

IEEE 802 LANs

SECTION – C

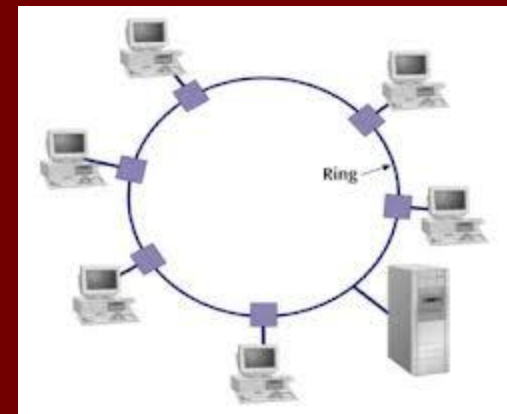
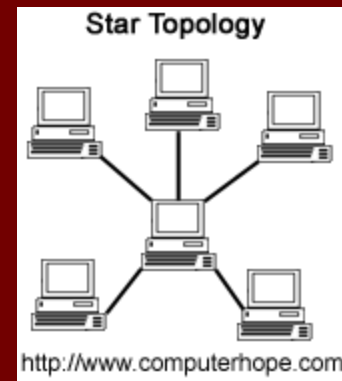
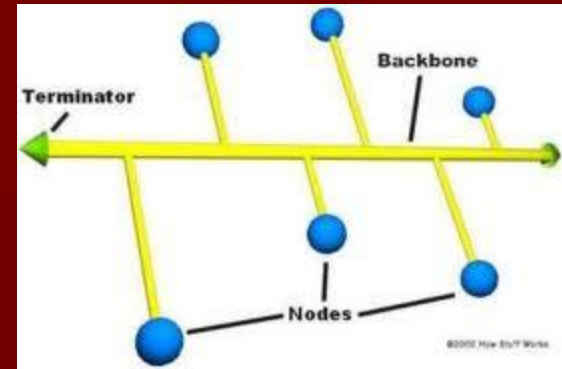
Outline of the Lecture

- **Basic characteristics of LAN**
 - **Topology**
 - **Transmission Media**
 - **MAC**
- **IEEE 802 LANs**
 - **802.3 - CSMA/CD based (Ethernet)**
 - **802.4 – Token bus-based**
 - **802.5 – Token ring-based**
 - **Comparison of the three types of LAN**

Local Area Networks

- **Local Area Networks**
 - **Small geographical area (5 Km)**
 - **High Reliability**
 - **High Data Rate (10Mbps – 10Gbps)**
 - **Privately owned** (individual, organization or academics etc)
- **Parameters that characterizes a LAN**
 - **Topology**
 - **Transmission Media**
 - **Medium Access Control Techniques**

- **Topology defines how nodes are connected**
- **Typical LAN topologies:**
- **Bus/Tree**
 - All nodes are connected to a common medium.
- **Star**
 - All nodes are connected to a central node.
- **Ring**
 - Nodes form a ring by point-to-point links to adjacent neighbors.



