2. Non-persistant CSMA

- It also senses the channel before transmitting
- However, if the channel is already in use, the station does not sense it ~~for~~ continuously. Thus missing out the chance of seizing the opportunity to transmit data on the end of previous transmission.
- It waits for random period of time and then repeats the algo. The algo leads to better channel utilization but longer delays than 1 persistant CSMA.

3. p-persistant CSMA:

- It applies to slotted channels
- When a station becomes ready to send, it senses the channel.
- If it is idle, it transmits with a probability p.
- with a probability $q = 1 - p$, it defers until the next slot
- If that slot is also idle, it either transmits or defers again, with probabilities p and q.
- This process is repeated until either the frame has been transmitted or another station has begun transmitting.
- In the latter case, the unlucky station acts as if

there had been a collision (i.e., it waits a random time and sends again.)

- If the station initially senses the channel busy, it waits until the next slot and applies the above algo

4. 0-persistant CSMA:

Each node is assigned a transmission order by a supervisory node.

CSMA/CD :-

- If the two ~~of~~ stations sense the channel to be idle and transmitting simultaneously, they will both detect collision almost simultaneously.
- Rather than ~~finishing~~ finish transmitting their frames, which are irretrievably garbled anyway, they should ~~not~~ abruptly stop transmitting as soon as the collision is detected.
- Quickly terminating damaged frames saves time and bandwidth.
- This protocol, known as CSMA/CD (CSMA with collision Detection) is widely used in LANs in the MAC sublayer.

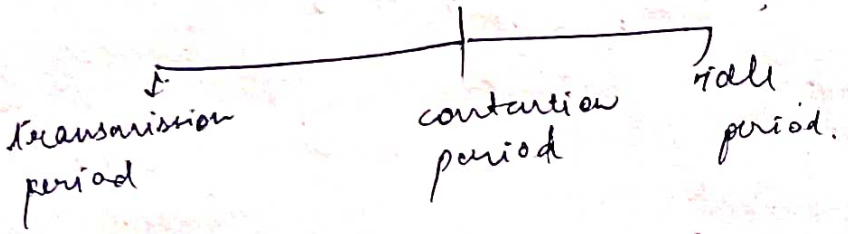
* CSMA/CD is used by Ethernet.

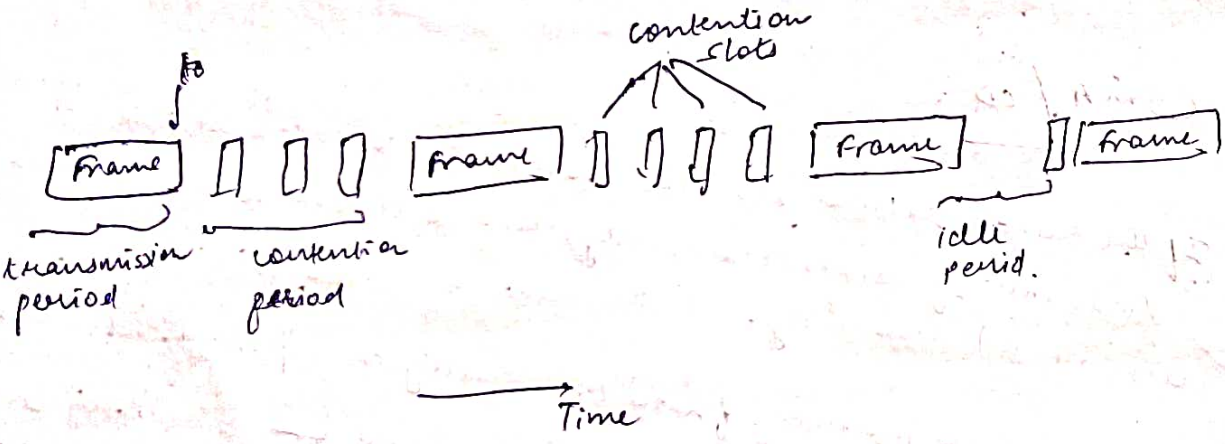
* collision can be detected by looking at the power or pulse width of the received signal and comparing it to the transmitted signal.

* After collision each station wait for a random period of time before transmitting again.

• ~~CSMA~~

CSMA/CD.





contention period: A contention period is the min. time a host must transmit such that it can be sure that no other host packets has been transmitting.

