EXPERIMENT 1

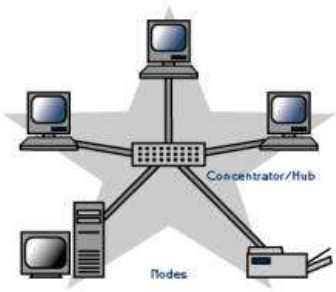
Name: Rishita Mote

UID: 2018130029

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

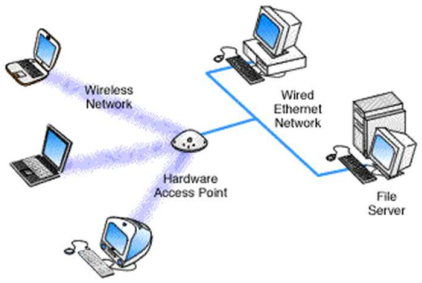
Types of connections: [1]

1) **Wired Connection:**



Wired networks, also called Ethernet networks, are the most common type of local area network (LAN) technology. A wired network is simply a collection of two or more computers, printers, and other devices linked by Ethernet cables.

2) **Wireless Connection:**



A wireless network, uses high-frequency radio waves rather than wires to communicate between nodes. Wireless allows for devices to be shared without networking cable which increases mobility but decreases range.

1) Types of wireless networking: [2]

Wireless access technologies are commonly divided into categories, based on speed and distance.

- **Wireless Personal Area Network (WPAN) technologies** are designed to reach only about 10 meters. IrDA and Bluetooth are two common WPAN examples. Emerging technologies in this space include 802.15.4a (Zigbee) and 802.15.3c (UWB).
- **Wireless Local Area Network (WLAN) technologies** can deliver up to 200 Mbps at distances up to 100 meters. 802.11a/b/g (Wi-Fi) are widely deployed WLAN examples. Proprietary MIMO products and the new 802.11n high-speed WLAN standard are emerging technologies in this category.
- **Wireless Metropolitan Area Network (WMAN) technologies** deliver up to 75 Mbps over wireless "first mile" links that span several kilometers. There have been several iterations of the 802.16 Broadband Wireless Access WMAN standard, certified under the brand WiMAX. Fixed WiMAX is now being complemented by the emerging 802.20 Mobile WiMAX standard.
- **Wireless Wide Area Network (WWAN) technologies** now deliver up to a few hundred Kbps over large service areas such as cities, regions or even countries. Commonly deployed WWAN technologies include GSM/GPRS/EDGE and CDMA2000 1xRTT. These services are gradually being complemented by newer third-generation technologies like UMTS/HSDPA and CDMA EV-DO Rev.0/A. Future technologies here include HSUPA and EV-DO Rec.C.

Protocols and specifications:

1:- Wifi: is a term for certain types of WLAN that use specifications in the 802.11 family. The term Wi-Fi was created by an organization called the Wi-Fi Alliance, which oversees tests that certify product interoperability. A wireless LAN node that provides a public Internet connection via Wi-Fi

from a given location is called a hot spot. Many airports, hotels, and fast-food facilities offer public access to Wi-Fi networks.

2:- Bluetooth: is a telecommunications industry specification that describes how mobile phones, computers and personal digital assistants (PDAs) can be easily interconnected using a short-range wireless connection.

3:- Ultraband: (also known as UWB or digital pulse wireless) is a wireless technology for transmitting large amounts of digital data over a wide spectrum of frequency bands with very low power for a short distance (up to 230 feet) and carrying signals through doors and other obstacles that tend to reflect signals at more limited bandwidths and a higher power.

4:- WAP (Wireless Application Protocol): is a specification for a set of communication protocols to standardize the way that wireless devices can be used for Internet access. Designed to provide a WLAN with a level of security and privacy comparable to what is usually expected of a wired LAN, Wired Equivalent Privacy (WEP) is a security protocol, specified in the IEEE Wi-Fi standard, 802.11. Another security standard for users of computers equipped with Wi-Fi wireless connection is Wi-Fi Protected Access (WPA). It is an improvement on, and is expected to replace, the original Wi-Fi security standard, WEP.

