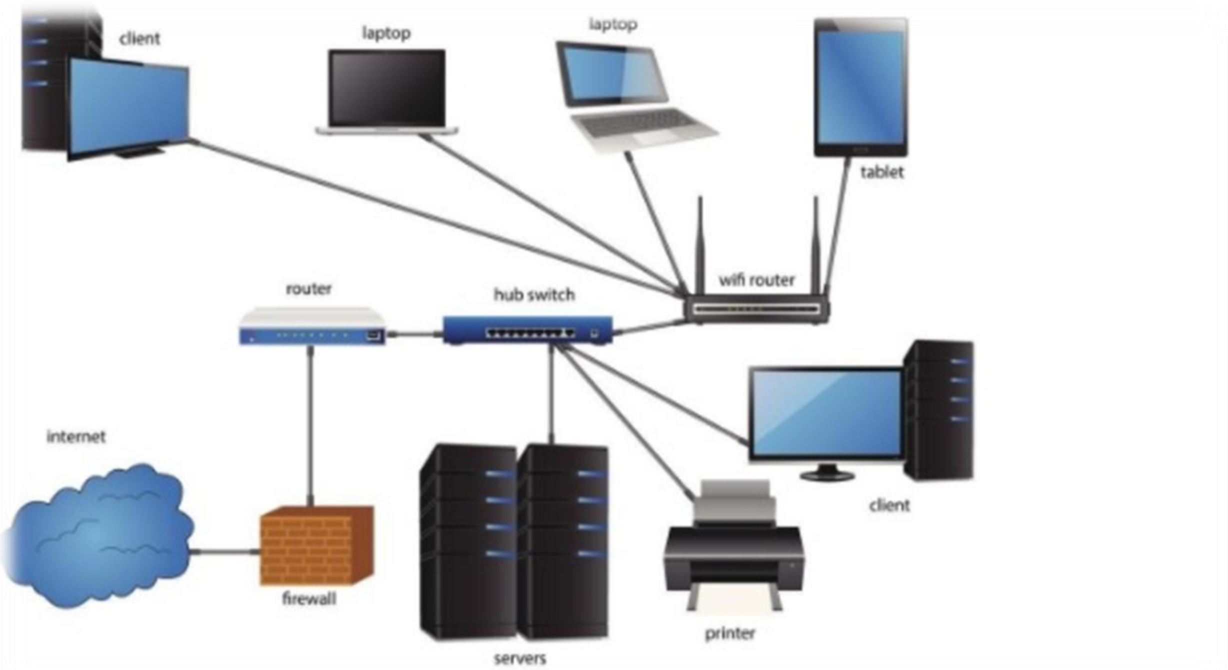
COMPUTER NETWORKS



Instructor: Mr. B. V. Sathish Kumar, Assistant Professor

Department of Electronics and Communication Engineering

UNIT-3 Syllabus

- Channel Allocation Problems, Multiple Access Protocols
- IEEE standards for Local Area Networks
- IEEE standards for WLAN, Bluetooth

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.

Network	
Data Link	**LLC Sublayer** *(Logical Link Control)*
	MAC Sublayer *(Media Access Control)*
Physical	

IEEE 802 Standards

Number	Topic
802.1	Overview and architecture of LANs
802.2 ↓	Logical link control
802.3 *	Ethernet
802.4 ↓	Token bus (was briefly used in manufacturing plants)
802.5	Token ring (IBM's entry into the LAN world)
802.6 ↓	Dual queue dual bus (early metropolitan area network)
802.7 ↓	Technical advisory group on broadband technologies
802.8 †	Technical advisory group on fiber optic technologies
802.9 ↓	Isochronous LANs (for real-time applications)
802.10 ↓	Virtual LANs and security
802.11 *	Wireless LANs
802.12 ↓	Demand priority (Hewlett-Packard's AnyLAN)
802.13	Unlucky number. Nobody wanted it
802.14 ↓	Cable modems (defunct: an industry consortium got there first)
802.15 *	Personal area networks (Bluetooth)
802.16 *	Broadband wireless
802.17	Resilient packet ring

The important are marked with *. The ones marked with ↓ are hibernating. The ones marked with ↑ gave up.

Data Link Layer (DLL)

Functions of DLL

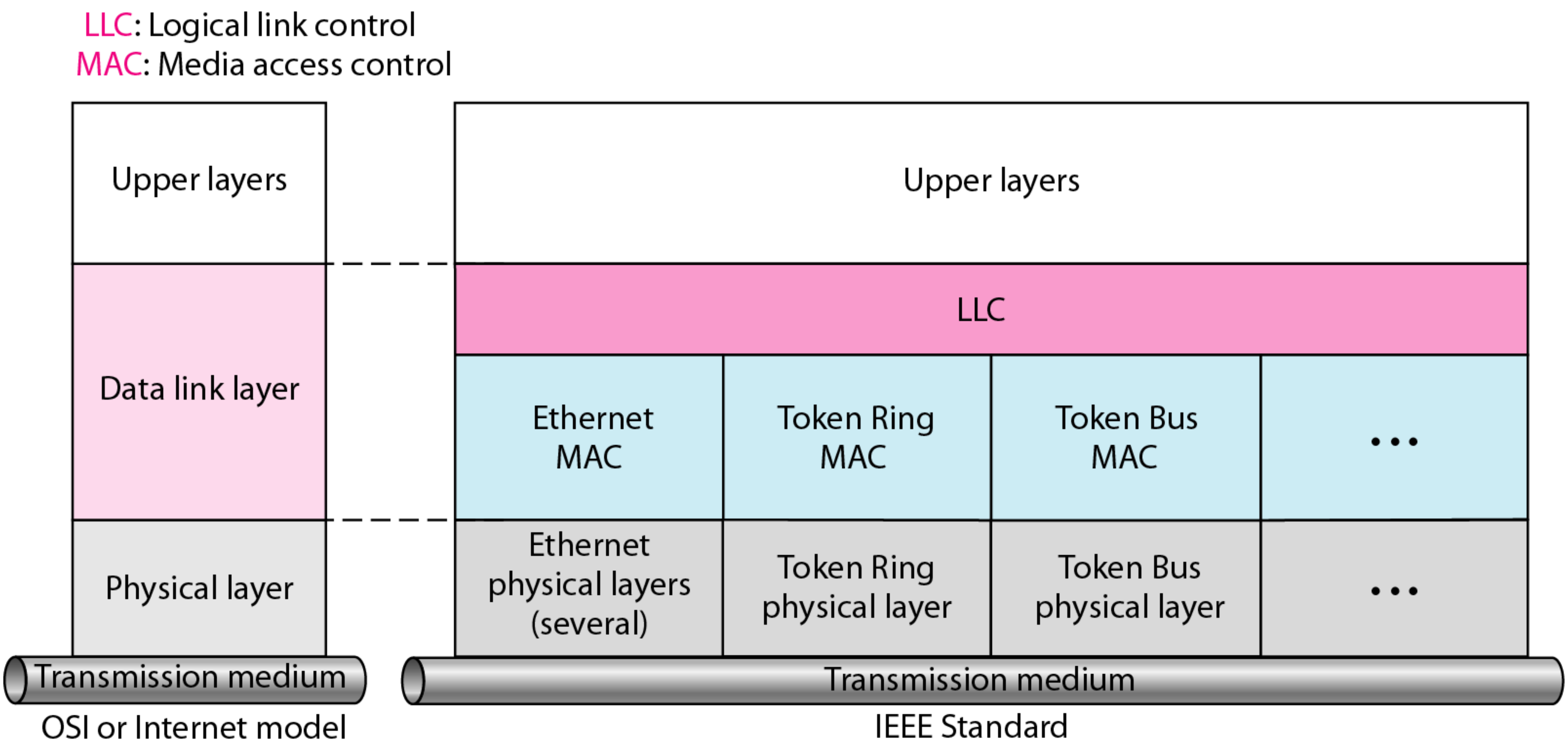
1. Framing
2. Physical Addressing or MAC Addressing
3. Error Control
4. Access Control