Transmission Media

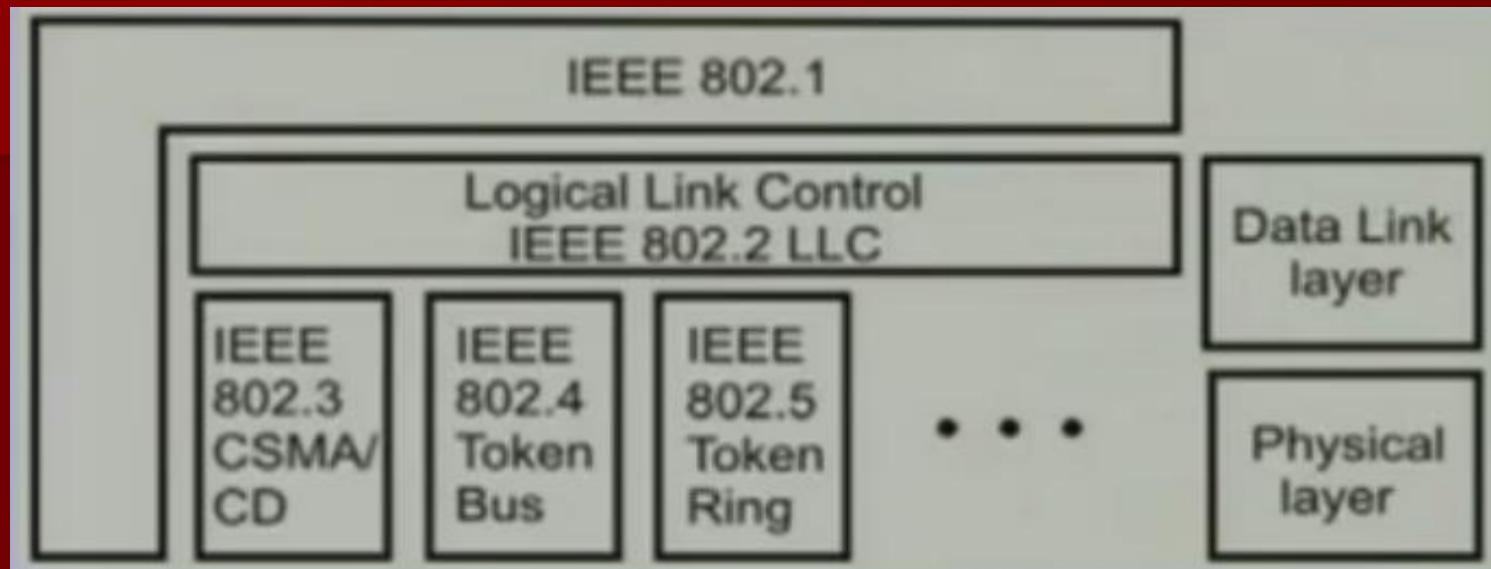
- **Transparent medium**
 - **Twisted-pair, coaxial cable, optical fiber, wireless.**

Topology	Transmission media
BUS	Coaxial
RING	Twisted-pair, Optical Fiber
Star	Twisted pair, Optical fiber

Medium Access Control

- CSMA/CD
- Token passing
- CSMA/CA

IEEE 802 Standard LANs



- **Physical layer**
 - Encoding & decoding
 - Collision detection
 - Carrier sensing
 - Transmission and receipt

- **Data link layer**
 - Station Interface
 - Data Encapsulation / Decapsulation
 - Link Management
 - Collision Management

IEEE 802.3 Specifications

➤ Physical layer:

•10Base5 →

thickwire coaxial

(Advantage: Original cable, now obsolete)

•10Base2 → thinwire coaxial

(cheapernet)

(Advantage: No hub needed)

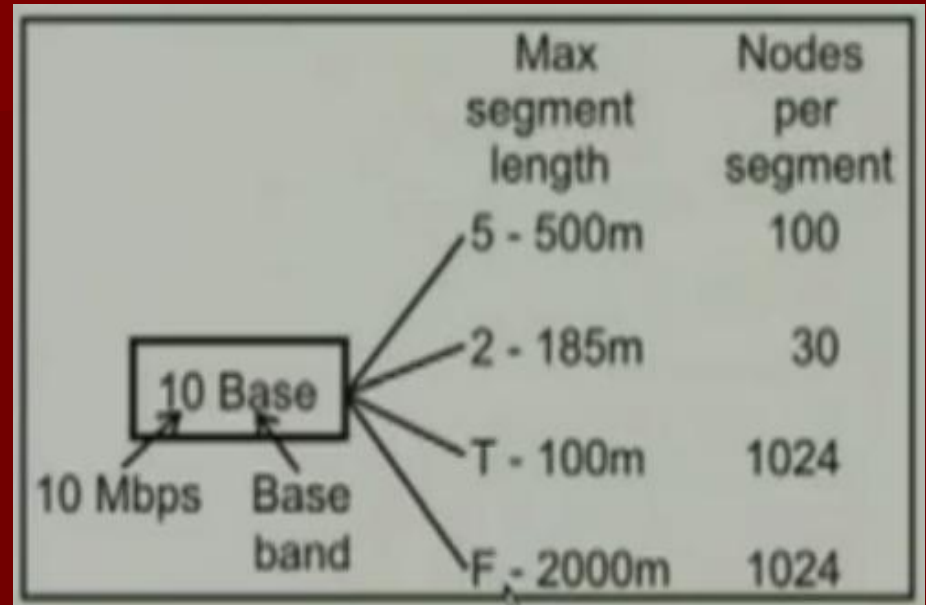
•10BaseT → twisted pair

(Advantage: Cheapest system)

