

**MAA OMWATI DEGREE COLLEGE HASSANPUR
(PALWAL)**

Notes

BCA 5th Sem

Data Comm. Networking

* Computer Network : →

A computer network means an interconnected collection of autonomous computers that can share & exchange information.

① Use of Computer Network —

1. Network for Companies

- Resource sharing
- High Reliability
- Saving Money
- Providing a powerful communication medium

2. Network for people —

- Access to remote information
- Person to person communication
- Resource sharing
- Interactive entertainment
- Exchange information

② Application of Computer Network

1. Communication Medium

2. Sharing

- 3. — Sharing of peripherals.
- Sharing of data and information.

3. Access to Remote database.

4. Financial Services

5. Information Service

6. Tele Conferencing

7. Entertainment

8. Marketing and Sales

9. Business Application

⑥ Advantages of Computer Networks

1. Resource sharing

2. Simultaneous Access

3. Easier backups

4. Communication

5. Help to keep Information Reliable and up-to-date

6. Interactive entertainment

7. Cost reduction

8. Increased reliability

* Network Topologies :->

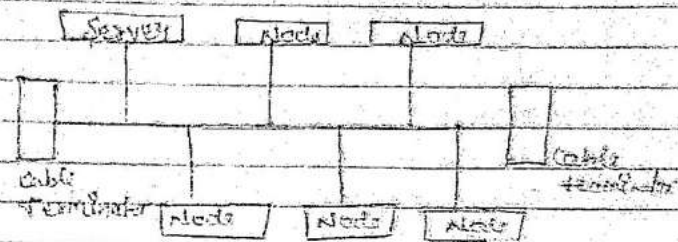
Network

topologies refer to the geometrical arrangement and connection of nodes in network

-> various type of Network topology

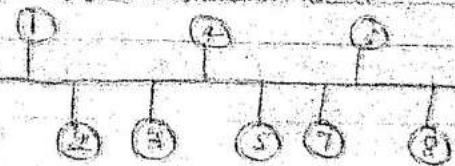
(1) Bus topology :->

Bus topology uses multipoint cabling i.e. multiple devices are connected by means of connector cables



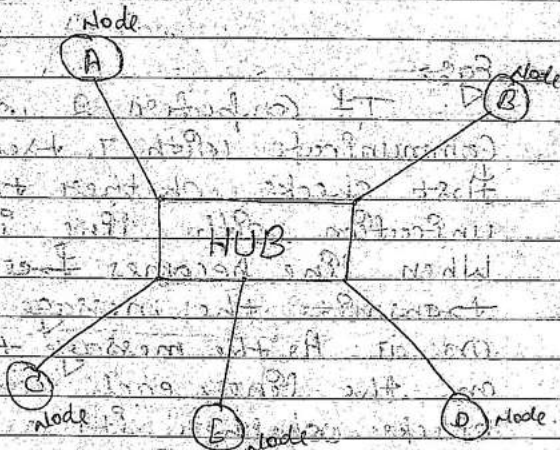
Eg:-

If Computer 2 want to communicate with 7, then it first checks whether the communication with line is free. When line becomes free, it transmits the message to 7 on it. As the message travels on the line, each computer checks whether it is addressed to it. In this case when 7 find its "address" in the message, it accepts it and send the acknowledgement to 2 and free the line.



2. Star Topologies

In Star topology, A device known as a hub is placed in the center of network and all nodes are connected to the central hub and communicate through it as shown below:-



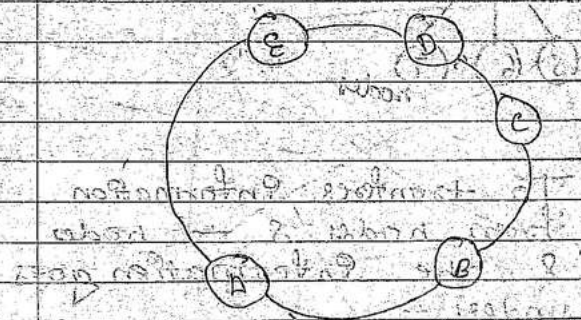
Hub manages and controls all function of the network, called central controller.

In Hub fault detection is easy.

3. Ring Topology

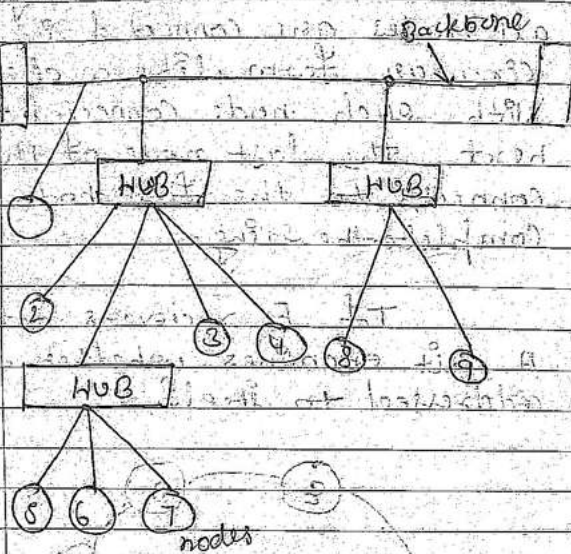
In Ring Topology all nodes are connected in a circular form like a chain, with each node connected to the next, the last node of the network connects to the first node to complete the ring.

If E receives data from A, it examines whether it is addressed to itself or not.

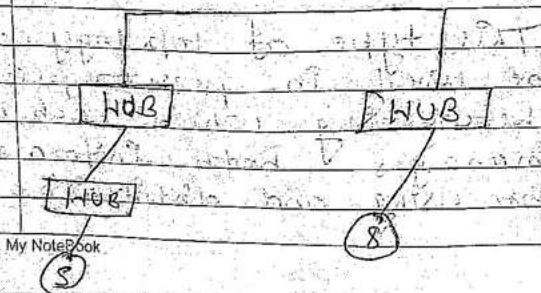


This type of topology can be used in peer-to-peer networking where each node manages both information processing and distribution of data.

Tree Topology :-

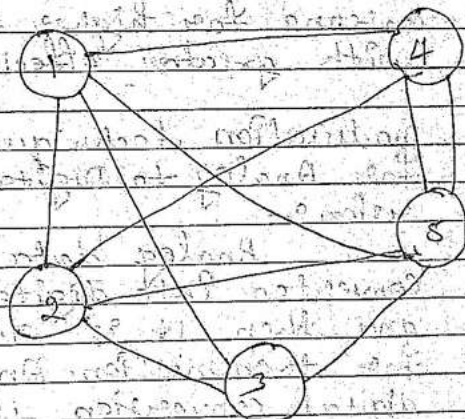


To transfer information from node 5 to node 8, the information goes under:-



Mesh Topology :-

Mesh topology is a network in which every node has a dedicated point to point link to all the nodes within network. There is no change of data facilities. If one connection goes down, there are other ways to route the data to its destination.



- Communication b/w nodes are very fast.
- To permit any devices in network to communicate directly.

- ★ Data Modulation's
- modulation is a modification of a frequency to carry data.
 - It allows the simultaneous transmission of two or more base band signals by translating them to different frequencies.
 - It also reduce the size of the antenna for higher frequencies with greater efficiency.

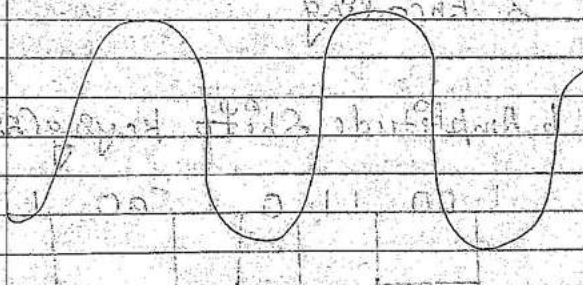
modulation techniques used for Analog to Digital Conversion:

Analog data is converted into digital data and then it is suitable for transmission. Analog to digital conversion is needed in many circumstances. For eg. to send the voice over long distances. The voice signal has to be converted into digital.

(1) Signal because digital signal are capable of running longer distances. In this case, the Analog to digital conversion will be needed.

Pulse Amplitude Modulation (PAM)

Pulse amplitude modulation is the first step in converting an analog signal into digital signal. The technique takes an analog signal and samples it.



A sample Analog signal

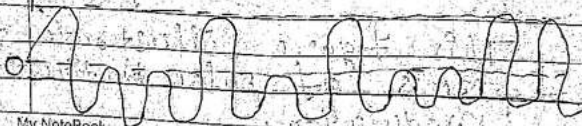
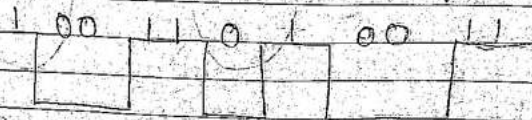
This figure illustrate the process of pulse Amplitude modulation.

