Experiment No-1

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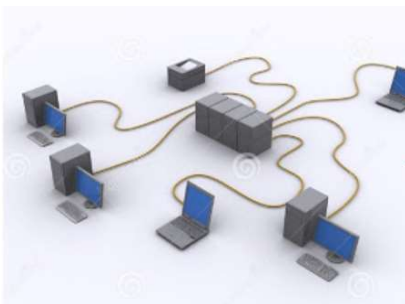
TE Comps

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Batch A

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Aim :- Study of different types of physical layer wired/wireless connections.

Types of Connections :-[1]

Wired Connections :- A wired network uses cables to connect devices, such as laptop or desktop computers, to the Internet or another network.

Wireless Connections:- wireless network refers to the use of infrared or radio frequency signals to share information and resources between devices. Wireless technologies are designed to reduce the time and different type of obstacles created by the cables. Access points amplify Wi-Fi signals, so a device can be far from a router but still be connected to the network.

Protocols under Wireless Networks:-

1. 802.11 Family (WiFi)
2. 802.15.1 (Bluetooth)
3. 802.15.4 & ZigBee
4. Worldwide Interoperability for Microwave Access (WiMax) 802.16a

802.11 Family:-

The 802.11 standard is defined through several specifications of WLANs. It defines an over-the-air interface between a wireless client and a base station or between two wireless clients.

## 802.11 Family of Wireless LANs use 2 types of topologies:

Ad Hoc Topology:-

➢ Ad hoc network is also known as IBSS (Independent Basic Service Set) configuration.
➢ Ad hoc WLANs include a number of nodes or wireless stations that communicate directly with one another on a peer-to-peer basis, without using an access point (AP) or any connection to a wired network.
➢ It's used to share files or internet connection between stations using the same ad hoc network.
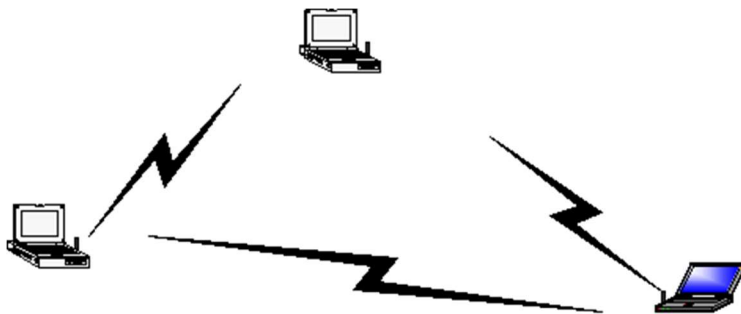
Infrastructure Topology:

- In this mode - also called an AP topology - client devices link up to a wired network through an access point (AP). This is a more common configuration emphasizing that the WLAN does not replace the wired LAN but extends the functionality to wireless devices.
- A single AP can typically support between 15 and 250 users depending on technology, configuration and usage with a range of between 20 and 500m.
- This is called a Basic service Set (BSS).
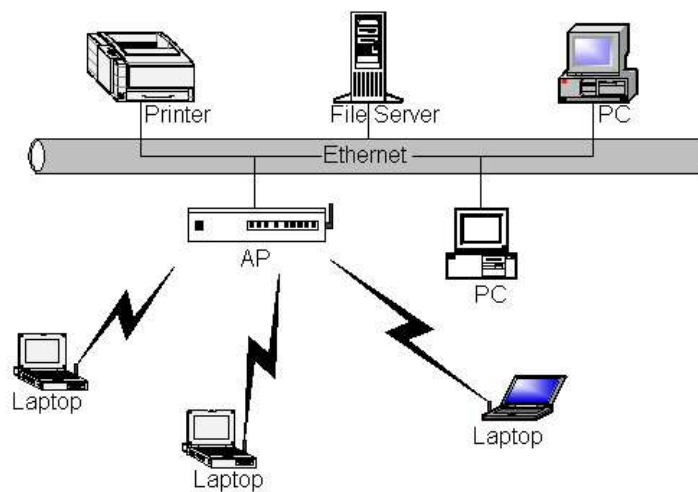
| Name	802.11	802.11a	802.11b	802.11g	802.11n
Primary application	Wireless LAN	Wireless LAN	Wireless LAN	Wireless LAN	Wireless LAN
Speed	1 to 2 Mbps	Up to 54 Mbps	Up to 11 Mbps	Up to 54 Mbps	Up to 600 Mbps
Transmission range	20 feet indoors	25 to 75 feet indoors; range can be affected by building materials	Up to 150 feet indoors; range can be affected by building materials	Up to 150 feet indoors; range can be affected by building materials	170+ feet indoors; range can be affected by building materials
Frequency Band	2.4 GHz	5 GHz	2.4 GHz	2.4 GHz	2.4/5 GHz

