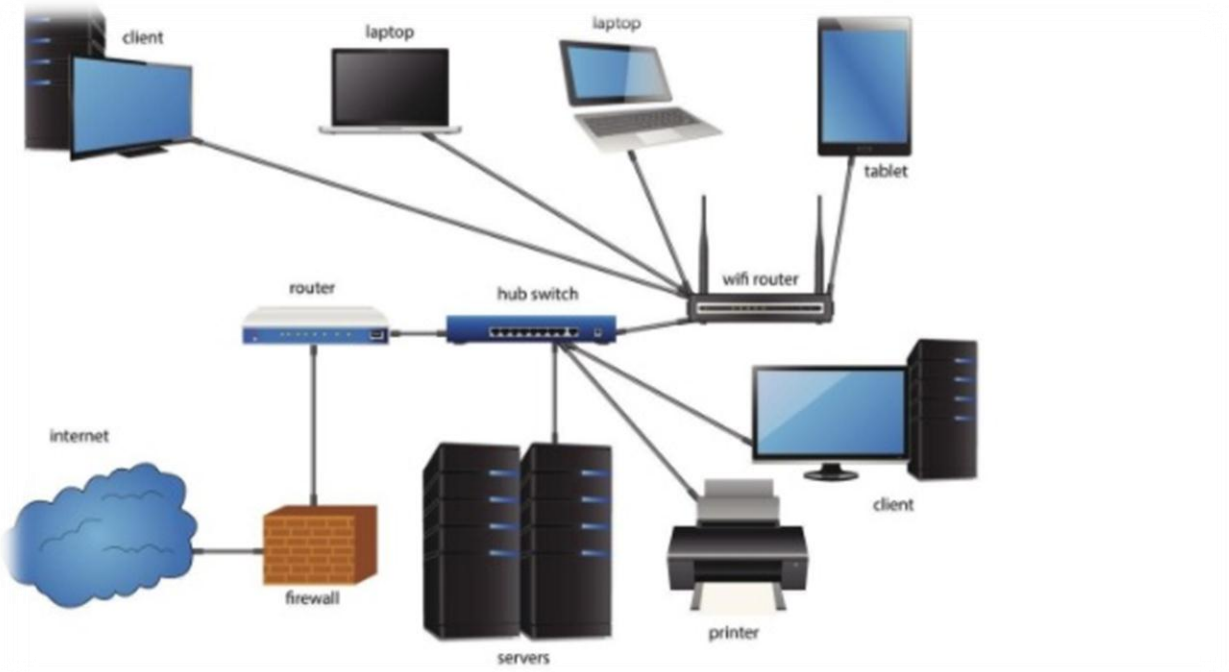
COMPUTER NETWORKS



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UNIT – IV

- The Medium Access Control Sublayer-The Channel Allocation Problem-Static Channel Allocation-Assumptions for Dynamic Channel Allocation, Multiple Access Protocols-Aloha-Carrier Sense Multiple Access Protocols-Collision-Free Protocols-Limited Contention Protocols

- Wired LAN Protocols, Ethernet-Classic Ethernet Physical Layer-Classic Ethernet MAC Sub layer Protocol-Ethernet Performance-Fast Ethernet Gigabit Ethernet-10-Gigabit Ethernet-Retrospective on Ethernet

- Wireless LAN-The 802.11 Architecture and Protocol Stack-The 802.11 Physical Layer-The802.11 MAC Sublayer Protocol-The 805.11 Frame Structure-Services

Chapter 4

Wired LANs: Ethernet

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.

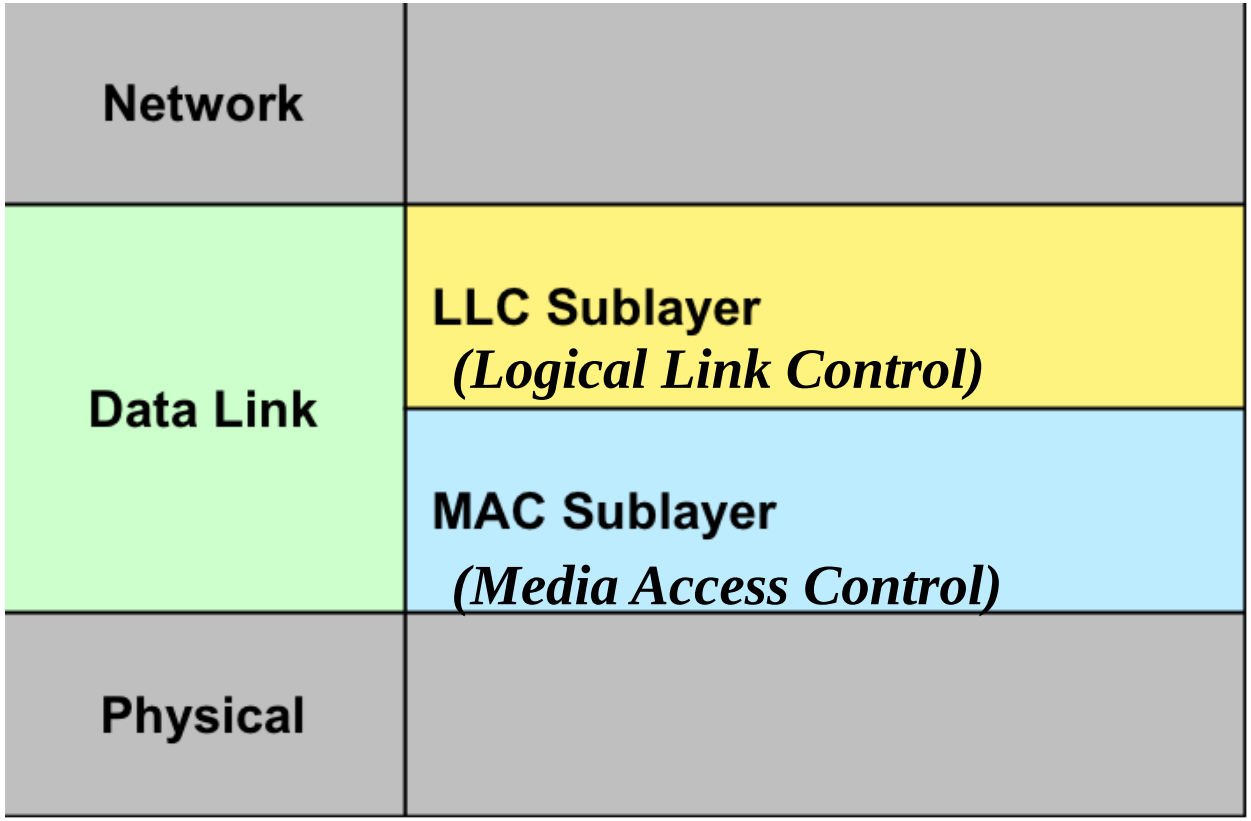
Project 802 does not seek to replace any part of the OSI model or TCP/IP protocol suite.

Instead, Project 802 is a way of specifying functions of the physical layer and the data link layer of major LAN protocols.

The standard was adopted by the American National Standards Institute (ANSI).

Cntd...

In 1987, the International Organization for Standardization (ISO) also approved it as an international standard under the designation ISO 8802.



Data Link Layer (DLL)

