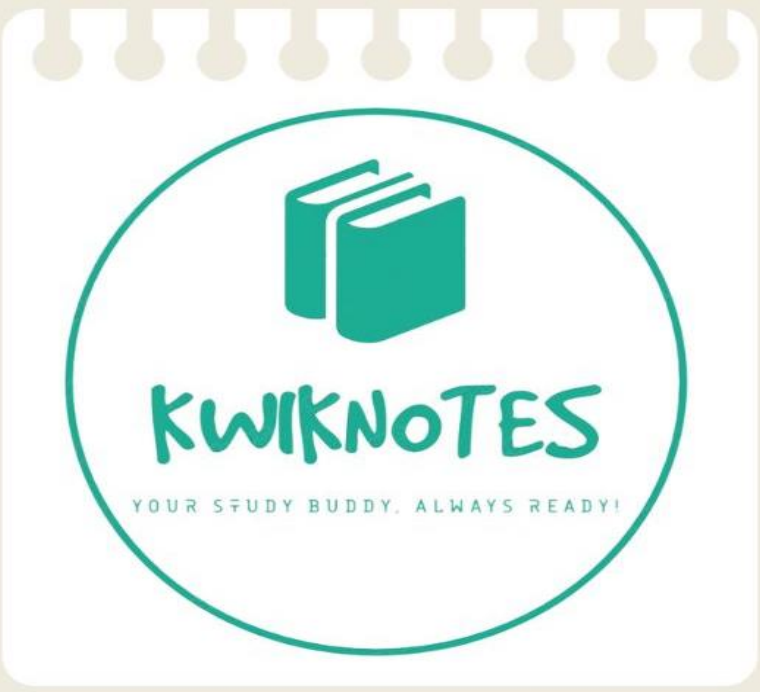

HANDWRITTEN NOTES

Networking - interconnected comp that exchange data & share resources with each other.

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Computer Network - an inter connection of multiple devices, also called hosts, connected using multiple paths for sending/receiving data through media

Network Devices → devices/medium to facilitate communication between two diff devices.
ex - router, Switch, hub, bridge.

Goals → 1) Resource Sharing 2) High Reliability 3) Flexible access 4) Inter process communication

Architecture → Comp Network Architecture is defined as physical & logical design of software, hardware, protocol.

2 types. → P2P → all nodes are linked with equal privilege and responsibility for processing data.
- has no dedicated server - used for small env

Ad - less costly - if one stop working other unaffected
Dis - Security issue - difficult to backup data - distributed data locations

Client/Server → designed for end user called clients, to access resources. Central controller called server while others called clients. Server perform major operations such as Security & network management. Manag Resources

Ad - Centralized control, easy backup, increase speed of sharing
Dis expensive, hard to mange.

Computer Network components -
NIC - network interface card, hardware component used to connect a comp with other comp.
Transfer rate of 10, 100 to 1000 Mb/s.
Wired NIC - present inside motherboard. Cables & connectors are used with wired NIC to transfer
Wireless NIC - it contains antenna to obtain the connection over wireless network. Ex - laptops.
HUB - Physical layer Networking Device, used hardware device that divides the network connection among multiple devices. Physical layer networking device used to connect multiple devices used to connect LAN. has many ports. Half duplex transmission, uses electrical signal or bits.
Types
- Passive - Active - Intelligent. Used for network monitoring
SWITCH - It is a datalink networking device and uses packet switching to send and receive data over network. A switch is a intelligent hub, has many ports, when data packet arrive it check destination address and then send frame. full duplex transmission. 24/48 ports.
Supports unicast, multicast or broadcast.
SWITCHING - technique of transferring info from one computer network to another.
BANDWIDTH - defined as maximum transfer rate of cable
Critical & expensive resource. amt of data that can be transfrd Calculated in Mbps
ROUTER - work in layer 3 (Network layer), used with LAN. Forward packet based on Routing table.
Determine best path from available paths.

Advantages - Security, Reliability, Performance.

MODEM - hardware device that allows comp to connect to internet over existing telephone line. Not installed with motherboard. Modulator/Demodulator, converts digital data into an analog signal over telephone lines. Bridge b/w internet and comp. Comp understand digital but internets and cables analog.

COMPUTER NETWORK MODELS

For data communication to take place and and info to be tramited, a systematic approach is required. This approach enables users to communicate & transmit through efficient & ordered path. It is implemented using models called CNM. Responisble for establishing a connection among sender & Receiver.