Topology	Ad hoc/ infrastructure	Ad hoc/ infrastructure	Ad hoc/ infrastructure	Ad hoc/ infrastructure	Ad hoc/ infrastructure
Half/Full duplex	Half	Half	Half	Half	Half
Radio Technology	Frequency Hopping spread spectrum / direct sequence spread spectrum (DSSS)	Orthogonal frequency division multiplexing (OFDM)	Direct Sequence Spread Spectrum	Orthogonal frequency division multiplexing (OFDM)	Orthogonal frequency division multiplexing (OFDM)
Modulation		BPSK, QPSK, 16-, 64-QAM	QPSK	BPSK, QPSK, 16-, 64-QAM	BPSK, QPSK, 16-, 64-QAM

802.15 family of Wireless PAN:-[2]

The 802.15 standard is defined through several specifications of WPANs.

802.15.1:-

> 802.15.1, more commonly known as Bluetooth, is a low-data-rate, low-power wireless networking standard aimed at replacing cables between lightweight devices.
> A Bluetooth network is called **piconet** and a collection of interconnected piconets is called **scatternet**.
> Bluetooth has master slave configuration.
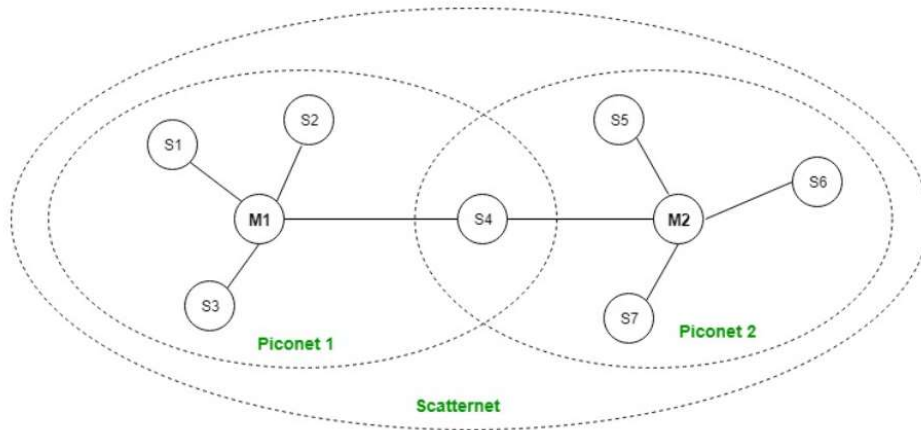
802.15.4:-

➤ Although Bluetooth's power requirements are much lower than that of 802.11b, it is still assumed that Bluetooth-enabled devices will be recharged every few days.
➤ The IEEE 802.15.4 standard is defined for very low-power, low-duty network links.
➤ This standard is intended for deployment on long-lived systems with low data rate requirements, where devices must be able to operate autonomously for months or even years without recharging the battery.

ZigBee :-

➤ The 802.15.4 standard only defines the PHY and MAC layers.
➤ ZigBee builds on top of 802.15.4's radio layer, specifying network, security, and application layers.

Name	Bluetooth (802.15.1)	802.1.5.4	
		standard	ZigBee
Radio Spectrum	2.4 GHz	868 MHz, 915 MHz, 2.4 GHz	
Max. Data Rate	3 Mbps	250Kbps	
Radio Power	< 100mW	> 1mW	

Max Range	1m – 100m	1m – 100m	
Network Topology	cluster	Star, peer to peer	Star , cluster, Mesh
Application	Low-bandwidth cable replacement	Sensors, home automation	

Worldwide Interoperability for Microwave Access (WiMax) 802.16a:- [3]

