Local Area Networks

ICNE532C - Computer Networks

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Wired Local Area Networks

- It is designed for a limited geographic area such as building or a campus.
- IEEE 802 has divided the data link layer into two sublayers: Logical Link Control (LLC) and Media Access Control (MAC)

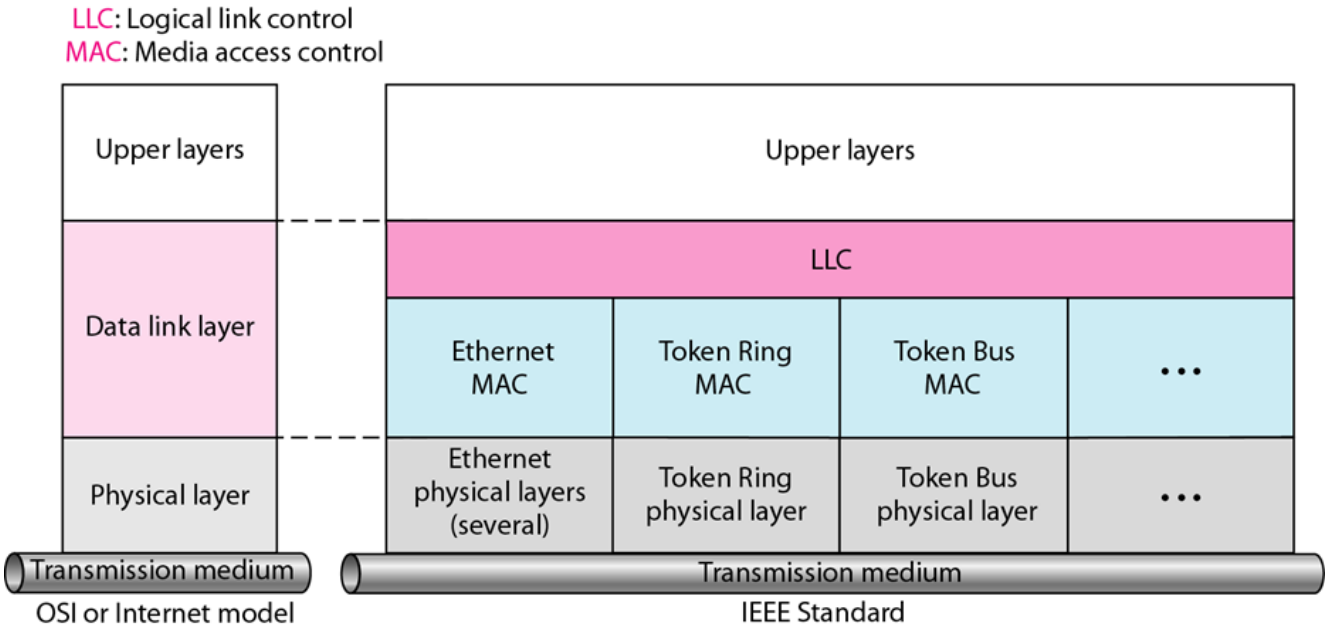


Figure: IEEE Standard for LANs

Ethernet Frame

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

SFD: Start frame delimiter, flag (10101011)