Pulse Code Modulation (PCM)

Pulse code modulation is based upon "Nyquist Sampling Theory". According to Nyquist sampling theory, if a signal is sampled at a rate twice the highest frequency supported by the channel.

1. Sampling
2. Quantizing
3. Encoding

1. Amplitude Shift Keying (ASK)



Modem

A modem is an internal or external device used to transmit data over a phone or cable line through a computer. The word modem is short for modulation demodulator.

There are many types of modems available such as an internal modem, external modem and a wireless modem. The information that passes through a phone or cable line does so in analog waves. A phone or cable line is analog because they are continuous feeds of variable information. Computers are digital because they are only able to understand a code of ones and zeros. They analog waves are converted by modem into a digital signals of ones and zeros so that the computer can process the information.

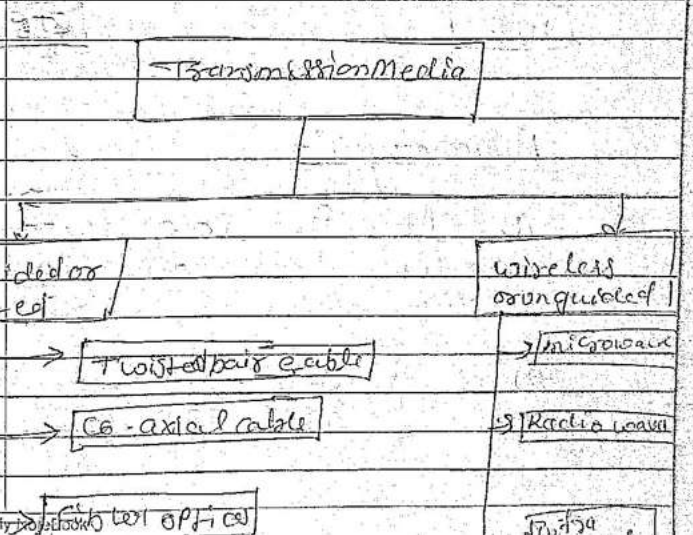
The modem is the catalyst that brings the reaction to completion with regard to data transfers. This means that the modem is capable of signaling from data mode, converting information to voice mode, telephone usage.

modem is a shorthand name for modulator-demodulator which basically means that all data sent through it will be sent through telephone line and back on the other side the demodulator part will transform sound back into data.

Transmission media:-

Transmission media is defined as the physical path between transmitter and receiver.

Different types of transmission media is used for different data transfer rates and long distances. The characteristics and quality of transmission are determined both by the characteristics of the medium and the characteristics of signal.



1. Guided media

(1) Twisted Pair Cable

(2) Co-axial cable

(3) Fiber optic cable

Twisted Pair
Cable

UTP

STP

Advantages:-

- (1) It is low cost medium than other guided media.
- (2) It is used for both analog and digital signal.

(1) It is flexible and easy to connect.

(2) It is best for short and medium range transmission.

Disadvantages:-

(1) These cable suffer from signal leakage, noise and low transmission rate.

(2) These are not secure.

Application of Twisted Pair Cable:-

- Twisted pair cables are used for analog and digital signals.

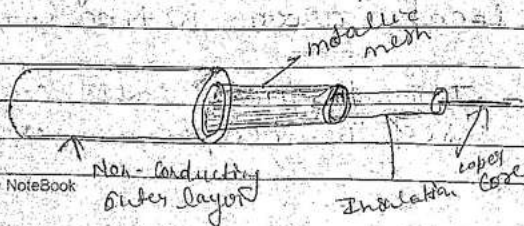
- These are also commonly used within building for local area network.

- Twisted pair cables are used in telephone networks.

2. Co-axial Cable

Co-axial cable is a two-conductor cable in which one conductor forms an electromagnetic shield around the other. The two conductors are separated by insulation.

Co-axial cable consists of a copper wire at the core. This is surrounded by an insulating material. This structure is then covered by a conducting mesh and then covered by an outer plastic jacket for protection. The co-axial cable has better structure and shielding than twisted pair cable.



Characteristics of Co-axial Cable:-

- It is bulky to handle and relatively expensive.
- Less expensive than fiber optics but more expensive than twisted pair cable.
- It carries Baseband or Broadband signals.
- Good resistance to electrical interference.
- It is flexible and easy to work with.
- Excellent noise immunity due to the shield provided.
- Easy to install, has large bandwidth and low losses.

Disadvantages of Coaxial Cable

- High cost as compared to twisted pair cable.
- Number of nodes & connections is limited.

- It is bulky to handle.

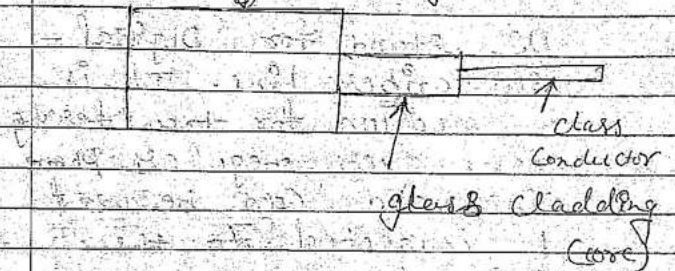
- Not compatible with twisted pair cables.

Fiber optics

An optical fiber cable has a cylindrical shape and consists of three concentric sections.

- The core
- The cladding
- The Jacket.

plastic covering jacket



Infrared waves Transmission

unguided Infrared waves are widely used for short range communication. The remote control used in TV, VCR, etc. all use Infrared communication.

Advantage of Infrared waves

- Relatively directional
- Very cheap
- Easier to build
- High speed waves.

DSL services:-

DSL stand for 'Digital subscriber line'. It is a medium for transferring data over regular phone line and can be used to connected to the Internet.

Working of DSL:-

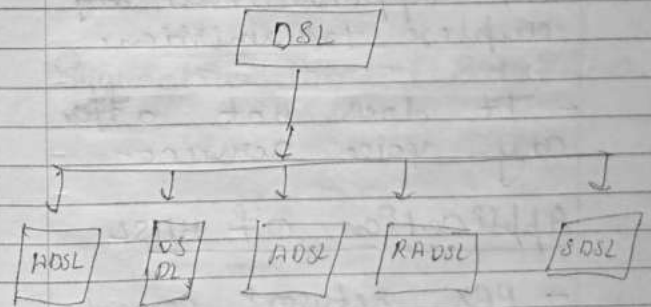
Like a dial-up connection DSL uses telephone line to connect to the Internet. Phone line are made of twisted copper wire known as twisted-pair wiring.

Advantages:-

- The speed of DSL is much higher than with modem.
- Bad weather does not effect DSL service.

Disadvantages of DSL:-

- DSL service is not available in all area.
- The quality and effectiveness of DSL service depend on the the proximity to a phone company central office. A CO is place where a receiving DSL model is located.
- The connection is faster for receiving data than it is for sending data over Internet.



Features of HDSL:-

- Data rate up to 2 mbps can be achieved.
- HDSL offers reliable data transfer.
- HDSL uses two twisted pair copper cable.
- Bit error rate almost equal to fiber optic cable.
- It supports full duplex transmission.
- It does not offer any voice service.

Application of HDSL

- PBX network connection
- Cellular antenna stations

Digital loop carrier system

- Internet access and access to private data network.



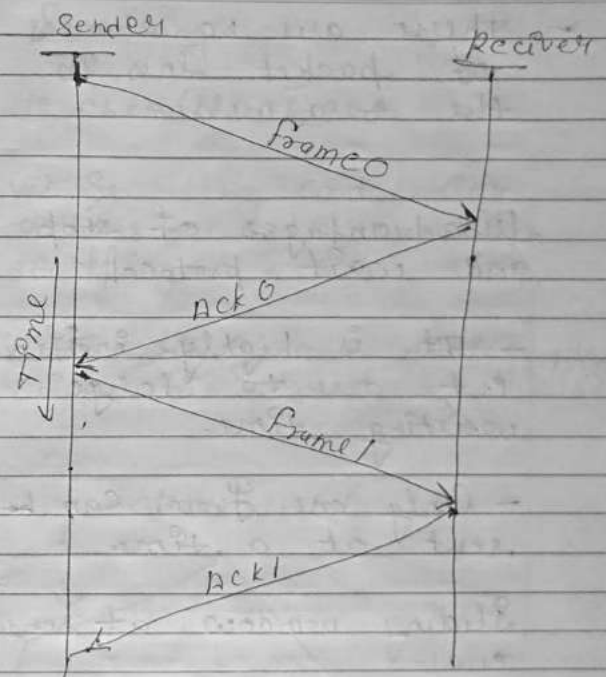
2. Very High Data Rate Digital Subscriber Line (VDSL)
3. Asymmetric Digital Subscriber Line (ADSL)
4. Rate Adaptive Asymmetric Digital Subscriber Line (RADSL)
- Symmetric Digital Subscriber Line (SDSL)