Functions of DLL

1. Framing
2. Physical Addressing or MAC Addressing
3. Error Control
4. Access Control

MAC Sublayer

5. Flow Control → LLC Sublayer

Figure: IEEE standard for LANs

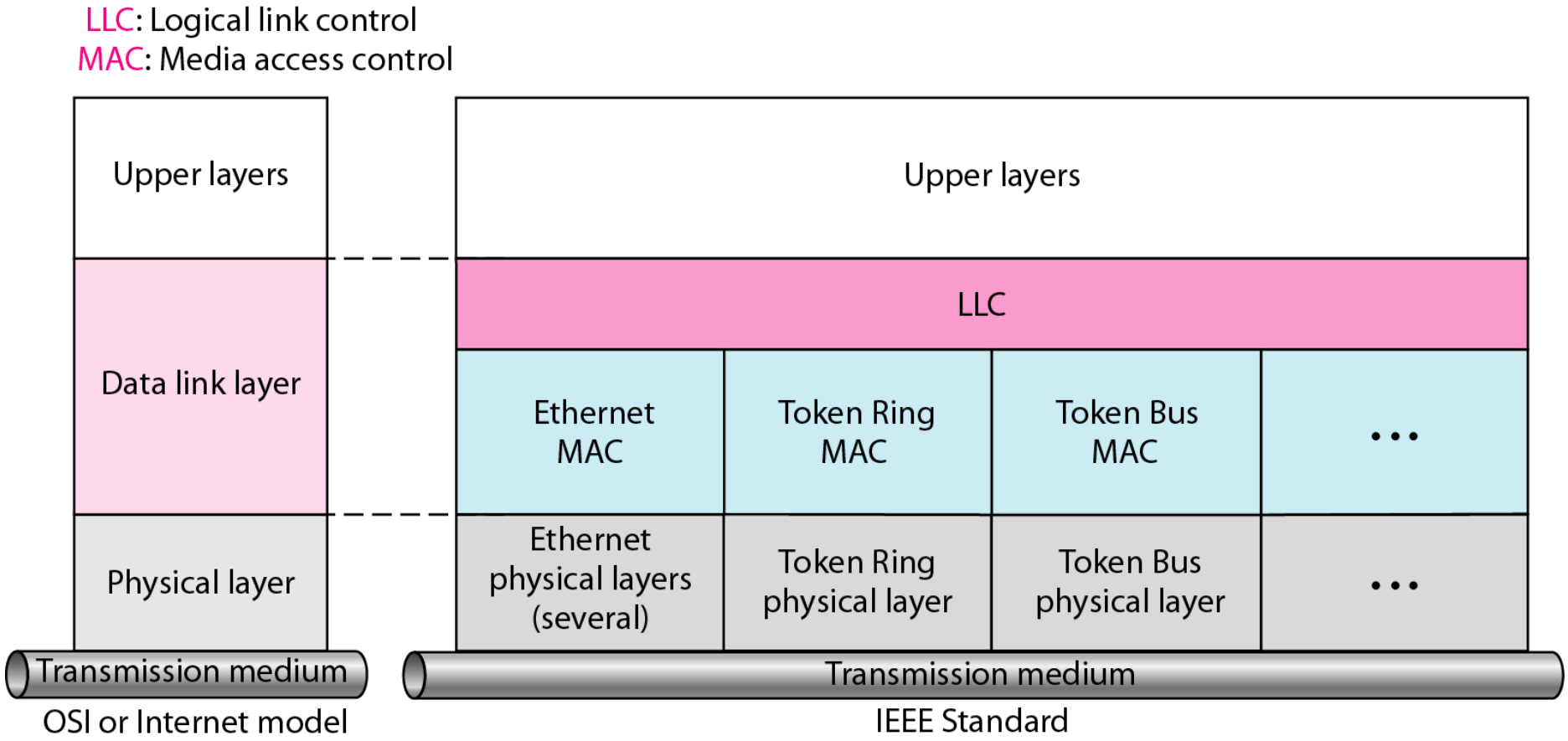


Figure: High-level Data Link Control(HDFC)