→ OSI Model → general purpose networking model or communication model responsible for connection in open manner.

OSI - Open System Interconnection, in 1984 name given by International org for Standerdization. Called opensource cause it can fit anywhere. It is a refrence model that describes how info from a software application moves through a physical medium to software app in another medium.

It has 7 layers, performing particular function

Application
Presentation
Session
Transport
Network
DataLink
Physical

Responsibility of Host s/f layers

→ Heart of OSI

Responsibility of Network H/W layers

1) Provide service to user
2) Responsible for translation
3) Establish/manage sessions
4) Reliable message delivery from process to process
5) Moving packet from source to dest
6) makes error free transfer
7) Provide physical medium

1) Physical Layer → lowest Layer of OSI reference model. Responsible for actual physical connection b/w devices. Contain info in form of bits. Responsible for transmitting ind. bits from one node to next. Convert data to 0s and 1s. Coordinates func required to carry a bit stream over a phy. medium.

2) Data Link layer - Responsible for node to node delivery of msg. Main func is to make sure that data transfer is error free from one node to another over physical layer. When a packet arrives, DLL is responsible to transmit it to host using MAC address.

cheap
Bus top - Baseband - Digital - short distace - 2 directional
Bus and tree top - Broad band - Analog - Long distance - unidirection
Expensive

3) Network Layer: works for transmission of data from one host to another located in different network. Takes care of packet routing i.e selection of shortest path to transmit the packet from no. of routes available.

4) Transport Layer: provide services to applayer & take services from network layer. Data in transport layer is refered to as Segments. Responsible for end to end delivery of messages.

5) Session Layer: establishes a session of transmission between nodes. Responsible for establishment of connection, maintainence of sessions, authentication, and ensure security.

6) Presentation Layer - also called translation Layer. Data from applayer is extracted here & manipulated as per required format to transmit over network.

7) Application Layer: implemented by network applications. These app produce data, that has to be transfered over network.
This layer Serves as a window for app services to access the network for displaying the received info to user
Also called Desktop layer

TCP/IP Model

→ developed before OSI Model.
→ have 4 layers: App, Transport, Internet, Network Access layer.

Designed by Department of Defense (DoD) in 1960 stands for transmission Control Protocol/Internet Protocol.
used when 2 device comm through internet

1) Network Access / Link layer
Corresponds to combination of Physical & Datalink layer of OSI Model

looks out for hardware addressing

2) Internet layer
Same as network layers. It defines the protocols which are responsible for logical transmission of data over entire network.

3) Transport / Host to Host Layer
It is analogous to transport layer. Responsible for end to end communication and error free delivery of data.

4) Application Layer.
Perform function of top3 layer of OSI model - App, Presentation, Layer. Responsible for node to node communication and controls user interface specifications.

Types of Networks

- LAN

A Lan is a collection of devices connected together in one physical location, such as a building, office or home. A lan can be small or large

used for connecting two or more PC's through a communication medium such as twisted pair, coaxial cable, etc.

- less costly, use inexpensive hardware like hub, network adapter, ethernet cables
- Data transmission is faster.
- Have high security.

- PAN

This type of network is arranged within an individual person, typically within a range of 10 m.

Thomas Zimmerman bought idea of PAN

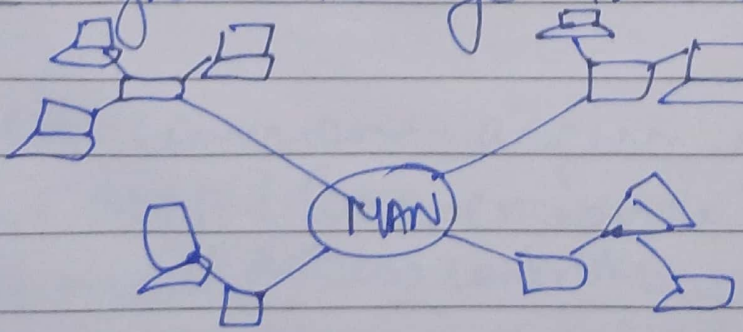
Covers a area of 30 feet.

PC devices that are used to develop

PAN are laptop, bluetooth, Mobile etc.
It can be
- Wired (using USB)
- Wireless (using Bluetooth).

- MAN

Metropolitan Area Network. covers a larger geographical area by interconnecting a different LAN to form a larger network.
- gov agencies use MAN to connect to citizens.
- various LANS are connected to each other through telephone exchange line.
- It uses RS-232, ATM, ADSL protocol
- Higher Range than LAN.