Flow Control

When the sender is running on fast machine and receiver is on slow machine, then the sender will transmit frames faster than the receiver can accept them. In this case, after every short time, the buffer of the receiver will be full and the sent further by the sender will overflow.

methods used for Flow Control :-

- 1) Stop and wait Protocol
- 2) Sliding window protocol



Advantages of stop and wait protocol :-

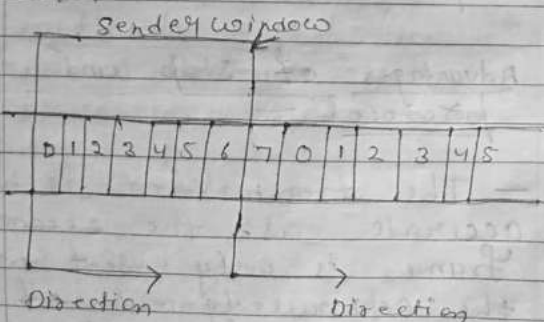
- The transmission is highly accurate as the second frame is only sent when the acknowledgment of the first is received.
- It is simple method.

- There are no chances of packet loss in the transmission.

Disadvantages of stop and wait protocol

- It is highly inefficient due to large waiting time.
- Only one frame can be sent at a time.

Sliding window at sender end:-



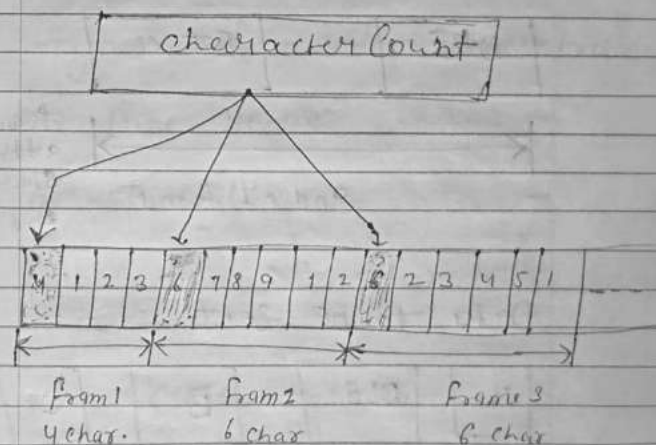
Sliding window width
Size = 7.

Programming

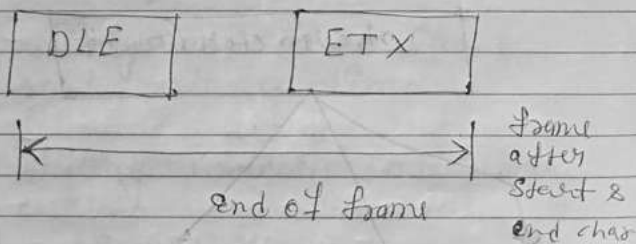
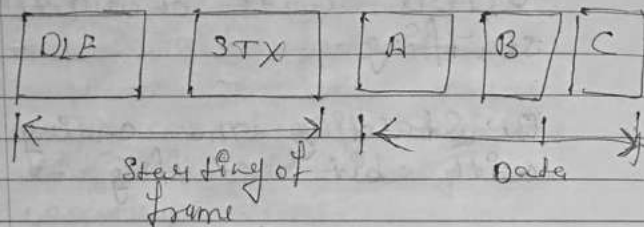
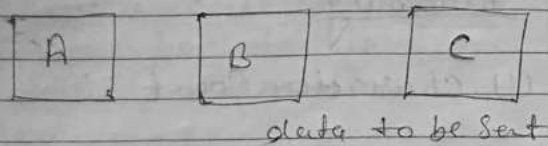
(1) Character Count

(2) Starting and ending characters with character stuffing.

(3) Starting and ending flags with bit stuffing



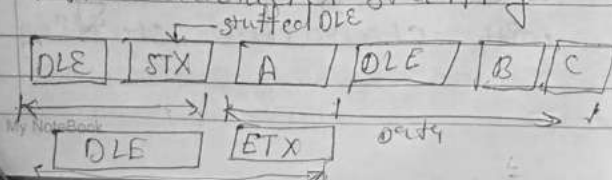
- Starting and ending characters with character stuffing



Data to be sent



After character stuffing



⇒ Random Access Protocols

The random access protocol is a set of rules that allows stations in the network to detect and avoid traffic or collision and determines what happens in the event of traffic or a collision to make the channel ready to resume transmission.

Types of Random Access Protocols

- (1) Pure ALOHA
- (2) slotted ALOHA
- (3) Carrier Sense Multiple Access (CSMA)
4. CSMA Collision Detection (CSMA/CD)

Advantages of Pure ALOHA

- The main advantage of Pure ALOHA is its simplicity

On Implementation;
there is no carrier
sensing, no token and
no times based synch-
ronization.

- It is superior to p-p
assignment when there
are a large number
of bursty stations.

- It adapts to varying
number of stations.

Slotted Aloha:-

- The big advantage
of Slotted ALLOHA is
the Increase in channel
utilization.

- Simple to Implement

- It double the effec-
tency of ALLOHA.

Carrier Sense Multiple Access:-

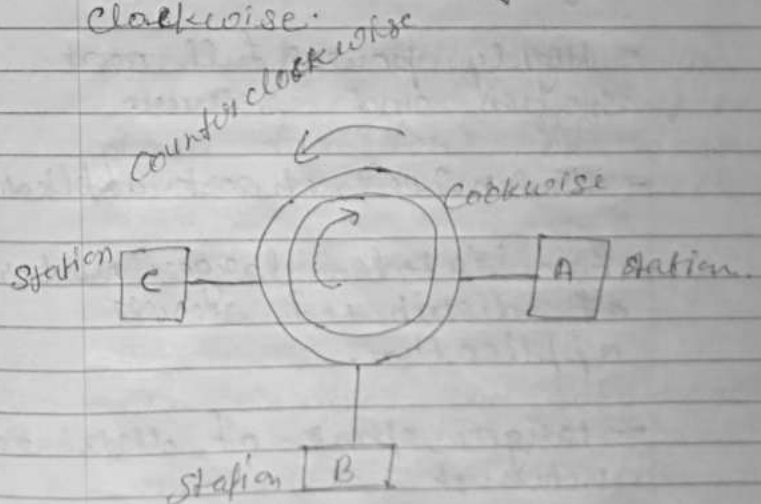
- 1- Persistence CSMA

- Non-persistent CSMA.

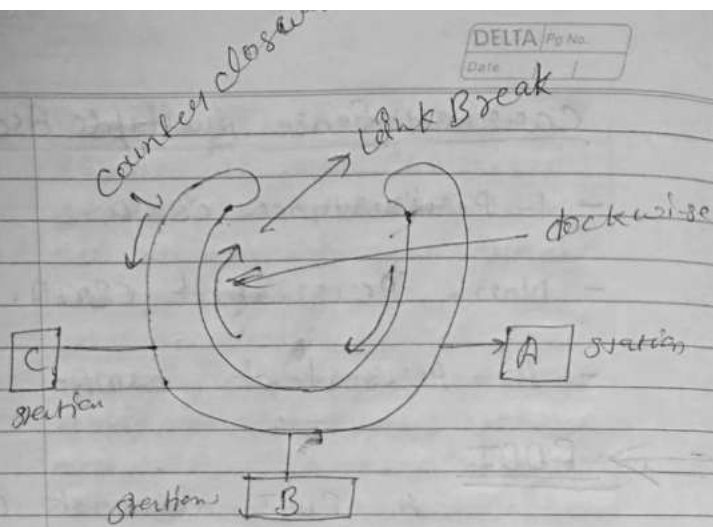
- P-persistent CSMA.

FDDI

A FDDI network consists
of two fiber rings, one
transmitting clockwise and
other transmitting counter
clockwise.



(FDDI Ring Configuration)



Objectives of FDDI

- Highly powerful work station and server.
- Intensive network application.
- Facilitate larger number of distributed server application.
- Larger spans of distributed network.
- Higher capacity.

Usefulness:-

- As a backbone network with higher traffic levels.
- In application which require higher security.
- In application which require a higher of fault tolerance.
- As a network connecting higher speed computers.
- In application programs which require high speed data transfers of large amounts of data eg. CAD.
- As backbone for factory automation.
- In Campus LAN Interconnect.
- In office automation at the desktop.

⇒ Bluetooth

Bluetooth network uses short range radio technology to create short range ad hoc network. By the term ad hoc, it meant that the network is formed spontaneously.