WiMAX is one of the hottest broadband wireless technologies around today. WiMAX systems are expected to deliver broadband access services to residential and enterprise customers in an economical way. It is based on Wireless MAN technology.
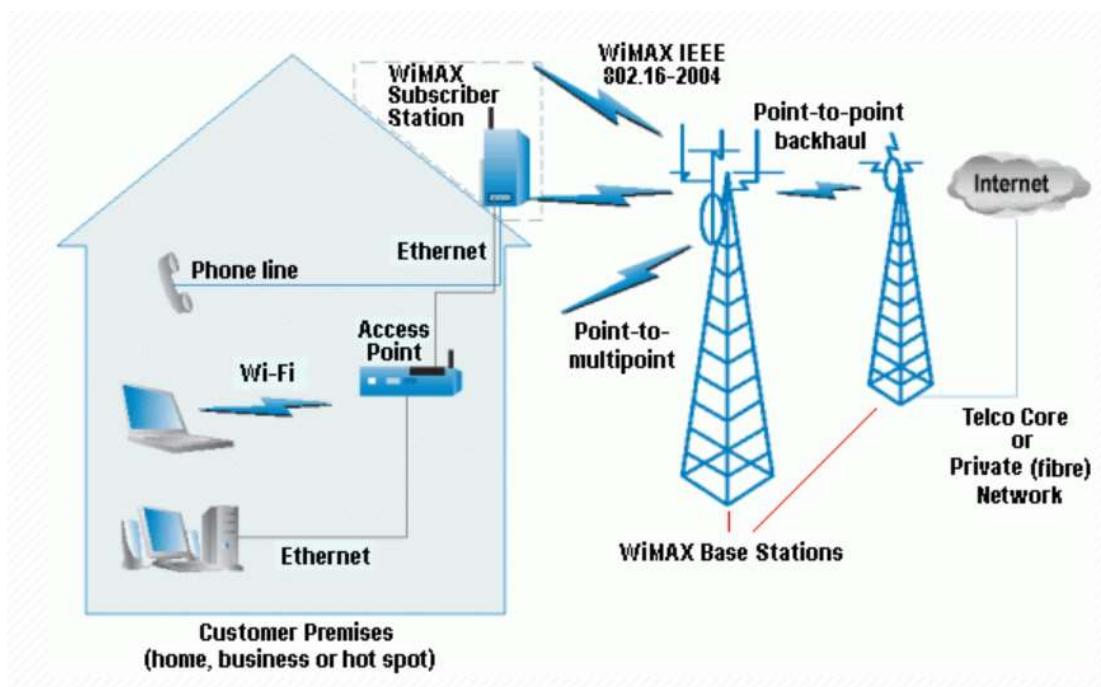
Primary Application	Frequency Band	Half/Full duplex	Radio Technology	Modulation
Broadband wireless access in MAN	2 GHz to 11 GHz	Full	OFDM(256-channels)	BPSK, QPSK,16-, 64-, 256-QA

Protocols under Wired Technology:

1. 802.3 (Ethernet)
2. 802.3u (Fast Ethernet)
3. Fiber Distribution Data Interface (FDDI)
4. 802.4 (Token Bus)

Ethernet:- IEEE 802.3

➢ Ethernet is the technology that is commonly used in wired local area networks (LANs).
➢ A LAN is a network of computers and other electronic devices that covers a small area such as a room, office, or building.
➢ Signalling :- baseband (digital signalling. Baseband comm is bidirectional)

Lifewire

IEEE shorthand identifiers, such as ***10Base5, 10Base2, 10BaseT, and 10BaseF*** include three pieces of information:

- **The number 10:** At the front of each identifier, 10 denotes the standard data transfer speed over these media - ten megabits per second (10Mbps).

- **The word Base:** Short for Baseband, this part of the identifier signifies a type of network that uses only one carrier frequency for signaling and requires all network stations to share its use.

- **The segment type or segment length:** This part of the identifier can be a digit or a letter:

- **Digit -** shorthand for how long (in meters) a cable segment may be before attenuation sets in. For example, a 10Base5 segment can be no more than 500 meters long.

- **Letter -** identifies a specific physical type of cable. For example, the **T** at the end of 10BaseT stands for twisted-pair.

Parts of Physical Layer:-

➤ Medium dependent sublayer: specifies the medium, physical connectors, related mechanical and electrical characteristics
➤ Medium independent sublayer: covers line coding – how to transmit 0 and 1 bits; other issues not directly linked to the medium

name	10Base5	10Base2	10BaseT
medium	Thick coax cable	Thin coax cable	Twisted pair
Max-length of transmission	500m	200m	100m
No. of nodes	100	30	1024
Data rate	10mbps	10mbps	10mbps
Topology	bus	Bus	Star
Physical connectors	Vampire taps	BNC	RJ45
Fault tolerant	no	no	yes
Data flow	Half duplex	Half duplex	Full/half duplex

