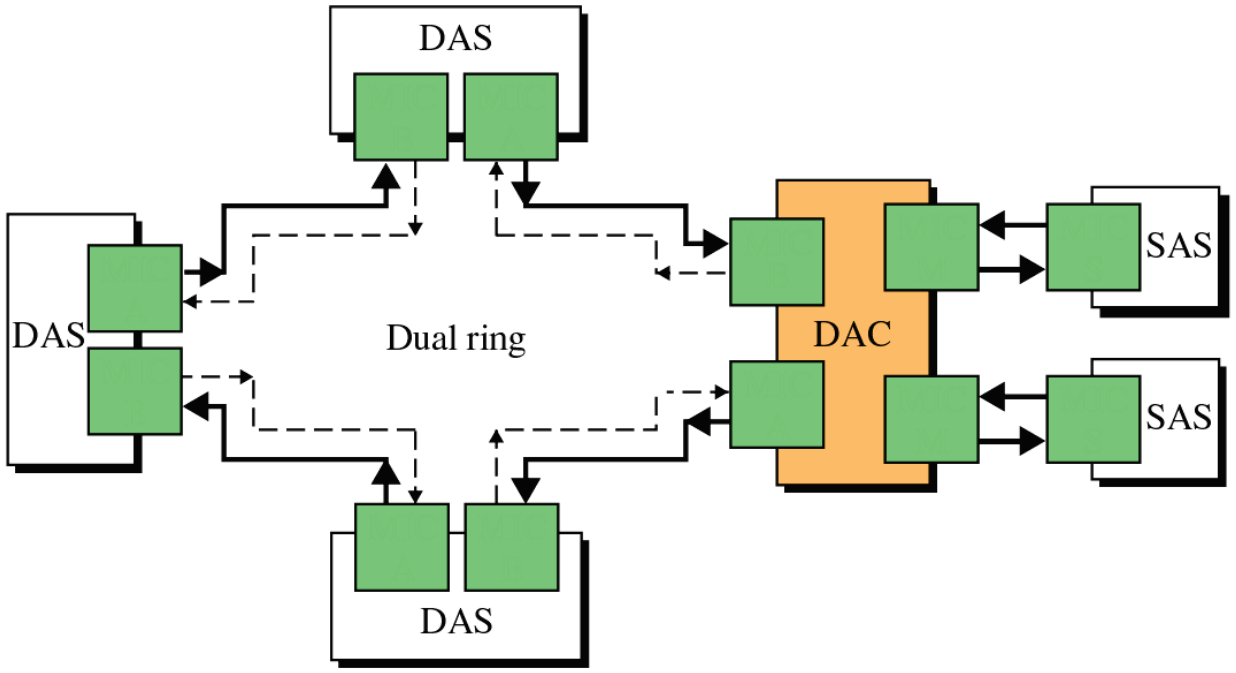


Multistation access unit
MAU

Token Ring

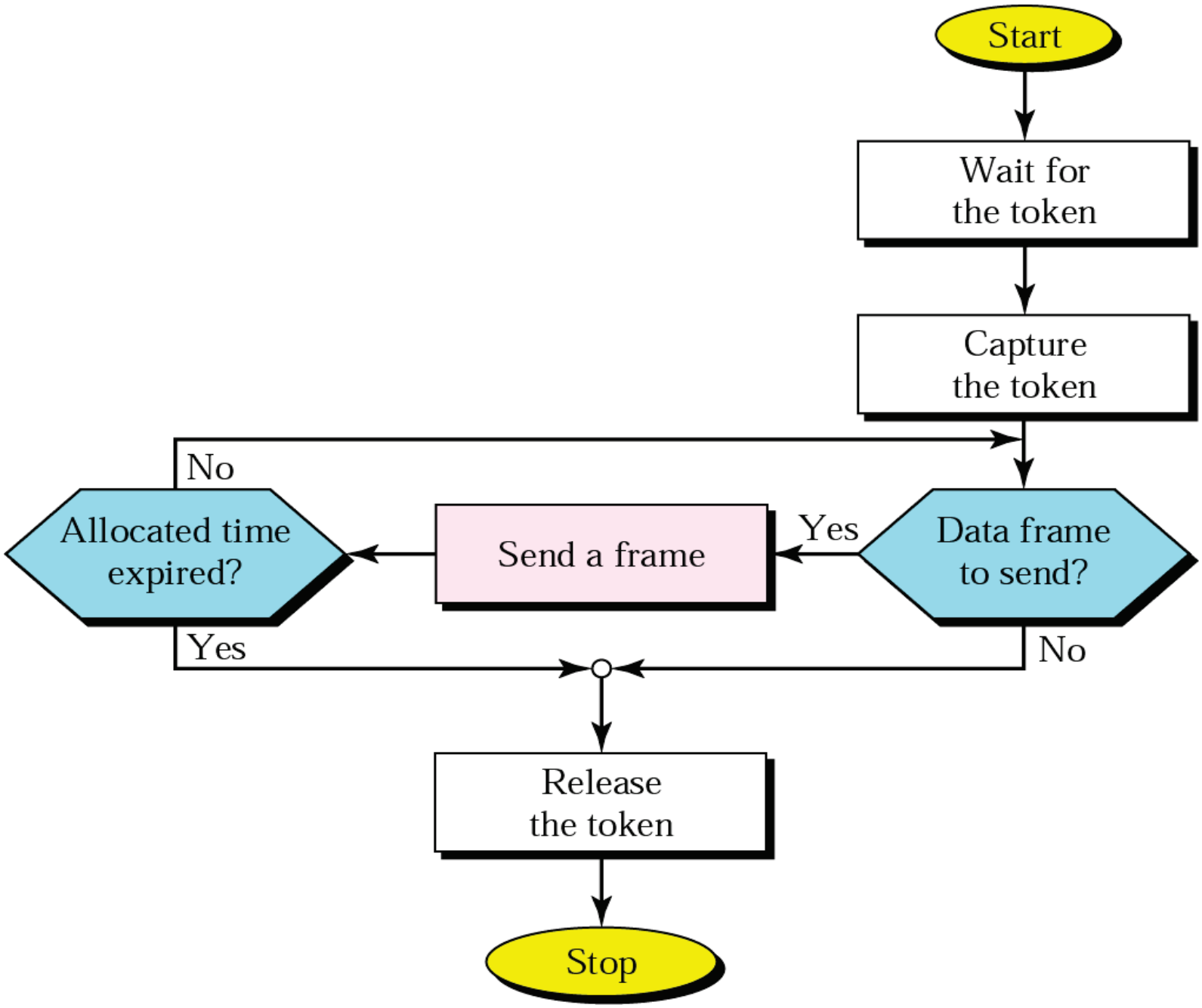


a. Primary ring failure



b. Ring implementation

Figure: Token-passing procedure



Types of LANs

- The three most popular types of LANs are:
  - Ethernet (IEEE 802.3)
  - Token ring network/Bus (IEEE 802.4)
  - FDDI (Fiber Distributed Data Interface) network (IEEE 802.5)

IEEE 802.5 FDDI

- High speed token ring Network (FDDI)
- Multipoint medium
- Transmission propagates throughout medium
- Heard by all stations
  - Need to identify target station
    - Each station has unique address
- Full duplex connection between station and tap
  - Allows for transmission and reception
- Need to regulate transmission
  - To avoid collisions
  - To avoid hogging
    - Data in small blocks - frames
- Terminator absorbs frames at end of medium

IEEE 802.5 FDDI

•FDDI uses optical fiber as its physical medium.

•It operates in the physical and medium access control (MAC layer) of the Open Systems Interconnection (OSI) network model.

•It provides high data rate of 100 Mbps and can support thousands of users.

•It is used in LANs up to **200 kilometers** for long distance voice and multimedia communication.

•It uses **ring based token passing** mechanism and is derived from IEEE 802.4 token bus standard.

•It **contains two token rings**, a primary ring for data and token transmission and a secondary ring that provides backup if the primary ring fails.

•FDDI technology can also be used as a **backbone for a wide area network** (WAN).