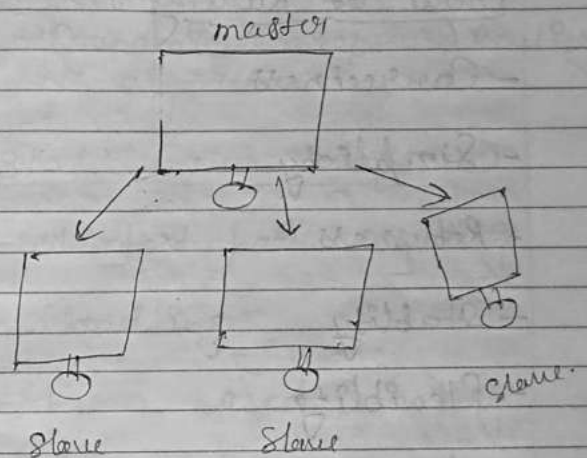
Feature of Bluetooth

- Less complicated
- less power consumption
- Available at cheaper rates.
- Robustness

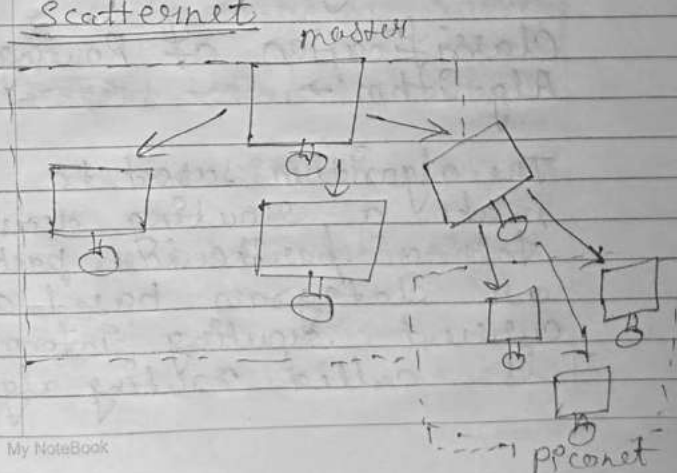
Architecture of Bluetooth

- (1) Piconet
- (2) Scatternet

Piconet



Scatternet



⇒ Routing:-

Goal of Routing :-

- Correctness
- Simplicity
- Robustness
- Stability
- Flexibility
- Optimality
- Efficiency

Classification of Routing Algorithm:-

The algorithm used to make a routing decision for a particular packet or datagram based on current routing information is called routing algorithm.

- Static (Non-adaptive) routing algorithms.

- Dynamic (Adaptive) Routing algorithm.

Static (Non-adaptive)

- Shortest path routing

- Flooding

- Flow based routing

Dynamic (Adaptive) Routing algorithms:-

- Distance vector routing
- Link state routing
- Hierarchical routing
- Broadcast routing

⇒ Distance Vector Routing :->

Distance vector Routing is the routing protocol that was originally used on the Internet. In distance vector Routing, each router periodically shares its knowledge about the entire network with its neighbours. In this routing, each router maintains a routing table containing one entry for each router in the subnet.

- The directions or Interface in which packet should be forwarded and
- The distance or how far it is to the destination network.
- Knowledge about the whole network

• Routing only to neighbour

• Information sharing at regular intervals.

Advantages:-

- Simple and efficient in small networks.
- The algorithm required to calculate routing tables from the routing information received from other routers is simple.
- Simple implementation and maintenance.
- Low resource requirements.
- One router can control the routing of its downstream routers. A router could not individually.

Disadvantages of Disadvantages Vector Routing:-

- Slow convergence
- Limited scalability
- Routing loops
- Heavy administrative burden

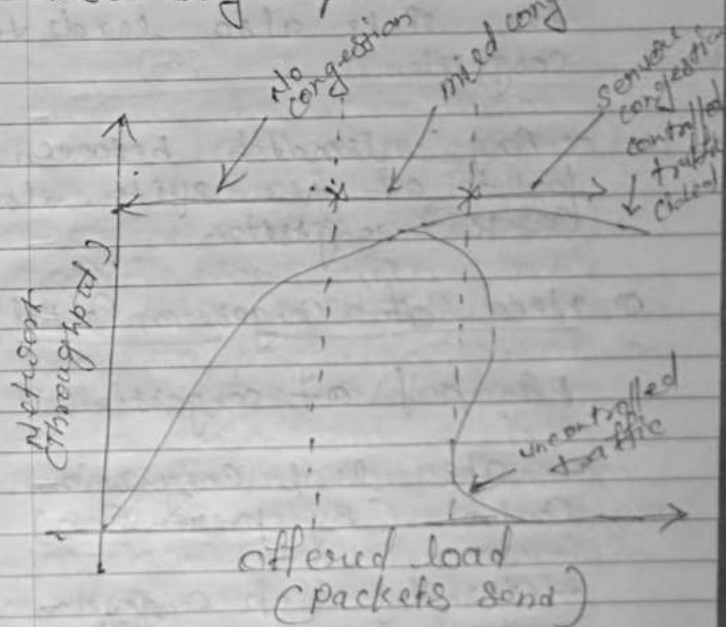
⇒ Congestion ⇒

Congestion control is a process of maintaining the number of packets in a network below a certain level at which performance falls off.

Effect of Congestion:-

Congestion affects the throughput of a network. As offered load increases, throughput also increases.

Practically throughput drops with increase in offered load because the buffer at node being full starts discarding packets.



Causes of Congestion:-

- Another cause of congestion is slow processor speed. If the router's CPU

speed is slow in queuing buffers, table updating queues start growing up.

- The low bandwidth of the links also leads to congestion

- Any mismatch between part of the system also cause congestion.

① Need of Congestion Control:-

Principal of congestion:-

- open loop congestion control (By prevention)

- closed loop congestion control (by removal)

② Open loop Congestion Control:-

- when to accept new traffic

- when to discard packets and which ones

- making scheduling at various points in the network.

2. close loop Congestion Control

close loop congestion control mechanism try to improve congestion after it happens. close loop solution are based on a feedback loop. This application can be done in three steps:-

- monitor the system to detect and locate congestion where congestion occurs.

- Pass this information to place where action can be taken.

- Adjust the system operation to correct the problem / congestion.

* Network Design Issues *

significant issues that deserve consideration in network design are discussed as follows:

1. Identifying and justifying a Network → The first step for determining the design issues for networking is to identify the set of constraints and the requirements of the network.

2. Scope → The scope of a network is bounded on one side by the communication facilities offered by the common carriers and on the other side by the application.

*3. Manageability → To make network more robust and more easily manageable increase the cost.

*4. Network architecture → Another Issue

real related to overall architecture of a network is whether to decompose the network into sub network to ease designing and operation.

*5. Node Placement and Sizing

While designing network a fundamental problem is the selection of the network node sites and where to place multiplexers hubs and switches.

major nodes handling large amount of traffic are placed at locations where there are trained personnel to keep maintenance also.

*6. Link Topology and Hierarchical

The topological optimization of a network involves selecting the specific links interconnecting nodes.

* Connection - Oriented Service

Connection - oriented service means establishing a dedicated connection b/w communicating entities before any data can be exchanged. The connection establishment may be at the physical or the logical level and involves some form of signaling.

A typical example of a connection-oriented service is the telephone network. A dedicated network is first set up after which the conversation takes place.

For example the connection oriented service undergoes the following operations.

- * 1. Establish a connection
- * 2. Use the connection exchange of user data
- 3. Release or clear the connection.

* Characteristics of Connection Oriented Service

* 1. A connection is first established and is accompanied by some form of resource reservation. After data transfer, the connection is released.

* 2. The services are reliable in the sense that the data loss is either minimal or there are mechanisms to re-transmit the lost data.

* 3. The packets are sent sequentially for a packet based connection service.

* Connectionless Service *

A Connectionless service is that which does not require a connection to be established before the exchange of data.

An example of a Connectionless service is the postal mail. Each mail carries a postal address. When it reaches a post office, the postal address written on the mail is used to forward it to the next post office.

* Characteristics of Connectionless Service *

1. Each message like a letter carries the full address of the destination.
2. Each message is routed independently from source to destination through the system.

* Differentiate between Connection-Oriented and Connectionless services

Connection-Oriented	Connectionless service
1) It requires a dedicated connection b/w the sender and the receiver.	1) It does not require a connection to be established between the sender and receiver.

2) There is call set up	2) There is call not set up.
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3) Resource reserved at call set up time	3) No resource is reserved
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4) Does not require routing tables	4) needs to maintain some from to routing tables to route a packet to the destination
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5) This scheme is suitable for long and steady transmissions.	5) This scheme is suitable for bursty transmissions
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* Peer-to-Peer Model ⇒ A Peer to peer network model is simply two or more computers linked together, sharing resources such as printer, scanner or internet connection and storing files and programs on their own hard drives.