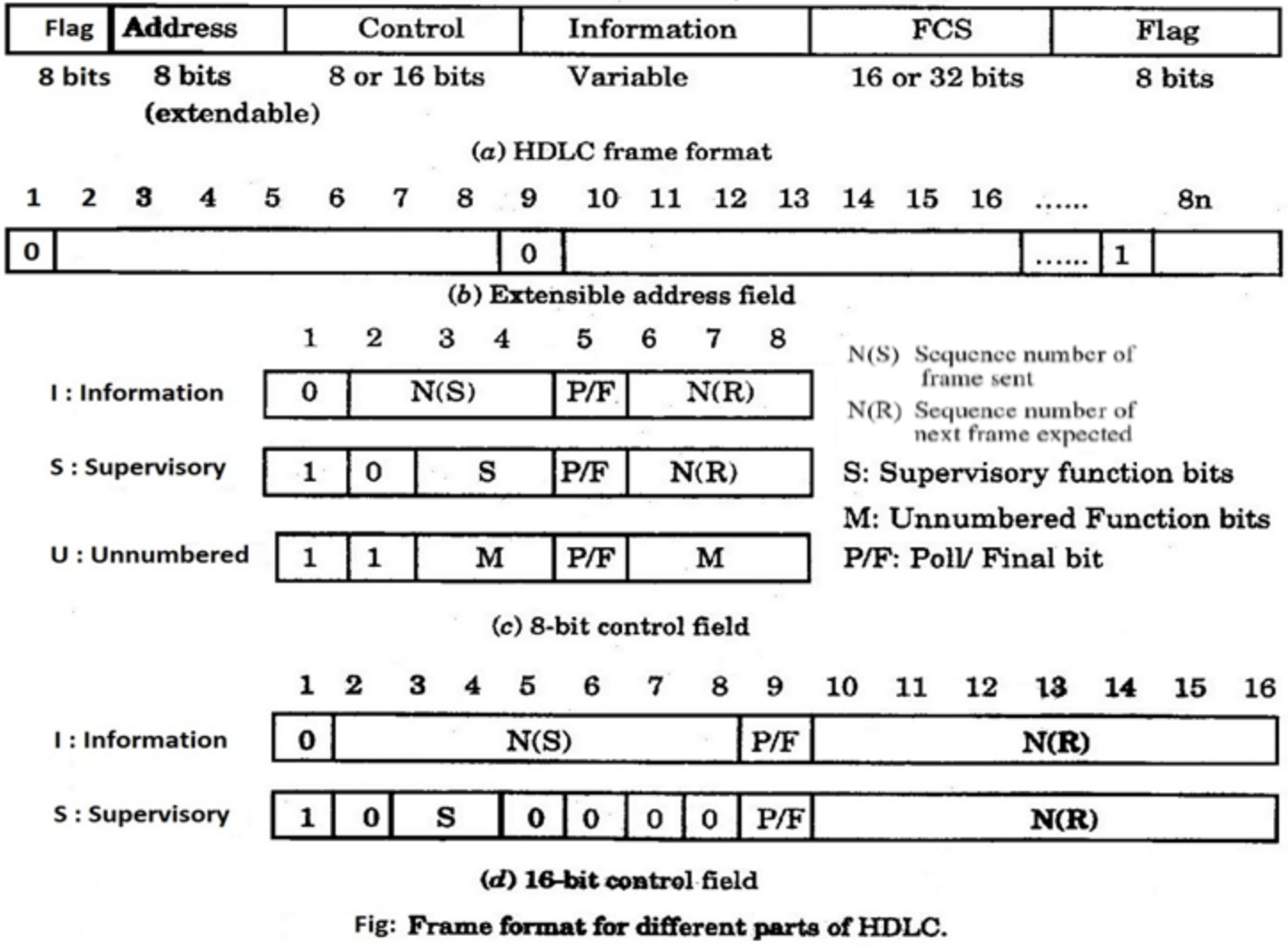


Fig: **Frame format for different parts of HDLC.**

Figure: HDLC Cntd…

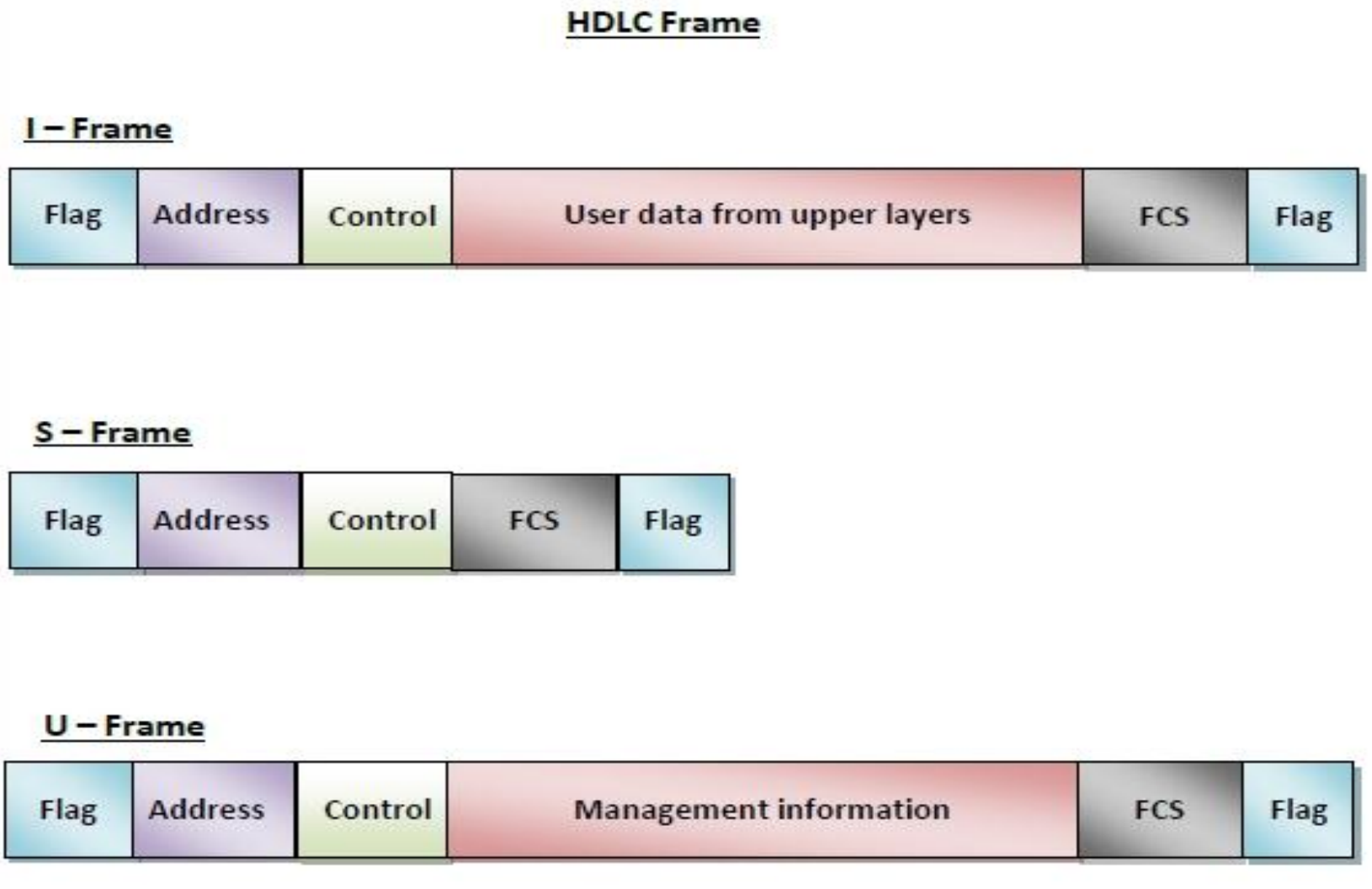
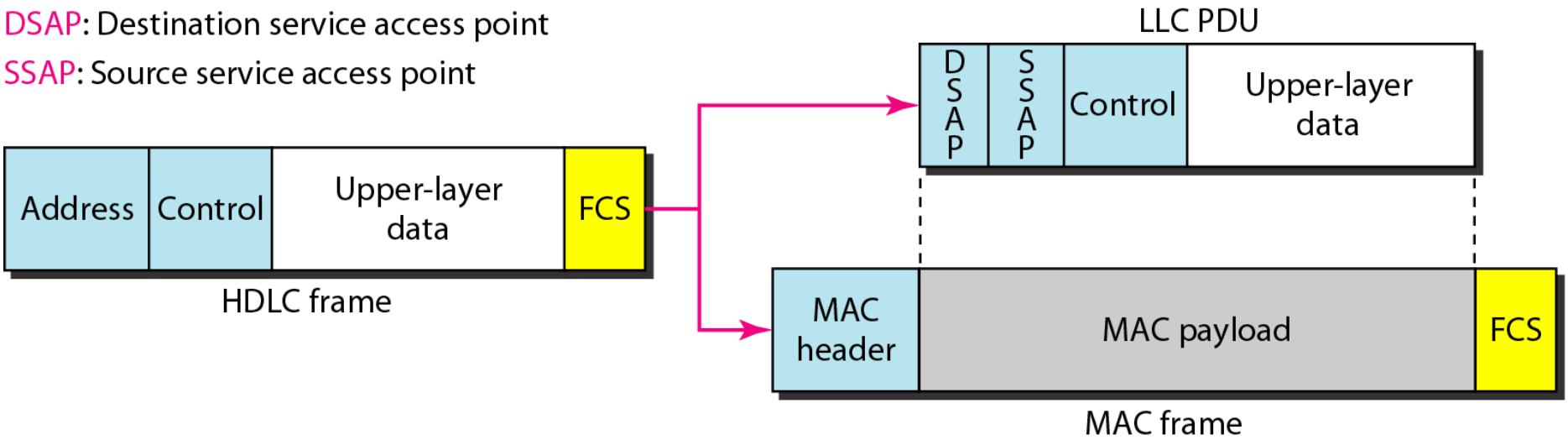


Figure: HDLC frame compared with LLC and MAC frames



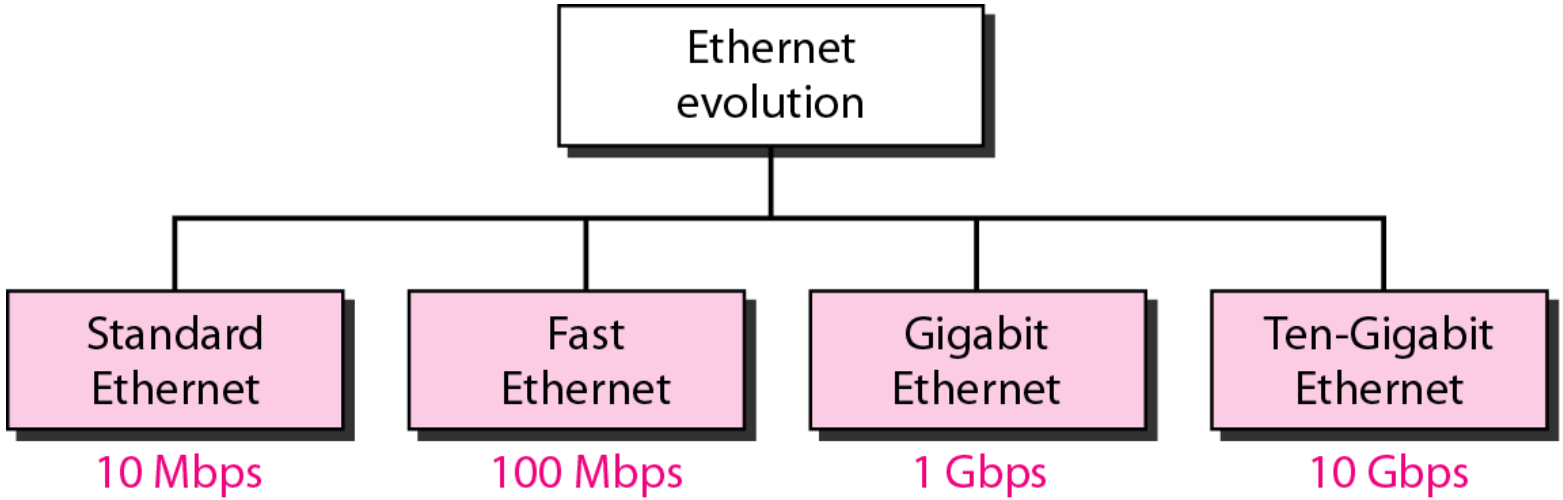
ETHERNET

The original Ethernet was created in 1970s at Xerox's Palo Alto Research Center (PARC) by Robert Metcalfe and David Boggs.

Since then, it has gone through four generations.

1. Standard Ethernet (10 Mbps)
2. Fast Ethernet (100 Mbps)
3. Gigabit Ethernet (1 Gbps)
4. 10 Gigabit Ethernet.

Figure: Ethernet evolution through four generations



1. STANDARD ETHERNET

Ethernet is the standard way to connect computers on a network over a wired connection. It provides a simple interface and for connecting multiple devices, such computers, routers, and switches.

Ethernet is commonly used in local area networks (LAN), metropolitan area networks (MAN) and wide area networks (WAN).

It was commercially introduced in 1980 and first standardized in 1983 as IEEE 802.3.

A standard Ethernet network can transmit data at a rate up to 10 Megabits per second (10 Mbps).

Topics discussed in this section:

MAC Sublayer
Physical Layer

Figure: 802.3 MAC frame

Preamble: 56 bits of alternating 1s and 0s.

SFD: Start frame delimiter, flag (10101011)