MAC Sublayer

5. Flow Control

LLC Sublayer

Figure: IEEE standard for LANs



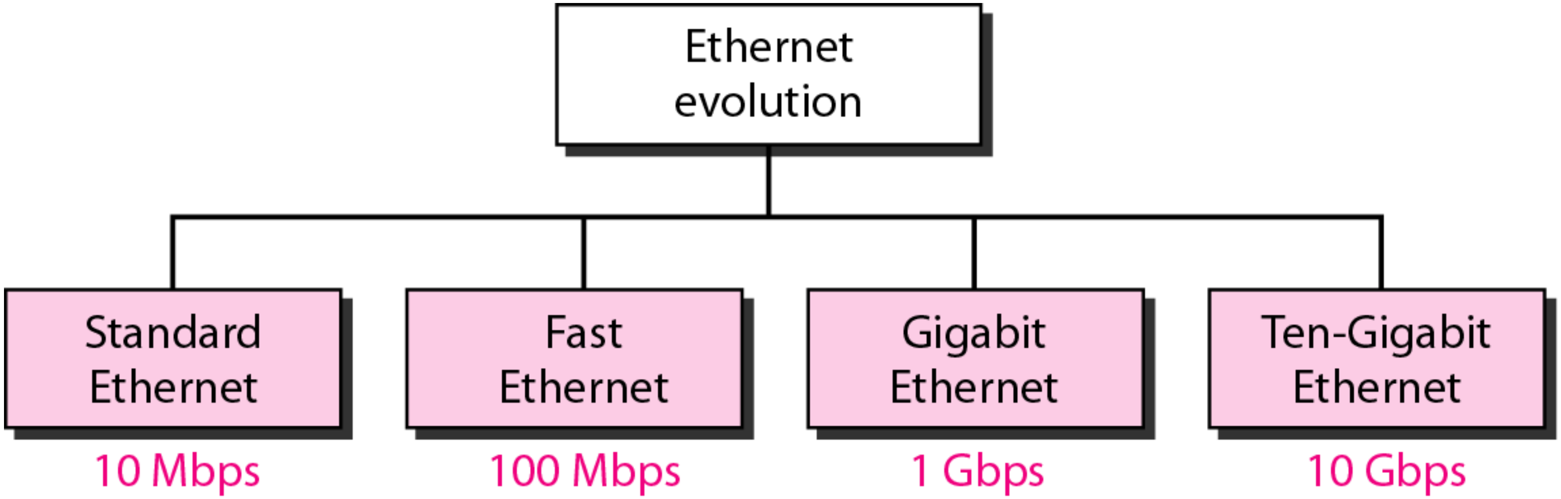
ETHERNET (IEEE 802.3)