In this type of network each computer is responsible for

* Making its own resources available to other computer on the network.

* Setting up and maintaining its own security for these resources.

In peer-to-peer network, user simply shares disk spaces and resources like printers and faxes. Peer-to-peer networks are relatively simple. Each peer in network can act as a client as well as a server.

* Advantages of peer-to-peer network model ⇒

1. Useful for small business.
2. Requires less expensive hardware as the resources are distributed over many computers.
3. Easy set up.
4. Easy to administer.
5. Users can control resource sharing.
6. Requires simple cabling scheme.

* Disadvantages of peer-to-peer network model ⇒

1. Not very secure.
2. Offers no central point of storage for file archiving.
3. Requires users to administer their own computer.
4. Causes additional load on computer because resource sharing.

* Distributed system ⇒

A distributed system consists of multiple autonomous computers that communicate through a network. Distributed computing interconnects one or more personal computers entities. It allows various services like files sharing, hardware sharing or network sharing.

* Characteristics / features of a Distributed System

1. The system may consist of different kinds of computer and network.
2. This system uses distributed processing in which task is divided among multiple computers.
3. Each node if required can work independently.

* Advantages of a distributed system ⇒

1. Distributed database
2. Cost efficiency
3. faster problem solving
4. Encapsulation
5. Collaborative processing
6. Shared resource.
7. Security through redundancy.

* Disadvantages of a distributed system ⇒

1. Hardware problems
2. Technical problems
3. maintenance of remote sites
4. Requires sophisticated communication system
5. Data integrity and security system issues.

* Centralized System ⇒

In a Centralized System all Processing is done at One Central Computer. In the early days of Computer technology, this type of processing was justified because data processing personnel were in short supply, hardware and software were expensive, and only large organizations could afford a computer.

* Advantage of Centralized System ⇒

This configuration is being able to exercise tight control on system operation and application.

* Disadvantage of Centralized System ⇒

Lack of responsiveness to users' needs, because the system and its users could be located far apart.

from each other. This configuration is not used much now.

* Decentralized System ⇒

In a decentralized system, each user, department, or division has its own computer for performing tasks.

Decentralized systems have some drawbacks, including lack of coordination among organization units, many systems, and duplication of effort.

* ATM (Asynchronous Transfer Mode) =>

ATM stands for Asynchronous transfer mode. It is a network technology based on transferring data in cells of a fixed size. These cells through small and constant size allow ATM equipment to transmit video audio and computer data over the same network.

ATM is a Connection Oriented network. It uses packets of fixed size for the communication of data. These packets are called as ATM cells. ATM is used for efficient data time and non real time services.

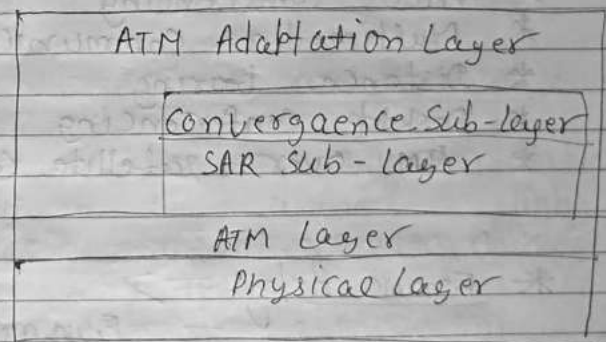
* ATM Technology =>

ATM provides good bandwidth and flexibility.

* ATM Architecture =>

The ATM Model consists of the following 3 layers.

1. The Physical Layer
2. The ATM Layer
3. The ATM Adaptation Layer.



* Advantages of ATM =>

1. ATM provides flexibility for different application.
2. It has ability to connect LAN to WAN
3. It provides the best Multiple service support.

* Disadvantages of ATM *

- 1) It is an expensive technique
- 2) ATM compatible equipments are required for network

* ATM application *

- * Video Conferencing
- * Multimedia Communications
- * Distance learning
- * Desktop Conferencing
- * ATM over satellite Communication

* Frame Relay =>

Frame relay is concept where the information is sent using data frames in a digital format.

* X.25

The X.25 protocol is a comm only used network protocol. This protocol allows computers on different public network to communicate. It supports both switched virtual circuit (SVC) and permanent virtual circuits (PVC).

* Advantages of X.25 Protocol *

1. it can use any available network channel or link.
2. uses redundant error checking at every node.

* Disadvantage of X.25 Protocol *

1. in transmissions that require extensive "back and forth" communications, the delay is caused

* Maximum Data Rate of channel *

The maximum data rate is the maximum amount of

DELTA Pg No.
 Date / /

Information (bits) that can be sent per second.

★ Principle of Maximum data rate ★

The maximum data rate limit over a medium is decided by following factors:

- 1 Bandwidth of channels
- 2 Signal levels
- 3 channels quality (level of noise)

★ Asynchronous Transmission ★

Asynchronous transmission sends only one character at a time where a character is either a letter of the alphabet or number or control character. In this transmission, bits are divided into small groups and sent independently. The sender can send the groups at any time and the

receiver never knows ~~when~~ when they will arrive.

★ Advantages of asynchronous transmission ★

- 1 it is cheaper and an attractive choice for low-speed communication.
- 2 There is no need of buffering on both transmitter and receiver ends.

★ Disadvantages ★

- 1) Performance is poor.
- 2) Efficiency is low.

★ Synchronous Transmission ★

When higher data rate are desirable, synchronous transmission is preferred to transfer a large number of characters consecutively. Thus instead of sending many characters

consecutively. Thus instead separately, They are grouped together and then transmitted as a whole. This group is called a data frame or frame.

★ Advantages

- 1) capable for high performance.
- 2) Efficiency of this transmission is high.

★ Disadvantages

- 1) it is a costly transmission.
- 2) There is a need of buffering on both transmitter and receiver ends.

★ Data encoding ★

Data encoding is the method by which certain communication devices encode digital data onto an analog signal for transmission.

★ Different Data Encoding Techniques ★

★ Digital data Digital signal ★

Digital signal is a sequence of discrete discontinuous voltage pulses. Each pulse is a signal element. Data is represented in binary. These binary data is transmitted by encoding each data bit into signal elements.

★ Digital data Analog signal ★

Digital data is transmitted using analog signal through public telephone network. The telephone network can receive switch and transmit analog signals in the voice frequency range of about 300 Hz to 3400 Hz.

★ Analog data Digital signal ★

Analog data is converted into digital data and then

it is suitable for transmission. The digital data can be transmitted using NRZ-L. The digital data can be encoded as a digital signal using a code.

★ Analog data Analog signal ★

Analog data in electrical form can be transmitted as base band signals easily and cheaply. Amplitude modulation frequency modulation and phase modulation techniques are used for transmitting analog signals.

★ Modulation ★

Modulation is a modification of a frequency to carry data.

★ modulation techniques used for Digital to Analog conversion

There are three main methods to convert digital signals to analog signals.

These are:

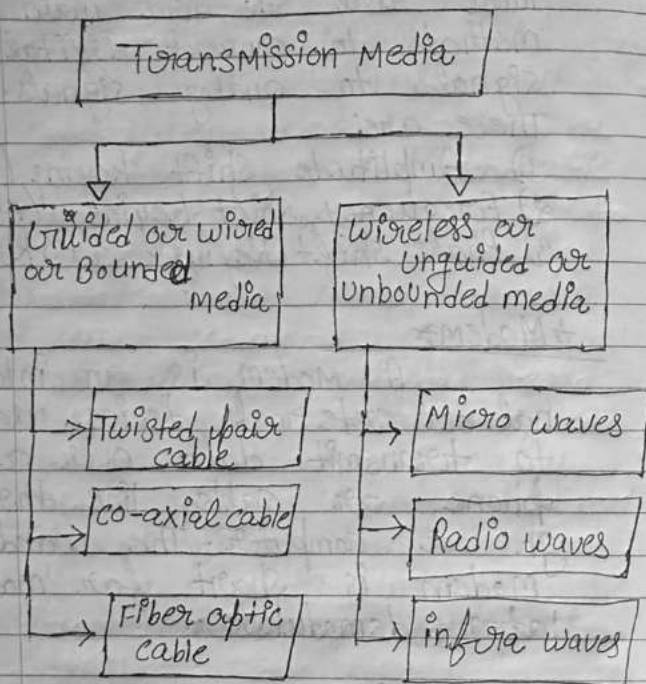
- 1) Amplitude Shift Keying (ASK)
- 2) Frequency Shift Keying (FSK)
- 3) Phase Shift Keying (PSK)

★ Modem ★

A modem is an internal or external device used to transmit data over a phone or cable line through a computer. The word modem is short for modulator-demodulator.

