SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE NAME :19IT401 COMPUTER NETWORKS

II YEAR /IV SEMESTER

Unit 2-**LINK LAYER**

Topic 7 : Wired LANs: Ethernet

Wired LANs: Ethernet

Ethernet: It is a LAN protocol that is used in Bus and Star topologies and implements CSMA/CD as the medium access method

STANDARD ETHERNET

Characteristics:

Unreliable, connectionless Service

Ethernet address : unicast, multicast and broadcast

Access Method CSMA/CD with 1-persistent method

Frame length without preamble

Minimum frame length: 64 bytes

Maximum frame length: 1518 bytes

Minimum data length: 46 bytes

Maximum data length: 1500 bytes

Wired LANs: Ethernet

Ethernet data link layer protocol provides **connectionless service** to the network layer

No handshaking between sending and receiving adapter.

Ethernet protocol provides *Unreliable* service to the network layer :

Receiving adapter doesn't send ACK or NAK to sending adapter

This means stream of datagrams passed to network layer can have gaps (missing data)

Gaps will be filled if application is using reliable transport layer protocol

Otherwise, application will see the gaps

Wired LANs: Ethernet

Addressing:

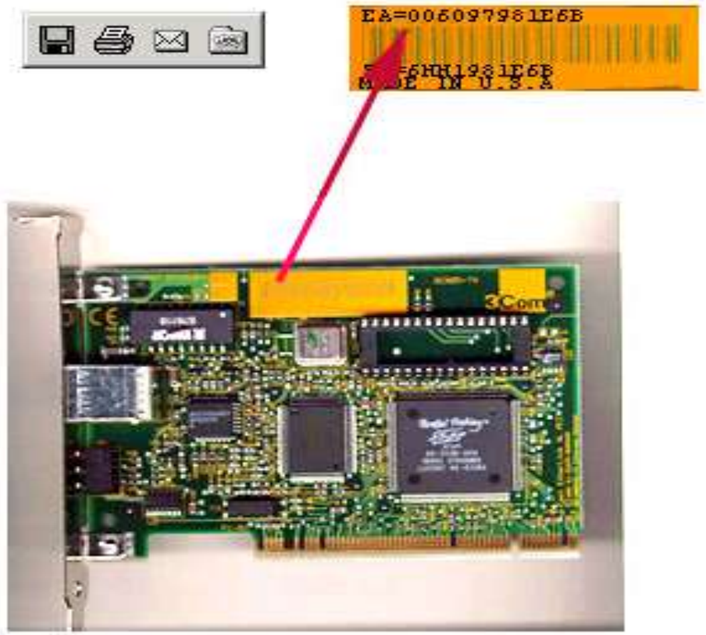
✓Link layer addressing
✓*Unicast, Multicast, and Broadcast Addresses*
✓4A:30:10:21:10:1A unicast(A-even)
✓47:20:1B:2E:08:EE multicast(7-odd)

- Destination Address can be:
  - Unicast: second digit from left is even (one recipient)
  - Multicast: Second digit from left is odd (group of stations to receive the frame – conferencing applications)
  - Broadcast (ALL ones) (all stations receive the frame)
- Source address is always Unicast

Wired LANs: Ethernet

Ethernet Address for Desktop PC ethernet card

For the 3Com 3C905-TX PCI PnP network card



The ethernet address for the above network card is : 006097981E6B

Wired LANs: Ethernet

The efficiency of the Ethernet is defined as the ratio of the time used by a station to send data to the time the medium is occupied by this station.

$$\text{Efficiency} = 1 / (1 + 6.4 \times a)$$

✓The practical efficiency of standard Ethernet has been measured to be in which the parameter *"a" is the number of frames that can fit on the medium.*

✓*It can* be calculated as *a = (propagation delay)/(transmission delay)*

✓the transmission delay is the time it takes a frame of average size to be sent out and the propagation delay is the time it takes to reach the end of the medium

✓ Note that as the value of parameter *a* decreases, the efficiency increases. This means that if the length of the media is shorter or the frame size longer, the efficiency increases.