- comm b/w banks
- Airline Reservation

-WAN.

It is a network that extends over a large geographical area such as states or countries.

- quite bigger than LAN.
- No limited ~~location~~ to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.

- Internet is biggest WAN.
- Used in fields of Business, govt and education
- ex - mobile broadband.

Topologies.

A topology defines the structure of network of how all the components are interconnected to each other

2 types → Physical
→ Logical

Types of network topology.

1) Bus

Designed in such a way that all stations are connected through a single cable known as backbone cable.

- Each node is connected to backbone cable by either drop cable or directly.
- Simple configuration
- Backbone considered as 'single lane'

Most common access method of bus top. is CSMA (Carrier Sense Multiple Access)
It is media access control used to control data flow so integrity is maintained.

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Ad → 1) low cost 2) Easy Maintainence 3) limited failiure 3) Moderate datarspeed. (upto 10 Mbps)

Disad → 1) Extensive cabling 2) Dificult trouble shooting 3) Signal interfrance

RING TOPOLOGY.

It is like bus topology but with connected ends.

- Connected in a circular manner.
- Node receive message from previous comp & transmit to next node.
- Unidirectional Dataflow
- flow in clockwise direction
- Uses token Passing Access Method.

Use twisted pair cables.

Token is a frame that circulates around network

Ad → Reliable, easy, Inexpensive

Div → Delay, Difficult to trouble shoot failiure

- STAR TOPOLOGY

- In this every node is connected to a central hub, switch or a central comp.

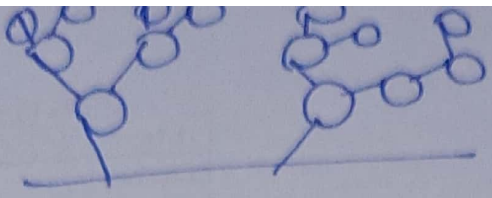
- Central comp known as sever, and all peripherals attached are called clients.

- Coaxiale cable or RJ-45 cables are used to connect computers.

- Hubs or switches mainly used

Ad - Efficient troubleshoting, Network control, United failure, Cost Effective

Dis - Cable, Central point of failure



TREE TOPOLOGY

- Combines character of star & bus topology
- Special structure where many connected elements are arranged like a branched tree.

There can only be one connection b/w two connected nodes
also called star bus topology

Only one path exist b/w two nodes for data transmission.
Forms parent child hierarchy.

Ad - 1) Error detection, limited failure. Point to Point wiring, Managable.

Dis → High cost, Failiure, Difficult to trouble shoot.

MESH TOPOLOGY

Arrangement of network in which each node is inter connected with each other through various connections.

- There are multiple paths from one comp to another
- Internet is example of Mesh topology
- Does not contain switch, hub.

No of cab = (n * (n-1)) / 2

- Mainly used for wireless connections

→ Full Mesh T → Partial Mesh T

Ad → Reliable, Fast, Easier Reconfiguration

Dis - Cost, Managemet, Efficiency

Hybrid Topology

- It is comb. of various topologies.
It is a connection b/w different links and nodes to transfer the data.

When 2 or more topologies are combined it is termed as Hybrid.
Ring of bank connected to Bus of another

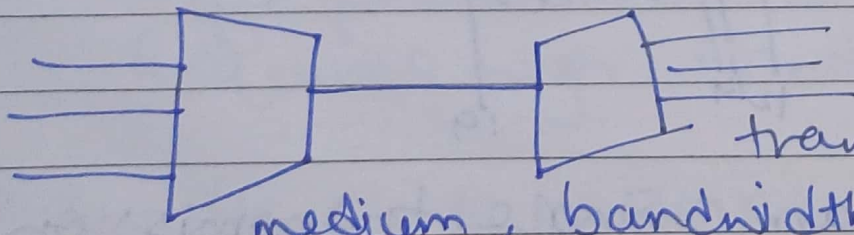
Ad → Reliable, scalable, Flexible, Effective,

Dis - Complex, costly, Infrastructure.

Multiplexing

A technique used to combine and send multiple data streams over a single medium. The process of combining the data stream is known as Multiplexing and hardware used is Multiplexer. (MUX)
Multiplexer combines n input lines to generate a single output line.
Multiplexing follows ~~one~~ many to one ie. n input lines and one output line.

Demultiplexing is achieved by demultiplexer (DEMUX) available at receiving end.
DEMUX separates a signal into its component signal (one input n output). It has one to many approach.