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



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

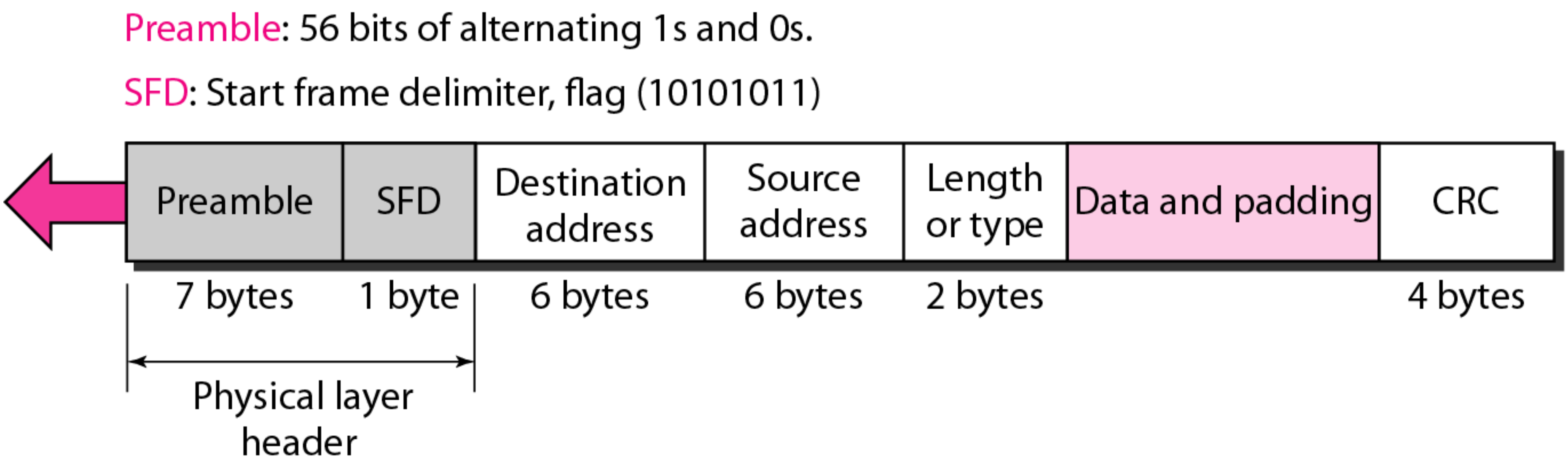
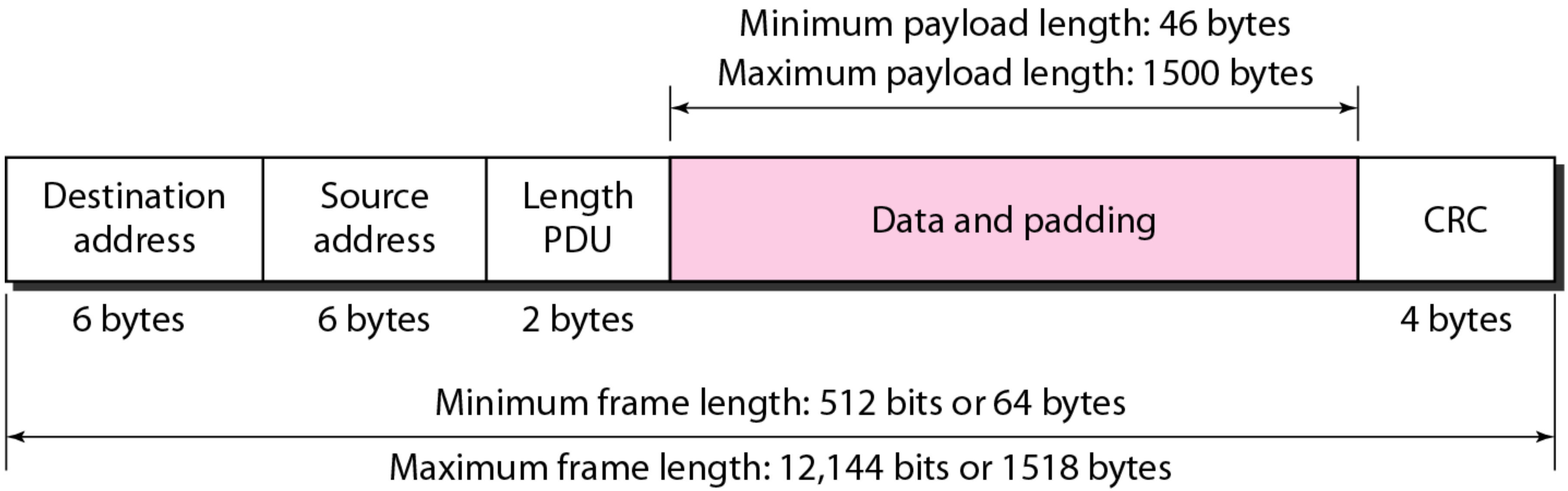


Figure: Minimum and maximum lengths



Note

Frame length:

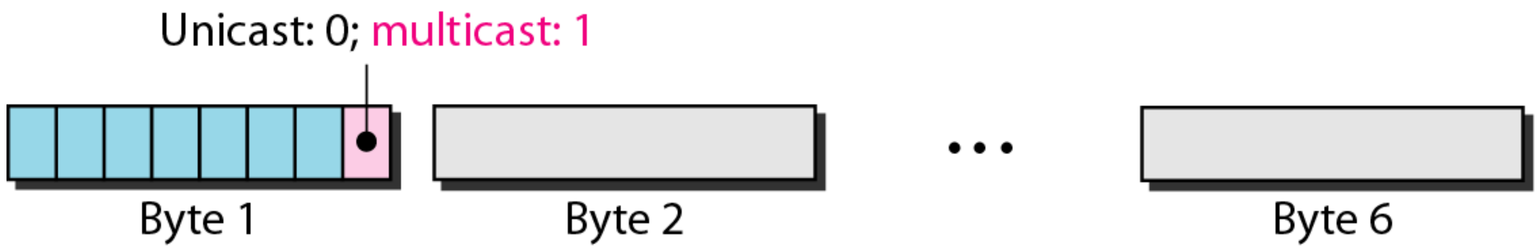
Minimum: 64 bytes (512 bits)

Maximum: 1518 bytes (12,144 bits)

Figure: Example of an Ethernet address in hexadecimal notation

$$\underbrace{06 : 01 : 02 : 01 : 2C : 4B}_{\text{6 bytes = 12 hex digits = 48 bits}}$$

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 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 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