802.11 is an evolving family of specifications for WLANs developed by a working group of the Institute of Electrical and Electronics Engineers (IEEE). There are several specifications in the family, and new ones are occasionally added.

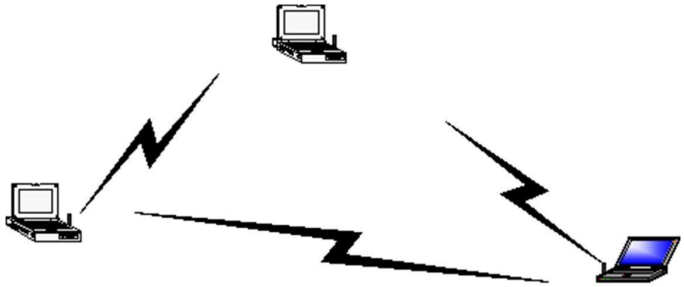
2) 802.11 Family:-[3]

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:-

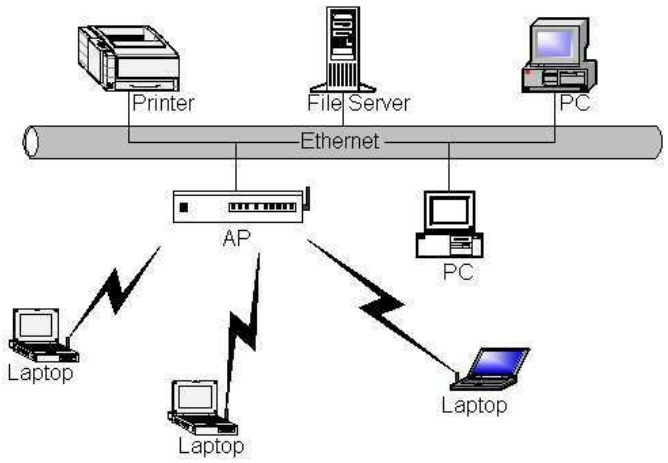
1) Ad hoc network is also known as IBSS (Independent Basic Service Set) configuration.
2) Ad hoc WLANs include a number of nodes or wireless stations that communicate directly with one another on a peer-to-peer basis, without using an access point (AP) or any connection to a wired network.



3) It's used to share files or internet connection between stations using the same ad hoc network.

Infrastructure Topology:

4) 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.
5) 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.
6) 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

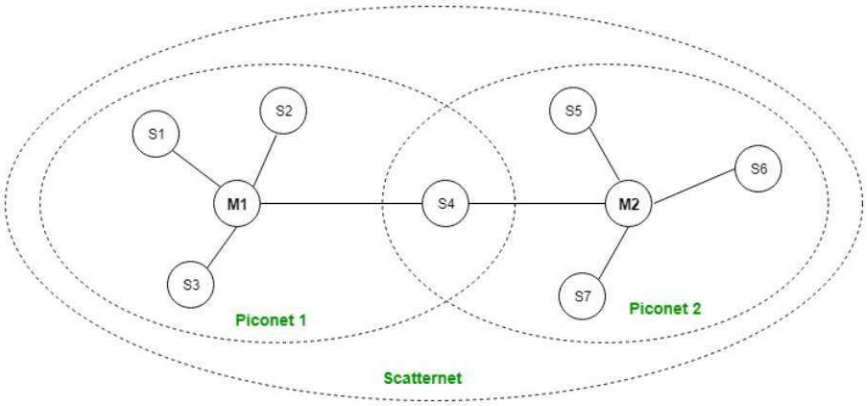
Frequency Band	2.4 GHz	5 GHz	2.4 GHz	2.4 GHz	2.4/5 GHz
Topology	Ad hoc/ infrastructu re	Ad hoc/ infrastructu re	Ad hoc/ infrastructu re	Ad hoc/ infrastructu re	Ad hoc/ infrastructu re
Half/Full duplex	Half	Half	Half	Half	Half
Radio Technology	Frequency Hopping spread spectrum / direct sequence spread spectrum (DSSS)	Orthogonal frequency division multiplexin g (OFDM)	Direct Sequence Spread Spectrum	Orthogonal frequency division multiplexin g (OFDM)	Orthogonal frequency division multiplexin g (OFDM)
Modulation		BPSK, QPSK, 16-, 64-QAM	QPSK	BPSK, QPSK, 16-, 64-QAM	BPSK, QPSK, 16-, 64-QAM

802.15 family of Wireless PAN:-

The 802.15 standard is defined through several specifications of WPANs.