Advantages
→ one signal can be transmitted over one medium, bandwidth of medium can be utilized effectively.

Multiplexing

FDM
Frequency Division Multiplexing

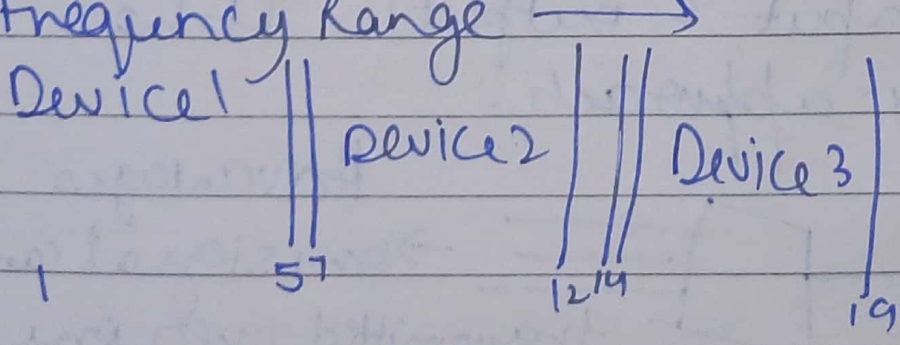
WDM
Wavelength Division Multiplexing

TDM
Time Division Multiplexing

- Synchronous TDM
- Asynchronous TDM

FDM – It is a analoge technique

FDM is a technique in which available bandwidth of a single transmission medium is subdivided into several channels.



In above diagram, Single transmission medium is subdivided into several

frequency channel, each frequency channel given to a different device.

Used mainly in radio broadcast & TV networks.

- Using modulation technique, input signals are transmitted into frequency bands & combined to form Composite signal.

Ad — ① used for analog signal
② Simple & easy modulation
③ large no. of signals can present simultaneously

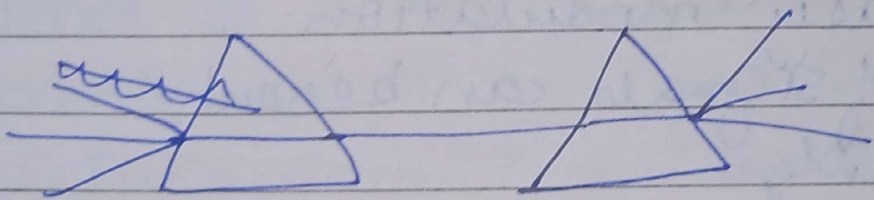
Dis — ① Used only when low speed channels are required
② Suffer problem of cross talk.
③ Requires high Bandwidth channel

App- Used in tv network, use din FM, AM broadcasting.

WDM

Same as FDM except that the Optical signals are transmitted through fibre optic cable

- used on fibre optics to improve capacity of single fibre.
- It is analog multiplexing technique
- Optical signals from different Source are combined to form a wider band of Light with help of Multiplexer
- At receiving end DEMUX separate signals.



TDM

It is a digital technique.

In FDM all signals operate at same time with diff. frequency but in TDM all signals operate at same frequency with different time.

- The total time available in the channel is distributed among different users. Therefore each user is allocated with diff. time interval called Time slot at which data is transfered.
- A user takes control of channel for afixed amount of time.

Types:

Synchronous:

- In this time slots are preassigned to every device
- In Synchronous TDM, each device is given some time slot irrespective of the

fact that device contains the data or not
— If there are n ~~slots~~ devices, n slots are given.

Ex - SONET Multiplexing, ISDN Multiplexing

Asynchronous
Known as Statistical TDM.
It is a technique in which time slots are not fixed as in Synchronous TDM.
Time slots are allocated to only those devices which have data to send
— It dynamically allocates.
total speed of input lines can be greater than capacity of channel.

Each slot contains an address part that identifies source

| Address | Data |

Switching

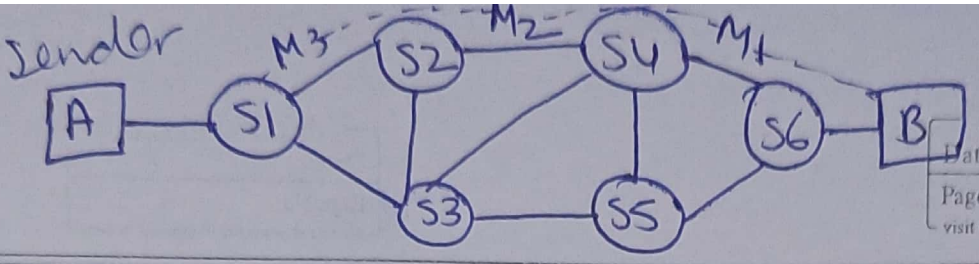
It is the process to forward packets coming in from one port to a port leading towards destinations.