•10BaseF → fiber optic

(Advantage: Best between buildings)

•10Broad36 - coaxial



➤ Signaling:

➤ Manchester in baseband (helps in synchronizing the clock at receiving end)

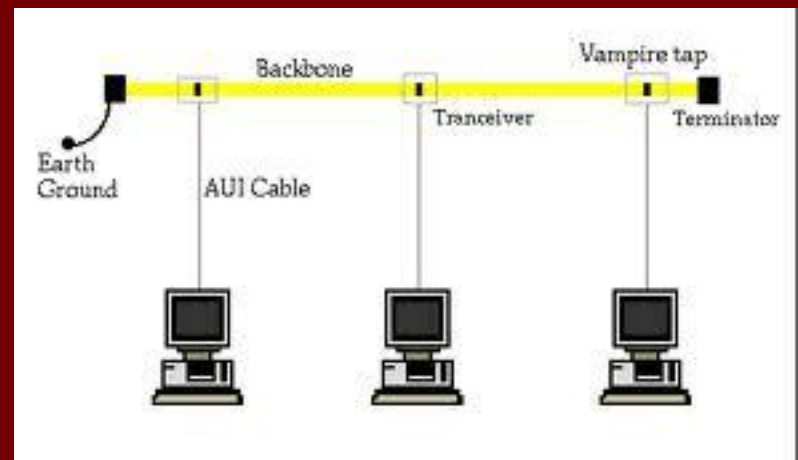
• Differential PSK (phase shift keying) in broadband

10Base5

- Supports 10Mbps baseband.
- The standard specifies 0.5 inch coaxial cable, known as yellow cable or thick Ethernet.
- Each cable segment can be maximum 500 meters long.
- Up to a maximum of 5 cable segments can be connected using repeaters, with maximum length 2500 meters.
- At most 1024 stations per Ethernet network is allowed.

➤ Some characteristics :

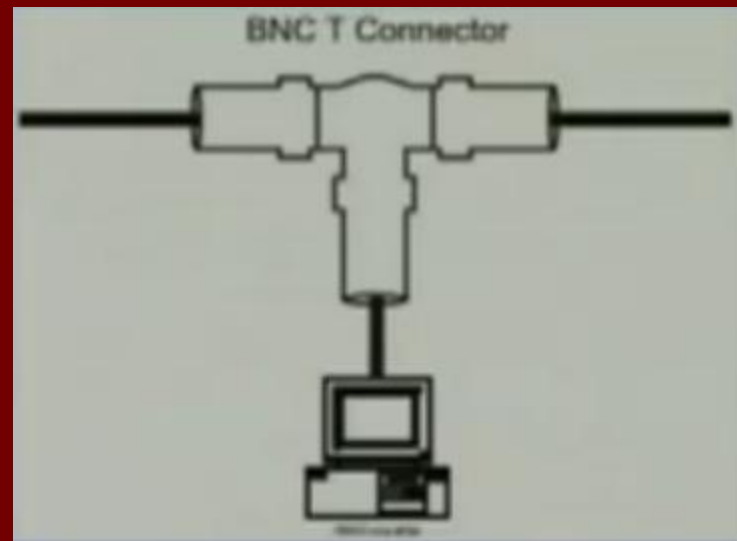
- Used for backbone networks
- Tap : cable need not be cut.
- Transceiver : send/receive, collision detection, electronic isolation.
- AUI: Attachment Unit Interface.