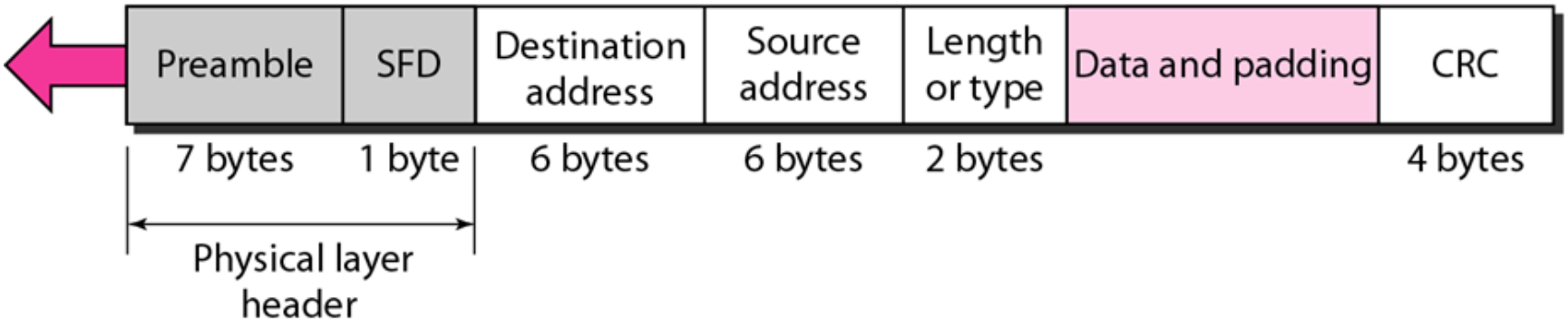


Figure: Frame

Frame Length

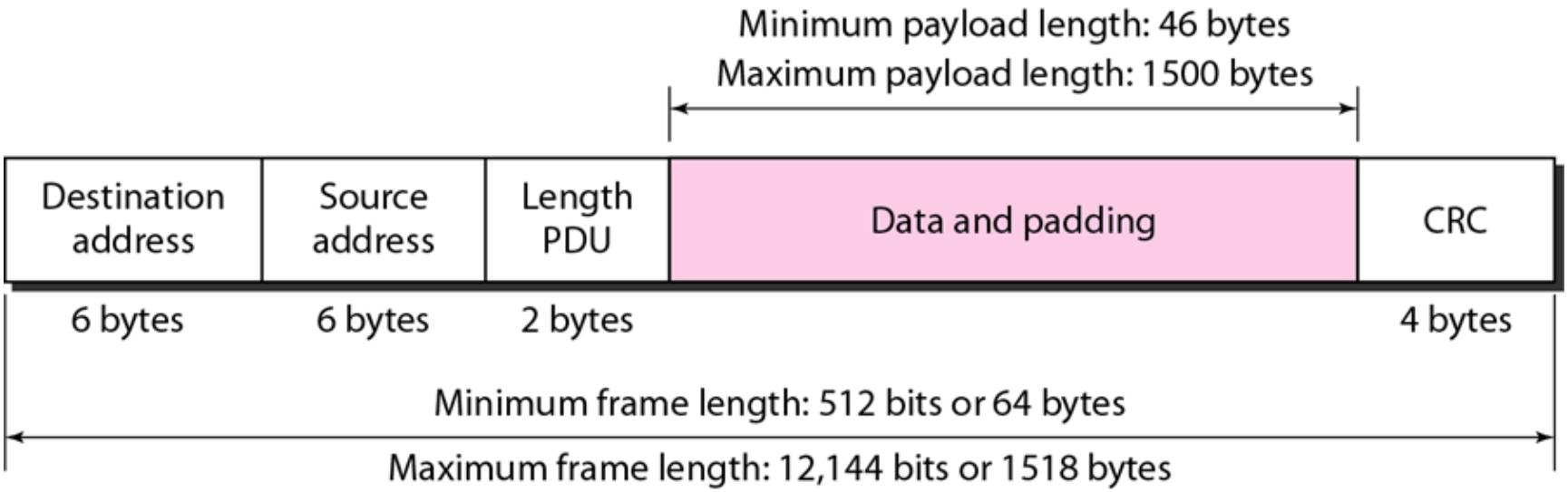


Figure: Minimum and Maximum lengths

Addressing

- Ethernet addess is 6 bytes, normally written in hexadecimal notation, with a colon between bytes.
- This is referred as data link address, physical address, or MAC address



Figure: Address

Addressing

- Unicast - Least Significant bit of the first byte defines the type of address. If it is 0, then it is unicast.
- Multicast - If it is 1, then it is multicast.
- Broadcast - All bits are set to 1.

Solution

- If the second hexadecimal digit from the left is even then the address is unicast otherwise it is multicast.