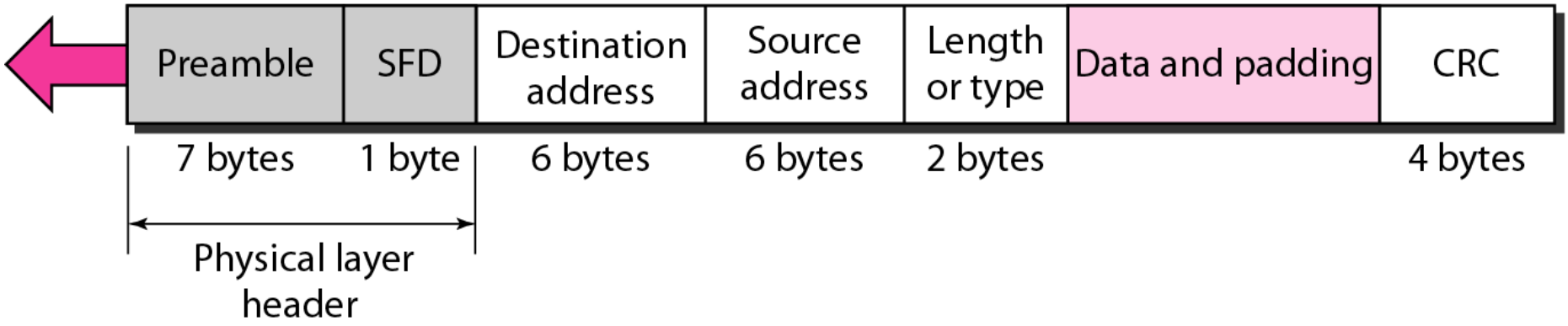
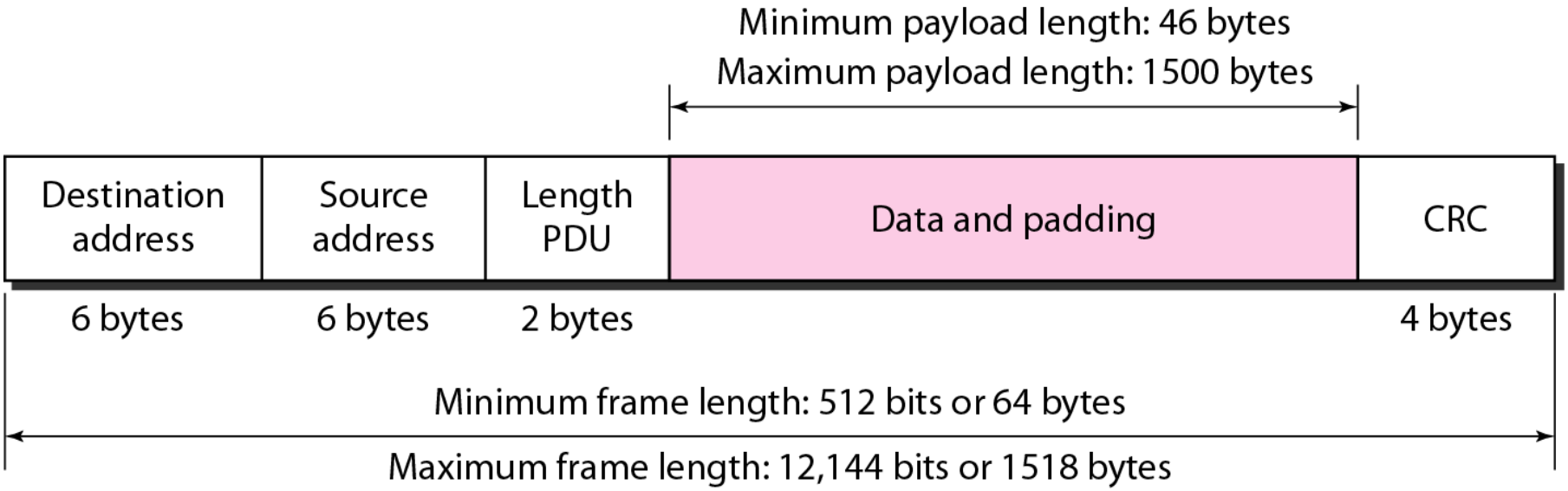


Figure: Minimum and maximum lengths



Note

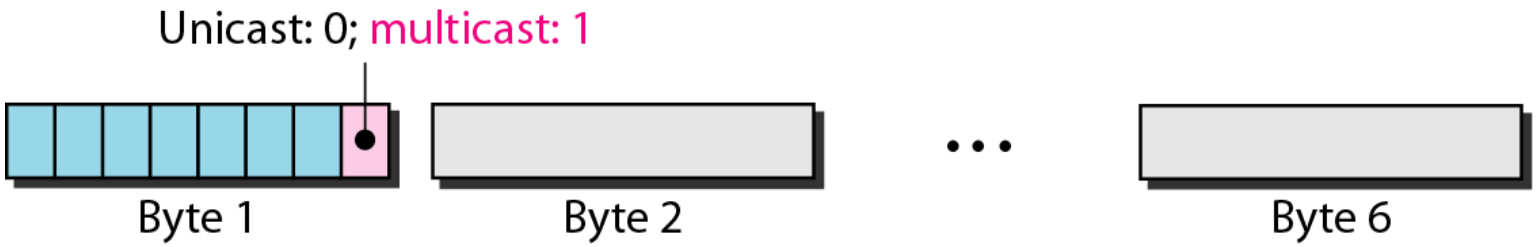
Frame length:

Minimum: 64 bytes (512 bits)

Maximum: 1518 bytes (12,144 bits)

Figure: **Example of an Ethernet address in hexadecimal notation**

Figure: Unicast and multicast addresses



Note

The least significant bit of the first byte defines the type of address. If the bit is 0, the address is unicast; otherwise, it is multicast.

Note

The broadcast destination address is a special case of the multicast address in which all bits are 1s.

Example 4.1

Define the type of the following destination addresses:

a. 4A:30:10:21:10:1A *b. 47:20:1B:2E:08:EE*

c. FF:FF:FF:FF:FF:FF

Solution

To find the type of the address, we need to look at the second hexadecimal digit from the left. If it is even, the address is unicast. If it is odd, the address is multicast. If all digits are F's, the address is broadcast. Therefore, we have the following:

a. This is a unicast address because A in binary is 1010.

b. This is a multicast address because 7 in binary is 0111.

c. This is a broadcast address because all digits are F's.

Example 4.2

Show how the address 47:20:1B:2E:08:EE is sent out on line.

Solution

The address is sent left-to-right, byte by byte; for each byte, it is sent right-to-left, bit by bit, as shown below:

Hexadecimal 47 20 IB 2E 08 EE

Binary 01000111 00100000 00011011 00101110 00001000 11101110

Figure: Categories of Standard Ethernet

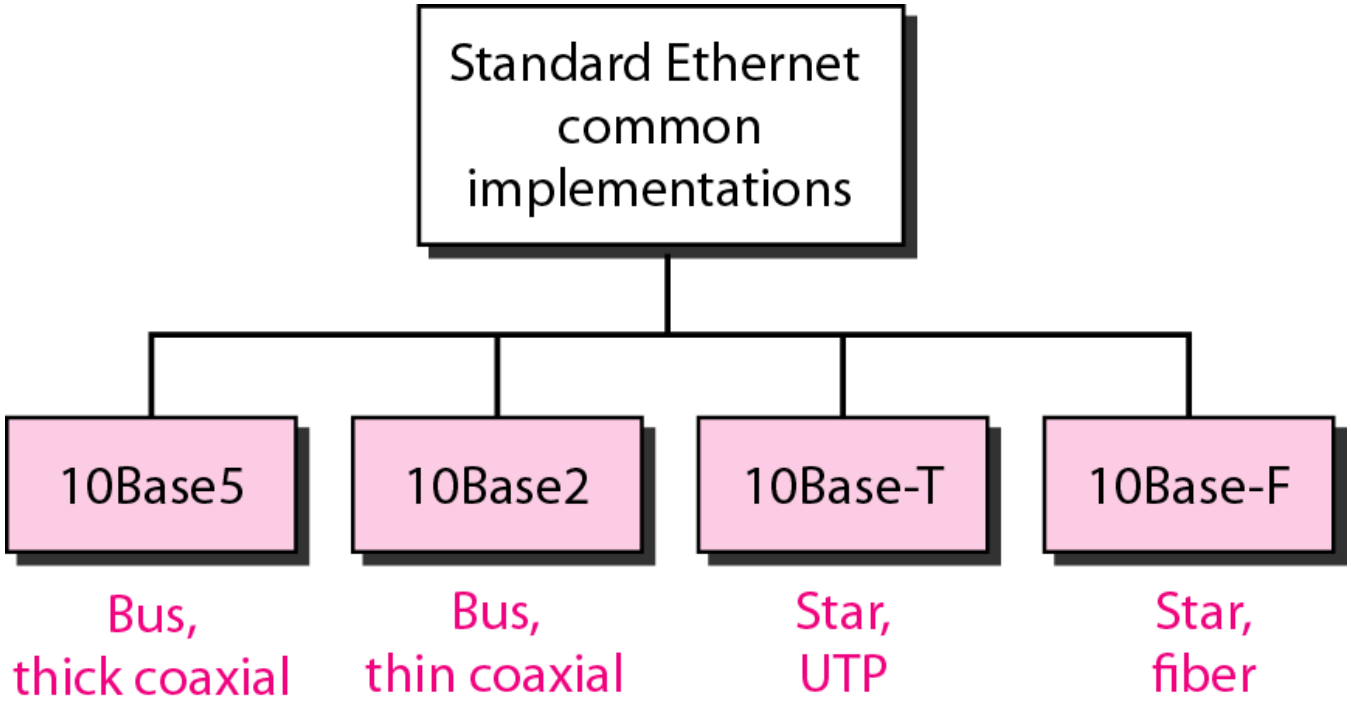


Figure: Encoding in a Standard Ethernet implementation

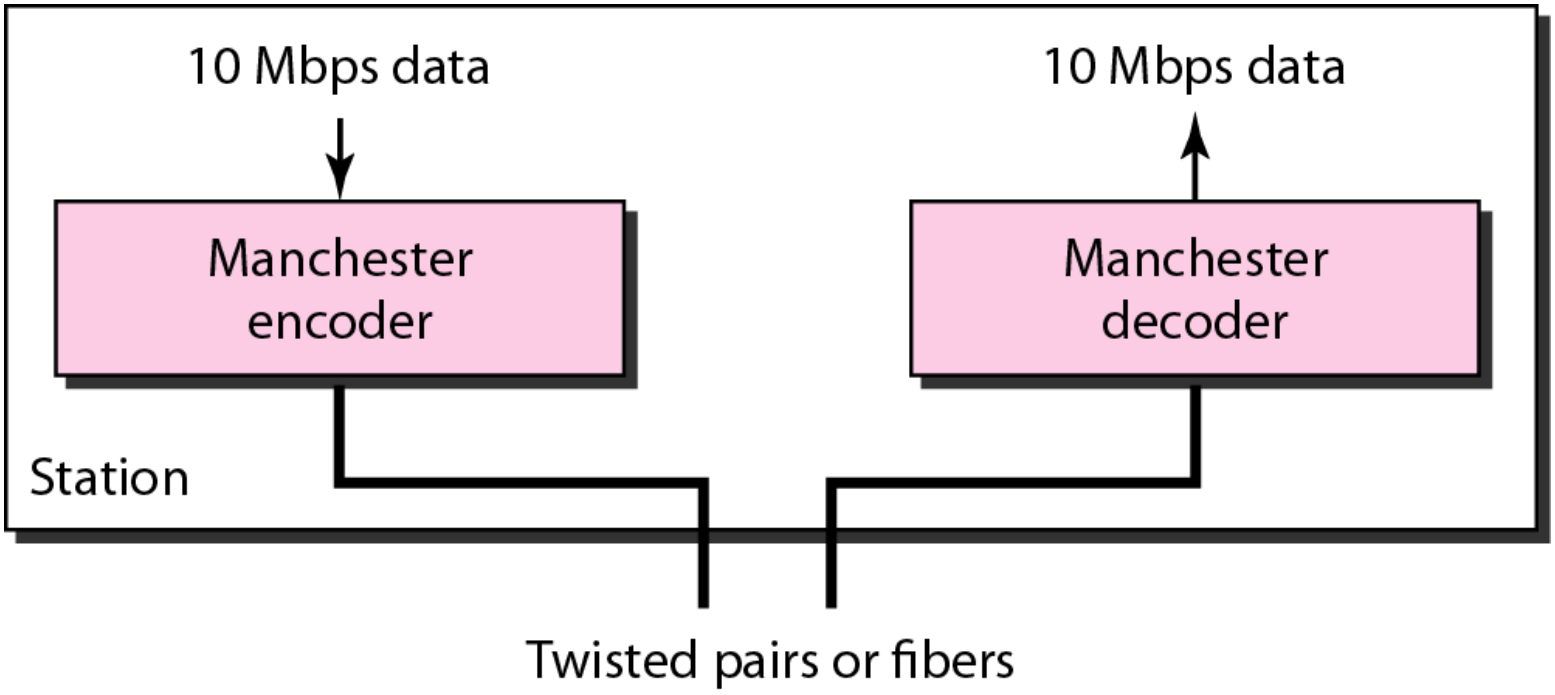


Figure: 10Base5(Thick Ethernet / Thicknet) implementation

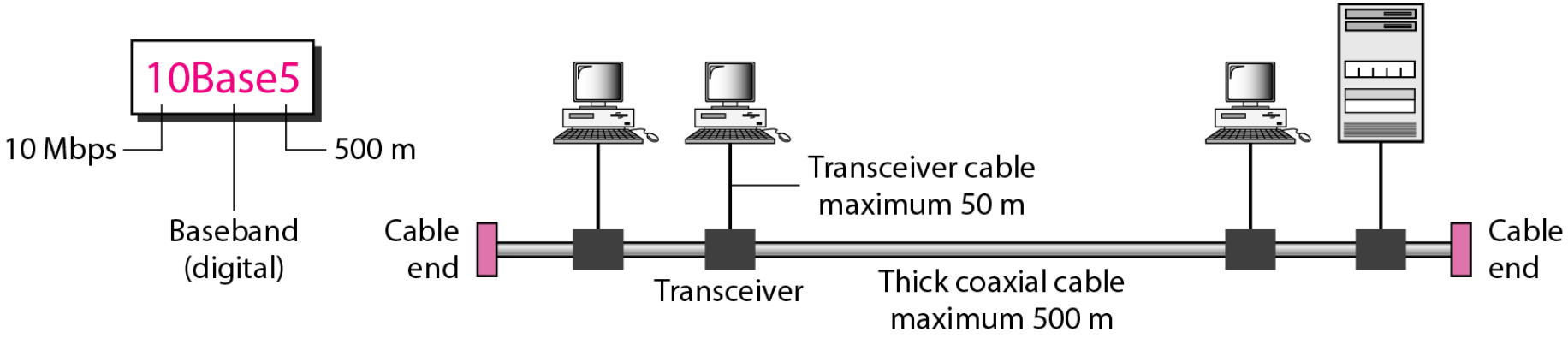


Figure: 10Base2(Thin Ethernet / Cheapernet) implementation

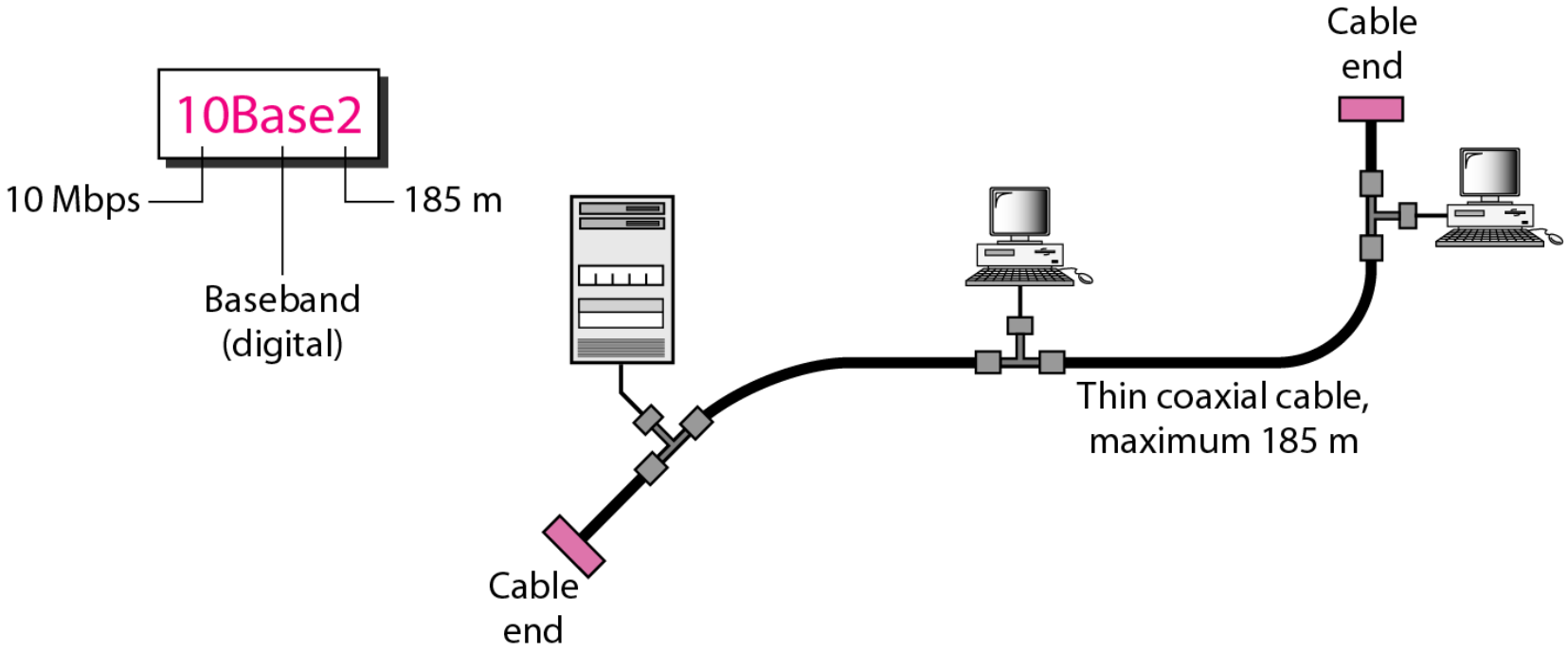


Figure: 10Base-T implementation

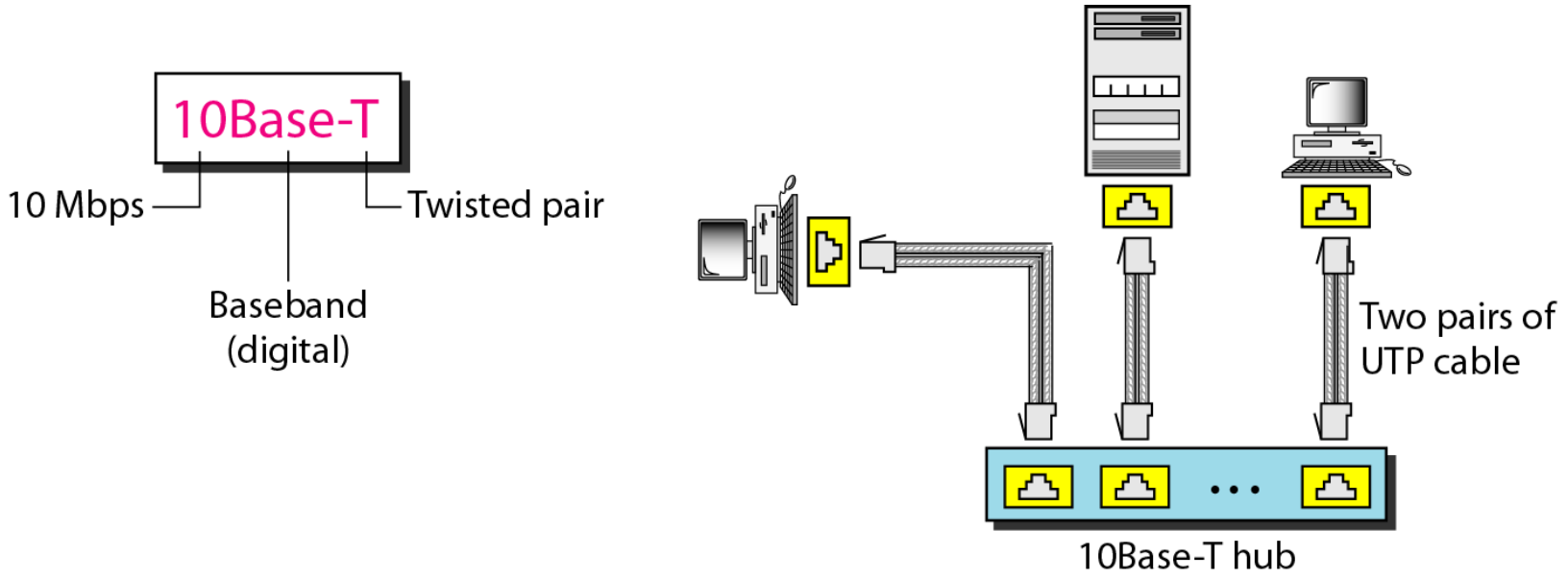


Figure: 10Base-F implementation

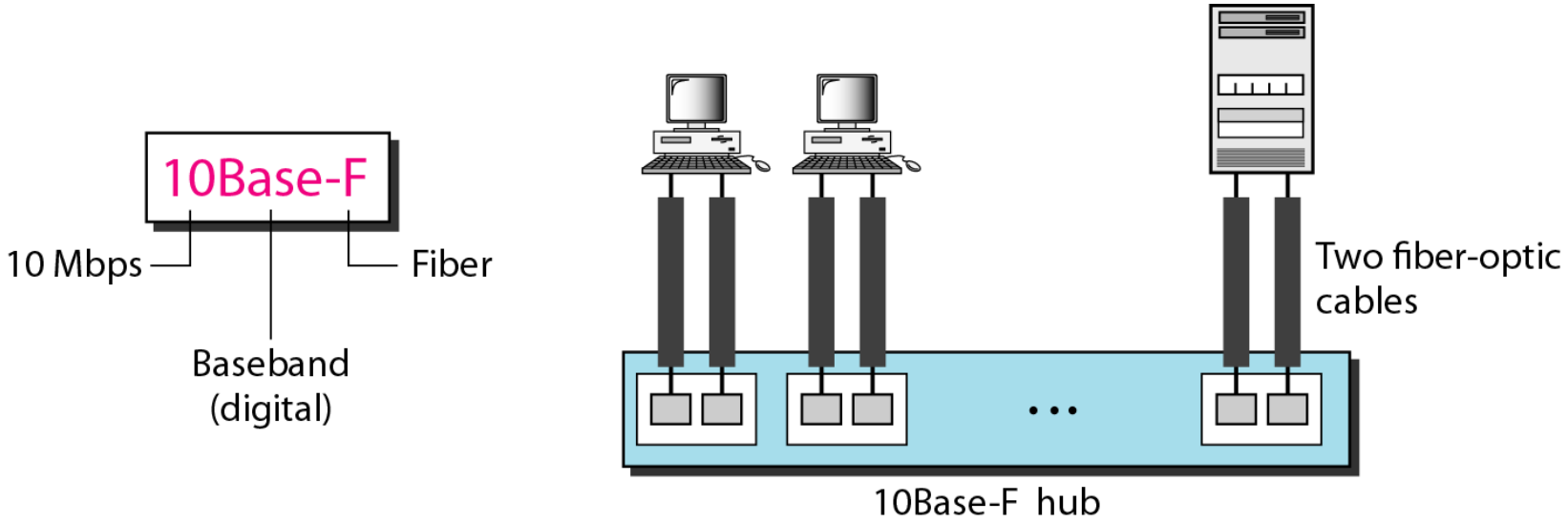


Table: Summary of Standard Ethernet implementations

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

Changes in the Standard Ethernet