← 11100010 00000100 11011000 01110100 00010000 01110111

Figure: Categories of Standard Ethernet

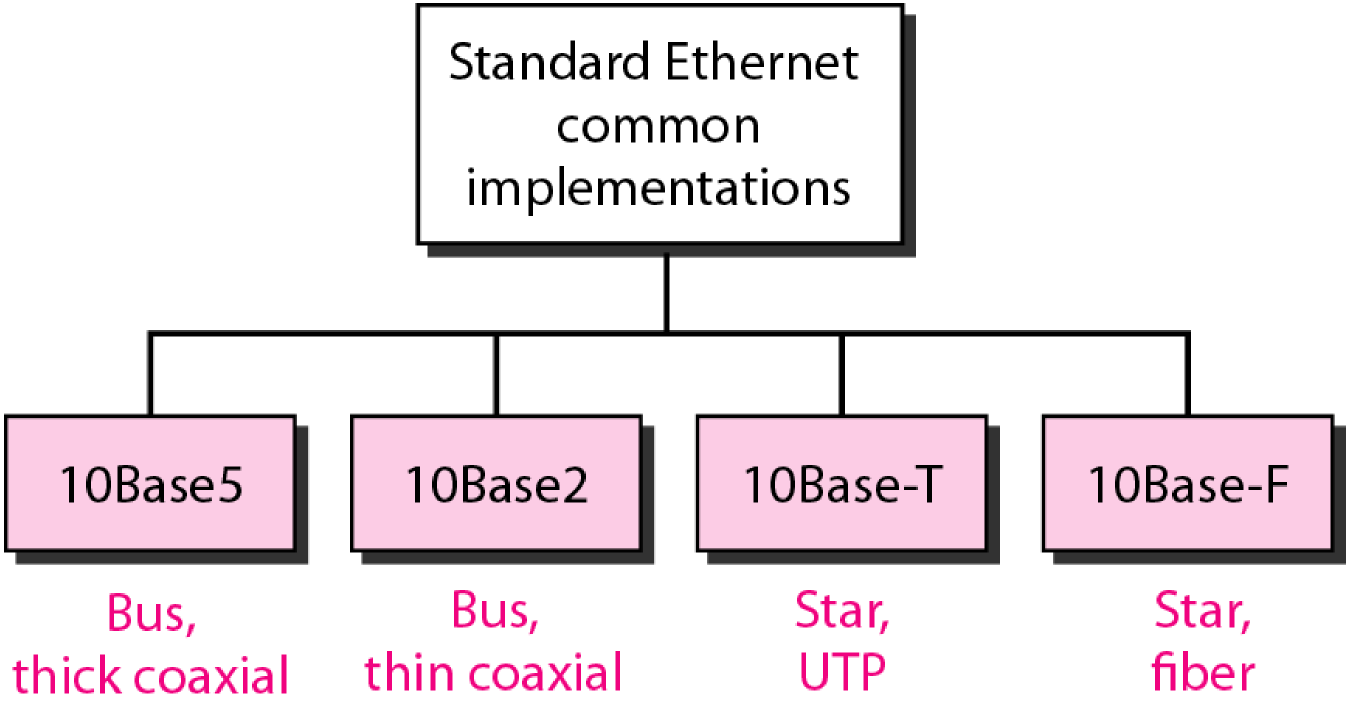


Figure: Encoding in a Standard Ethernet implementation

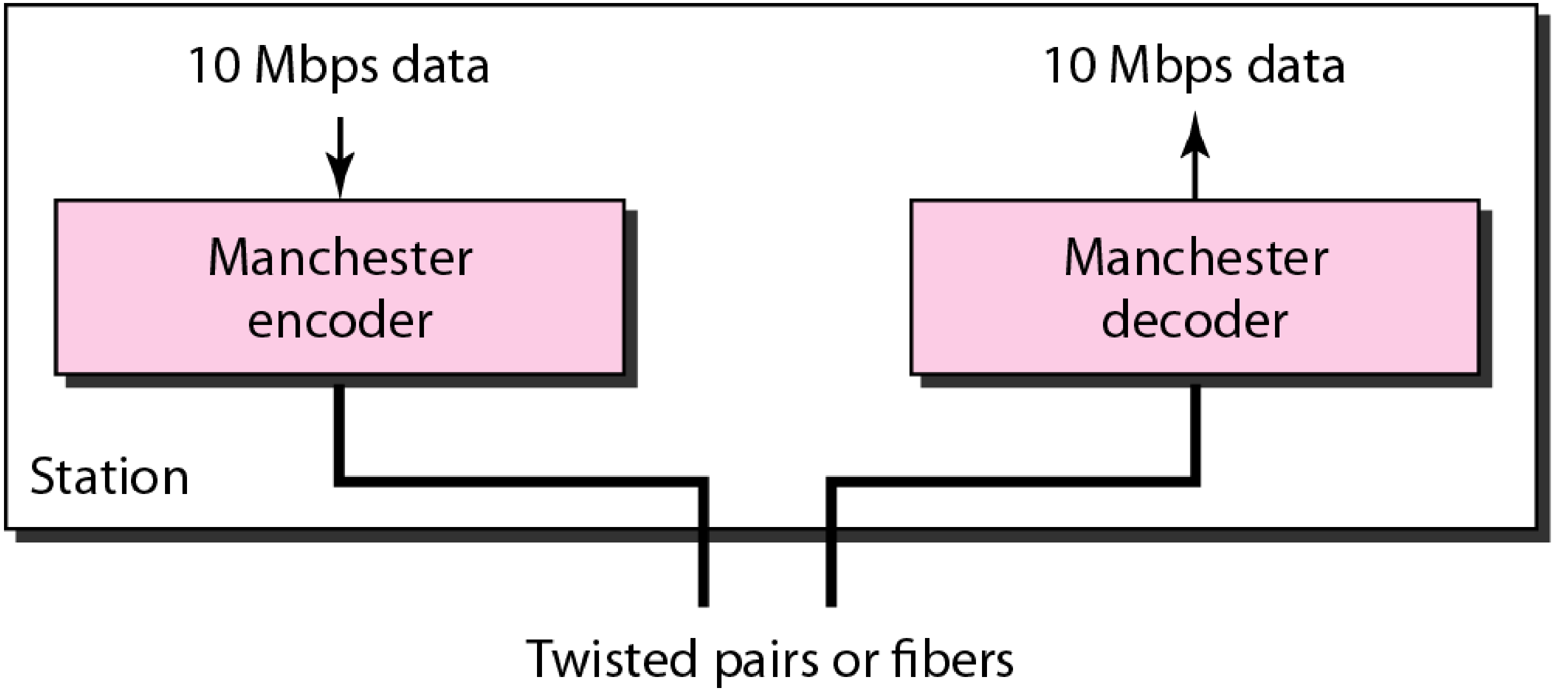


Figure: 10Base5(Thick Ethernet / Thicknet) implementation

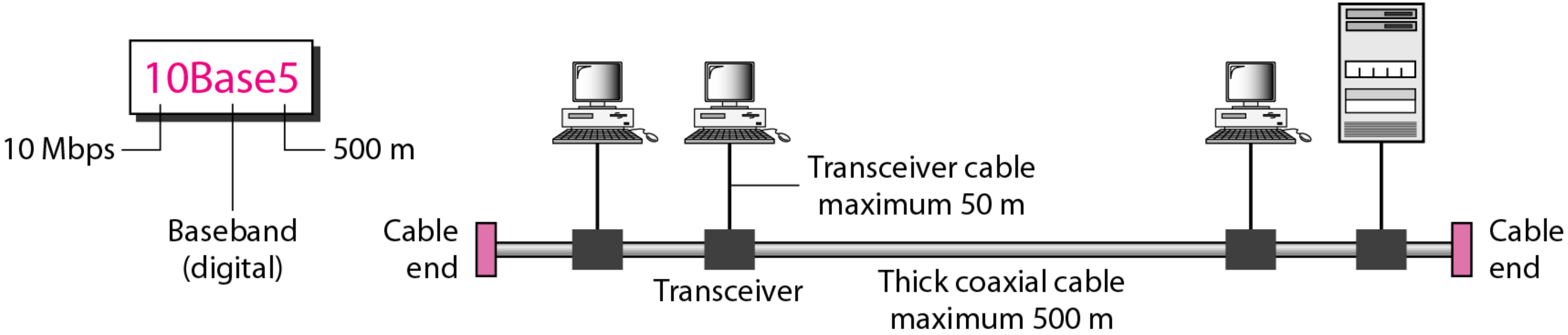


Figure: **10Base2(Thin Ethernet / Cheapernet) implementation**

