OS

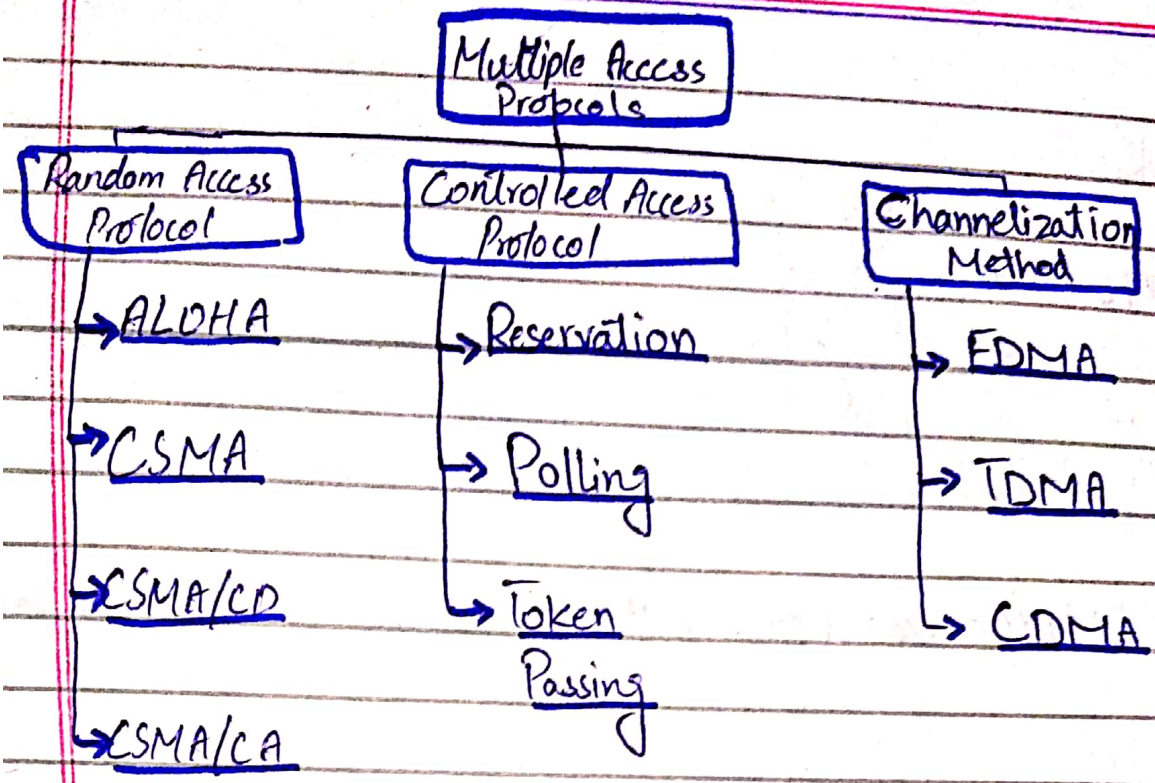
Multiple Access Control Protocols :-

Multiple Access protocols are a set of protocols, operating in the Medium Access Control (MAC) sublayer of the open System Interconnection (OSI) model.

These protocols allow a number of nodes or users to access a shared network channel.
The main objective of multiple access protocols are optimization of transmission time, minimization of collisions and avoidance of cross talks.

Categories of Multiple Access Protocols

Multiple Access Protocols are broadly classified into three categories
Random Access Protocols
Controlled Access Protocols
Channelization Protocols



1. RANDOM ACCESS

Random Access protocols assign uniform priority to all connected nodes. Any node can send data if the transmission chanel is idle

In random access, there is no sheduled time for a station to transmit and no rules are specified which station should send next
At each instance, a station that has data to send uses a procedure defined by the protocol to make a decision on whether or not to send data. This decision depends on the state of the network Channel eitheir it is idle or busy.

Random Access ~~includes~~ evolved from an interesting protocol knowns as **ALOHA.**
This method later evolved into two parallel methods
CSMA/CD: carrier sense multiple access with collision detection

CSMA/CA: carrier sense multiple access with collision avoidance.

(A) ALOHA:

Aloha is multiple access protocol for transmission of data via shared network channel.
In ALOHA, each node or station transmits a frame without trying to detect whether the transmission channel is idle or busy. If the channel is idle, then frames will be successfully transmitted.

If frames attempt to occupy the channel simultaneously, collision of frames will occur and frames will be discarded. These stations may choose to retransmit the corrupted frames repeatedly until successful transmission occur.