802.15.1:-

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.
2) A Bluetooth network is called **piconet** and a collection of interconnected piconets is called **scatternet**.
3) Bluetooth has master slave configuration.

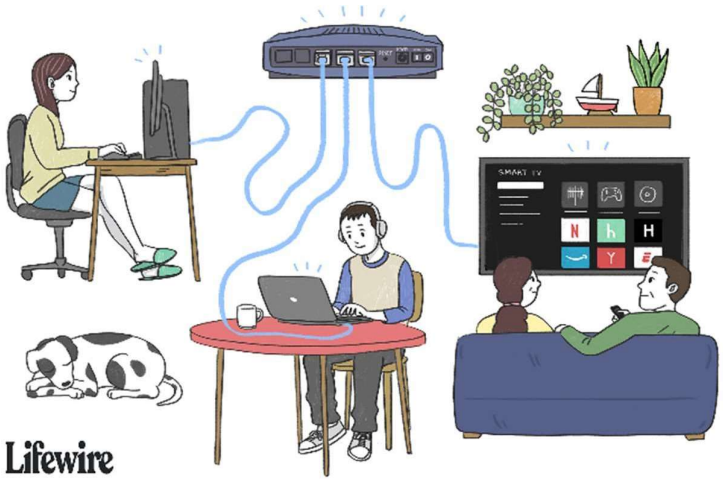


3] Protocols under Wired Technology:[4]

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

Ethernet:- IEEE 802.3

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



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

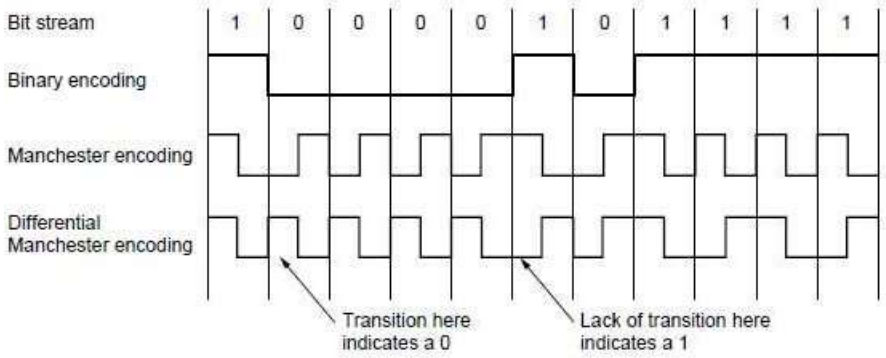
- **The number 10:** At the front of each identifier, 10 denotes the standard data transfer speed over these media - ten megabits per second (10Mbps).
- **The word Base:** Short for Baseband, this part of the identifier signifies a type of network that uses only one carrier frequency for signaling and 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:-

7) Medium dependent sublayer: specifies the medium, physical connectors, related mechanical and electrical characteristics
8) 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.