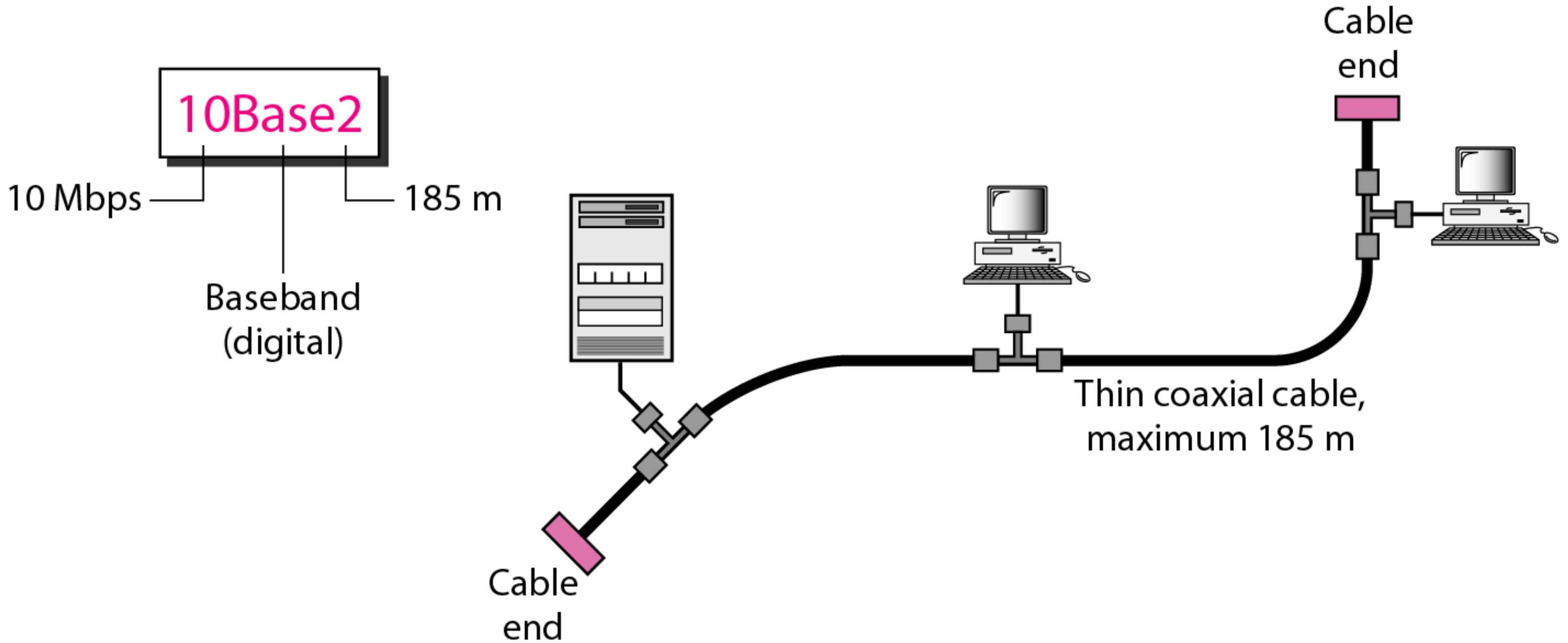


Figure: 10Base-T implementation

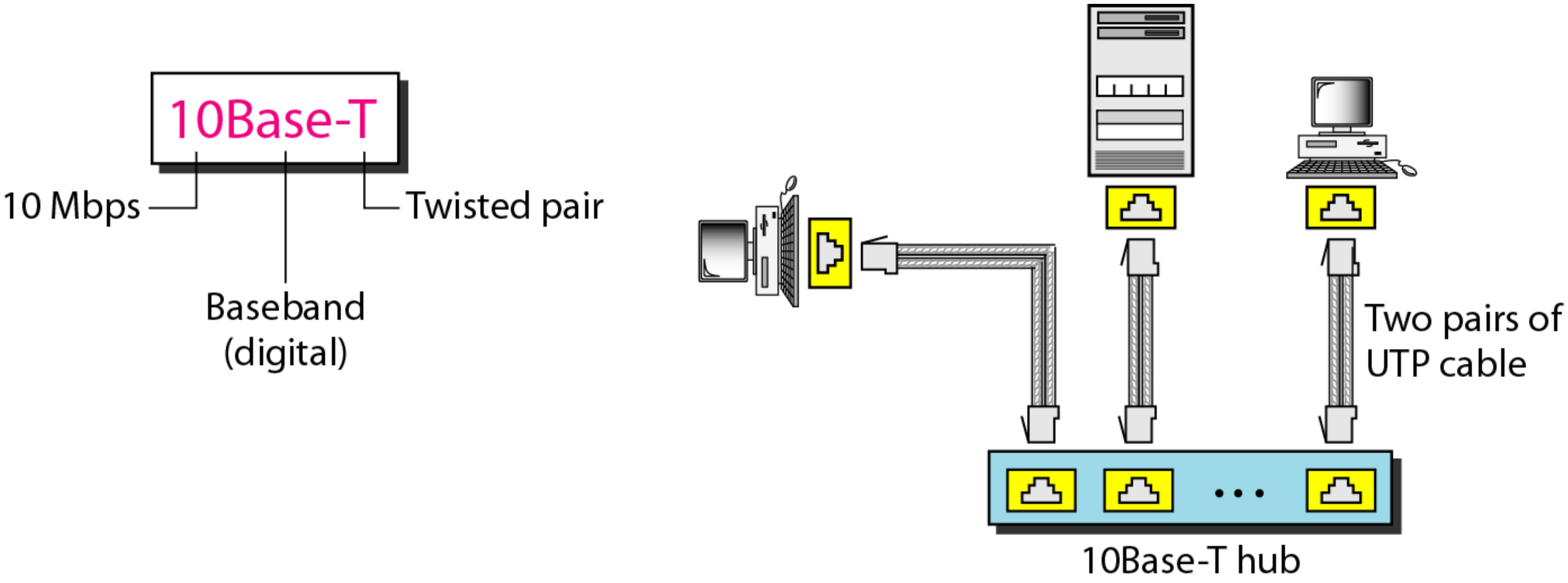


Figure: **10Base-F implementation**

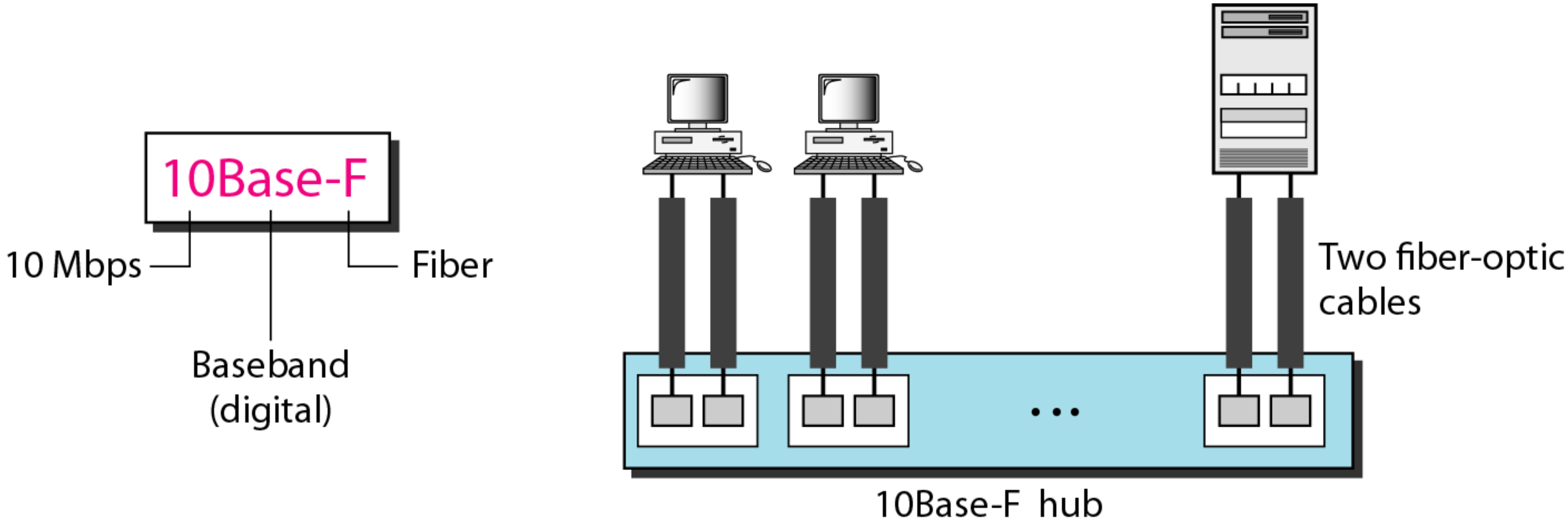


Table: **Summary of Standard Ethernet implementations**

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

Figure: Fast Ethernet implementations

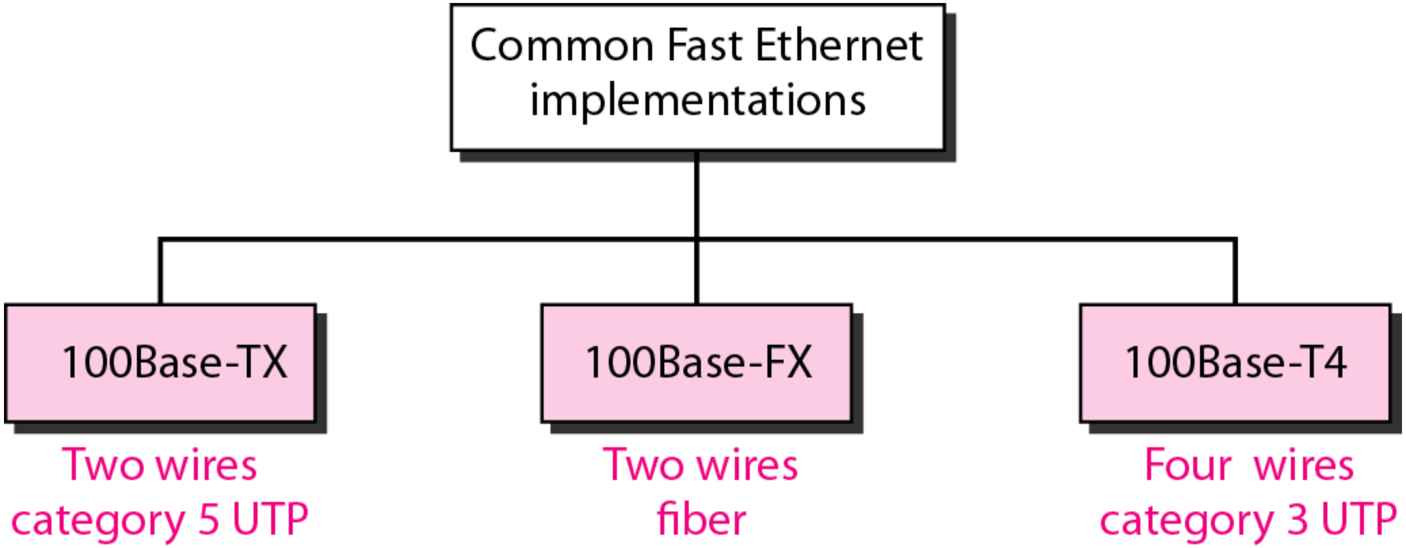