Efficiency of CSMA/CD

$$\varepsilon = \frac{1}{1 + 6.44a}$$

$$a = \frac{T_p}{T_t}$$

T_p = propagation time

T_t = Transmission time

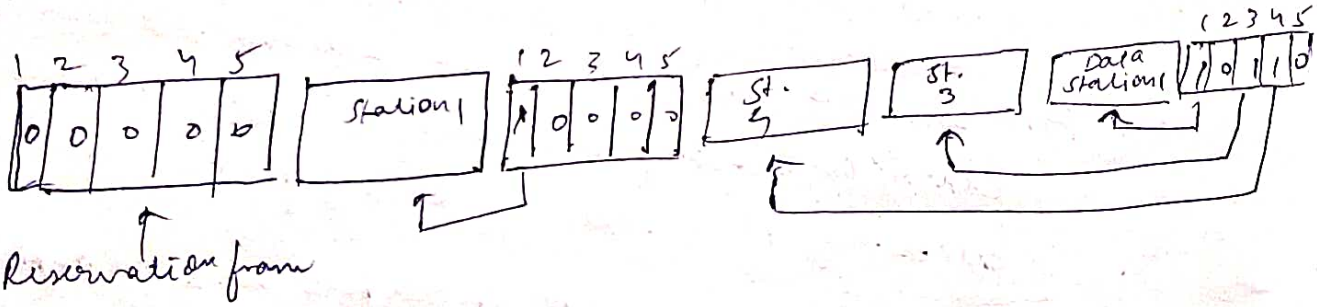
- If distance ↑, efficiency of CSMA ↓
- Not suited for WAN, but works optimally for LAN.

CSMA/CA

- CSMA with collision avoidance (CSMA/CA) is a network multiple access method in which carrier sensing is used, but nodes attempt to avoid collision by beginning transmission only after the channel is sensed to be idle.
- For wireless network, where collision detection of CSMA/CD is not possible due to wireless transmitters deafening their receivers during packet transmission.
- Unreliable due to hidden node problem and exposed terminal problem.
- It works in Data Link layer of OSI model.

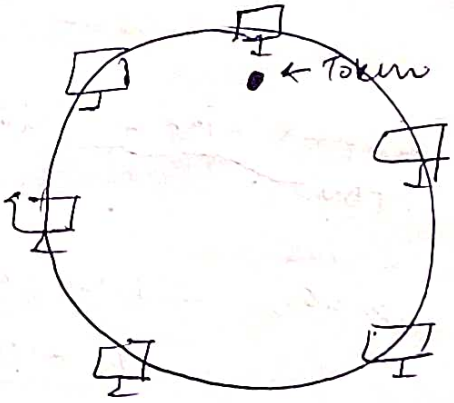
- Controlled Access Protocol (Reservation)

- A station need to ~~send~~ make a reservation before sending data.
- In each interval, a reservation frame precedes the data frames sent in that interval.
- If ~~there~~ there are N stations in the system, there are exactly N reservation minislots in the reservation frames.
  - Each minislot belongs to a station.
  - When the station need to send a data frame, it makes a reservation in its own minislot.
  - The st. that have made reservations can send their data frames after the reservation frame.



Control Access Protocol (Token Passing)

- A M. is authorised to send data whenever it received a special frame called a token.
- Here there is no master node.
- Token is exchanged among nodes in fixed order.
- If a node has frames to transmit when it receives the token, it sends upto a max. no of frames and then forwards the token to next node.
- Failures
  1) The failure of one node can crash the entire channel.
  2) A node accidentally forgets to release the token, then some recovery procedure must be invoked to get the token back in circulation.



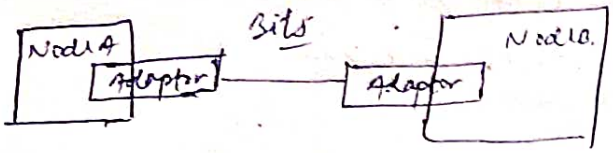
$S = \frac{1}{1+\frac{a}{N}}$: for $a < 1$

$S = \frac{1}{a(1+\frac{1}{N})}$: for $a > 1$

S = throughput
N = no. of stations
T_p = prop. delay
T_t = Transmission delay.

$$a = \frac{T_p}{T_t}$$

Framing:



Bits flow b/w adapters, frames h/w hosts.