★ Transmission media ★

Transmission media is defined as the physical path between transmission transmitter and receiver.



★ Dialup networking ★

Dialup Networking refers to a network connection that is established by dialing into the network through the public telephone system.

★ creating a Dial up network- ing connection on windows 7★

Step-1 click start then computer Panel.

Step-2 click Network and internet then Network and sharing center.

Step-3 click on the set up a new connection or network option.

Step-4 click on connect to the Internet.

Step-5 click Dial up.

Step-6 Enter the service Provider's Dial-up (POP) Phone number in the Dial up Phone number field. In the user name field, type in your full email address allotted by the service provider. In the Password field, type in your password. For connection name, name your connection click the connect option to

dial up or new dial-up connection.

Setup - Once connected you will see a The connection to the Internet is ready to use window click close

* Frame relay ⇒

frame relay is a concept where the information is sent using data frames in a digital format.

* frame relay was developed to solve:

- * Communication Problems.
- * The increased need for highest speeds.
- * The increased need for large bandwidth efficiency
- * The needs to connect LANS and WANS.

* Baud Rate ⇒

Baud rate is number of signals per second that are sent on a given wire. baud rate is 1/2 of them or equal to the bit rate.

* Bit Rate ⇒

The bit rate is the number of bits of data that are transmitted on a given wire per second.

* Web based model ⇒

For ensuring scalability, the world-wide web has adopted a stateless approach to client-server communication called the web-based model.

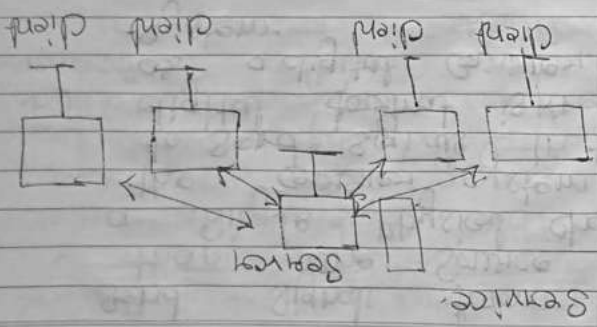
In this model each interaction between the client and the server is independent of the other interactions. No permanent connection is established b/w the client and the server and the

X Channel

channel refers to the physical path used from one or several senders to one or several receivers. A channel has a certain capacity for transmitting information. often measured by its bandwidth in Hz but its data rate in bits per second.

X Client Server model

In client server model of a computer system, one computer is designed as a server that it is a central computer in the network that provides services to clients. A client is a machine that is requesting something from another computer. A server responds to the request with the desired data or



Client/Server Computing Environments of a hierarchical structure of computer in which each computer shares processing and storage workload with a central server.

A client/server is an example of distributed data processing. client/server model is the most commonly used model on the internet.

digital X services Systems

Systems are the mechanisms that provide a means to

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Send signals from more than one source over a single physical channel. The carrier system used to send signals in the digital format is known as a digital carrier system.

media Access Control

media access control orders to controlling when computer transmit

There are three basic approaches:

1. Roll-call Polling

The server poll client computers to see if they have data to send. Computers can send only when they have been polled.

2. Hub Polling or Token Passing:

The computer themselves manage when they can transmit by passing a token to one another. no computer can transmit unless it has a token.

3. Contention:

With contention computers listen and transmit only when no others are transmitting.

Sliding Window Protocol:

Sliding Window Protocol is a bi-directional data transmission protocol used in the data link layer of OSI model and transport layer of TCP model. It is used to keep record of the frame sequences sent and their respective acknowledgements.

Sliding Window Protocols can be categorized in three types. These types are

- 1) Stop and Wait Protocol
- 2) A Protocol using go-back-n
- 3) Selective Repeat ARQ

Bridges and Gateways

Bridges:
Bridge is an interface between two or more separate collision domains.

A bridge joins two similar types of networks. It operates at the data link layer of OSI-OSI reference model.

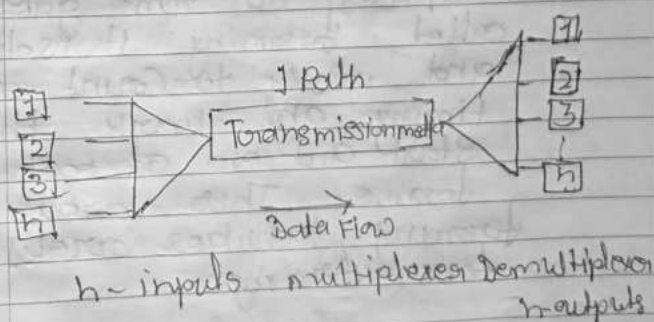
Gateways

Gateway is either an entrance point to a network and performs changes in protocols if required.

A gateway joins two dissimilar networks. It operates at application layer of ISO-OSI reference model.

multiplexing

multiplexing is the process where multiple channels are combined for transmission over a common transmission path i.e. multiplexing is used to combine a number of independent signals into a composite signal suitable for transmission over a common channel.



VLAN

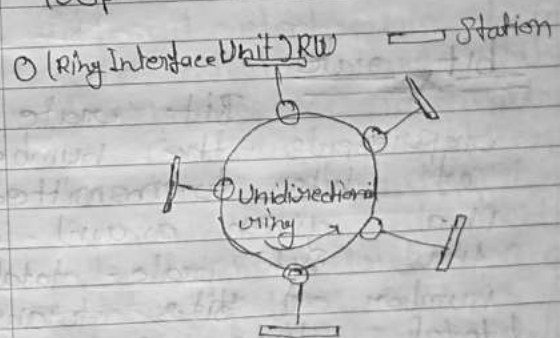
VLAN (Virtual Local Area Network) is a local area network which groups together a collection of machines in a logical and non-physical way. VLAN is a Software-defined LAN, not by physical wiring. VLAN groups users by logical addresses into a virtual, rather than physical.

Frame

The breaking of bit stream by inserting spaces or time gaps is called framing. It is difficult and risky to count on timing and mark the start and end of each frame. This various framing techniques are used for framing.

Token Ring

Token ring is a local area network protocol which resides at the data link layer (DLL) of the OSI model. It uses a special three-byte frame called a token that travels around the ring. Token ring frames travel completely around the loop.



Signal

The data is transmitted from one to the other computer in the form of signals. These signals can be digital signals or

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analog signals

bandwidth

Bandwidth is defined as the difference of highest and lowest frequencies present in the signal. In other words, it is the measure of number of frequencies supported by a particular medium.

bit rate

Bit rate represents the number of bits transmitted in a given amount of time. Bit rate = $\frac{\text{total number of bits transmitted}}{\text{total time}}$. The unit of bit rate is given by bits per second (bps).

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Hub

Hub is a Central Concentrating Point for Computer networks. The hub is a device that joins multiple devices together.

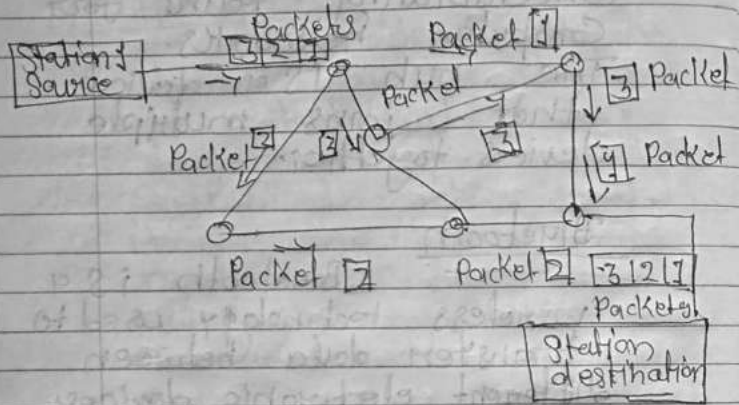
Bluetooth

Bluetooth is a wireless technology used to transfer data between different electronic devices. The distance of data transmission is small in comparison to other modes of wireless communication. Bluetooth develops wireless connections between the laptops, handheld PCs, wireless communication devices and mobile phones.

datagram

A datagram is an independent self-content message sent over

the network whose arrival time is not guaranteed.



Authentication

Authentication means validating the identity of a user who needs to access a set of resources.

Switching

Switching means creating a path by setting up temporary connections between two or more network points.

It allows connections to be established and maintained between senders and receivers so that they can exchange messages and information.