Medium independent: the Manchester encoding is used for the line coding – A 1 bit is transmitted as a half-width positive pulse followed by a half-width negative pulse, and a 0 bit is another way round.
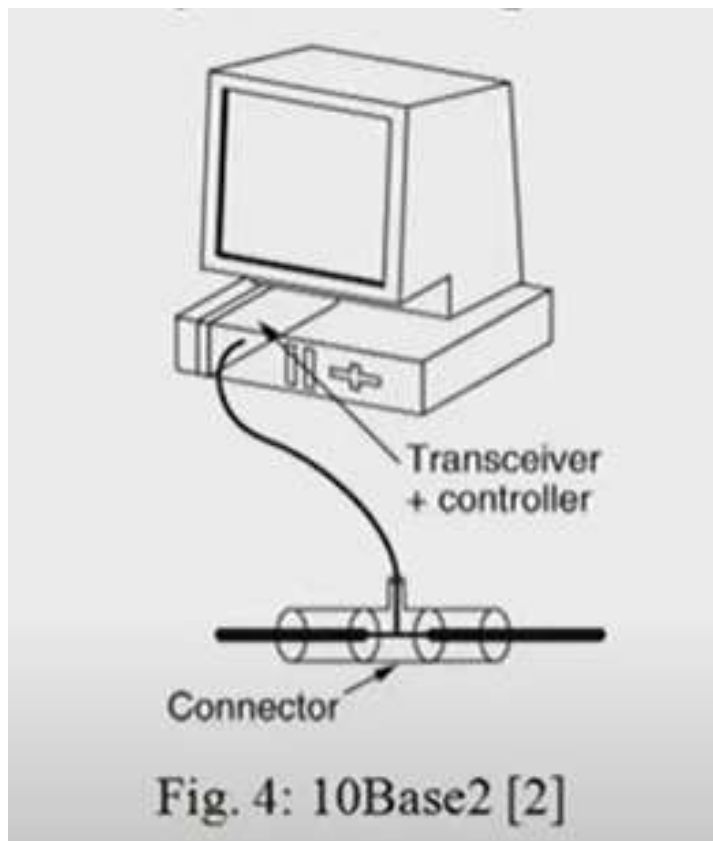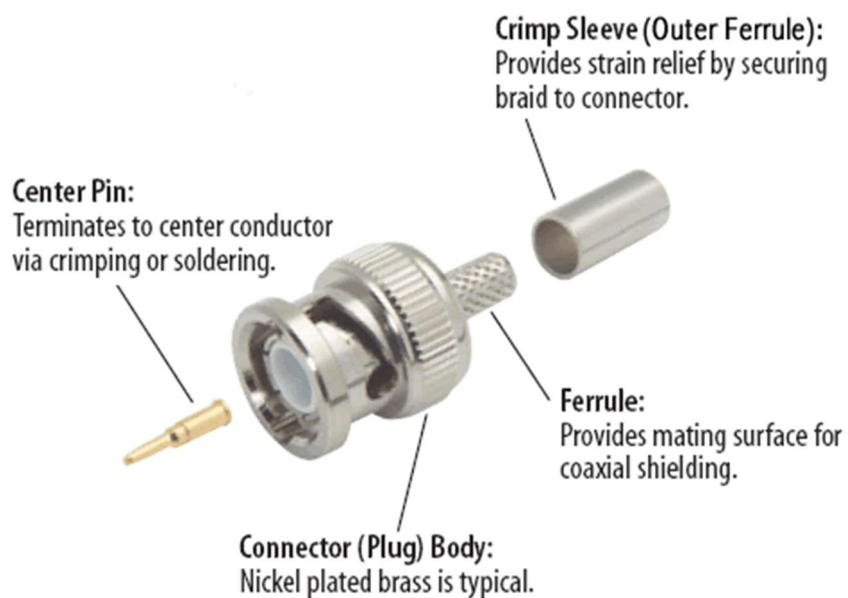

10Base5

Fig. 2: 10Base5 [2]