Ethernet Frame

Preamble:
8 bytes with pattern 10101010 used to synchronize receiver, sender clock rates.
In IEEE 802.3, eighth byte is start of frame (10101011)

Addresses: 6 bytes (explained latter)

Type (DIX)
Indicates the type of the **Network layer protocol** being carried in the **payload (data)** field, **mostly IP** but others may be supported such as IP (**0800**), Novell IPX (**8137**) and AppleTalk (**809B**), ARP (**0806**))
Allow **multiple network layer** protocols to be supported on a single machine (multiplexing)
Its value starts at **0600h (=1536 in decimal)**

Length (IEEE 802.3): number of bytes in the **data field**.
Maximum 1500 bytes **(= 05DCh)**

CRC: checked at receiver, if error is detected, the frame is **discarded**
CRC-32

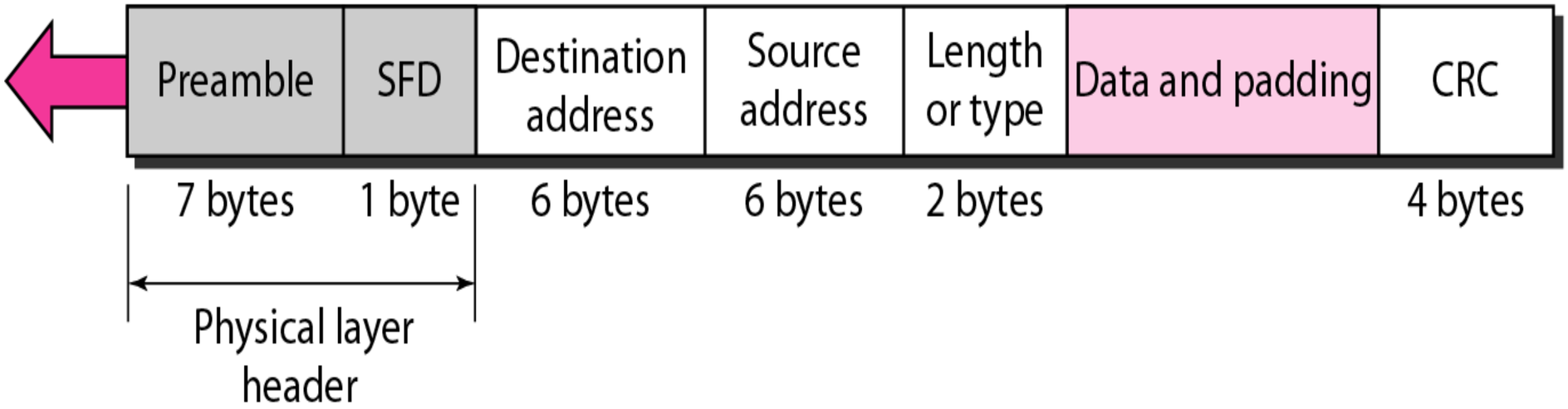
Data: carries data encapsulated from the upper-layer protocols

Pad: Zeros are added to the data field to make the **minimum data length = 46 bytes**