10Base2

- Also supports 10Mbps baseband transmission.
- The standard specifies 0.25 inch coaxial cable known as cheapernet or thin Ethernet. (used in Cable TV)
- Each cable segment can be maximum 185 m long.
- Up to a maximum 5 cable segments can be connected using repeaters, with maximum length of 925 meters.

- Some characteristics:
 - Use for office LAN/departmental LAN
 - BNC connector
 - No drop cable



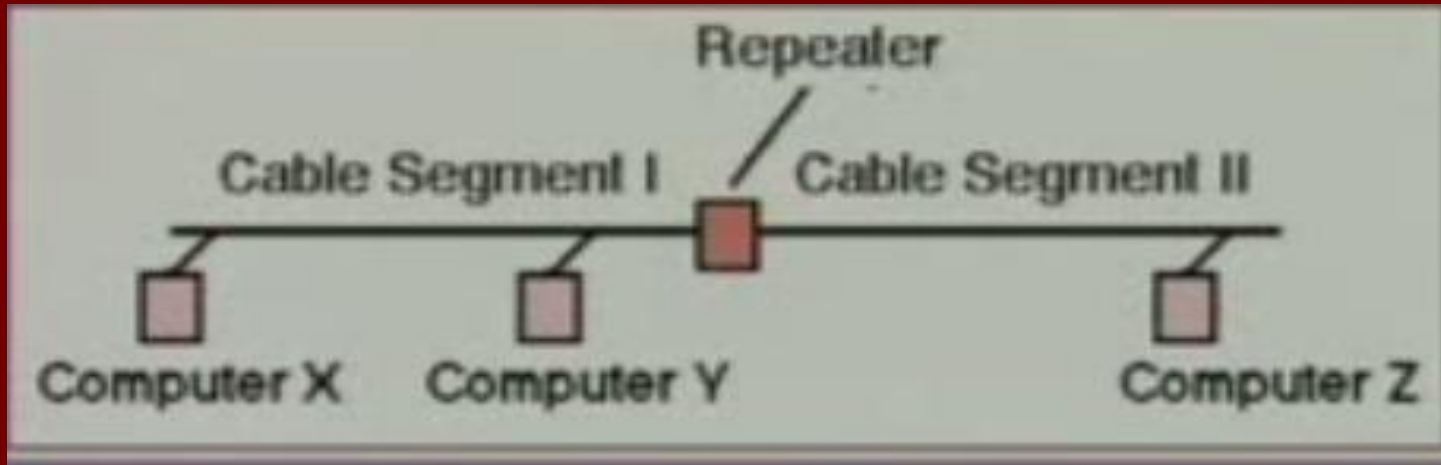
Repeaters

- **Regenerate the signal**
- **Provide more flexibility in network design**
- **Extend the distance over which a signal may travel down a cable.**
- **Example → Ethernet HUB (it has two purpose one is, provide a collision domain and replace the cable secondly repeaters function means regenerate signals)**

Ethernet Repeaters and Hubs

- Connect together one or more Ethernet Cable segments of any media type.
- If an Ethernet segment were allowed to exceed the maximum length or the maximum number of attached systems to the segments, the signal quality would deteriorate.

Ethernet Repeaters and Hubs



Used between a pair of segments Provide signal amplification and regeneration to restore a good signal level before sending it from one cable segment to another.

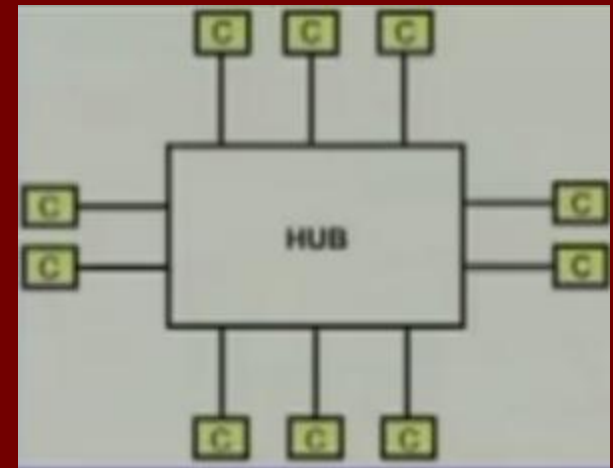
Hubs

- **Hubs are essentially physical-layer repeaters:**
 - **Bits coming in one link go out all other links.**
 - **No frame buffering**
 - **No CSMA/CD at hub: adapters detect collisions**
 - **Provide net management functionality.**