Fig. 3: 10Base5 [2]
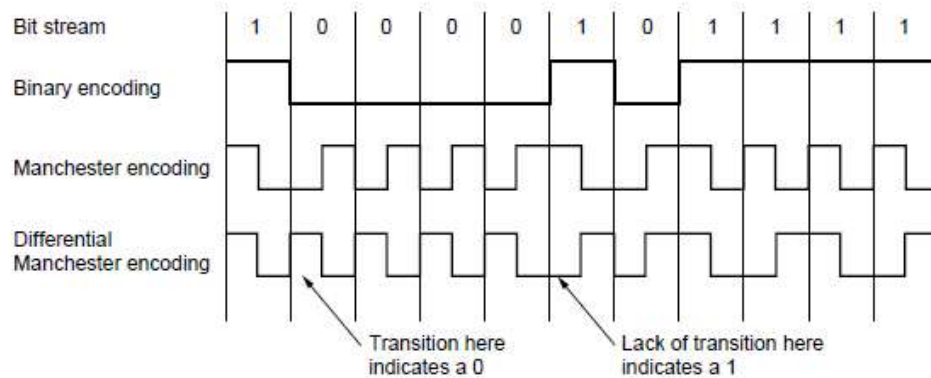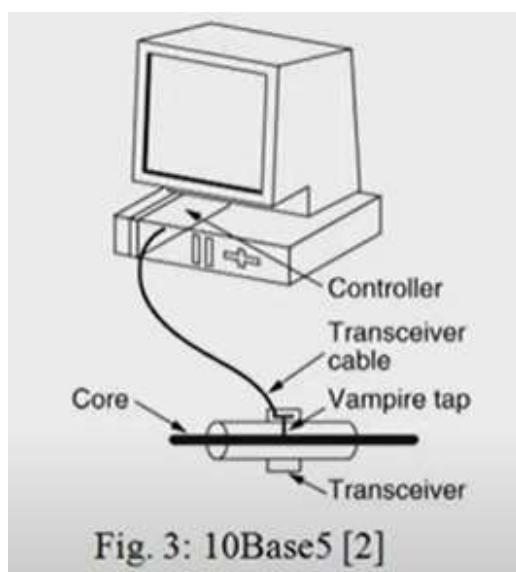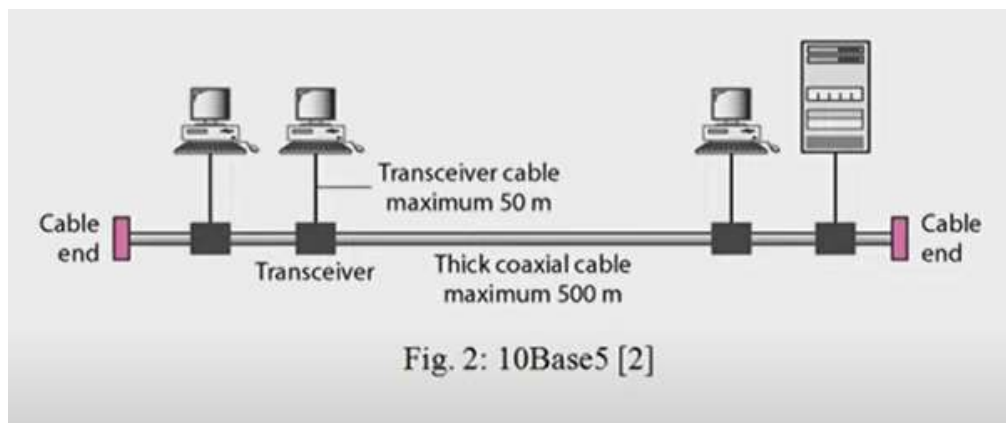
Vampire taps are used for connection. Transceiver cable connects to interface board

10Base2

Fig. 4: 10Base2 [2]

It uses BNC connector.
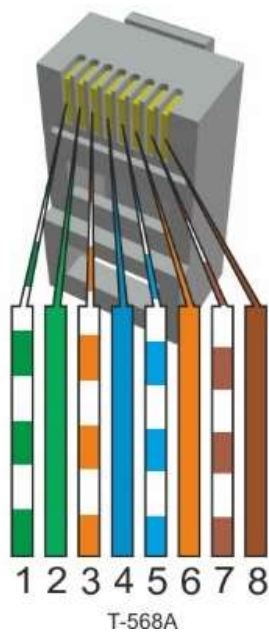

Crimp Sleeve (Outer Ferrule):
Provides strain relief by securing braid to connector.

Center Pin:
Terminates to center conductor via crimping or soldering.

Ferrule:
Provides mating surface for coaxial shielding.

Connector (Plug) Body:
Nickel plated brass is typical.