Table: **Summary of Fast Ethernet implementations**

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

Figure: Gigabit Ethernet implementations

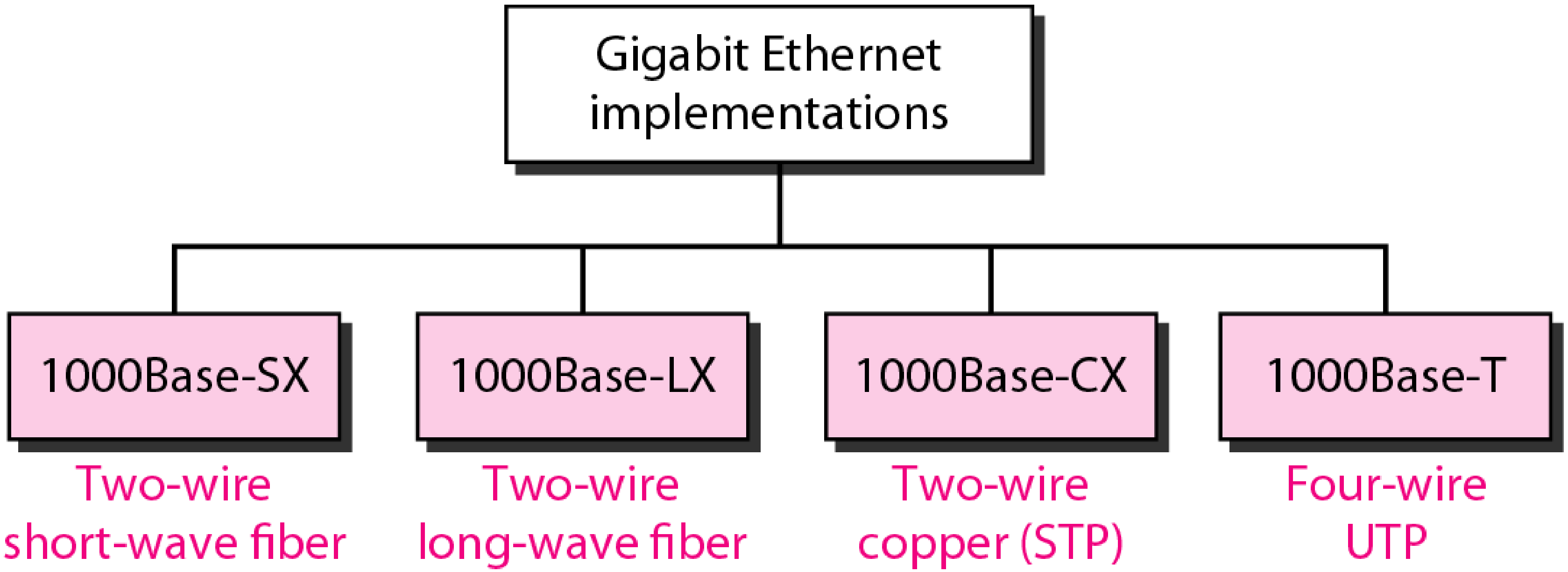


Table: Summary of Gigabit Ethernet implementations

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

TOKEN BUS (IEEE 802.4)

Token Bus (IEEE 802.4) is a standard for implementing token ring over the virtual ring in LANs.