The 10-Mbps Standard Ethernet has gone through several changes before moving to the higher data rates. These changes actually opened the road to the evolution of the Ethernet to become compatible with other high-data-rate LANs.

Several changes:

Bridged Ethernet
Switched Ethernet
Full-Duplex Ethernet

2. FAST ETHERNET

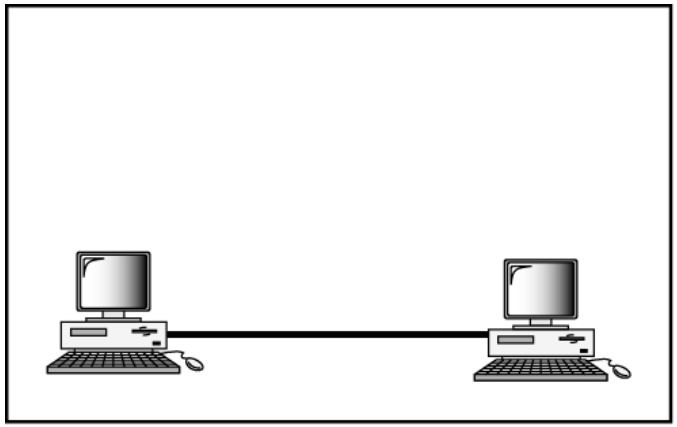
Fast Ethernet was designed to compete with LAN protocols such as FDDI or Fiber Channel.

IEEE created Fast Ethernet under the name 802.3u.

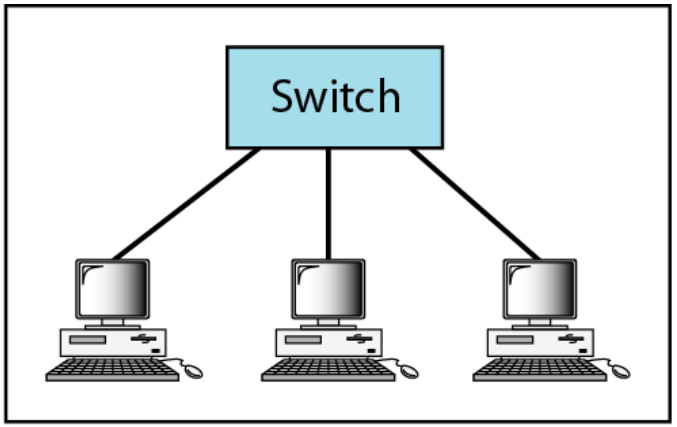
The goals of Fast Ethernet can be summarized as follows:

- Upgrade the data rate to 100 Mbps.
- Make it compatible with Standard Ethernet.
- Keep the same 48-bit address.
- Keep the same frame format.
- Keep the same minimum and maximum frame lengths.