In large networks, there can be multiple path to send packets from sender to receiver. Switching technique decides best route for transmission.

It is used to connect the systems for making one to one connection.

Switching Technique

- Circuit Switching
  - Space Division Switches
  - Time Div Switches
- Message Switching
- Packet Switching
  - Datagram Approach
  - Virtual Circuit Approach.



Circuit Switching

It is a technique that directly connects Sender & receiver in unbroken path
It establish a dedicated path between Sender & Receiver.
Once the connection is established, then the dedicated path will remain to exist until connection is terminated
- Operates similar to telephones
- Connection using physical connection
- Complete end to end path must exist before communication takes place
- Comp initiating the data transfer must asic for a connection to the destination
- Fixed data can be transferred at a time
In circuit switching technology

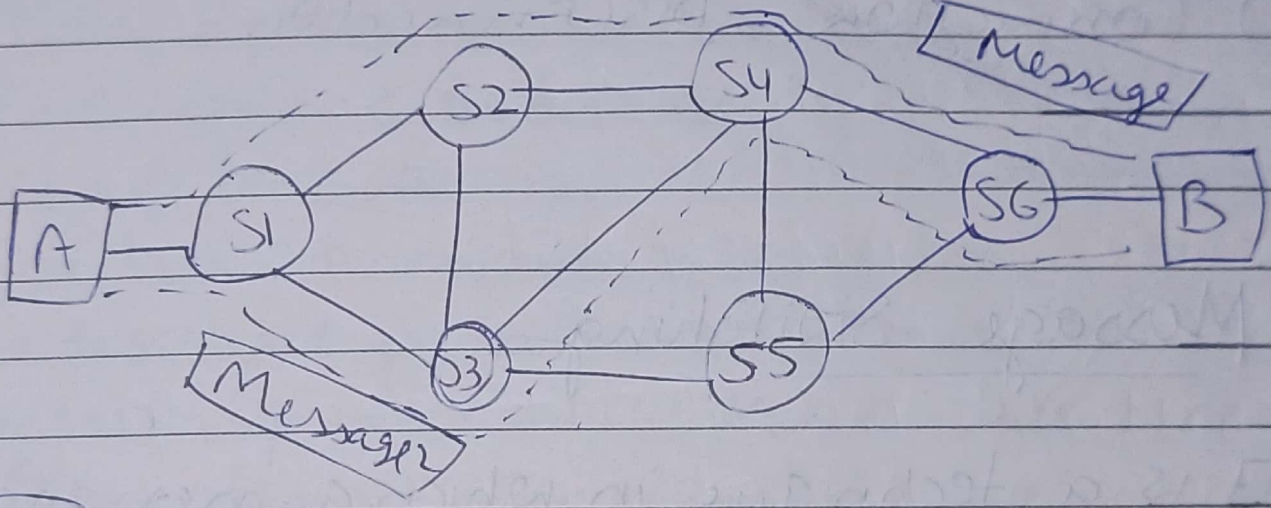
Ad → Dedicated comm Channel
Dis → Expensive, inefficient, slow
Wait to establish a connection → 10 secon more
→ Before data transfer, connection will be established first ex- Telephone network

3 phases in Circuit Switching
1) Connection Establishment
2) Data Transfer
3) Connection Disconnection

Message Switching

It is a technique in which a message is transferred as a complete unit and routed through intermediate nodes at which message is stored and forwarded
There is no need to establish a dedicated path between 2 stations
- When station sends a message, address is appended to it
- This type of network is called Store - and - forward Network
- It treats each message as independent entity.

- Message switches are programmed in such a way that they can provide most efficient routes



Ad → • Message priority can be used to manage the network.
• Size of message sent can be varied Thus it supports unlimited size
• Better in controlling traffic
• Efficient of using available bandwidth

Dis → • Long delay can occur due to storing & forwarding facility
• Message switch must have enough storage.

