NAME: ISHITA BADOLE
CLASS: T.E. COMPS
BATCH: A
ROLL NO: 3
UID NO: 2018130001

DATE: 10/08/2020

# Lab Assignment 1

## AIM:

To study different types of physical layer wired/wireless connections

## THEORY:

## A. WIRED CONNECTIONS

### 1. Etherloop

Etherloop is a kind of DSL technology that combines the features of Ethernet and DSL. It allows the combination of voice and data transmission on standard phone lines.

#### 1.1 Specifications

- **Range**
  Under the right conditions, it will allow speeds of up to 6 megabits per second over a distance of up to 6.4 km (21,000 feet).

- **Modulation**
  EtherLoop uses two related signal modulations techniques: QPSK (Quadrature Phased Shift Keying) and QAM (Quadrature Amplitude Modulation).

  Quadrature Phase Shift Keying (QPSK) is a form of Phase Shift Keying in which two bits are modulated at once, selecting one of four possible carrier phase shifts (0, 90, 180, or 270 degrees). QPSK allows the signal to carry twice as much information as ordinary PSK using the same bandwidth.

  Quadrature amplitude modulation (QAM) is a modulation scheme that moderates two sinusoidal carriers 90 ° out-of-phase with each other. Both modulated carriers are summed to result in a signal with amplitude and phase modulation.

- **Signaling**
  For high-quality subscriber loops, EtherLoop is designed to use a range of frequencies from approximately 30 kHz to 3 MHz. This frequency range is divided up into 10 overlapping frequency spectra, only one of which is active at any point in time. The lowest spectrum has a total frequency range of 62.5 kHz, and the highest has a frequency range of 1.667 MHz. Historically speaking, one Hertz is equivalent to one symbol per second, which would give EtherLoop a theoretical maximum symbol rate of 1.667 megasymbols per second. Using standard signal modulation techniques, such as BPSK, which support 1 data bit per symbol, this would translate to 1.667 megabits per second.

### 1.2 Scalability

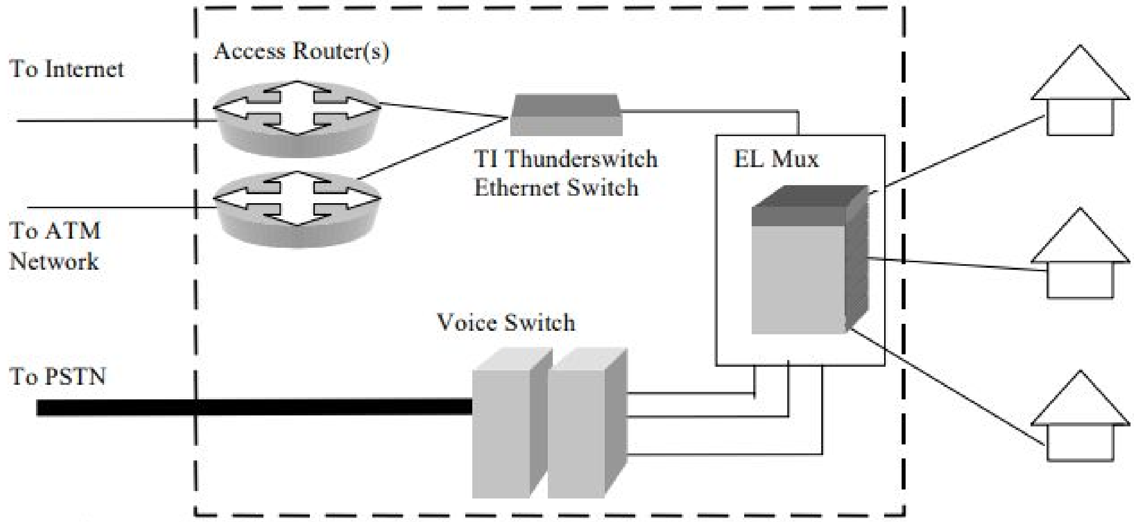
EtherLoop market niche is long-range Ethernet network extensions. There are five major markets where long-range Ethernet is a viable product:

- Residential Internet Access
- SOHO (Small Office Home Office) Internet and corporate access
- Hotel/Hospitality/Lodging Internet Access
- CAN (Campus Area Network) deployment
- Data T1 Replacement (LAN extension)

Some of these configurations are discussed below:

#### a. Central Office Configuration

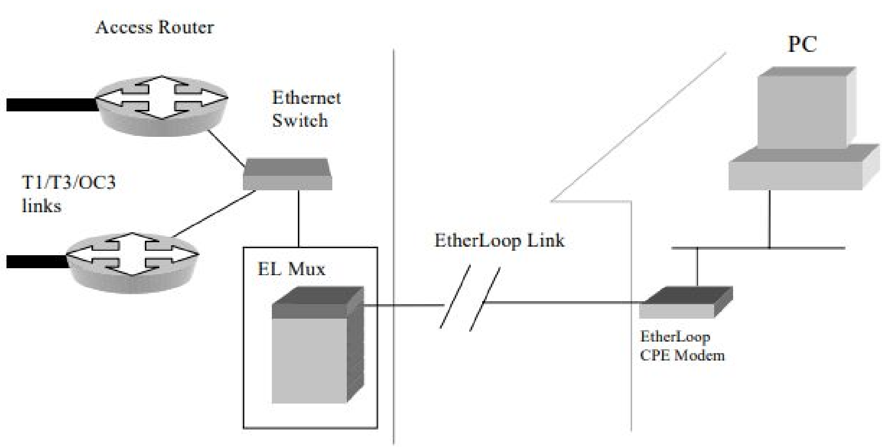
The EtherLoop CO configuration is relatively straightforward. Each subscriber is brought back to an EtherLoop Multiplexer shelf product, which is EtherLoop ready. The voice and data channels are separated, and the voice channel is passed on to the PSTN switch. The data channel is passed on to a TI ThunderSWITCH Ethernet switch, which then connects to any standard TCP/IP or ATM network. Depending on the needs of the customer, multiple networks can be attached, for example, some users may wish to use the public Internet, some may wish to use the telco's regional broadband network, and some may wish to connect to private corporate Networks.




modems, and the first stage of Ethernet packet multiplexing.

**b. Residential Access**

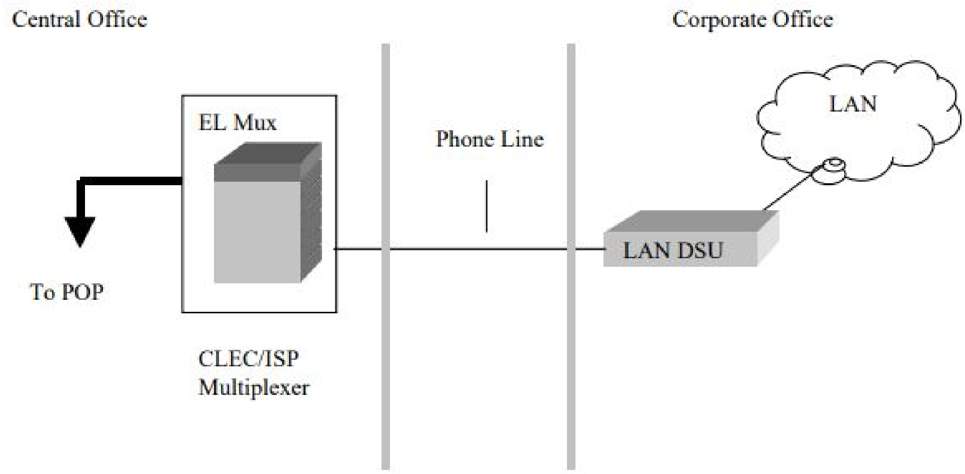
The Residential access model is the most straightforward. The end-user will typically have only one device connected to the EtherLoop link, which simplifies the overall architecture. The CO end provides Ethernet switching, to deliver data to one of several routing resources, which could be connections to the Internet, to private Intranets, or to an ATM/Frame Relay transport network.



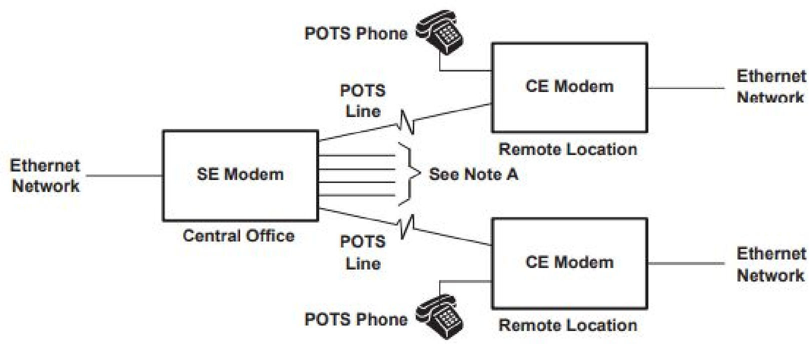

**c. Campus Networks/T1 Replacement**

In a campus or downtown environment, EtherLoop can be used to provide data network access to corporations, universities or institutions at speeds of up to 10 megabits per second, over existing voice lines.