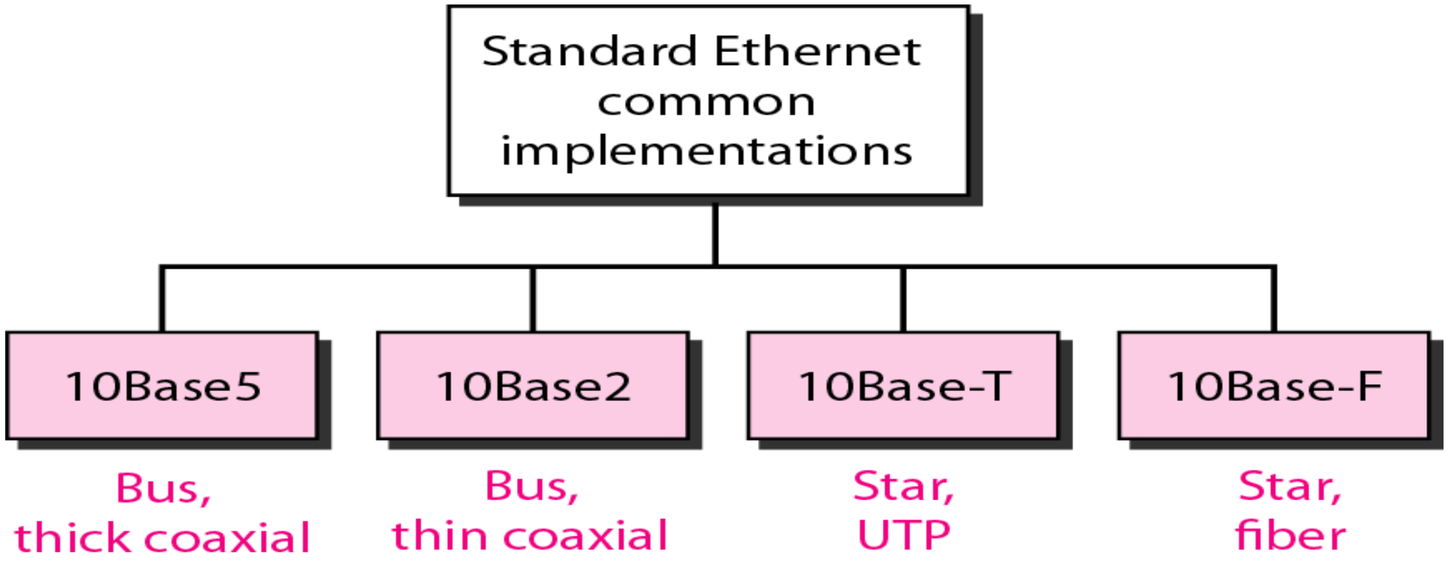
802.3 MAC frame

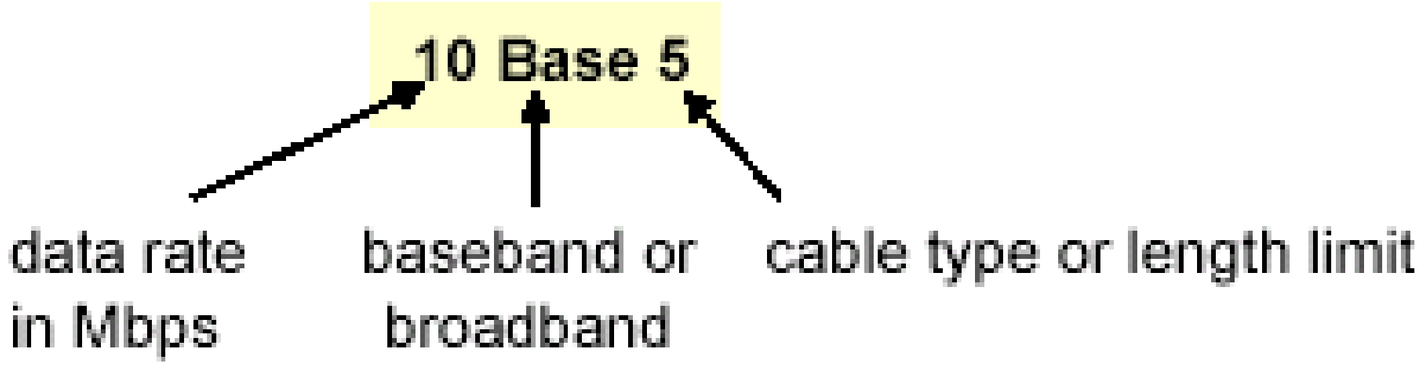
Preamble: 56 bits of alternating 1s and 0s.