10BaseT

- Category 5 cable : data transmission upto 100 Mbps
- Supports 10 Mbps baseband transmission.
- The standard specifies the 24AWG Unshielded Twisted Pair (UTP).
 - Both Cat – 3 and Cat-5 cables may be used.
- A HUB functions as a repeater
- Stations connect to the hub with RJ45 connector.
- Maximum segment length is 100 meters.
- Easy to maintain and diagnose.



10BaseF

- **Allows long distance connections using optical fiber.**
 - **10BaseFP → A passive-star topology, up to 1 Km link.**
 - **10BaseFL → An asynchronous point-to-point link, up to 2Km.**
 - **10BaseFB → A synchronous point-to-point link, up to 2 Km with 15 cascaded repeaters.**

Fast Ethernet

- To increase to 100 Mbps, different encoding is used to reduce the bandwidth of the transmission.
- Encoding data at 100 Mbps using Manchester encoding would create a bit stream of 200 Mbps, which would require at least 100 MHz of analog bandwidth.
- Category 5 UTP cable is rated up to 100 MHz, but transmitting a signal of 100 MHz bandwidth would be unreliable).

Fast Ethernet

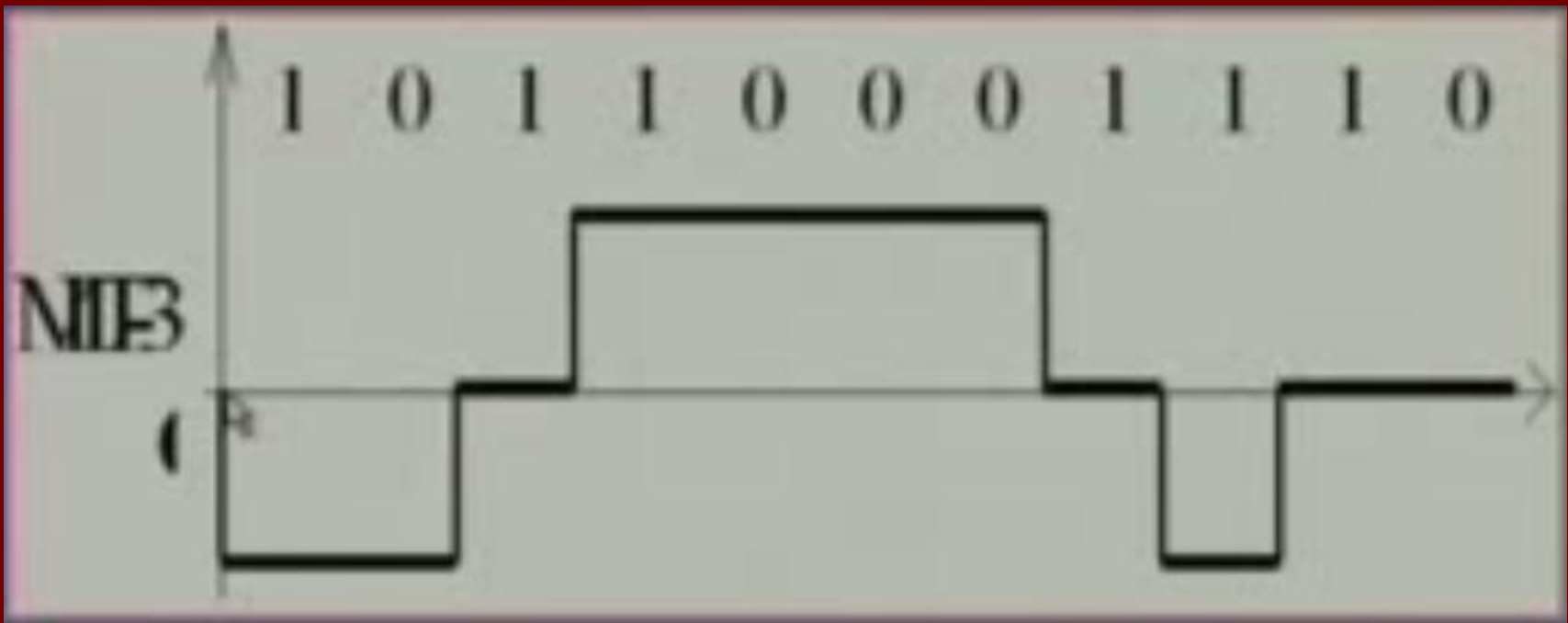
To reduce the bandwidth – different encoding scheme is required.