In this environment, a rack-mounted EtherLoop LAN DSU will be installed at the customer premise, with a corresponding connection either in a central office, or at a nearby site, depending on the nature of the copper access regulations.




**3. Schematic View**




NOTE A: Flexible multiplexing scheme allows one SE modem to interface with many CE modems.

**Figure 1. Typical EtherLoop System**

The figure above shows a typical system with an EtherLoop modem located at each end of the plain old telephone service (POTS) line. Each EtherLoop modem has a 10Base-T Ethernet interface and is responsible for buffering Ethernet data before sending it over the POTS wire. The server-end (SE) EtherLoop modem is located in a central switching office and can communicate with several client-end (CE) EtherLoop modems, based on a round-robin arbitration scheme. The CE EtherLoop modem typically is located at a remote site.

## 2. Fiber Distributed 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.

### 2.1 Specifications

- Transmission rate: 125 megabaud (100 Mb/s at the data link)
- Physical layer entities: 1000 (max)
- Total Ring length: 200 km (124 mi) (max)
- Transmission medium: Fiber optic or copper cable
- Network topology: Dual ring of trees
- Media access method: Timed-token passing

### 2.2 Scalability

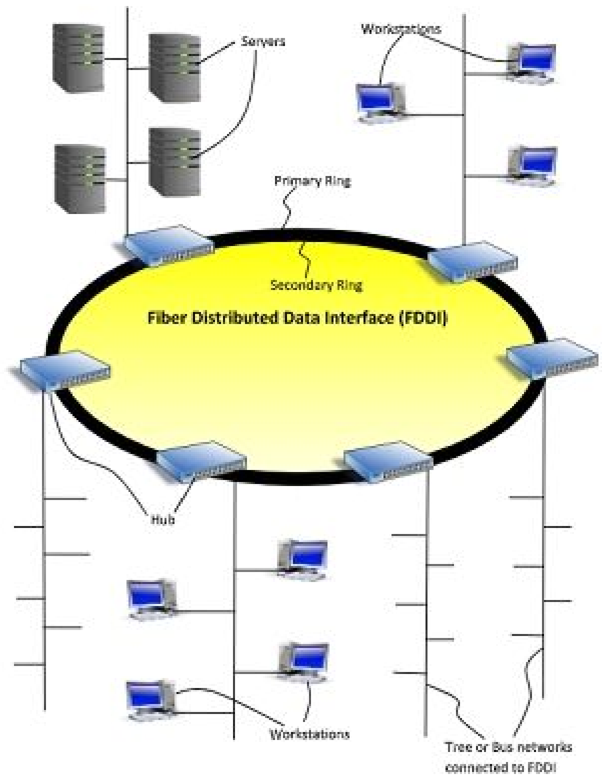
Fiber Distributed Data Interface (FDDI) is usually implemented as a dual token-passing ring within a ring topology (for campus networks) or star topology (within a building).

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

Designers normally constructed FDDI rings in a network topology such as a "dual ring of trees". A small number of devices, typically infrastructure devices such as routers and concentrators rather than host computers, were "dual-attached" to both rings. Host computers then connect as single-attached devices to the routers or concentrators. The dual ring in its most degenerate form simply collapses into a single device.

For these reasons, FDDI is not often used as a wide area network (WAN) solution, but is more often implemented in campus-wide networks as a network backbone. Typically, a computer-room contained the whole dual ring, although some implementations deployed FDDI as a metropolitan area network.

### 2.3 Schematic View




## B. WIRELESS CONNECTIONS

### 1. TransferJet

TransferJet is a close proximity wireless transfer technology initially proposed by Sony and demonstrated publicly in early 2008. By touching (or bringing very close together) two electronic devices, TransferJet allows high speed exchange of data. The concept of TransferJet consists of a touch-activated interface which can be applied for applications requiring high-speed data transfer between two devices in a peer-to-peer mode without the need for external physical connectors.

### 1.1 Specifications

- Center Frequency: 4.48 GHz
- Bandwidth: 560 MHz
- Transmission Power: At or below -70 dBm/MHz (average)
  Corresponds to low-intensity radio wave regulation in Japan and Taiwan, and with local regulations in other countries and regions.
- Transmission Rate: 560 Mbit/s (max) / 375 Mbit/s (effective throughput)

System can adjust the transmission rate depending on the wireless environment.