SFD: Start frame delimiter, flag (10101011)



Categories of traditional Ethernet

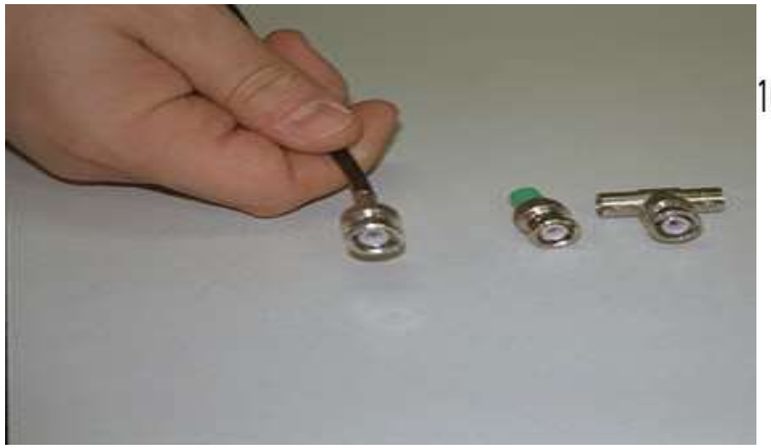


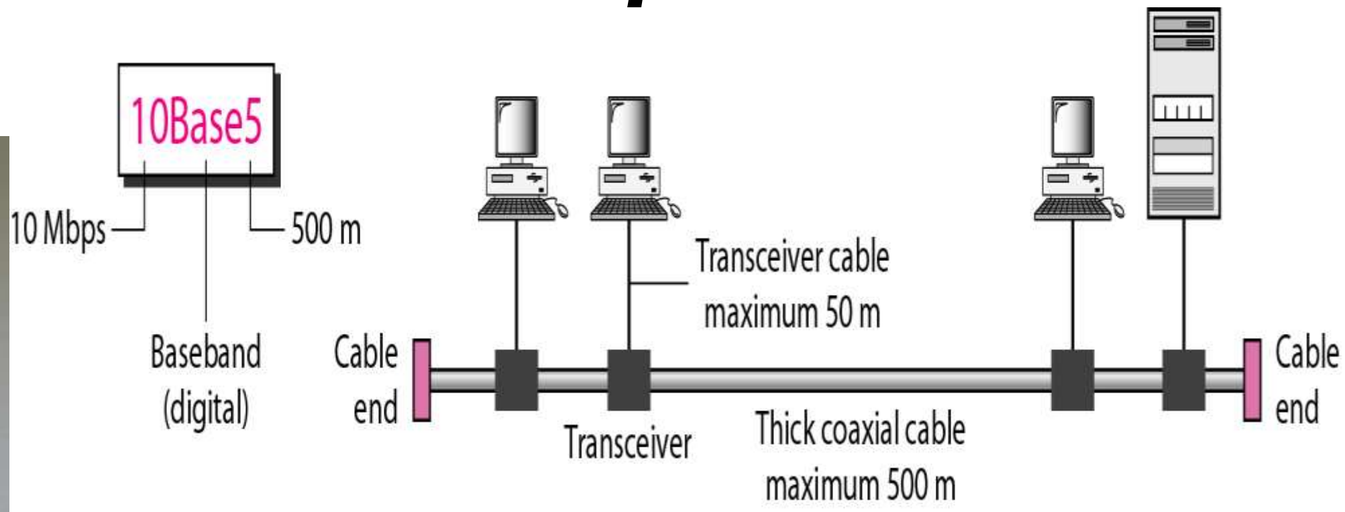


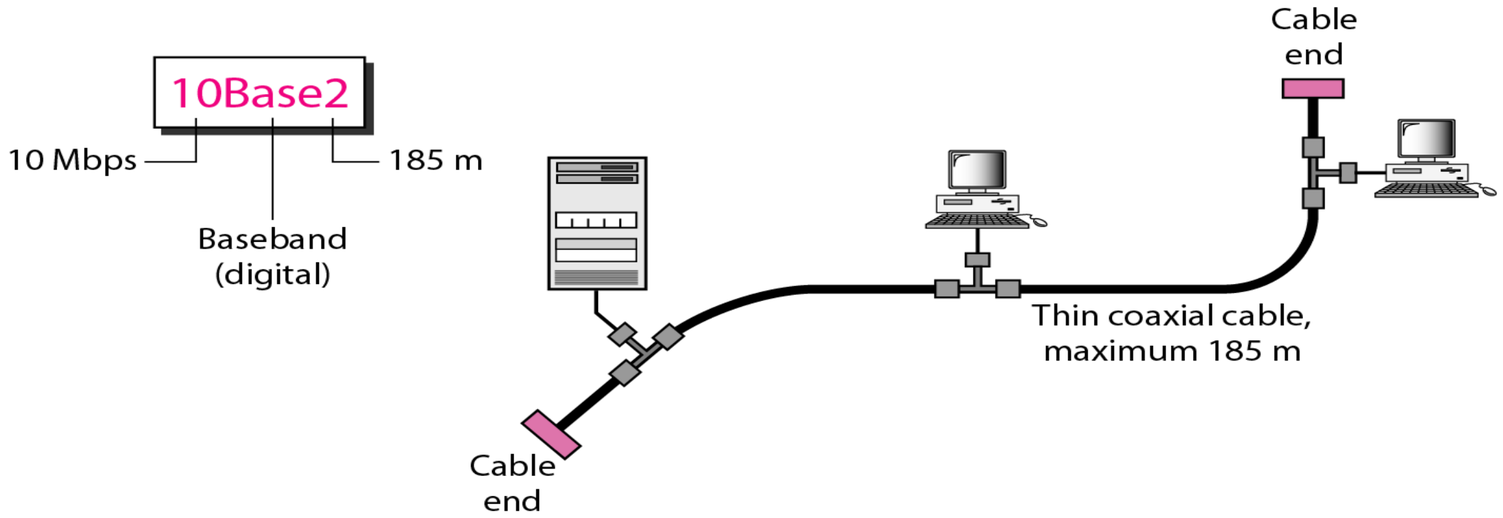
IEEE 802.3 Cable Types

Name	Cable Max.	Max Cable Segment Length	Nodes /segment
10Base5	thick coax	500 meters	100
10Base2	thin coax	185 meters	30
10BaseT	twisted pair	100 meters	1
10BaseF	Fiber Optic	2Km	1