10Base2

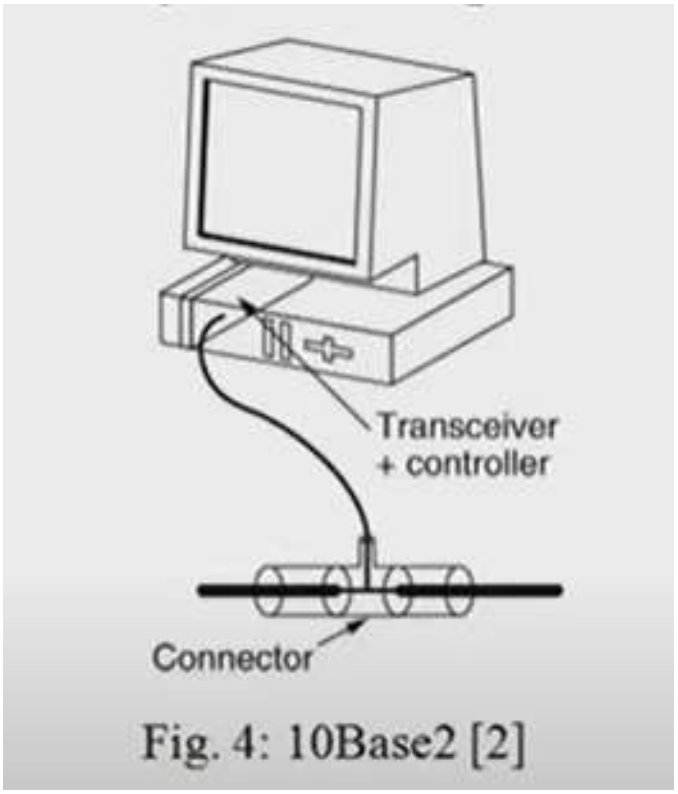
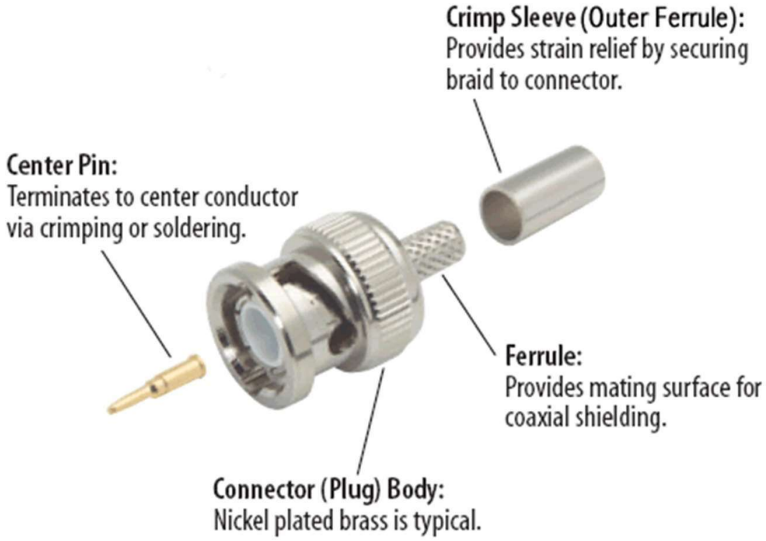


Fig. 4: 10Base2 [2]

It uses BNC connector.



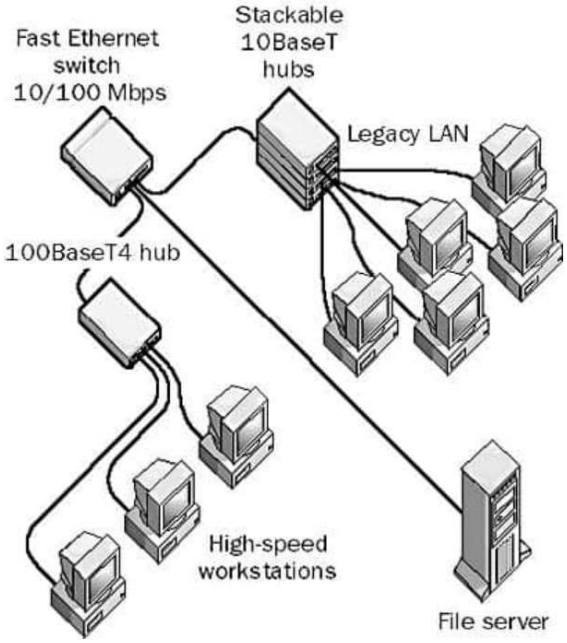
Fast Ethernet (802.3u):-

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

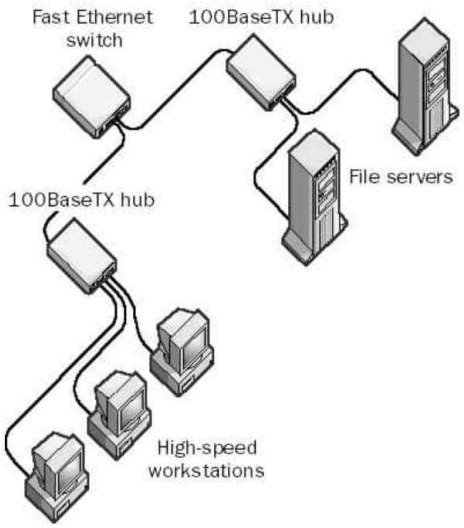


100BaseT4 network

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.