Versions of ALOHA

(i) Pure ALOHA (ii) Slotted ALOHA

(i) Pure ALOHA:

In pure ALOHA, the transmission is continous. Whenever a station has an available frame, it sends the frame. If there is collision and the frame is destroyed, the sender waits a random amount of time before retransmitting it.

The pure ALOHA relies on acknowledgments from the reciever. If the acknowledgment signal doesn't arrive after a time out period, the sending node assumes that the frame has been destroyed and resends it

Each station waits a random amount of time after time-out period. This random amount of time is called **back-off time.** T_B

Vulnerable time

It is the time in which there is a possibility of collision.

Pure ALOHA vulnerable time $= 2 \times T_{fr}$

$\because T_{fr}$ time taken by station to send a frame

Throughput

$S = G \times e^{-2G}$

(ii) Slotted ALOHA

Slotted ALOHA reduces the number of collisions and doubles the capacity of pure ALOHA

In slotted ALOHA, we divide the time into slots of T_{fr} seconds and force the station to send only at the beginning of the time slot.

There is still the possibility of collision if two stations try to send at the beginning of the same time slot.

However, the vulnerable time is now reduced to one-half

Vulnerable time:

Slotted ALOHA Vulnerable Time $= T_{fr}$

$\therefore T_{fr}$ = time taken by station to send a frame

Throughput:

$$S = G \times e^{-G}$$

(B) CSMA (Carrier sense multiple Access)

CSMA protocol was developed to decrease the chances of collisions when two or more stations start sending their signals over the data-link layer.

CSMA requires that each station first check the state of the medium before sending

Vulnerable Time

Vulnerable Time of CSMA is the the propagation time T_p

Propagation time is the time needed for a signal to propagate from one end of the medium to the other.

Vulnerable Time = Propagation time (T_p)

Presistance Methods

Three methods were proposed to overcome the difficulty in data transmission if the channel is busy.

(i) **1-Persistent:** Station sends data as it sense the channel is idle. There is chance of collision if two or more stations sends their frame imediately.

(ii) **Nonpersistent:** If line is idle, station sends data immediately. If the line is not idle, it waits a random time the senses the line again