10Base5 and 10 base 2 implementation







10BaseT

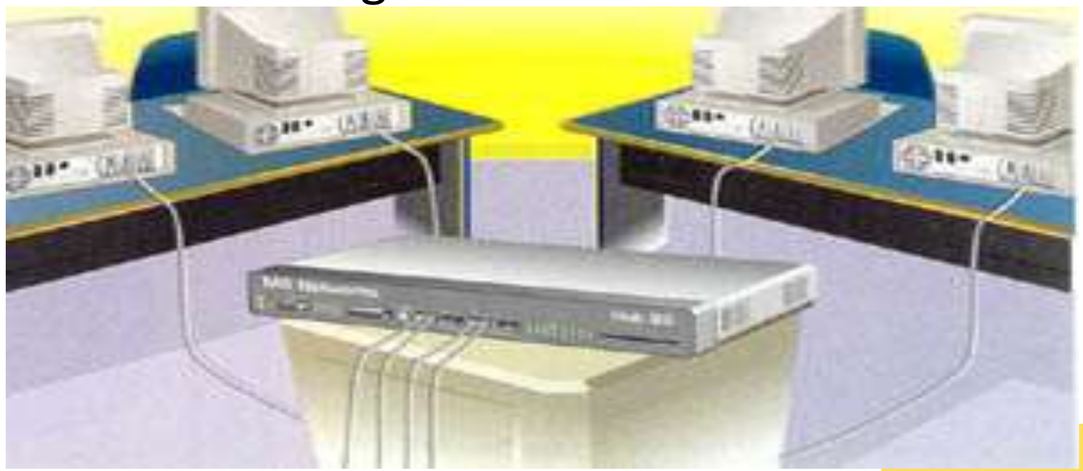
Uses twisted pair Cat3 cable

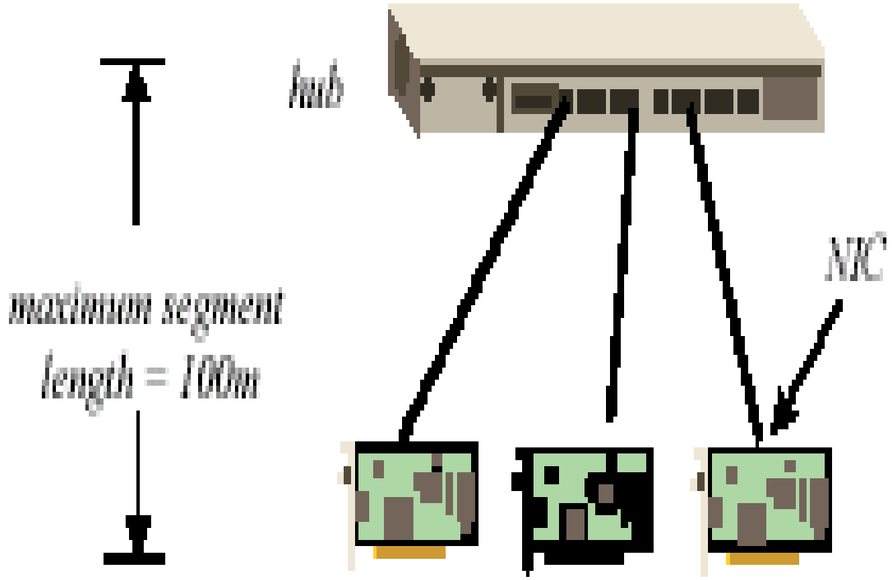
- Star-wire topology

• A hub functions as a repeater with additional functions

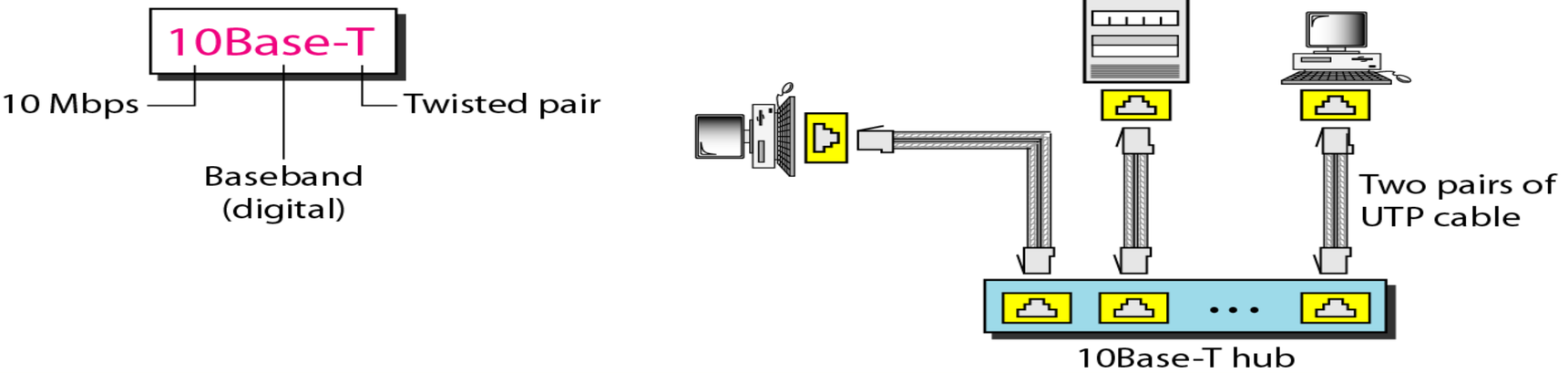
• Fewer cable problems, easier to troubleshoot than coax