100BASE-TX uses a multiple level encoding scheme: **MLT-3** (Multiple Level Transition – 3): Bandwidth required = **31.25 MHz**

0: No transition

1: Transition (low to zero, high to zero, zero to low or high)

Multiple Level Transition



Fast Ethernet

- **Bandwidth required for MLT is $\frac{1}{2}$ the bandwidth required for a two level scheme.**
- **Long stream of zeros will cause the line to hold a constant voltage, and lose clocking synchronization necessary to read the signal.**

Fast Ethernet

- **Encoding each 4-bit sequence as a 5-bit pattern**

4B5B encoding.

- **The bit rate to 125 Mbps for 100BASE-TX data is only $125 \text{ Mbps} / 4 = 31.25 \text{ MHz}$**

100BASE-T4 Ethernet

- **Category 3 or 4 cable for rate of 100 Mbps by using all four twisted pairs in the UTP cable. Three pairs will transmit data, while the fourth pair is used by each station for collisions.**
- **As in 100BASE-TX, a three-level signal is transmitted in 100BASE-T4, but the data rate must be minimized further. Therefore, the signal is broken into 8-bit sequences, and each 8-bit sequence is represented as 6 three-level signals.
8B6T encoding.**

Fast Ethernet

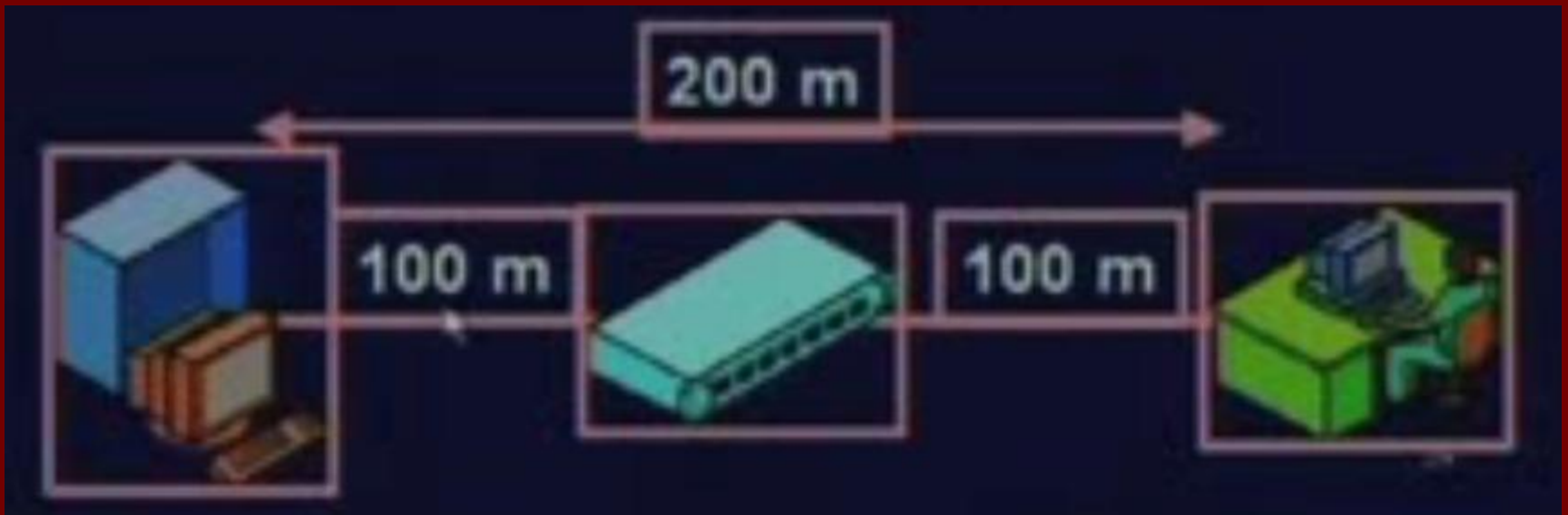
The original fast Ethernet cabling

Name	Cable	Max Segment	Advantages
100Base-T4	Twisted pair	100 m	Uses category 3 UTP
100Base-TX	Twisted pair	100 m	Full duplex at 100 Mbps
100Base-FX	Fiber optics	2000 m	Full duplex at 100 Mbps; long runs

10Base-T & 100Base-TX wiring

■ Wiring

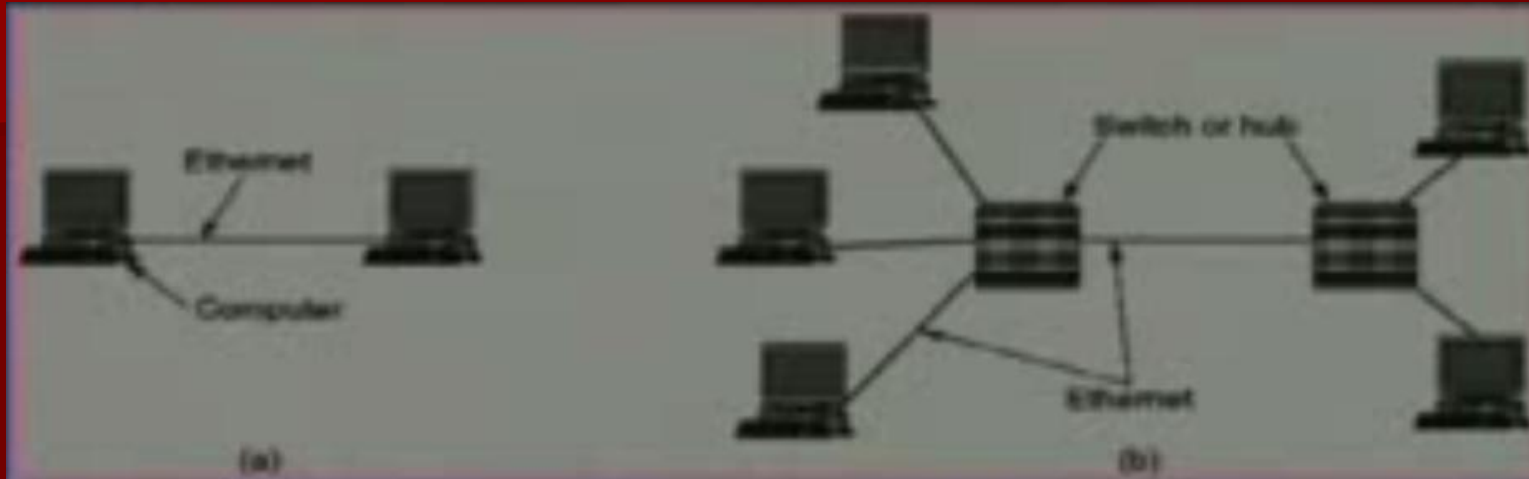
- 100 meters maximum distance hub-to-station.
- Can use multiple hubs (max 4) to increase the distance between any two stations.



10Base-T to 100Base-TX

- Upgrading from 10Base-T to 100Base-TX
 - Need new hub/switch
 - May have some 10Mbps ports to handle 10Base-T NICs
 - May have autosensing 10/100 ports that handle either,
 - Need new NICs
 - Only for stations that need more speed.
 - No need to rewire
 - This would be expensive.