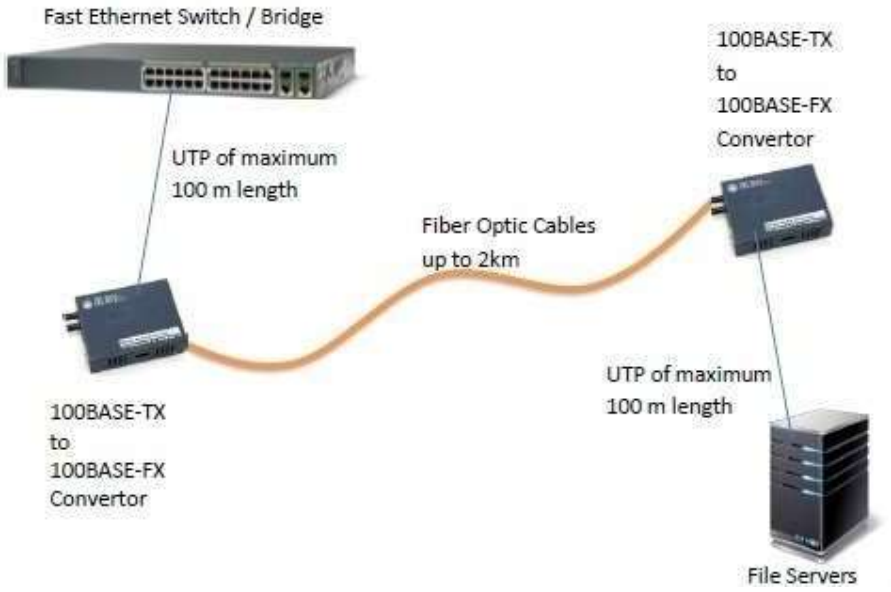
100BaseTX



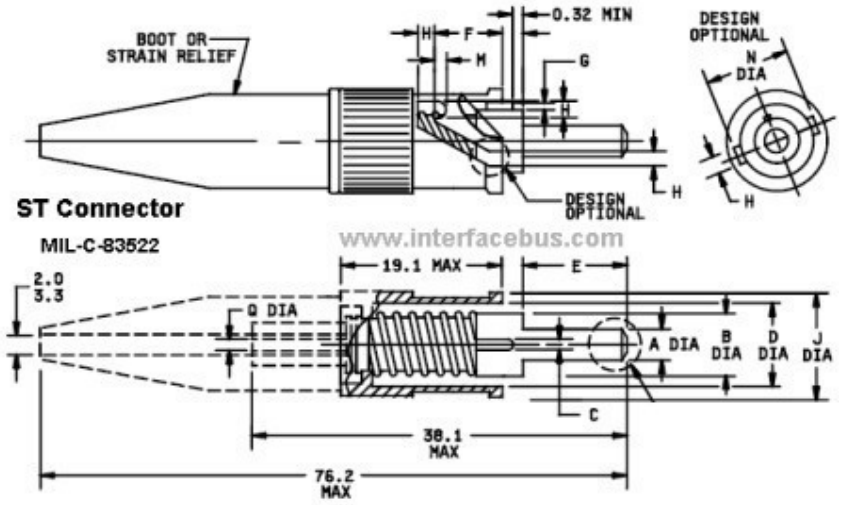
100BaseTX network.

100BaseFX:

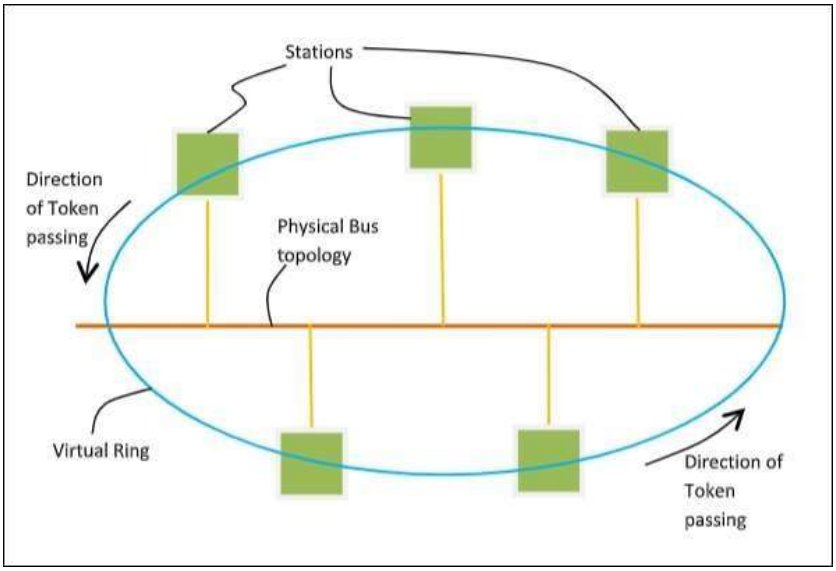
- It uses two standard multimode fibers, one for each direction, to achieve full duplex 100 Mbps data rate.
- In most Fast Ethernet applications, fiber optics is used for the long haul transmission, which the individual devices are connected by twisted pair copper wires, i.e. 100BASE-TX. This requires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



Schematic diagram of ST connector:-



802.4 (Token Bus) :-



Physical Layer:-

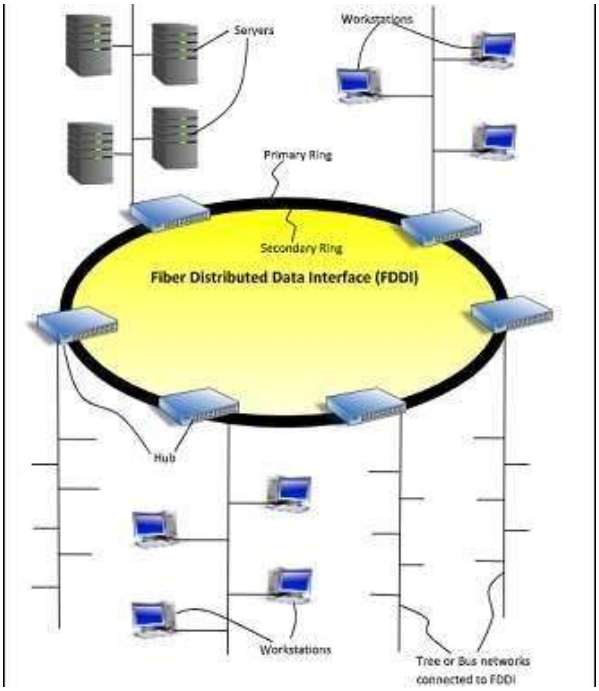
1) Token Bus (IEEE 802.4) is a standard for implementing token ring over the virtual ring in LANs.
2) It uses physical bus topology
3) The conventional 75 ohm coaxial cable used as the physical layer of the token bus.
4) Signal speeds in the range 1 Mbps, 5 Mbps, and 10 Mbps are achievable.
5) A virtual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

Fiber Distribution Data Interface (FDDI):-

7) 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.
8) It is applicable in large LANs that can extend up to 200 kilometers in diameter.

Features

9) FDDI uses optical fiber as its physical medium.
10) It provides high data rate of 100 Mbps and can support thousands of users.
11) It is used in LANs up to 200 kilometers for long distance voice and multimedia communication.
12) It uses ring based token passing mechanism and is derived from IEEE
802.4 token bus standard.
13) 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.
14) FDDI technology can also be used as a backbone for a wide area network (WAN).


Servers
Workstations
Primary Ring
Secondary Ring
Fiber Distributed Data Interface (FDDI)
Hub
Workstations
Tree or Bus networks
connected to FDDI

References:-

1) https://www.cse.wustl.edu/~jain/cse574-06/ftp/wpans/index.html

2) https://www.computernetworkingnotes.com/ccna-study-guide/types-of-wireless-network-explained-with-standards.html

3) https://www.cisco.com/c/en_in/solutions/small-business/resource-center/networking/wireless-network.html

4) https://www.tutorialspoint.com/wimax/wimax_wifi_comparison.htm