The physical media has a bus or a tree topology and uses coaxial cables.

A virtual ring is created with the nodes/stations and the token is passed from one node to the next in a sequence along this virtual ring.

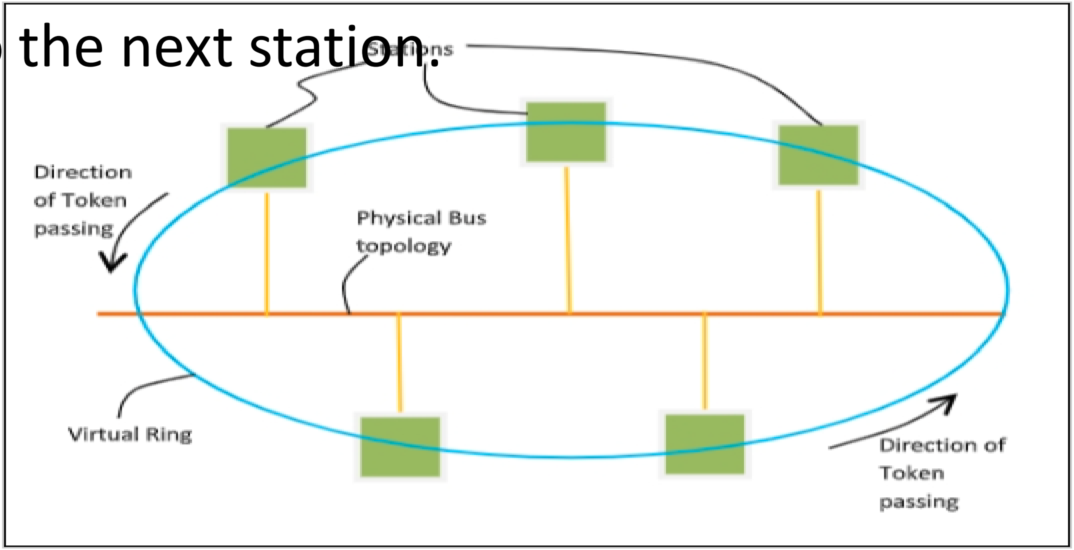
Each node knows the address of its preceding station and its succeeding station.

A station can only transmit data when it has the token.