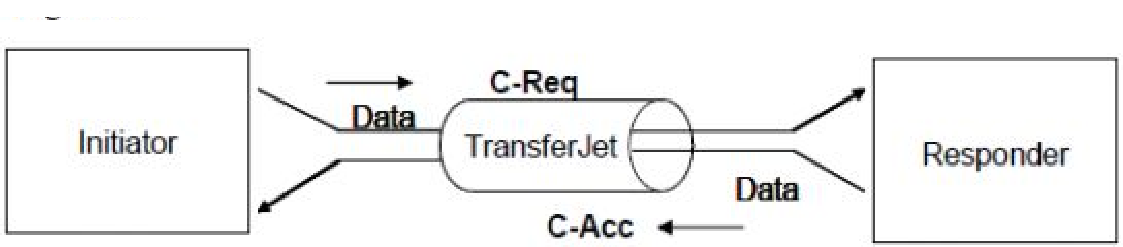
- Modulation: Direct Sequence Spread Spectrum (DSSS)
  $\pi$ /2-shift BPSK
- Connection Distance: A few cm (nominal)
- Connection Topology: 1-to-1, Point-to-Point
- Antenna Element: Longitudinal electric induction coupler

**1.2 Scalability**

The maximum range of operation is on the order of a few centimeters and the network topology is always point-to-point between two active (powered) devices. TransferJet has the capability of identifying the unique MAC addresses of individual devices, enabling users to choose which devices can establish a connection. By allowing only devices inside the household, for example, one can prevent data theft from strangers while riding a crowded train. If, on the other hand, one wishes to connect the device with any other device at a party, this can be done by simply disabling the filtering function.

**1.3 Schematic View**

The two TransferJet™ devices that enable data transmission and reception serve as “Responder” and “Initiator” respectively, and they can establish a link only in this combination. Communications cannot take place between two Responders or two Initiators.
The two roles have no relation to the actual direction of data transfer.




**2. Z Wave**

Z-Wave is a wireless communications protocol used primarily for home automation. It is a mesh network using low-energy radio waves to communicate from appliance to appliance, allowing for wireless control of residential appliances and other devices, such as lighting control, security systems, thermostats, windows, locks, swimming pools and garage door openers.

### 2.1 Specifications

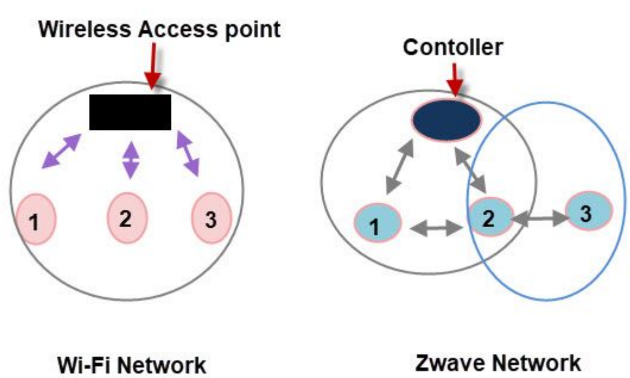
- Z-Wave is designed to provide reliable, low-latency transmission of small data packets at data rates up to 100kbit/s.
- The throughput is 40kbit/s (9.6kbit/s using old chips) and suitable for control and sensor applications
- Communication distance between two nodes is about 30 meters (40 meters with 500 series chip), and with message ability to hop up to four times between nodes, it gives enough coverage for most residential houses.
- Modulation is frequency-shift keying (FSK) with Manchester encoding.
- Z-Wave uses the Part 15 unlicensed industrial, scientific, and medical (ISM) band.
- It operates at 868.42 MHz in Europe, at 908.42 MHz in the North America and uses other frequencies in other countries depending on their regulations.
- Data rates include 9600 bps and 40 kbps, with output power at 1 mW or 0 dBm.
- The Z-Wave transceiver chips are supplied by Silicon Labs.

### 2.2 Scalability

Z-Wave can be used within a network (Home Area Network, HAN), and can, therefore, be used to set up all areas of home automation, possibly controlled by a single controller.

A mesh topology allows any node to connect to any other node and allows multiple connections.