→ Data link layer adds header and trailer on the packet received from network layer. (framing)

→ Framing errors means, suppose 11011 is the agreed protocol for start and end of the frame and the data ~~also~~ contains (b/w the header and tailer) ~~always~~ also contains ~~the~~ 11011, the receiver might get confused.

→ Framing in data-link layer separates a frame distinguishable from another frame.

→ Frame = Header + Network layer + Trailer
PDU

→ In packet switched networks, the blocks of data called frames are exchanged b/w nodes, not bits streams.

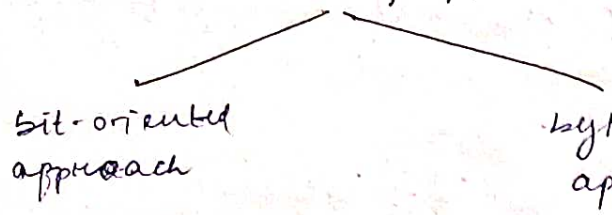
- When node A wishes to transmit a frame to node B, it tells its adapter to transmit a frame from the node's memory.
- This results in a sequence of bits sent over the link.
- The adapter of node B then collects together the sequence of bits arriving on the link and deposits the corresponding frame in B's memory

Types of framing:-

1) Fixed size framing: Sender and receiver know the size of the frame which is fixed. The frame length acts as the delimiter of the frame.
   - Consequently, it does not require addn boundary bits to identify start and end of the frame

2) Variable size framing:-
   - Here, the size of each frame may be different.
   - So, additional mechanism are kept to mark the beg^n and end of frames.

Framing approaches



Bit-oriented approach:- It simply views the ~~data~~ frame as a collection of bits.

- In bit-oriented framing, data is transmitted as a sequence of bits that can be interpreted in the upper layers both as text as well as multimedia data.

Bit-oriented protocol :-

HDLC ↦ High Level Data Link control.

Byte oriented framing:- Here each frame is ~~viewed~~ viewed as a collection of bytes (characters) ~~after~~ rather than bits.

protocols:-

1) BISYNC – Binary Synchronous Communication Protocol.
2) DDCMP – Digital Data communication Message Protocol.
3) PPP – point-to-point protocol.

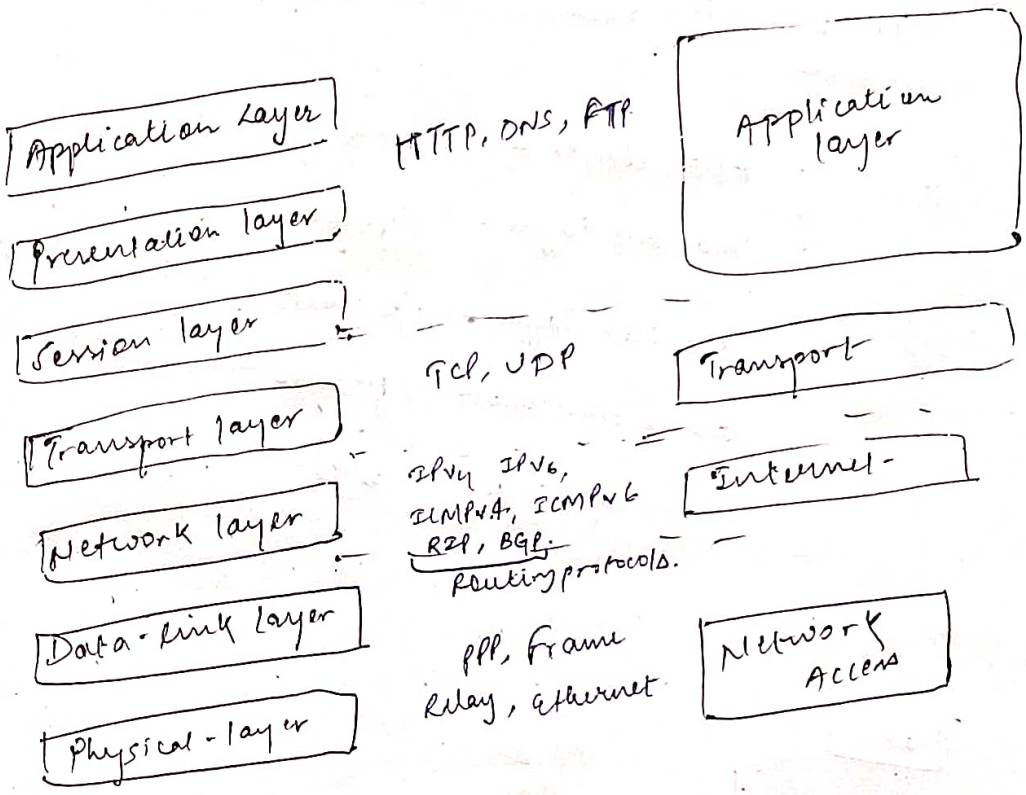
Clock based framing :- (mainly for optical network)