Figure: Fast Ethernet topology



a. Point-to-point



b. Star

Figure: Fast Ethernet implementations

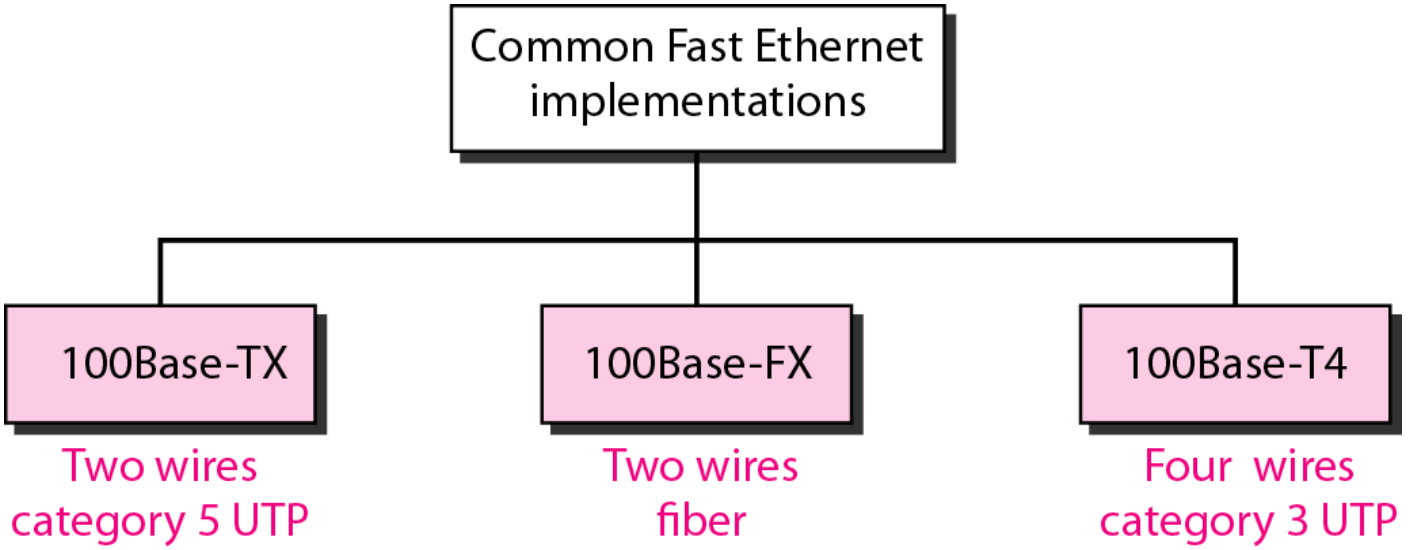


Figure: Encoding for Fast Ethernet implementation

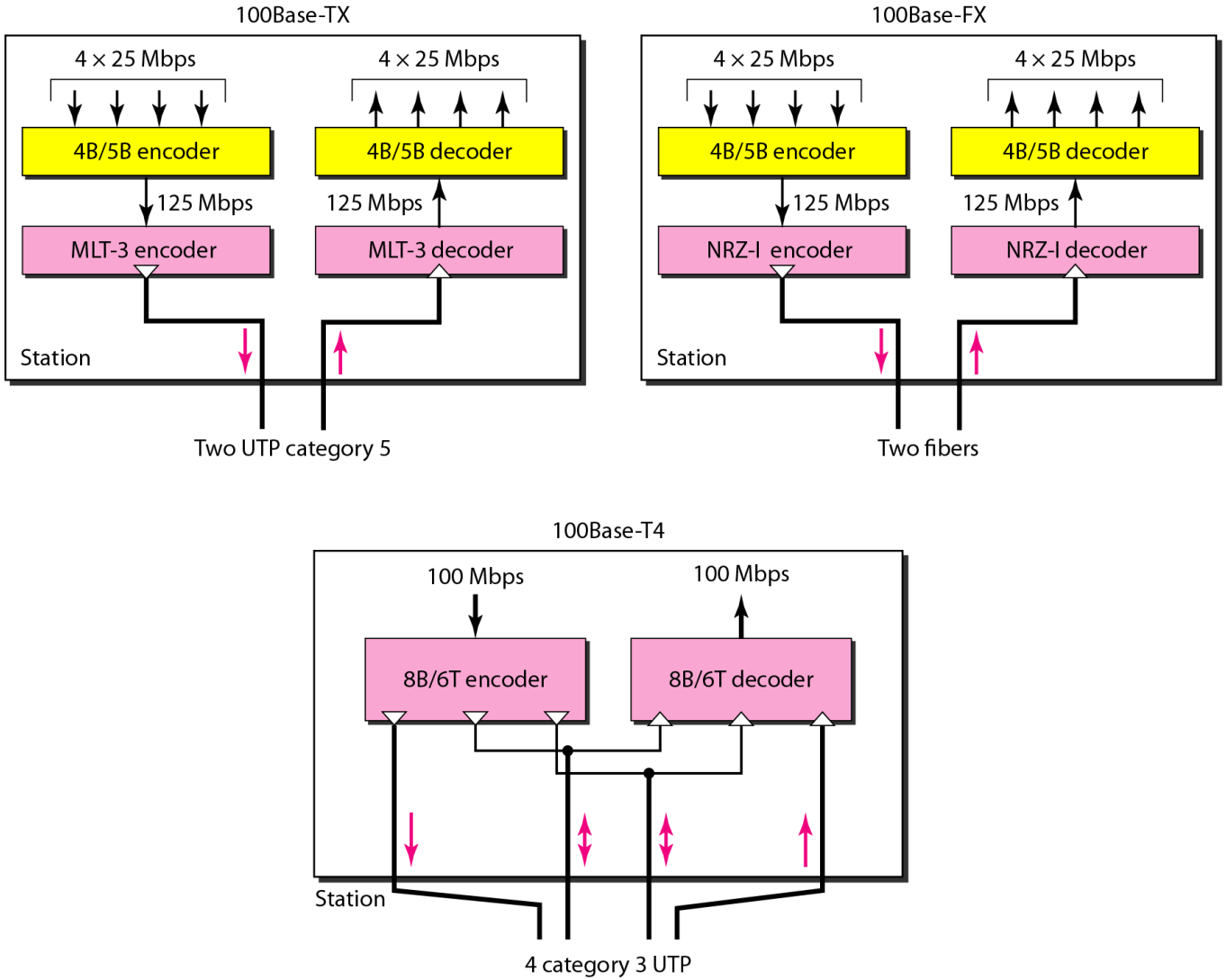


Table: Summary of Fast Ethernet implementations

Characteristics	*100Base-TX*	*100Base-FX*	*100Base-T4*
Media	Cat 5 UTP or STP	Fiber	Cat 4 UTP
Number of wires	2	2	4
Maximum length	100 m	100 m	100 m
Block encoding	4B/5B	4B/5B	
Line encoding	MLT-3	NRZ-I	8B/6T

3. GIGABIT ETHERNET

The need for an even higher data rate resulted in the design of the Gigabit Ethernet protocol (1000 Mbps).

The IEEE committee calls the standard 802.3z.

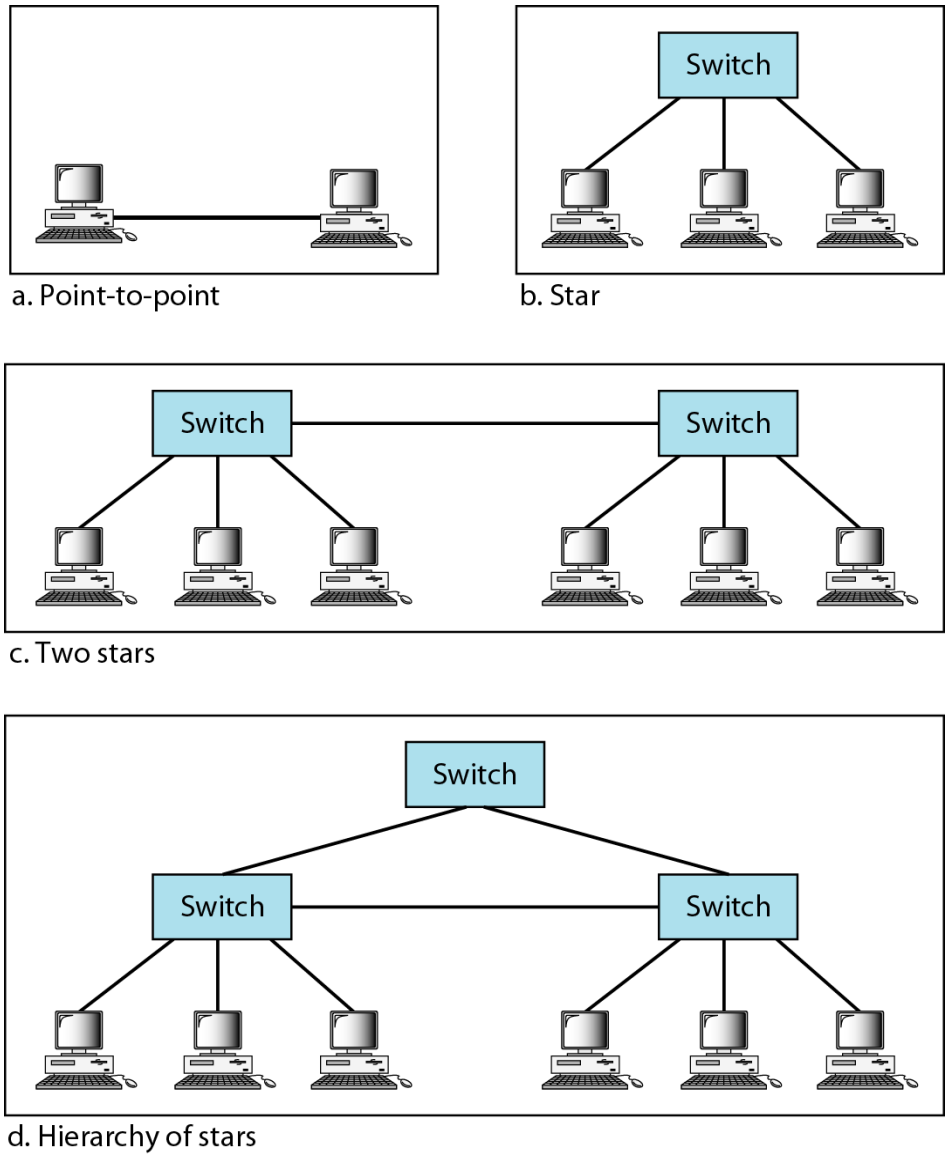
Topics discussed in this section:

MAC Sublayer
Physical Layer

Note

In the full-duplex mode of Gigabit Ethernet, there is no collision; the maximum length of the cable is determined by the signal attenuation in the cable.

Figure: Topologies of Gigabit Ethernet



a. Point-to-point

b. Star

c. Two stars

d. Hierarchy of stars

Figure: Gigabit Ethernet implementations

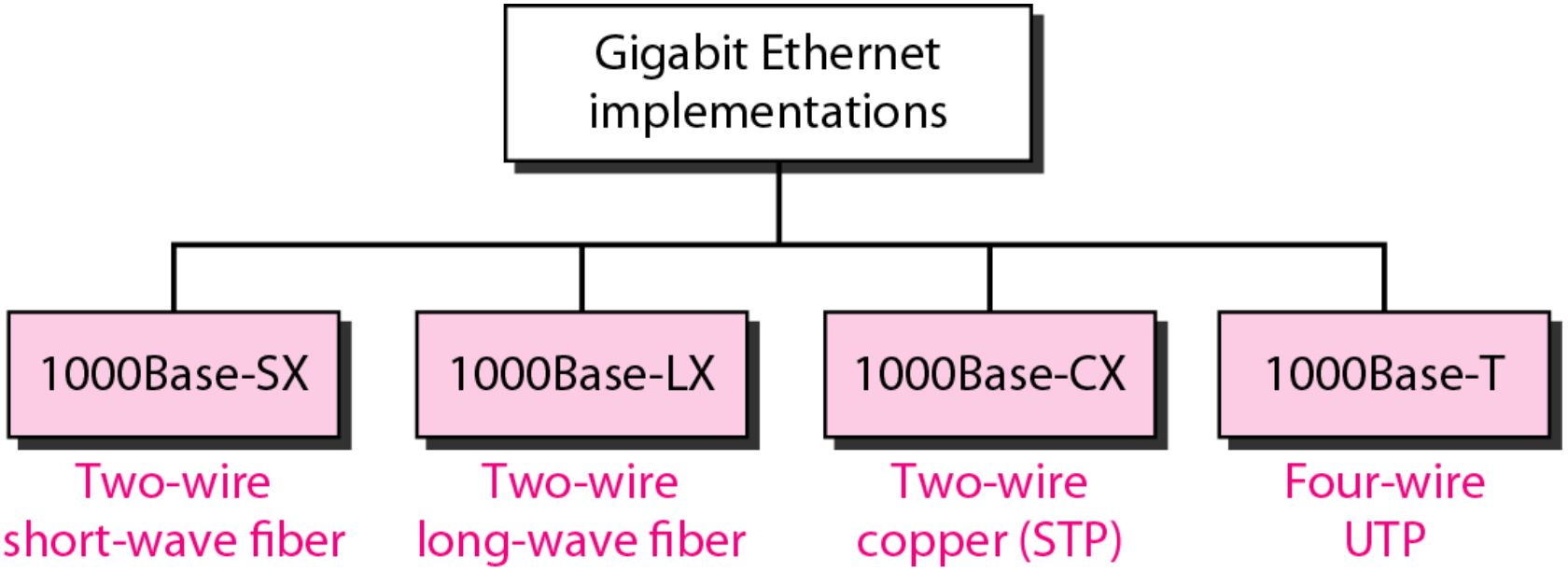


Figure: Encoding in Gigabit Ethernet implementations

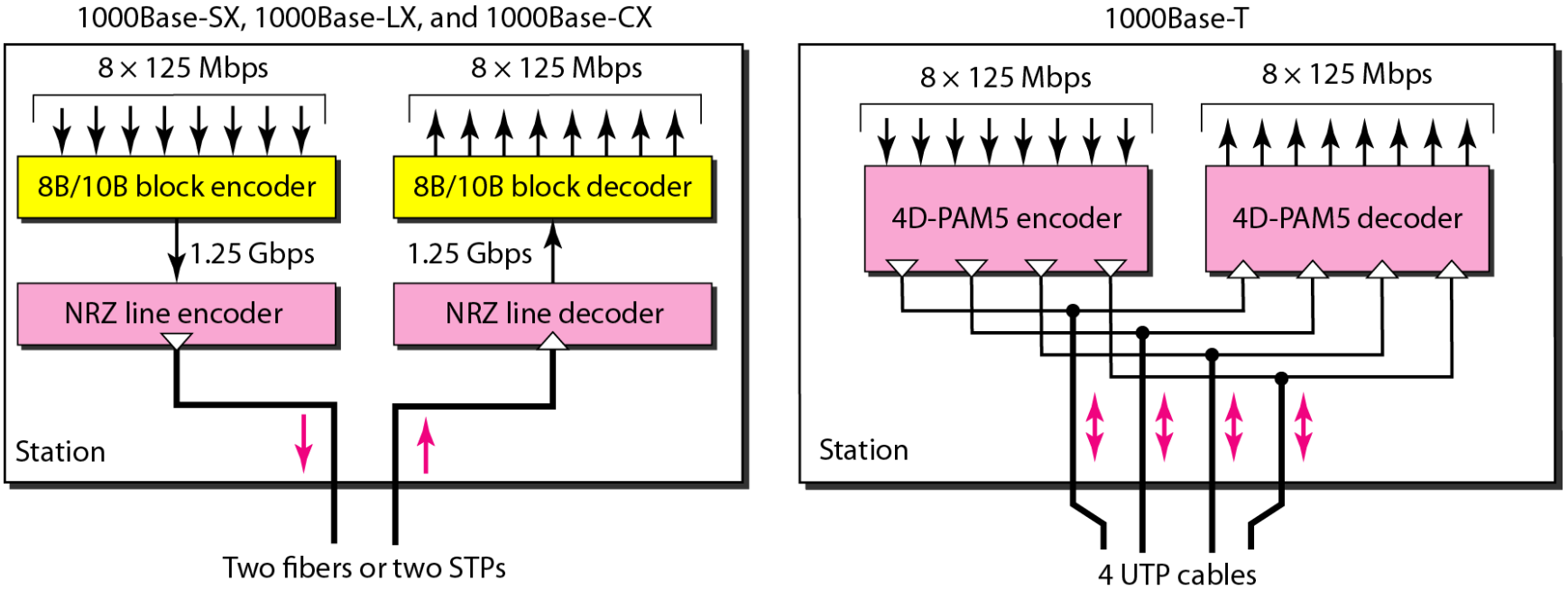


Table: Summary of Gigabit Ethernet implementations

Characteristics	*1000Base-SX*	*1000Base-LX*	*1000Base-CX*	*1000Base-T*
Media	Fiber short-wave	Fiber long-wave	STP	Cat 5 UTP
Number of wires	2	2	2	4
Maximum length	550 m	5000 m	25 m	100 m
Block encoding	8B/10B	8B/10B	8B/10B	
Line encoding	NRZ	NRZ	NRZ	4D-PAM5

Table: Summary of Ten-Gigabit Ethernet implementations

Characteristics	*10GBase-S*	*10GBase-L*	*10GBase-E*
Media	Short-wave 850-nm multimode	Long-wave 1310-nm single mode	Extended 1550-mm single mode
Maximum length	300 m	10 km	40 km

Thanks for your attention…!!!

Any Queries ??