Token Passing Mechanism in Token Bus

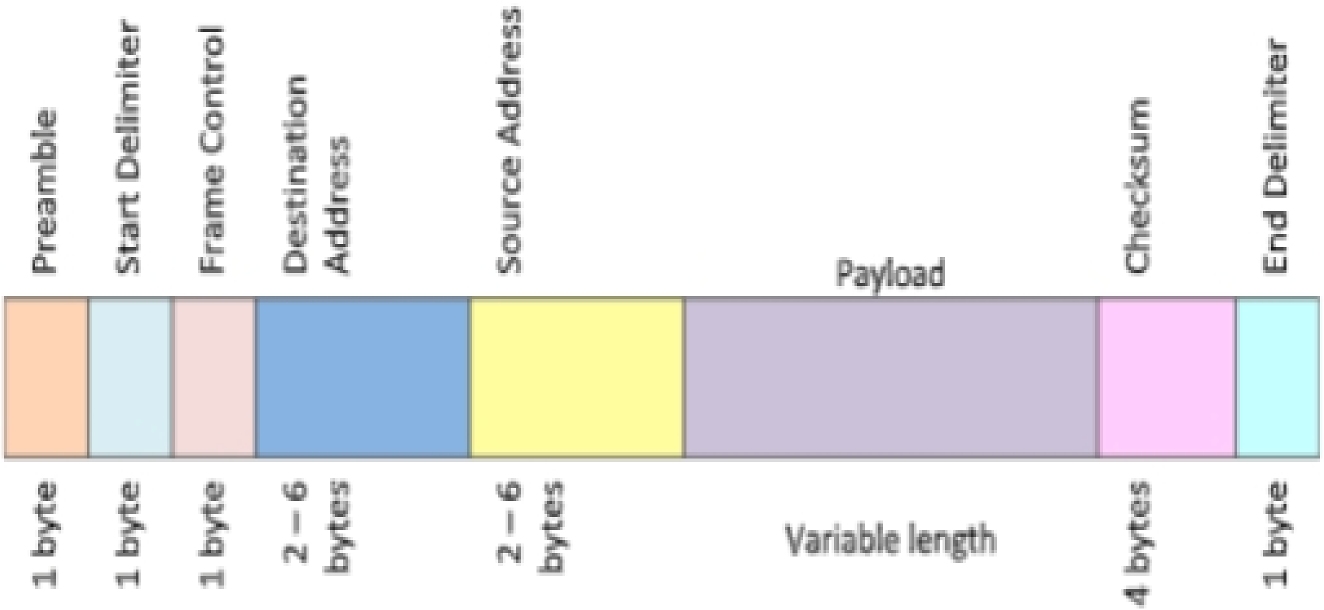
A token is a small message that circulates among the stations of a computer network providing permission to the stations for transmission.

If a station has data to transmit when it receives a token, it sends the data and then passes the token to the next station; otherwise, it simply passes the token to the next station.



Frame Format of Token Bus

The frame format is given by the following diagram –



FDDI Frame Format

The fields of a token bus frame are –

- 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.

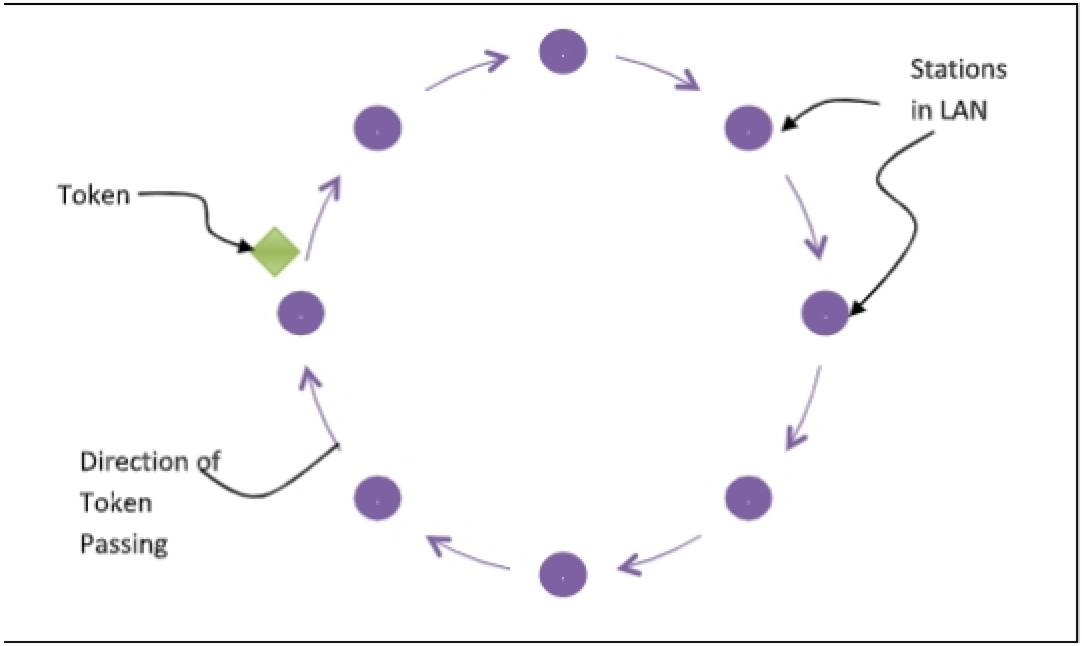
TOKEN RING (IEEE 802.5)

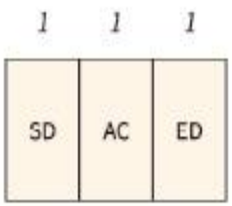
Token ring (IEEE 802.5) is a communication protocol in a local area network (LAN) where all stations are connected in a ring topology and pass one or more tokens for channel acquisition.

A token is a special frame of 3 bytes that circulates along the ring of stations.

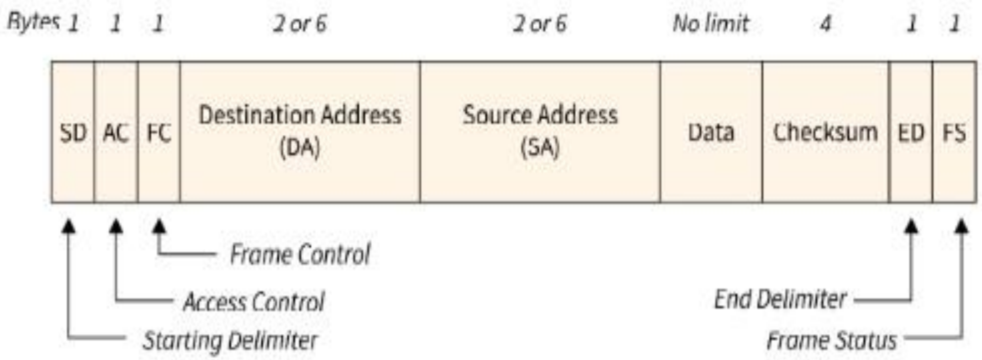
A station can send data frames only if it holds a token.

The tokens are released on successful receipt of the data frame.





(A) Token Frame Format



(B) Data Frame Format

Starting and ending delimiter: Ending and starting of the frame are marked by the starting and ending delimiter. This does not contain the coded patterns of the differential manchester so that it can be easily differentiated from the data.

Access control: 3-byte token with frame's starting and ending is represented by the access control field. While data transmission, reservation, monitoring, and priority are performed in this field.

Frame control: Data field is differentiated from other fields with the help of this field.

Source address and destination address: This field is used to represent the address of the source and destination.

Checksum: The Checksum is used for error detection purposes.