example: SONET - synchronous optical Network

~~HDLC~~

~~PPP~~

TCP/IP Protocol suite



Application layer :- Represents data to the user - plus encoding and dialog control.

Trans' layer: supports comm. b/w diverse devices across diverse networks.

Internet: Determines the best path through the network.

Network Access :- controls the hardware devices and media that make up the network.

Protocol Data unit (PDU) :-

Protocol data units are named according to the pro. of the TCP/IP suite : data, segment, packet, bits.

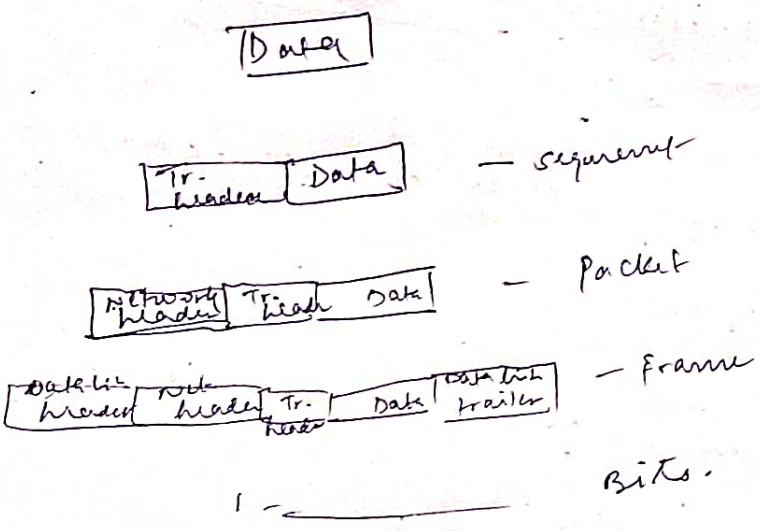
Appl. layer - Data

Transport layer - segment

Network layer - packet

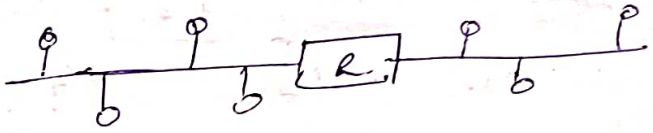
Data-link layer - frame

Physical layer - bits.



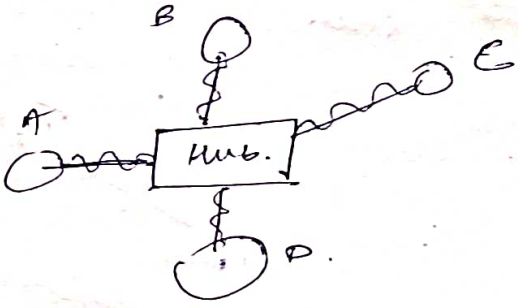
~~Routers~~ :-

Repeater :- ; regenerate the strength of the signal
; physical layer device (pure hardware)



1) 2 port device
2) Forwarding
3) ~~filtering~~ No filtering
4) collision domain. = 'n'
n = no. of devices connected to repeater

Hub:- (physical layer device)



1) multiport repeater.
2) Forwarding
3) No filtering

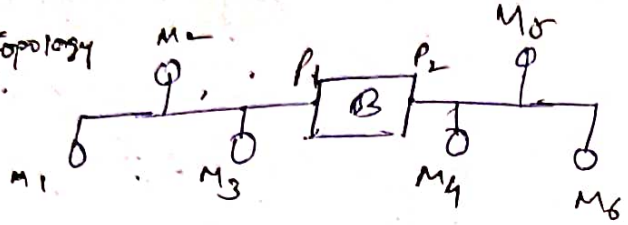
∴ └ A & B mein transfer karte time sabmein data ~~se~~ jaayega.

4) collision domain - n
5) ~~Tight~~ High traffic
6) Half Duplex
7) Only broadcast.