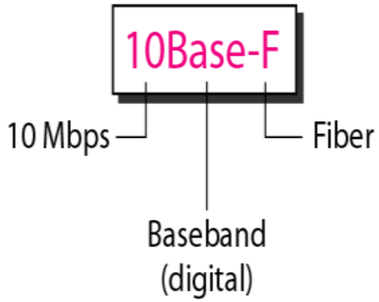
• Cable length at most 100 meters

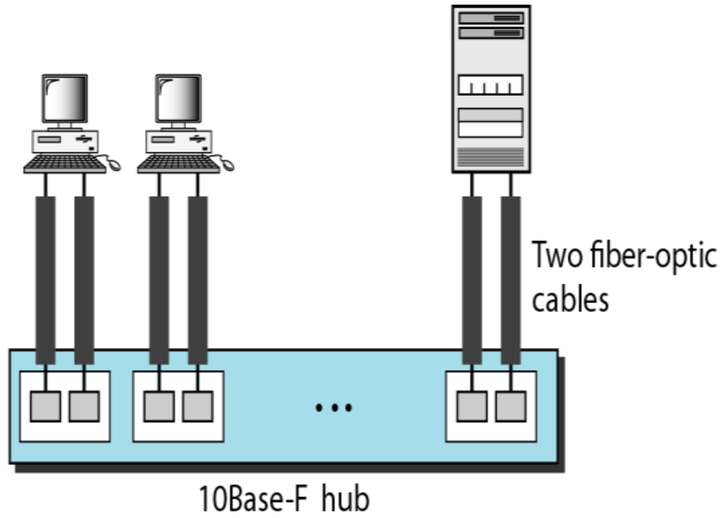




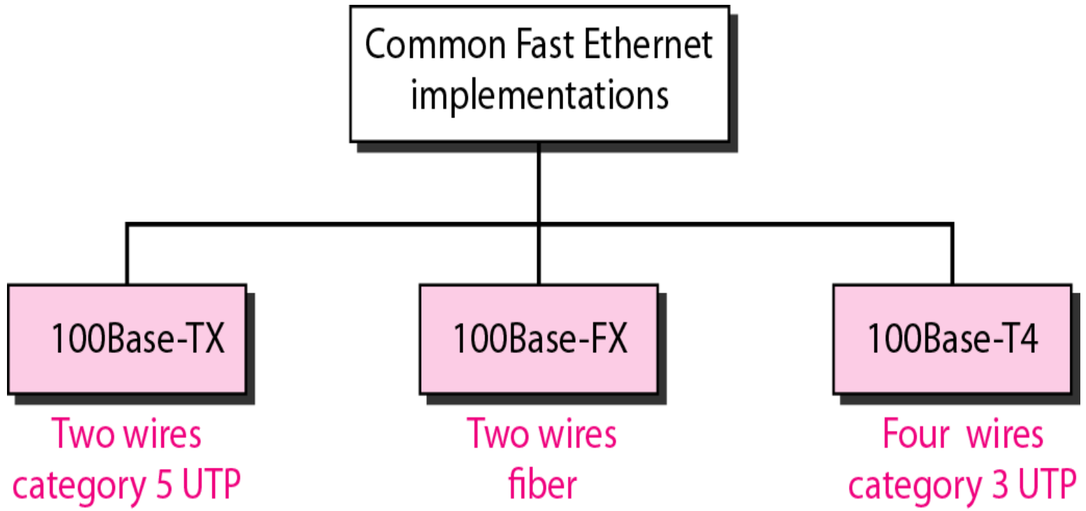
10 base T and 10Base-F implementation







Fast Ethernet implementations



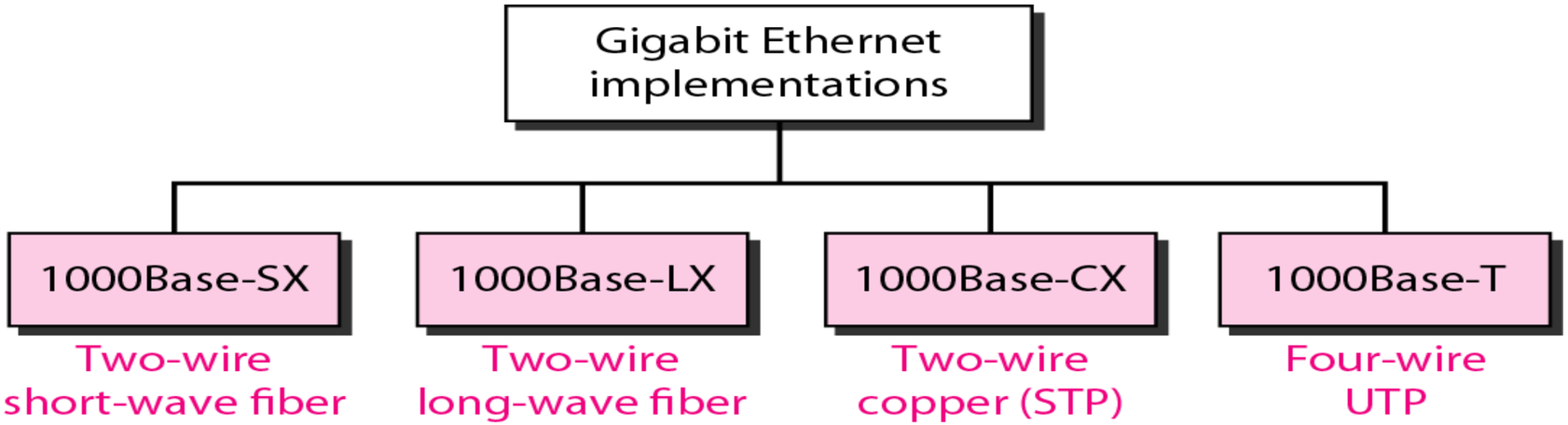
Name	Cable	Max. segment	
100Base-T4	Twisted pair	100 m	CAT 3
100Base-TX	Twisted pair	100 m	CAT 5
100Base-FX	Fiber optics	2000 m	

Wired LANs: Ethernet

- Traditional Ethernet is half duplex
  - Either transmit or receive but not both simultaneously
- With full-duplex, station can transmit and receive *data* simultaneously
- With full duplex, Throughput (actual transmission rate) is doubled.
  - 10-Mbps Ethernet in full-duplex mode, theoretical transfer rate becomes 20 Mbps
  - 100-Mbps Ethernet in full-duplex mode, theoretical transfer rate becomes 200 Mbps
- Changes that should be made with any computer in order to operate in Full-Duplex Mode
  1) Attached stations must have full-duplex NIC cards
  2) Must use two pairs of wire one pair for transmitting from host to switch (inbound) and the other pair for transmitting from switch to host (outbound)
  3) Must use a switch as a central device not a hub
  4) Devices must be connected point-to-point (dedicated) to the switch
  - Each station constitutes separate collision domain
    - CSMA/CD algorithm no longer needed (no collision)
    - No limit on the segment length