Types of Switching

Different types

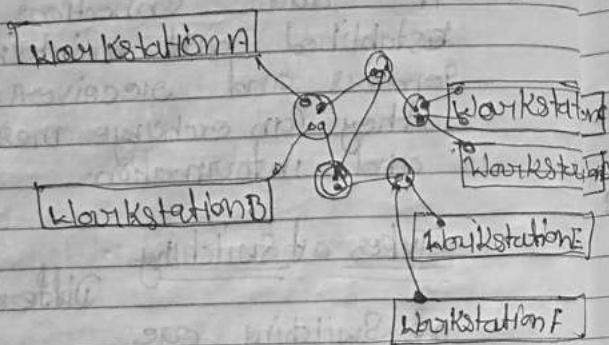
of Switching are:

- 1) Circuit Switching
- 2) Packet Switching
- 3) Message Switching

Circuit Switching

Circuit Switching

is defined as the process of connecting two workstations in a communication network where the path remains fixed during the operation of a communication circuit. A dedicated circuit is created between two workstations through one or more intermediate switching nodes to transfer data.



Thus an end-to-end path setup beginning of a session, dedicated to the application, and then released at the end of session, is called circuit switching.

One data transmission starts all channels in the path are used simultaneously and the entire path remains allocated to the transmission. After the data flow stops, the link is released.

Advantages of Circuit Switching

once the circuit has been set up, communication fast and without errors.

It is highly reliable i.e. data will reach its destination.

There is no delay in data because of the dedicated path.

Guaranteed continuous delivery.

Disadvantages of circuit switching

Introduces extra overhead during channel set up.

Dedicated channels require more bandwidth. Channel set up may take long time to establish connection.

Packet Switching

In Packet Switching, data/messages are broken into fixed size data units called packets. The packets are numbered and the routers examine the packets and send them to their destination. The maximum length of packet is established by network. Each packet is forwarded from switch to switch eventually reaching its destination.

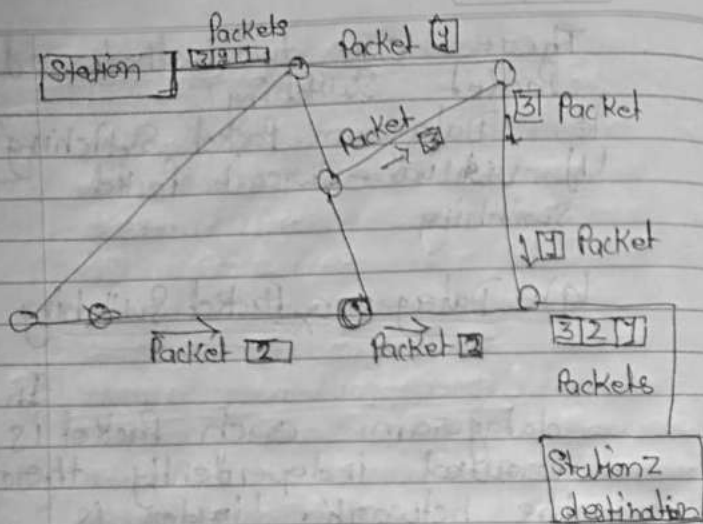
They are reassembled at the destination and into the original message. The facility which converts a message into packets and reassembles packets into messages is called a Packet Assembly/Disassembly (PAD) Facility.

There are two methods of Packet Switching:

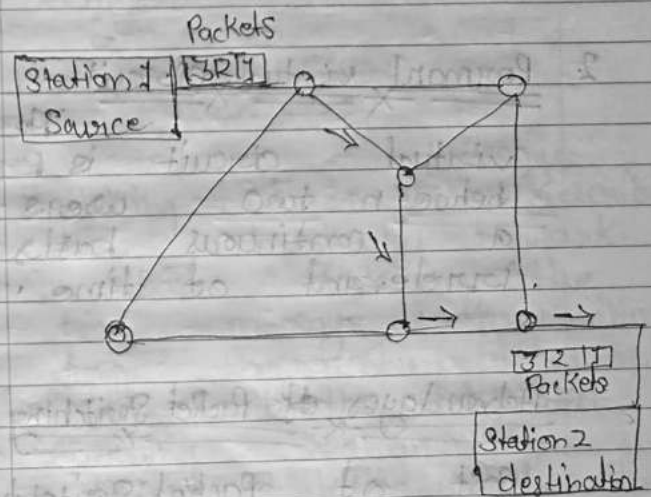
- (a) Datagram Packet Switching
- (b) Virtual-Circuit Packet Switching

(a) Datagram Packet Switching

In datagram each packet is routed independently through the network. Header is attached to each packet. It provides all the information required to route the packet to its destination. Each packet is delivered to the destination using a different path. Hence they are out of order. Datagram approach is also called connectionless. The datagram service is unreliable.



a Connection on a Packet-by-Packet or message-by-message basis, but it appears to be a dedicated circuit to the user. virtual circuit service is reliable.



Virtual Circuit Packet Switching

In virtual circuit Packet Switching a single route is chosen between a source and a destination prior to transfer of packets. When data is sent, all packets of transmission travel one after the other on this route. A virtual circuit is a logical circuit that provides

There are two types of virtual circuits!
 (1) Switched virtual circuit (SVC)
 (2) Permanent virtual circuit (PVC)

Switched x virtual circuit

Switched virtual circuit is dynamically established on demand and terminated when transmission is complete.

2. Permant x virtual x circuit

Permanent virtual circuit is provided between two users on a continuous basis independent of time.

Advantages of Packet Switching

The cost of Packet Switching is lower than that of circuit switching because the internal links between the switches are shared between many users.

Disadvantages of Packet Switching

Switching nodes need large amount of RAM to handle quantities of packets. Since packet switching protocols are complex so switching nodes need more processing power.

Message x Switching

message switching is used to describe the telegraph network. In this switching, the text message is transmitted from the source telegraph office to the telegraph switching station. From this switching station the operator either forwards it or stores the message till the communication line becomes free. Each intermediate device receives the message. Stores it until the next device is ready to receive it and then forwards

it to the next device.

Ans X DSL

DSL Stands for Digital Subscriber Line. It is a medium for transferring data over regular phone lines and can be used to connect to the Internet.

Working of DSL

Like dial-up connection, DSL uses telephone line to connect to the Internet. Phone lines are made of twisted copper wires known as twisted-pair wiring.

X Advantages of DSL

DSL technology uses advanced modems to achieve high data rates over standard twisted-pair copper cable in the local loop.

The Speed of DSL is much higher than a regular modem.

Bad weather does not affect DSL service.

In times of peak Internet usage, DSL speed is not affected.

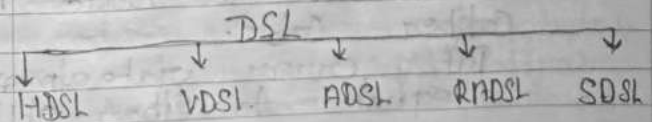
Disadvantages of DSL

DSL service is not available in all areas.

The connection is faster for receiving data than it is for sending data over the Internet.

Types / Classification / Versions of DSL

DSL can be classified into five types as given below



1) High Bit Rate Digital Subscriber Line

HDSL is the first generation of DSL technology. HDSL was developed as an alternative to T1 digital carrier service in the local loop area. HDSL service uses less bandwidth than a T1 carrier and it requires two twisted copper pairs.

Depending on line characteristics, HDSL speeds may range from 1.5 mbps to 2.048 mbps over distances up to 12000 feet from the central office.

Features of HDSL

Data rate up to 2 mbps can be achieved.

HDSL offers reliable data transfer.

HDSL uses two twisted pair copper cable.

Bit error rate almost equal to fiber optic

Cable

2. Very High Data Rate Digital Subscriber Line (VDSL)

A second common type of DSL is very high data rate digital subscriber line (VDSL). It uses twisted pair copper telephone lines with a range of speeds depending on actual line length. Also VDSL uses fiber-optic twisted pair or coaxial cable for short distances. It also provides three channels: the normal analog voice channel, an upstream digital channel and a downstream digital channel.

Features of VDSL

main features of VDSL are given below:
Four upstream. VDSL offers data rate of 16 to 23

Mbps.
Four downstream VDSL
data rate of 13
to 55 Mbps.
VDSL Supports Single
duplex transmission.

3. Asymmetric Digital Subscriber Line (ADSL)

ADSL is a
method to use the existing
analog local loop lines for
digital data transfer. This
technology achieves higher bandwidths
on the existing local loops of
twisted pair cables.

This means, when one downloads
data from the internet it is
transferred at a greater speed
as compared to the situation,
when one uploads it to the
internet. The data transfer
rate of ADSL is adaptive.
ADSL is ideal for internet, video
on demand and remote
LAN access. It eliminates
call setup time.

Advantages of ADSL

It allows
digital data to be transmitted
over existing copper phone
lines faster than conventional.
High bandwidth is available on
the existing local loops.
The telephone services work
irrespective of ADSL service.

The data transfer rate is
automatically adjusted according
to the line situation. It is
a "best effort" for data
transmission.

Disadvantages of ADSL

This service
is not available in all locations.