IEEE 802.5 FDDI

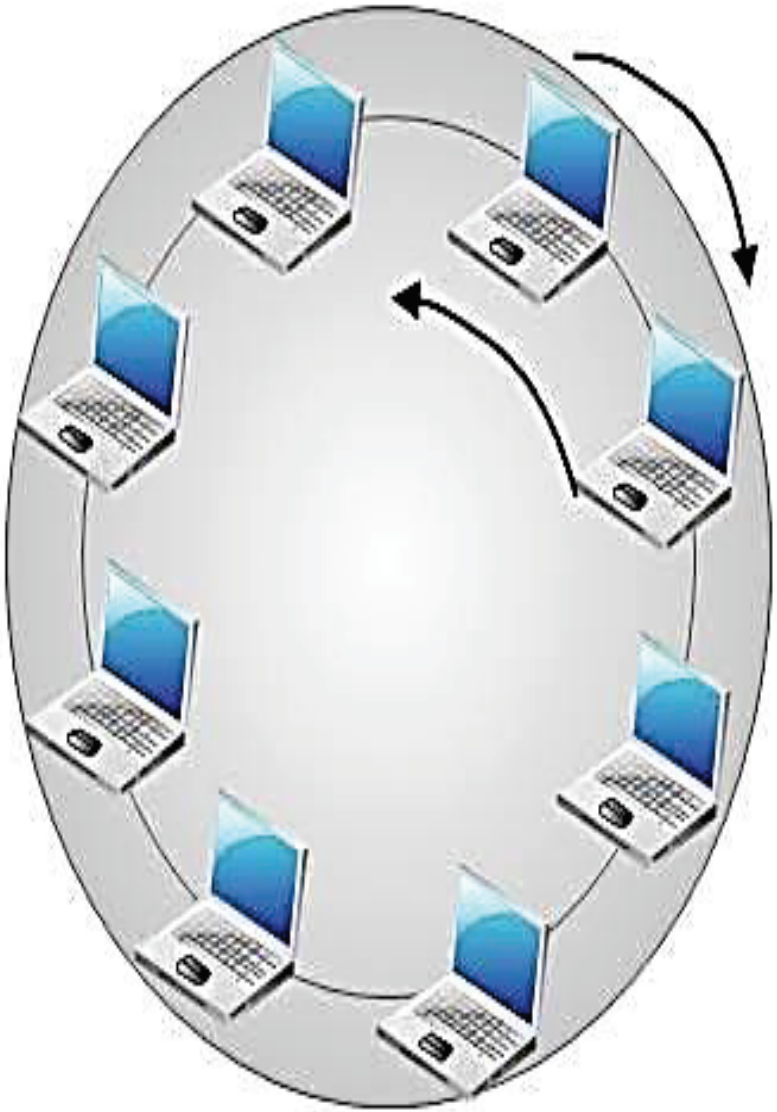


Figure A

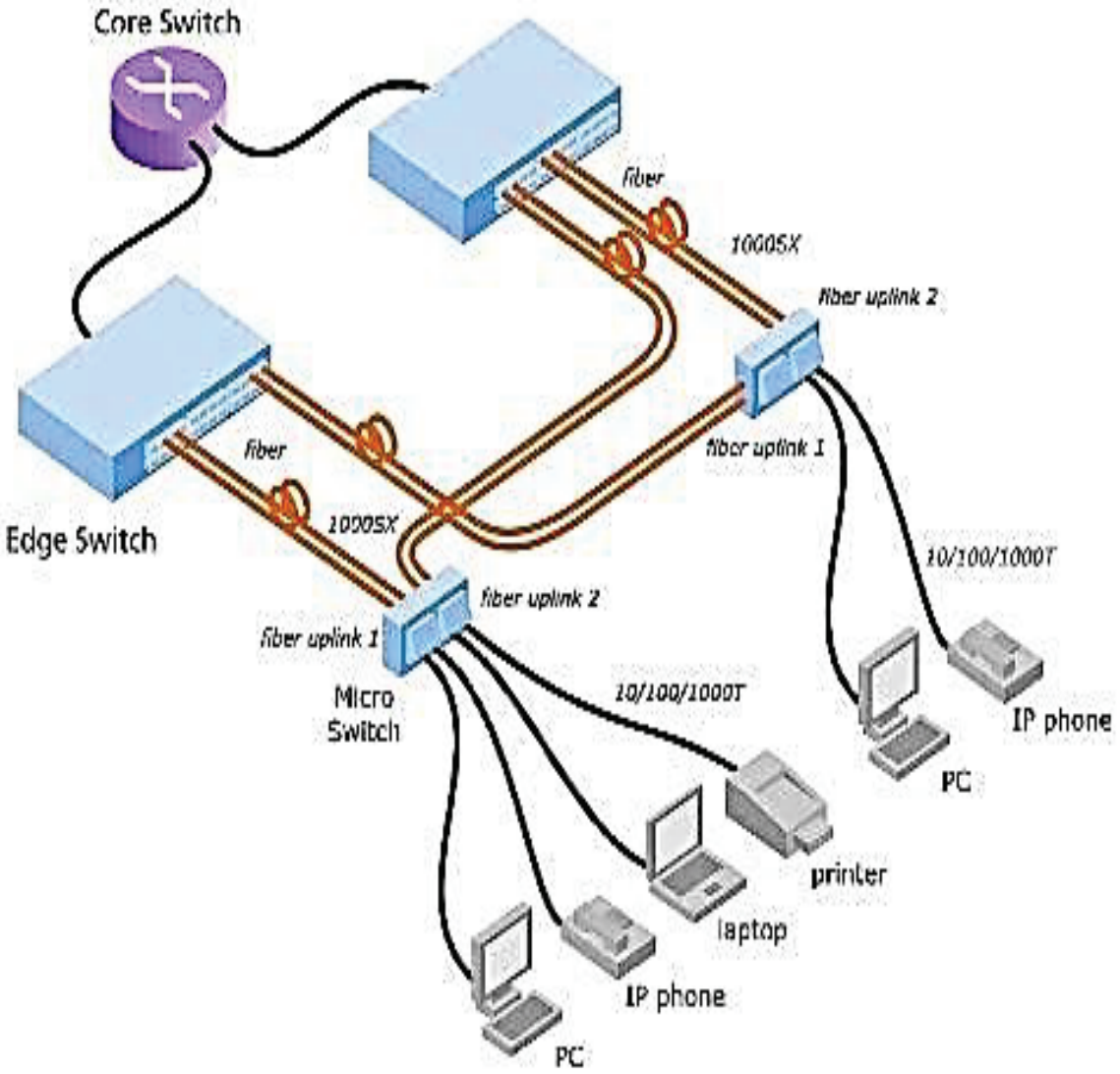
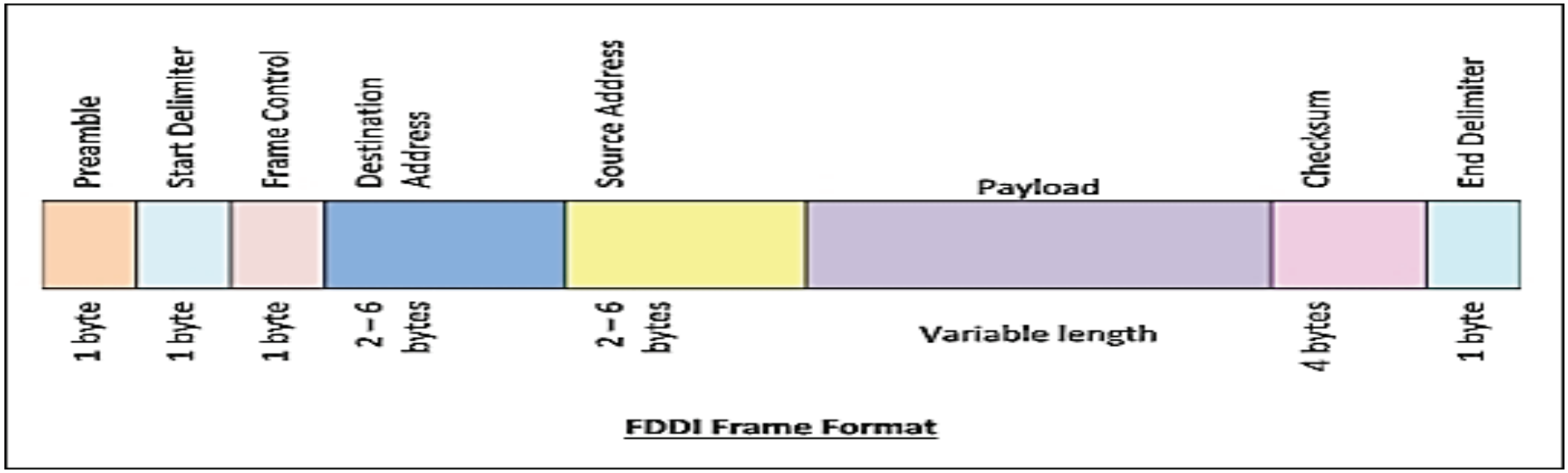


Figure B

IEEE 802.5 FDDI



- **Preamble:** 1 byte for synchronization.
- **Start Delimiter:** 1 byte that marks the beginning of the frame.
- **Frame Control:** 1 byte that specifies whether this is a data frame or control frame.
- **Destination Address:** 2-6 bytes that specifies address of destination station.
- **Source Address:** 2-6 bytes that specifies address of source station.
- **Payload:** A variable length field that carries the data from the network layer.
- **Checksum:** 4 bytes frame check sequence for error detection.
- **End Delimiter:** 1 byte that marks the end of the frame.

COMPARISON WITH OTHER NETWORKS

FEATURES	FDDI	ETHERNET	TOKEN RING
TRANSMISSION RATE	125 MBAUD	20 MBAUD	8 & 32 MBAUD
DATA RATE	100 MBPS	10 MBPS	4 & 16 MBPS
SIGNAL ENCODING	4B/5B (80% EFFICIENT)	MANCHESTER (50% EFFICIENT)	DIFFERENTIAL MANCHESTER (50% EFFICIENT)
MAXIMUM COVERAGE	100 KM	2.5 KM	CONFIGURATION DEPENDENT
MAXIMUM NODES	500	1024	250
MAXIMUM DISTANCE BETWEEN NODES	2 KM (MULTIMODE FIBER) 40 KM (SINGLE-MODE FIBER)	2.5 KM	300 M (RECOMMENDED 100 M)