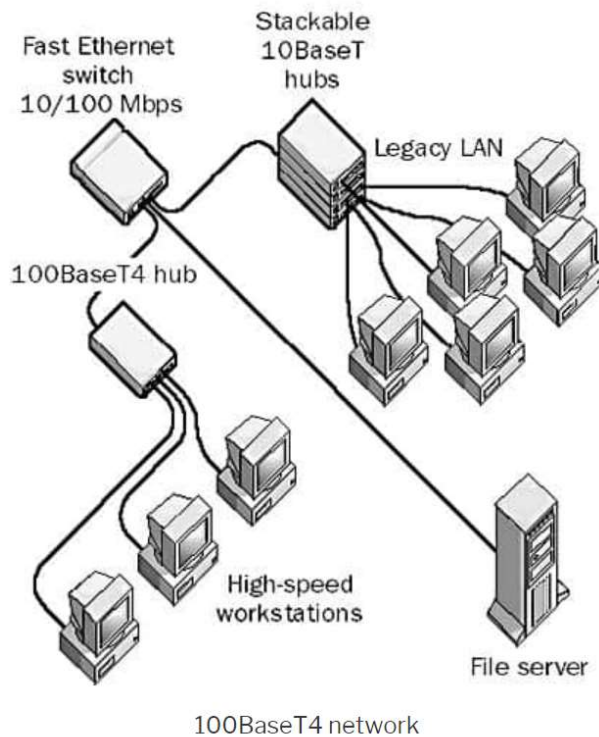## 10baseT

Fig. 5: 10BaseT [2]
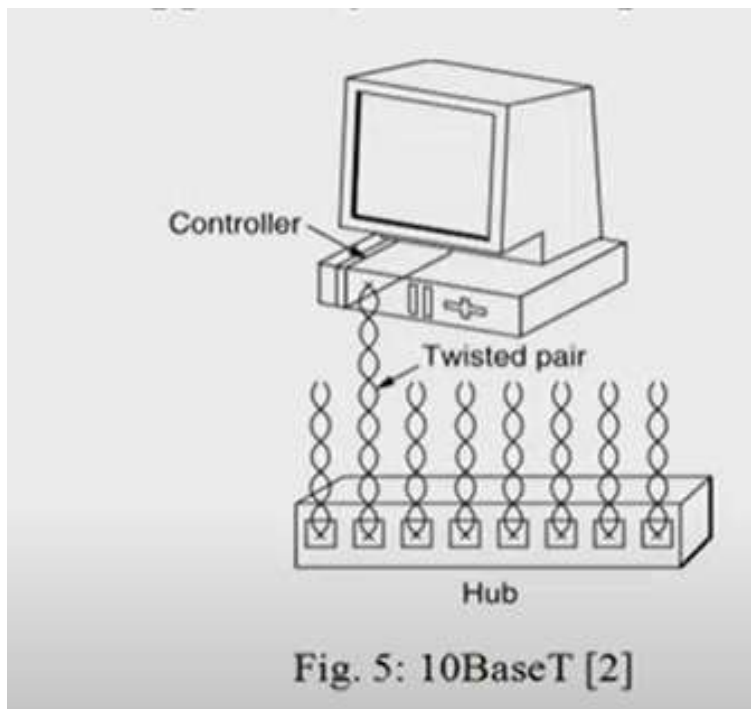
RJ45 Connector
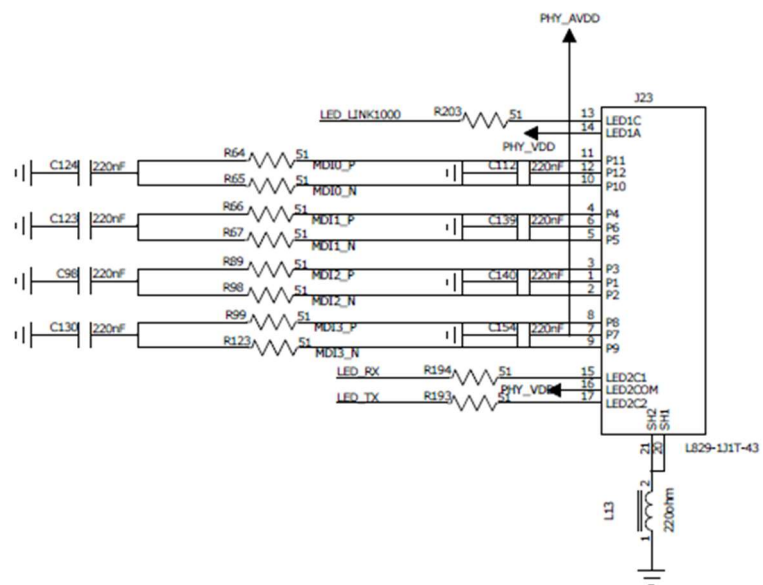
Fast Ethernet (802.3u):-

Fast ethernet is a technology commonly used in wired LAN.

Signalling :- Baseband (Digital)

| name	100BaseT4	100BaseTX	100BaseFX
medium	4 Twisted pair (UTP-3)	2 Twisted pair (UTP-5)	2 multimode optical fibre
Max-length of transmission	100m	100m	2000m
Data rate	100mbps	100mbps	100mbps
Topology	Star	Star	Star
Physical connectors	RJ45	RJ45	ST
Fault tolerant	yes	yes	yes
Data flow	Half duplex	Full duplex	Full duplex

100BaseT4

100BaseT4 network

100BaseT4 uses all four pairs of wire standard UTP cabling.

One pair is used for transmission and another pair for reception. The other two pairs are bidirectional and can be used to transmit or receive data. In this way, three of the four-wire pairs are used at any given time to provide half-duplex transmission or reception of signals.