The services are not available
if there is a problem at
the communication server
at central office.

Rate x Adaptive Asymmetric Digital

Subscriber Line (RADSL)
RADSL

is a variation of ADSL which automatically adjusts the connection speed depending on the quality and length of the telephone line. In RADSL the broadband modem is configured at startup to test the phone line and adjust the data rate. RADSL typically operates at a lower data rate than regular ADSL. Like ADSL, RADSL provides relatively more bandwidth for downloads and less for uploads.

5. Symmetric Digital Subscriber Line (SDSL)
SDSL is mainly used for the business users that use internet for downloading as well as uploading the data.

Error Detection

An error detection system is needed at the receiver end that should check the incoming data and notify

number and types of errors occurred. The error detection system should not be very complex because it will slow down the performance.

The redundancy based error detection techniques are:

- (1) Vertical Redundancy Check (VRC) or Parity check
- (2) Longitudinal Redundancy Check (LRC)
- (3) Cyclic Redundancy Check (CRC)
- (4) Checksum

Error Correction

Error correction is the mechanism by which changes can be made in the received erroneous data to make it free from error.

There are two different approaches for error correction: Backward Error Correction (BEC) and Forward Error Correction (FEC).

Flow Control

When the Flow Sender is running on fast machine and receiver is on slow machine, then the Sender will transmit frames faster than the receiver can accept them. In this case after a very short time the buffer of the receiver will be full and the data sent further by the Sender will overflow. Flow Control may be defined as the set of protocols that are used to restrict the amount of data that the Sender can send before waiting for acknowledgement.

Methods used for Flow Control

There are two main methods that are used for flow control.

- (1) Stop and Wait Protocol.
- (2) Sliding Window Protocol.

Network Hardware Components

Connectors

Connectors are used to connect network cables to terminals or other devices.

Transceivers

A transceiver is a device comprising both a transmitter and a receiver which are combined and share common circuitry in a single housing.

Repeaters

The repeaters is a device that is used to regenerate or repeat the signal on the wire. Repeaters operate at the Physical layer of the OSI model.

Hubs

A hub is similar to a repeater, except it broadcasts data received by any port to all other ports on the hub.

Network Interface Card

A network interface card, commonly referred to as NIC, is a device that allows computers to be joined together in a LAN (local area network).

Switches

A switch is a device that breaks a larger network down into smaller segments, isolating each segment into its own collision domain. It is used on a computer network to physically connect devices together.

Routers

A router is a network device that forwards data packets between computer networks. A router is connected to two or more data lines from different networks.

8. PC Cards

A PC card is a standard form factor peripheral interface for laptop/notebook

Computers

Gateway

A gateway joins two dissimilar networks. It operates at application layer of ISO-OSI reference model.

Bridge

A bridge joins two similar types of networks. It operates at the data link layer of OSI-OSI reference model.

Sliding Window Protocol

Sliding Window Protocol is a bi-directional data transmission protocol used in the data link layer of OSI model and transport layer of TCP model. It is used to keep record of the frame sequences sent and their respective acknowledgements.

Categories of Sliding Window Protocols

- (1) A one bit Sliding Window Protocol
- (2) A Protocol using go-back-N
- (3) Selective repeat NRA

Random Access Protocols

The random access protocols is a set of rules that allows stations in the network to detect and avoid traffic collision and determines what happens in the event of traffic collision to make the channel ready to resume transmission.

Types of Random Access Protocol

Several types of random access protocols have been developed over the years. Some of them are:

- (1) Pure ALOHA
- (2) Slotted ALOHA
- (3) Carrier Sense Multiple Access (CSMA)
- (4) CSMA Collision Detection (CSMA/CD)

FDDI

Fiber Distributed Data Interface (FDDI) provides a standard for data transmission in a local area network. It is a high performance fiber optic token ring. It is highly reliable way to transmit data using a dual-ring protocol based on the token ring protocol.

Objective FDDI

FDDI has several objectives. The aim is to provide the following:

- Highly powered workstations and servers.

Facilitate larger number of distributed client/server applications
Larger spans of distributed network

Higher capacity
Longer distance links

Wireless LAN

A wireless LAN uses wireless transmission medium for data transfer operation.

The IEEE 802.11 Standard defines two kinds of services.

These are

- (1) Basic Service Set (BSS)
- (2) Extended Service Set (ESS)

Applications of wireless LAN

Wireless LANs have many applications. They are frequently used to enhance a wired network. The following describes some of the applications that are made possible through the power and flexibility of wireless

technology.

Conducting everyday business

In business, people can work more productively with customers and suppliers. Senior executives in meetings can make quicker decisions because they have access to real-time information.

Healthcare

Doctors and nurses equipped with laptops have faster access to patient data. Furthermore, in an emergency situation they can communicate with other departments within the hospital by using WLAN in order to provide.

LAN extension

Wireless LAN can be used to enhance an already existing wired network. It saves the cost of the installation of LAN cabling and eases the task of relocation and other modification to network structure.

VLAN

A virtual local area network (VLAN) is a local area network which groups together of machines in a logical and not physical way. Virtual local area network (VLAN) is a software defined LAN, not by physical wiring. VLAN groups users by logical addresses into a virtual rather than physical.

Advantages of VLANs

Reduction in cost

VLANs can reduce the migration cost of stations going from one group to another.

Reduction in time: Physical reconfiguration takes time and is costly. In VLANs we need to change the physical configuration. Time required for wiring is also saved.

Increased Security

VLANs provide additional security. The message broadcast in one group cannot be listened by members of other groups.

Increased Performance

By reducing broadcast traffic throughout the network, VLANs free up bandwidth.

Organization

Network users who resources that are linked and communicate frequently can be grouped together in VLAN.

Simplified Administration

With a VLAN the network administrator's job is easier.

Ethernet

Ethernet is the most popular type of LAN currently in use. It employs a CSMA/CD MAC Protocol.

The Ethernet is a multi-access network i.e. a set of nodes that send and receive frames over a shared link.

Ethernet has the following advantages:

- Inexpensive way to get high speed up to 100 mbps.
- Supports various technologies
- Easy to install.

Connectors

Connectors are used to connect network cables to terminals or other devices.

The most common connectors are the following:

- (1) UTP Cable connectors
- (2) Co-axial cable connectors
- (3) Fiber optic cable connectors

Routing

Routing is the process of selecting path in a network along which to send network traffic. Routing is performed for many kind of

network, including the telephone networks, electronic data networks like Internet and transportation networks.

Goals of Routing

Routing should be done correctly so that the packets may reach the intended destination.

Simplicity

Routing algorithms must be designed to be as simple as possible.

Robustness

Routing algorithms must be robust, i.e. they should perform correctly in unusual or unforeseen circumstances such as hardware failures, high load conditions and incorrect implementations.

Stability

Stability refers to equilibrium state of algorithm. It is the technique that reacts to changing conditions such as congestion. Routing algorithms must be stable under a variety of network conditions.

Flexibility

Routing algorithms should be flexible i.e. routing algorithms should quickly and accurately adapt to a variety of network circumstances.

optimality

optimality refers to the ability to the routing algorithm to select the best route.

Efficiency

Routing algorithms must offer its functionality efficiently with a minimum of software and utilization overhead.

Classification of Routing Algorithms

The algorithm used to make a routing decision for a particular packet or data gram based on current routing information is called routing algorithm.

Routing x algorithms

- (1) Static (non-adaptive) routing algorithms
- (2) Dynamic (adaptive) routing algorithms

(1) Static (non-adaptive) routing algorithms

In static routing algorithms the network connection is established between source and destination depending on any parameter or property.

Static x algorithms

Shows Path

Routing

Flooding
Flow based routing

2. Dynamic (adaptive) routing algorithms

Dynamic routing algorithms change their routing decision if there is change in topology, traffic. Each router continuously checks the network status by communication with neighbours.

Popular dynamic routing algorithms

Distance vector routing
Link State routing
Hierarchical routing
Broadcast routing

Virtual circuit

A circuit is a logical circuit that provides a connection on a packet-by-packet or message-by-message basis, but it appears to be a dedicated circuit to the user. Virtual circuit service is reliable.

two types of virtual

(1) Switched virtual circuit (SVC)
Permanent virtual circuit (PVC)

(1) Switched virtual circuit

Switched virtual circuit is dynamically established on demand and terminated when transmission is complete. It is created whenever it is needed and exists for duration of specific exchange. Thus the communication over this circuit consists of three phases

that are circuit establishment, data transfer and circuit termination.

2. Permanent virtual circuit

A permanent virtual circuit is provided between two users on a continuous basis independent of time. The circuit is dedicated to a specific user. Thus, permanent virtual circuit consists of one mode i.e. data transfer and it is used in situations where data transfer between devices is constant.