    - Same 802.3 MAC frame format used

Gigabit Ethernet

- ✓Speed 1Gpbs
- ✓Minimum frame length is 512 bytes
- ✓Operates in full/half duplex modes mostly full duplex
- ✓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.



10 Gbps Ethernet

- Maximum link distances cover 300 m to 40 km
- Full-duplex mode only
- No CSMA/CD
- Uses optical fiber only

Name	Cable	Max. segment	Advantages
1000Base-SX	Fiber optics	550 m	Multimode fiber (50, 62.5 microns)
1000Base-LX	Fiber optics	5000 m	Single (10 μ) or multimode (50, 62.5 μ)
1000Base-CX	2 Pairs of STP	25 m	Shielded twisted pair
1000Base-T	4 Pairs of UTP	100 m	Standard category 5 UTP

Prefix	First Suffix= Media type	Second Suffix= PHYSICAL LAYER encoding Type	Third Suffix=
10GBASE-	C=Copper (twoaxial) S=Short L=Long E=Extended Z=Ultra extended T=Copper(UTP)	R= LAN PHY W=WAN PHY X=LAN PHY	4 = 4 WWDM wavelengths or 4 XAUI lanes M = Multimode

Assessment

a) List Ethernet types.
 b) What is Fast Ethernet?
c) What is Gigabit Ethernet?
d) What is Full duplex mode?.

Reference

TEXT BOOKS

Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

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1. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
2. Andrew Tanenbaum, Computer Networks, Fifth Edition, Pearson (5th Edition) Education, 2013.
3. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.
4. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.