100BaseTX

100BaseTX network.
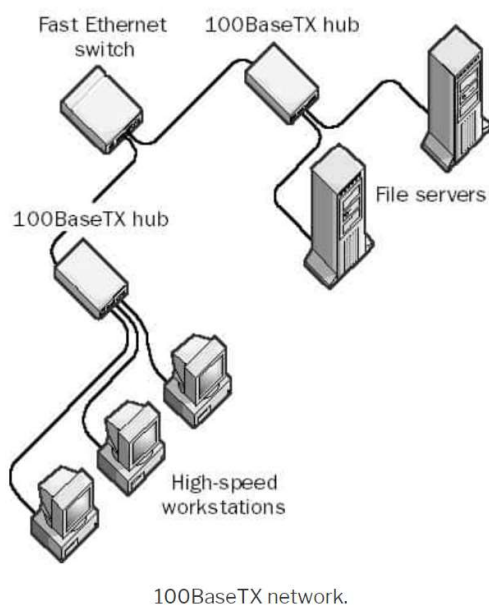
100BaseFX:

- ➢ It uses two standard multimode fibers, one for each direction, to achieve full duplex 100 Mbps data rate.
- ➢ In most Fast Ethernet applications, fiber optics is used for the long haul transmission, which the individual devices are connected by twisted pair copper wires, i.e. 100BASE-TX. This requires a convertor between the connections. The following diagram shows the set up required –
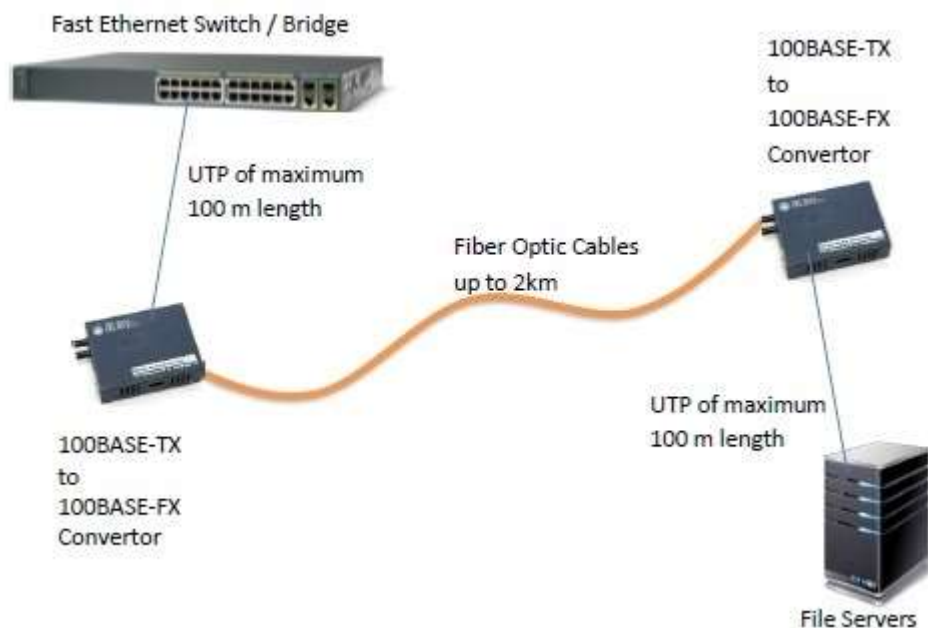
Schematic diagram of ST connector:-
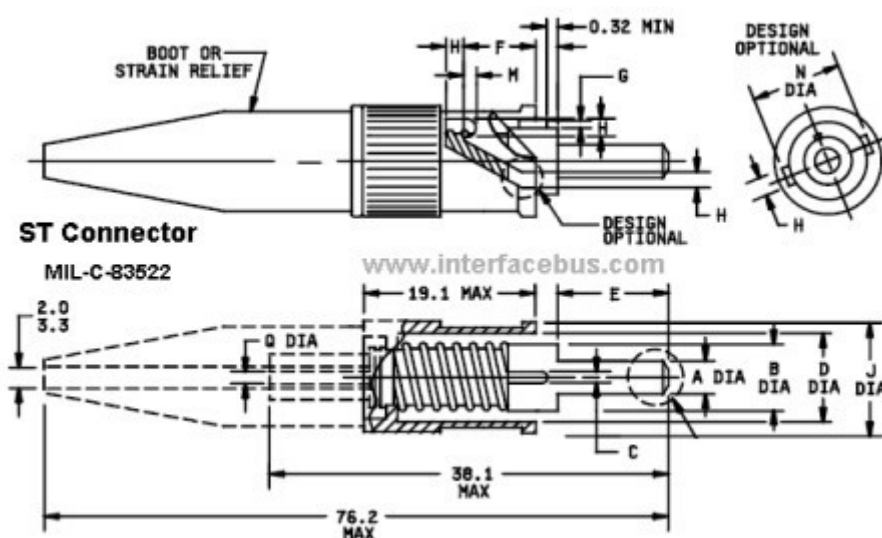
802.4 (Token Bus) :-
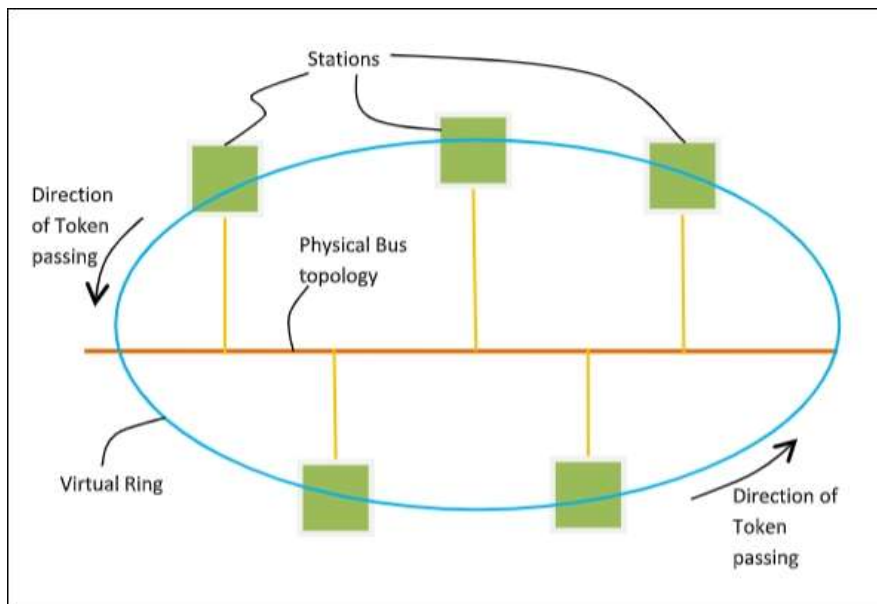