The diagram below compares a Wi-Fi network with a Z-Wave network

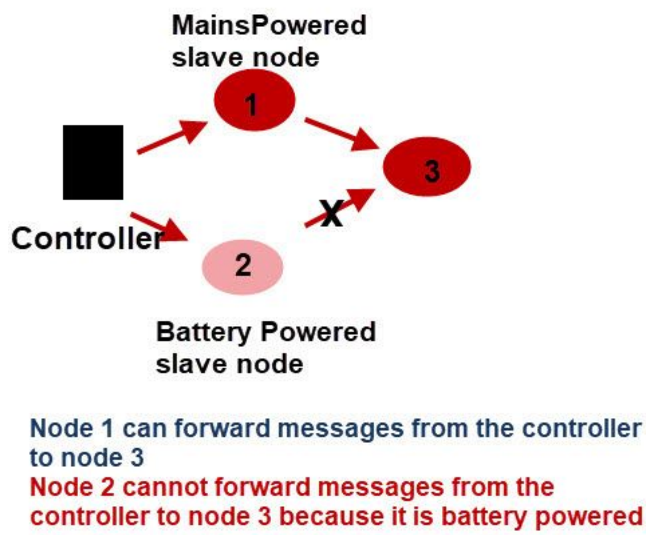



**Mesh and Point to Point Topologies Compared**

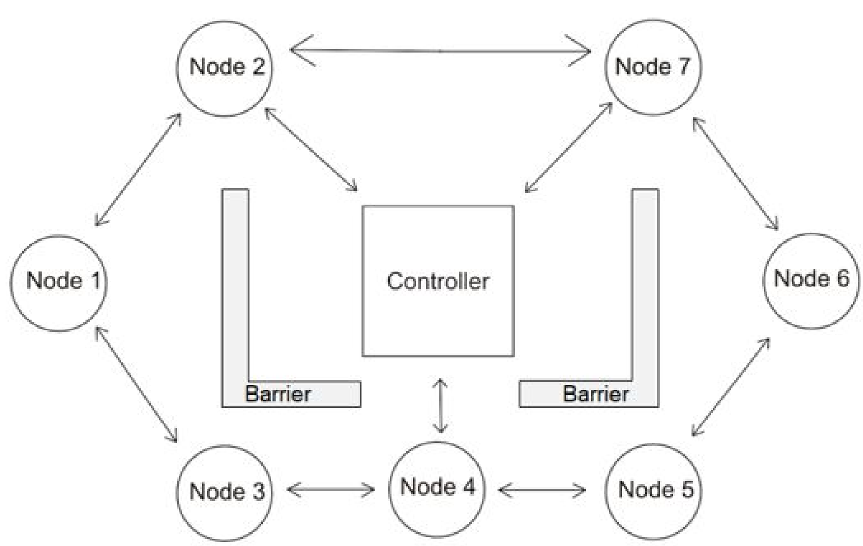
In a Wi-Fi network, all nodes must be in the wireless range of the Wireless Access point, and they can only communicate through the access point.

In Z-Wave, a node must be in the range of another node and can communicate with adjacent nodes. A packet can hop over 4 nodes which means effectively limits the distance between a controller and the farthest node.

A node can forward packets to the adjacent nodes as shown in the diagram above. However to act as a forwarding node the node must be mains powered. Battery-powered nodes cannot forward packets.




**2.3 Schematic View**



## REFERENCES:

**Etherloop**
https://en.wikipedia.org/wiki/Etherloop
"White Paper describing EtherLoop Technology, 1999, preliminary, from Texas Instruments":
https://www.ti.com/sc/docs/products/network/tiwpapr12.pdf
TNETEL1400 EtherLoop Transceiver: http://www.ic72.com/pdf_file/t/317096.pdf
**TransferJet**
https://en.wikipedia.org/wiki/TransferJet
https://www.transferjet.org/tj/transferjet_overview.pdf
**Z-Wave**
https://en.wikipedia.org/wiki/Z-Wave#Network_setup,_topology_and_routing
https://stevessmarthomeguide.com/z-wave-basics/
https://www.clarecontrols.com/helpcenter/installing-z-wave-with-clarehome-tech-bulletin
**FDDI**
Fiber Distributed Data Interface Network Config Guidelines:
http://sup.xenya.si/sup/info/digital/MDS/jun99/Cd2/NETWORK/DFDDICG1.PDF
https://www.tutorialspoint.com/fiber-distributed-data-interface-fddi
https://en.wikipedia.org/wiki/Fiber_Distributed_Data_Interface

## CONCLUSION:

I studied types of wired and wireless connections in terms of their specifications, scalability with respect to their application in types of network architectures and a schematic view of the connection.