Address sent out on line

- 47:20:1B:2E:08:EE

Solution

- 11100010 00000100 11011000 01110100 00010000 01110111

Ethernet Evolution

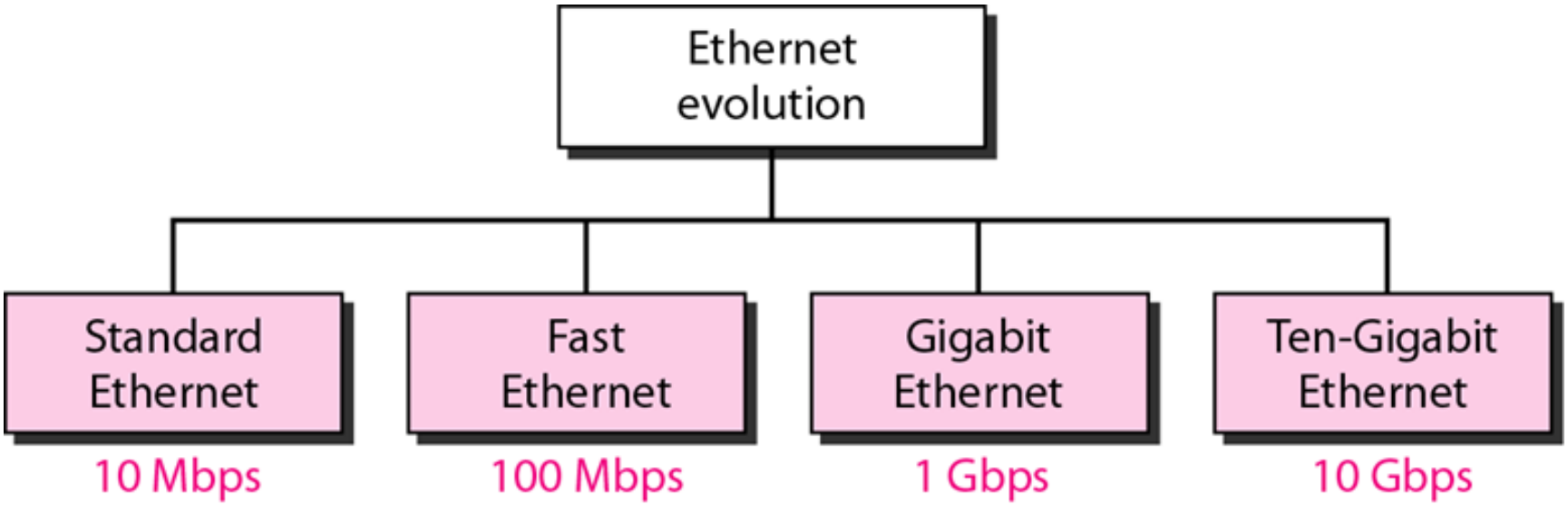
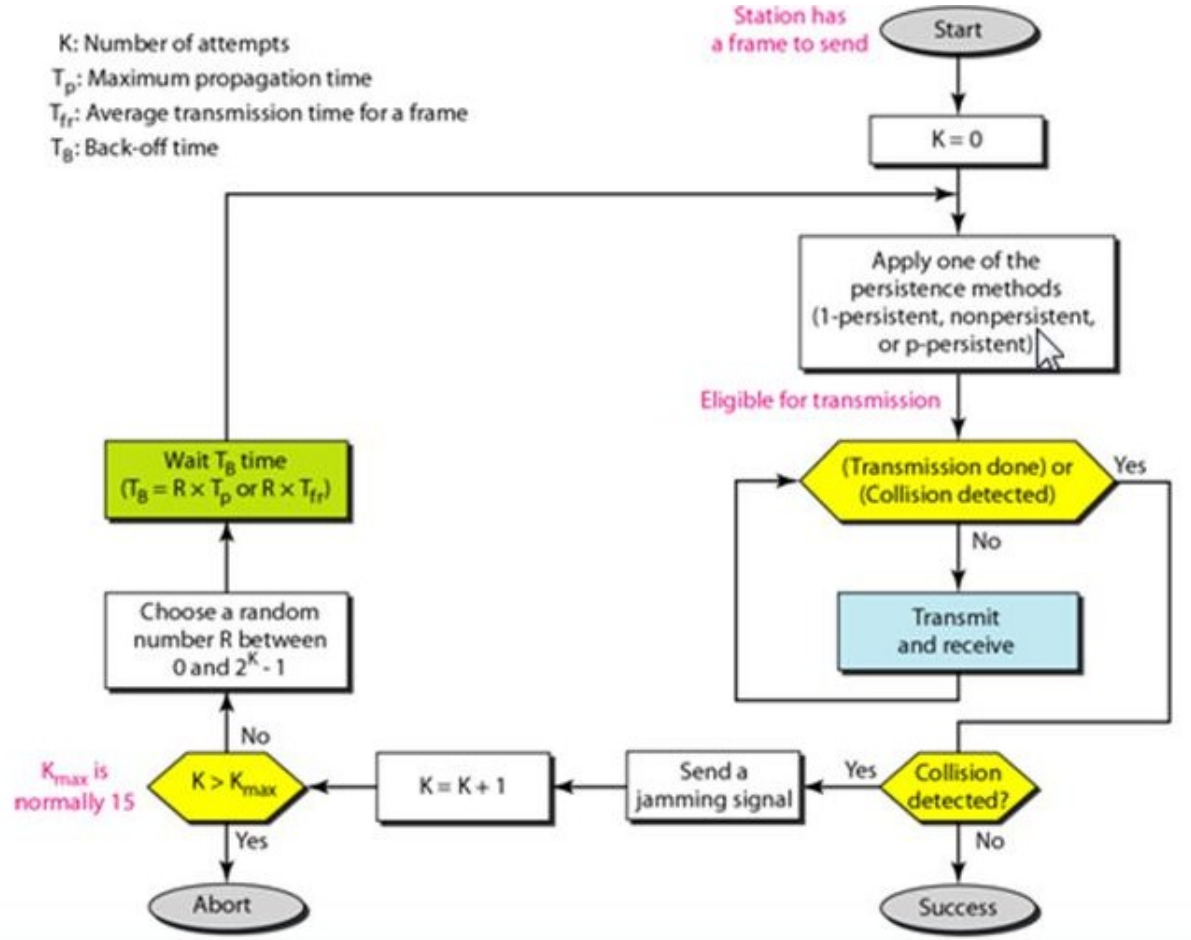