Physical Layer:-

- ➢ Token Bus (IEEE 802.4) is a standard for implementing token ring over the virtual ring in LANs.
- ➢ It uses physical bus topology
- ➢ The conventional 75 ohm coaxial cable used as the physical layer of the token bus.
- ➢ Signal speeds in the range 1 Mbps, 5 Mbps, and 10 Mbps are achievable.
- ➢ 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.
- ➢ A station can only transmit data when it has the token.

Fiber Distribution Data Interface (FDDI):-

➢ Fiber Distributed Data Interface (FDDI) is a set of ANSI and ISO standards for transmission of data in local area network (LAN) over fiber optic cables.

➢ It is applicable in large LANs that can extend up to 200 kilometers in diameter.

Features

➢ FDDI uses optical fiber as its physical medium.

➢ It provides high data rate of 100 Mbps and can support thousands of users.

➢ It is used in LANs up to 200 kilometers for long distance voice and multimedia communication.

➢ It uses ring based token passing mechanism and is derived from IEEE 802.4 token bus standard.

➢ It contains two token rings, a primary ring for data and token transmission and a secondary ring that provides backup if the primary ring fails.

➢ FDDI technology can also be used as a backbone for a wide area network (WAN).
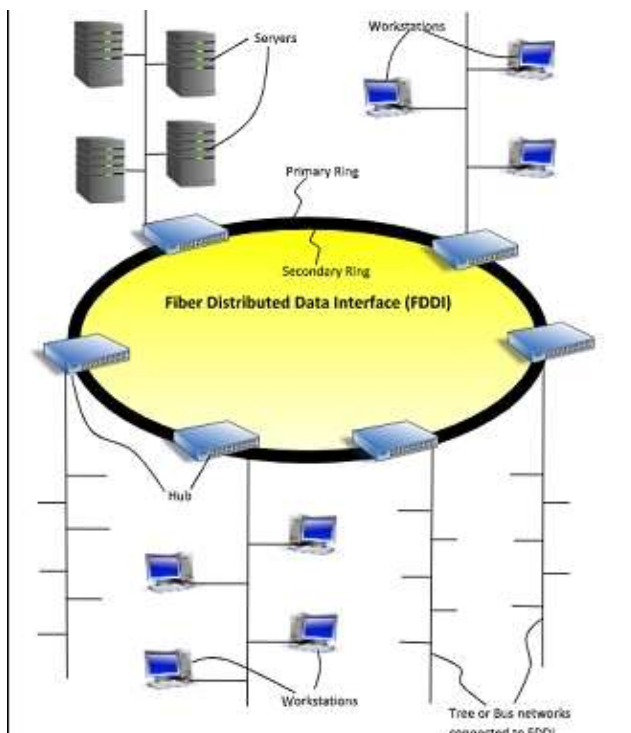
References:-

1. https://www.cisco.com/c/en_in/solutions/small-business/resource-center/networking/wireless-network.html
2. https://www.cse.wustl.edu/~jain/cse574-06/ftp/wpans/index.html
3. https://www.tutorialspoint.com/wimax/wimax_wifi_comparison.htm