Gigabit Ethernet



(a) A two-station Ethernet. (b) A multi-station Ethernet

- **Allows for p-to-p links and shared broadcast channels.**
- **In shared mode, CSMA/CD is used; short distances between nodes to be efficient.**

Gbit Ethernet

- **Use standard Ethernet frame format (802.3z standard)**
- **The normal mode is full-duplex mode, with a central switch connected to computers. In this configuration, all lines are buffered.**
- **No sense the channel to see if it is idle because contention is impossible. CSMA/CD protocol is not used.**

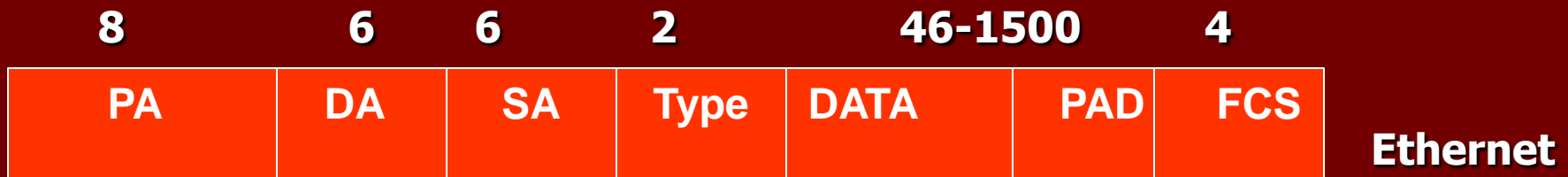
- **Uses hubs, called here “Buffered Distributers”**
- **Full-Duplex at 1 Gbps for point-to-point links**
- **10 Gbps now !**
- **Copper and fiber (with LD, 850 nm or 1300 nm; 8B/10B)**

Gigabit Ethernet

Gigabit Ethernet cabling.

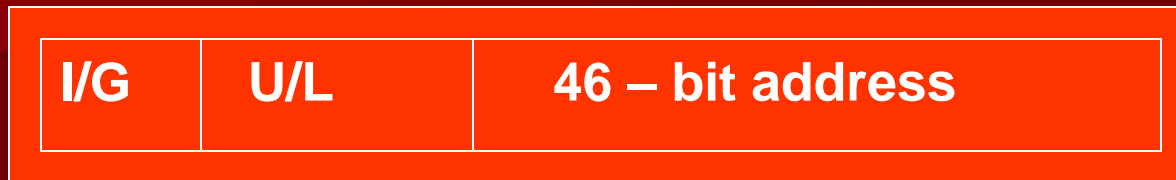
Name	Cable	Max Segment	Advantages
1000Base-SX	Fiber optics	550 m	Multimode fiber (50, 62.5 microns)
1000Base-LX	Fiber optics	5000 m	Single (10 microns) or multimode (50,62.5 microns)
1000Base-CX	2 Pairs of STP	25 m	Shielded twisted pair
1000Base-T	4 Pairs of UTP	100 m	Standard category 5 UTP

Ethernet Frame Format



- PA :** Preamble – 10101010s for synchronization
- SFD :** Start of frame delimiter – 10101011 to start frame
- DA :** Destination MAC address
- SA :** Source MAC address
- LEN :** Length => number of data bytes
- Type :** Identify the higher-level protocol
- LLC PDU + Pad :** minimum 46 bytes, maximum 1500 bytes.
- FCS :** Frame check Sequence => CRC – 32.

Ethernet MAC Address



I/G = 0 → Individual address

= 1 → group address

U/L = 0 → global administered address

= 1 → local administered address

Unicast: Defines a single destination

Broadcast: FFFFFFFFFFFFFFFF each station on the network receive and accept frames

Multicast: A group address defines multiple recipient

Inter-frame Gap

- **Mandatory 9.6 μs between two frames**
 - **That is, 96 bit-time delays provided between frame transmissions**
 - **To enable other stations wishing to transmit to take over at this time.**