Figure: Evolution

Standard Ethernet

- Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
- Minimum frame size



Standard Ethernet Implementation

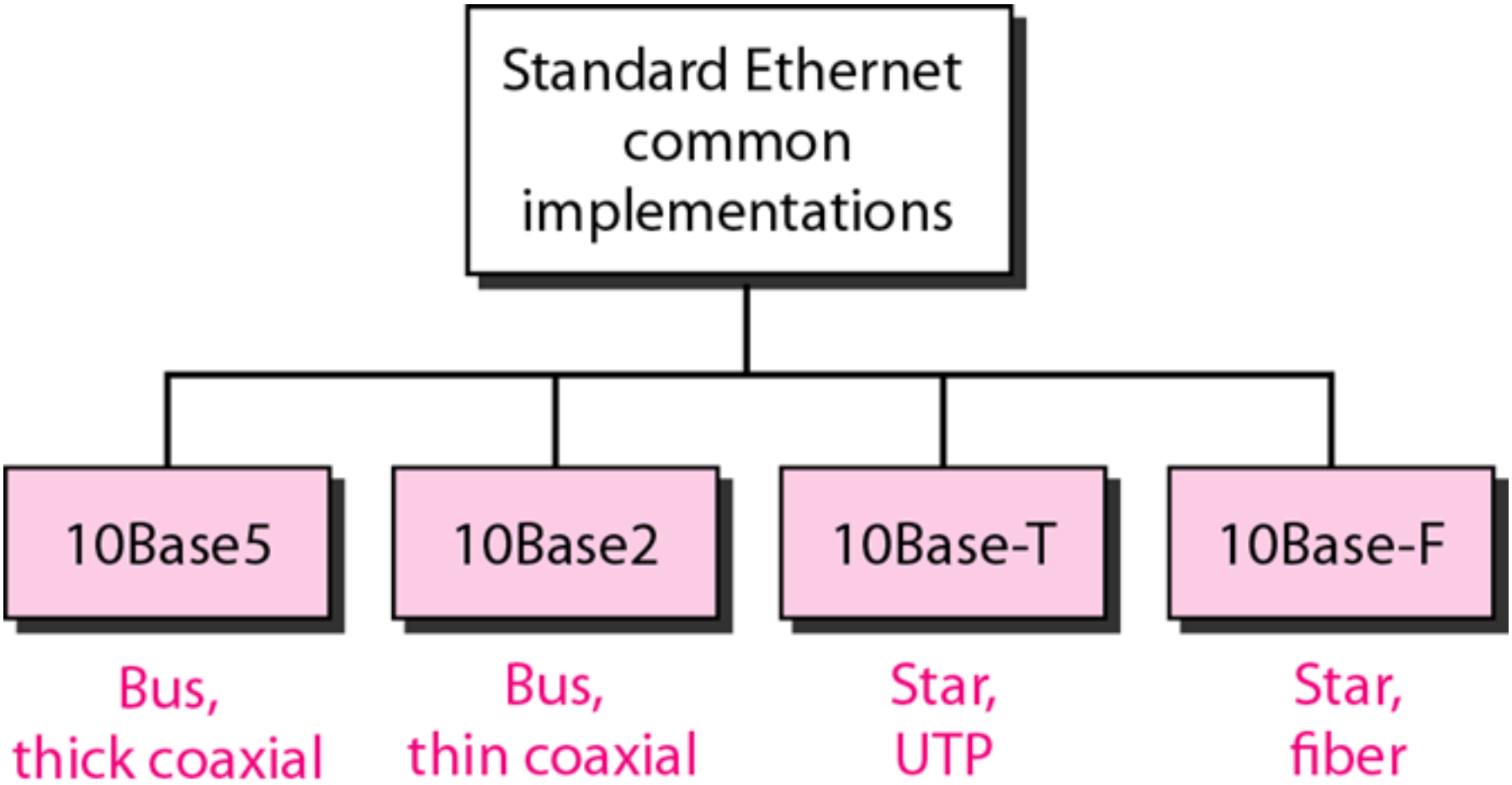


Figure: Implementation

Fast Ethernet

- Upgrade the data rate to 100mbps.
- 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.

MAC sublayer

- Drop the bus topology and keep only the star topology
- There are two choices in star topology: half-duplex and full duplex
- Half duplex stations are connected via a hub.
- Full duplex stations are connected via a switch with buffers at each port.
- Half duplex needs CSMA/CD and full duplex does not need CSMA/CD

Autonegotiation

- A device with a maximum capacity of 10mbps can communicate with a device with a 100mbps.
- To allow one device to have multiple capabilities.
- To allow a station to check a hub's capabilities