Bridges: (Physical and data link layer)

1. connect two different LANs

2. Star topology LAN and Bus topology LAN.



2. forwarding

3. filtering.

4. collision domain - 0

   ↳ Bridge uses store and forward mechanism.

5. Bridge Data unit Protocol - uses spanning tree

Types

Static

- MAC address and port table is maintained by administrator.
- Needs to be manually changed.

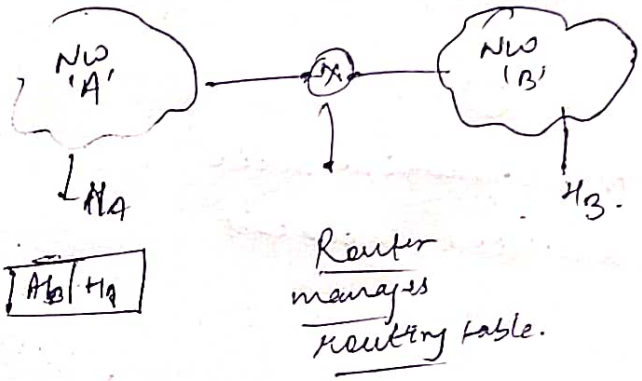
Dynamic or (Transparent).

- Self-manages the port number and MAC addresses.
- First time, it broadcasts but from second time it sends to particular device.
- dynamically implemented.

MAC	Port
M1	P1
M2	P1
M3	P1
M4	P2
M5	P2
M6	P2

MAC	Port
M1	

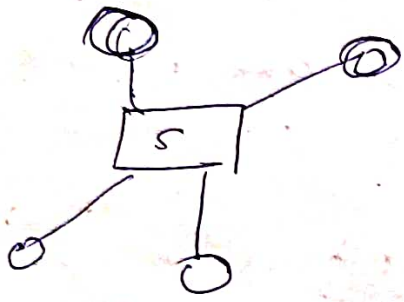
Routers:- (Physical, Data-link, Network layer)



- Forwarding
- Filtering using routing table.
- Routing
- Flooding: when router can't find the IP address mentioned, it broadcasts the message.
- collision domain - 0. (store and forward method).

Switches: (Data-link layer) device.

- Multiport device
- Full duplex links.
- Traffic is minimal
- Collison domain is 0 (Because full-duplex)



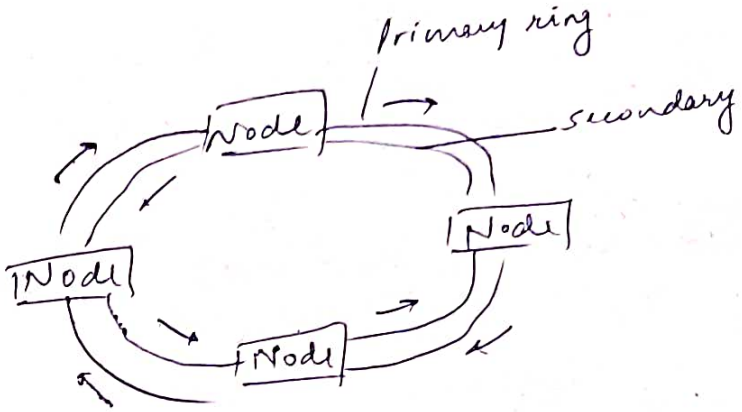
- Full duplex transmission mode
- Unicast, multicast, broadcast

FDDI:

FDDI - Fibre Distributed Data Interface (FDDI)

- allow transmission of data in LAN over fibre optic cable
- ANSI and ISO std
- 200 Km range
- speed is very high (200 Mbps)
- uses dual ring: primary - transmission of frames from one point to other. (100 Mbps)
  secondary: used for backup and recovery purpose
- based on token ring protocol.

- topologies - ring, star, tree and support upto 1000 nodes or stations
- backbone of WAN.



primary and secondary ring ~~is~~ data flows in opposite directions.

2 types of stations:

(i) SAS: single attach station. ← attached to single ring
(ii) DAS: double " " ← attached to both rings

Frame format:

1 byte	1 byte	1 byte	2-6 byte	2-6 B	variable length	4 byte	1 byte
PA	SD	FC	DA	SA	Data	Checksum	ED/FS

PA - Preamble
SD - start delimiter.
DA - Destn address
FC - Frame control.
SA - Source address
ED - end delimiter
FS: Frame Status.