Packet Switching

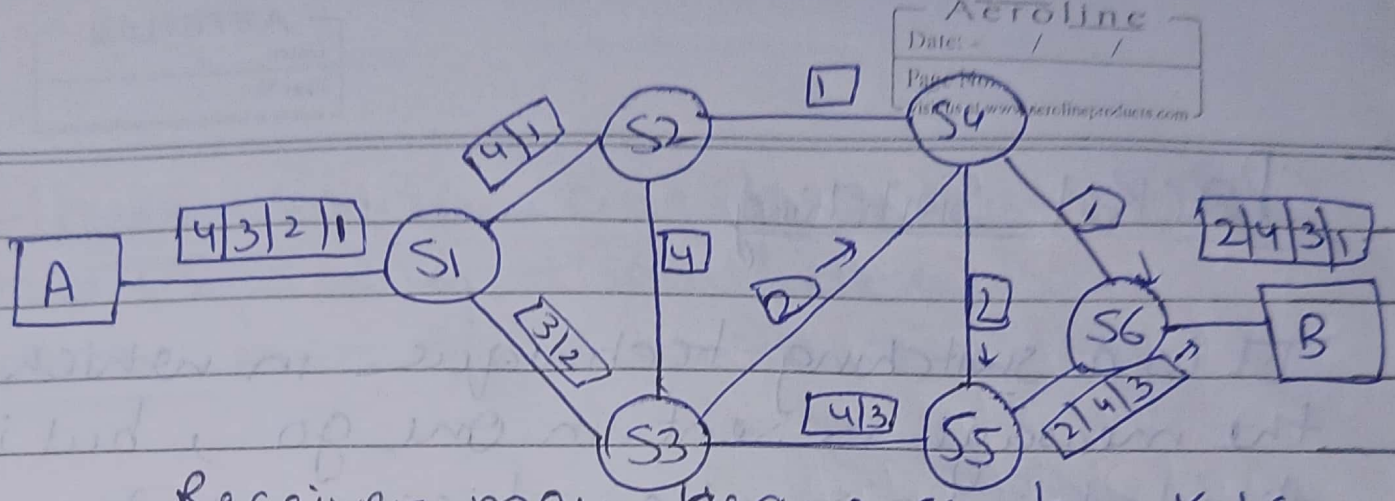
It is a switching technique in which the message is sent in one go, but is divided into smaller pieces, and they sent individually

- The message split into smaller pieces known as packets, each packet is given a unique no. to identify their order at receiving end.

- Every packet contains some information in its header such as source address, distination address, sequence no.

- Packet travel accross network through shortest path.

- If any packet is missing or corrupted it will say to resend message.



Receiver may sequence packets

Data Gram Packet Switching

Technology in which packet is called datagram and considered an independent entity.

- Packet resembled at receiving end
- Also called connectionless switching
- Path is not fixed
- Intermediate node take routing decision

Virtual Circuit Switching

- Connection Oriented switching
- Preplaned route is established before transmission of message
- Call request and call accept used to establish connection
- Path fixed for Logical Connection.

Adv → • Cost effective ← don't require massive secondary storage to store packets
• Reliable
↳ If a node is busy, packet can be rerouted.
• Efficient - dont require established path before transmission.

Dis →
Cannot be implemented to low delay / high quality services.
• Add cost in implementation.
• Protocols used are very complex and have high implementation cost.
• If packet lost, send again
• If network is overloaded, we need to resent message

Sequence →
- Reorder the packet
- Find Missing Packt
- Send acknowledgment.

DATA LINK CONTROL

FRAMES

The main func of data link layer include framing, error detection & correction, flow control ensuring well defined reliable service interface to network layer.

→ The data link layer needs to pack bits into frames, so that each frame is distinguishable from other.

A frame is a unit of data. It helps to identify data packets.

Error Control - based on automatic repeat request, which is retransmission of data

FLOW CONTROL

It is a technique that tells Sender that how much data should be sent to receiver so that it is not Lost.

The mechanism makes the sender wait for an acknowledgment (message) before sending next data.

2 types → Stop and Wait Protocol

Flow Control allows two stations working at different speeds to communicate with each other.

It restricts the no. of frames the Sender can sent befor acknowledgment

Approaches

Feedback based Flow Control
Rate based flow Control

Algoriths from ppt ch-11

Feedback based

→ Sender sends data only when it receives acknowledgment (Feedback) from the user. Used in data link layer

Rate based

These protocols have built in mechanisms to restrict the rate of transmission of data without requiring ack. from Rec.

Operate in network & transport Layer

Techniques

1) → **Stop and wait**: Sender wait for ack from user after every frame is sent
- after ack, next frame is sent
- this is done till end of transmission.

2) **Sliding Window**- Sender can transmit several frames befor getting acknowledgment.