Fast Ethernet Implementation

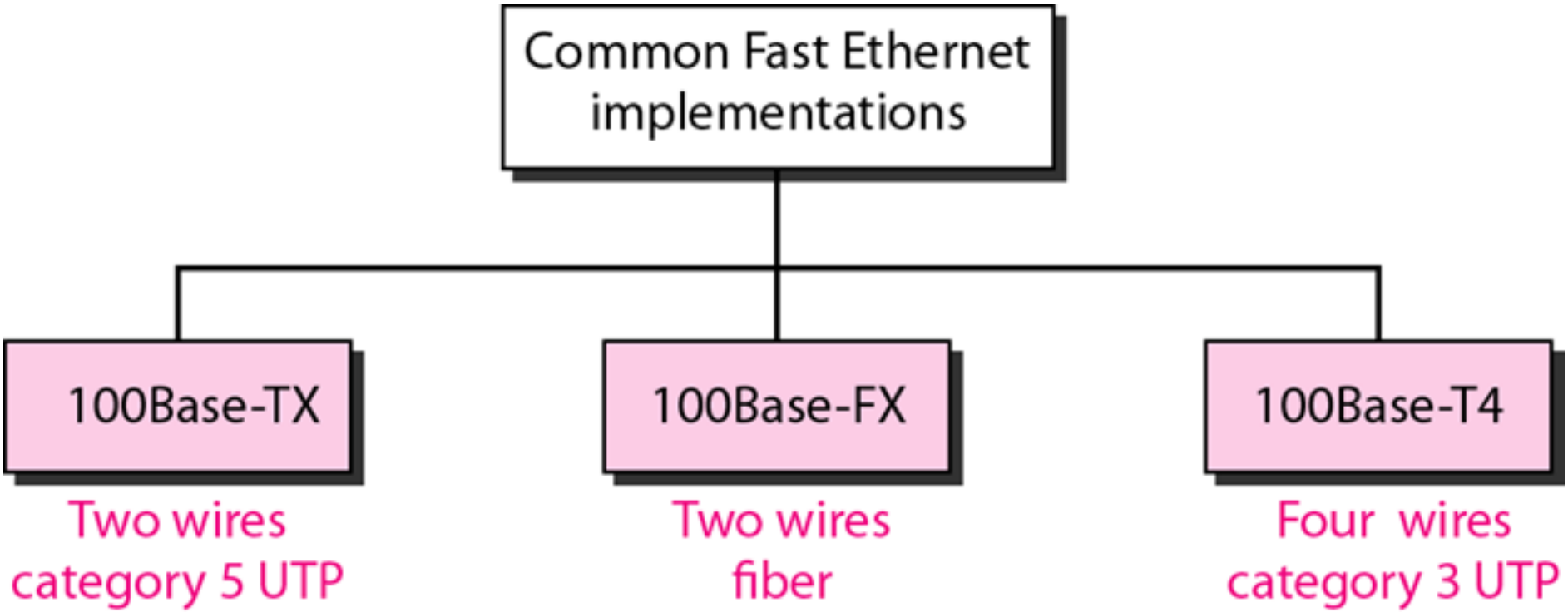


Figure: Implementation

Gigabit Ethernet

- Upgrade the data rate to 1Gbps.
- Make it compatible with Standard or Fast Ethernet.
- Keep the same 48-bit address.
- Keep the same frame format.
- Keep the same minimum and maximum frame lengths.
- To support autonegotiation as defined in Fast Ethernet.

MAC sublayer

- Half-duplex and full duplex. However, almost all implementations of Gigabit Ethernet follow the full-duplex approach.
- Half duplex stations are connected via a Switch.
- Full duplex stations are connected via a switch with buffers at each port.

Frame Size for CSMA/CD

- Traditional
- Carrier Extension
- Frame Bursting

Gigabit Ethernet Implementation

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

Figure: Implementation

Ten- Gigabit Ethernet

- Upgrade the data rate to 1Gbps.
- Make it compatible with Standard or Fast Ethernet or Gigabit Ethernet.
- Keep the same 48-bit address.
- Keep the same frame format.
- Keep the same minimum and maximum frame lengths.
- Allow interconnections of existing LANs into a MAN or WAN.
- Make Ethernet compatible with technologies such as Frame Relay and ATM.

Ten-Gigabit Ethernet Implementation

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

Figure: Implementation

Clock Synchronization

$$\theta = \frac{(t_1 - t_0) + (t_2 - t_3)}{2}$$

$$\delta = (t_3 - t_0) - (t_2 - t_1)$$

References

[1] Behrouz A. Forouzan *TCP/IP Protocol Suite*. Tata McGraw-Hill fourth edition.