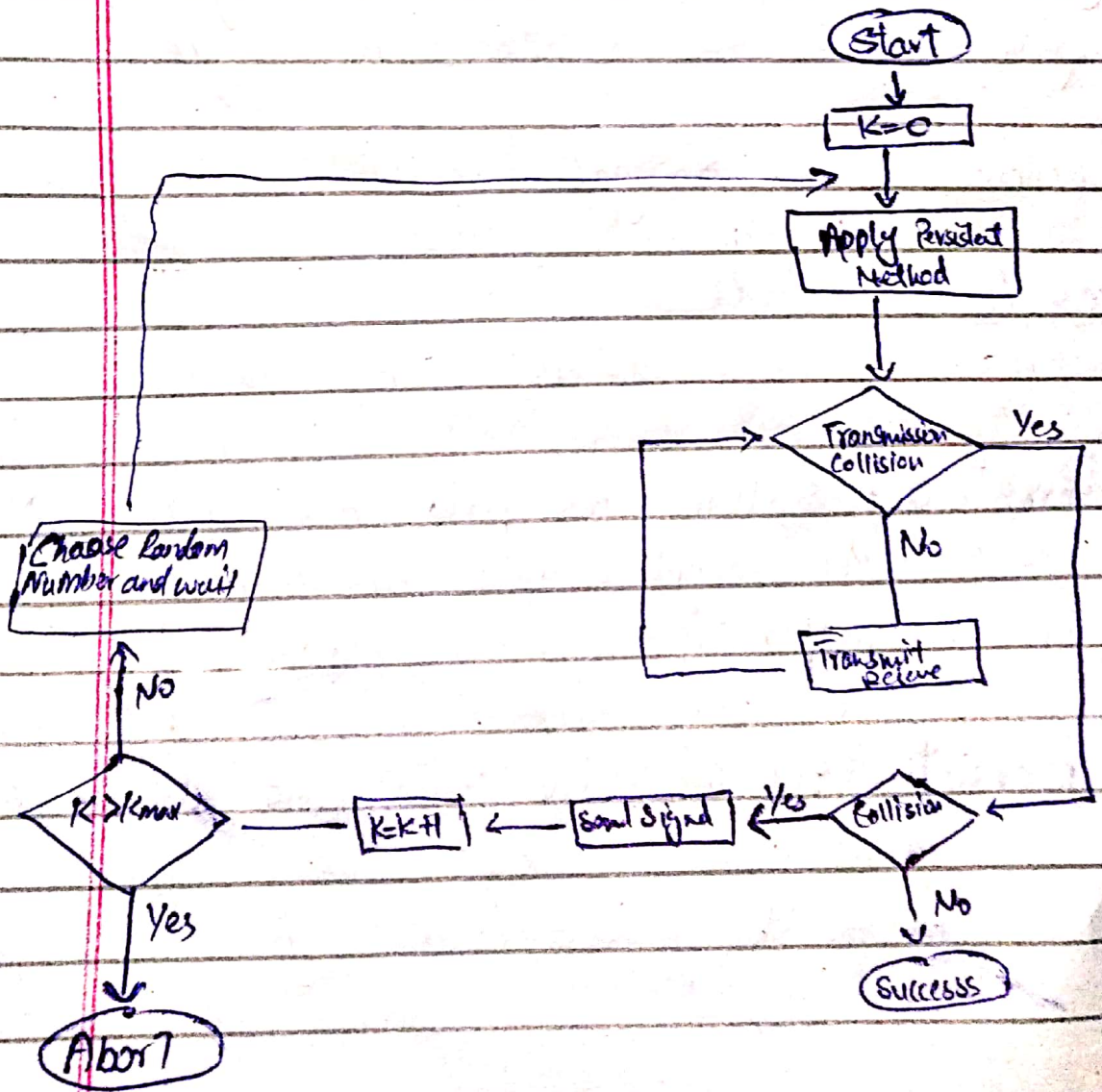
(i) CSMA/CD

In this method, a station monitors the medium after it sends a frame to see if the transmission was successfull.

If transmission is succeeded, the station is finished, if not, the frame is sent again

Frame transmission time T_{fr} should be atleast twice the maximum propagation time.

Collision Detection Process



(ii) CSMA/CA

Carrier Sense Multiple Access with collision avoidance

The basic idea behind CSMA/CA is that the station should be able to recieve while transmitting to detect a collision from different stations.
In wired networks, if a collision has occured then the energy of recieved signal almost doubles and the station can sense the possibility of collision.
In case of wireless network, most of the energy is used for transmission and the energy of recieved signal increases by only 5-10% if a collision occurs. It can't be sense by the station to sense collision.

3 types of strategies for CSMA/CA

InterFrame Space (IFS): When a station finds the channel busy, it waits for a period of time called IFS. IFS also define priority of frame or station.

Contention Window: It is the amount of time divided into slots. A station which is ready to send frames chooses random number of slots as wait time.

Acknowledgments: The positive acknowledgments and time-out timer can help guarantee a successful transmission of the frame.

2:- Controlled Access

In controlled access technique, all stations need to consult with one another in order to find out which station has the right to send the data.

=> The controlled access protocols mainly grant premission to send only one node at a time, that removes the chances of collision

=> No station can send the data unless it has been authorized by the other stations.

Controlled Access Protocols are

(i) Reservation
(ii) Polling
(iii) Token Passing

(i) Reservation

In this method, a station needs to make a reservation before sending the data.

=> Time is mainly divided into intervals

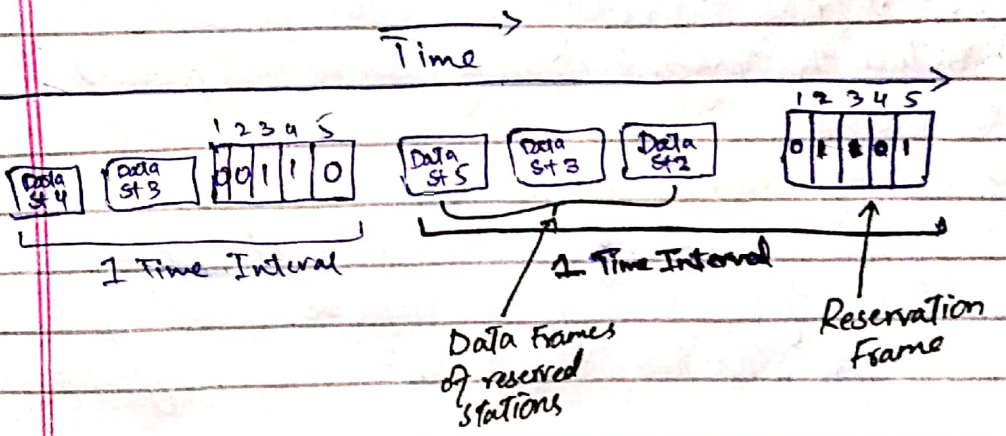
=> At each frame, there is a reservation frame that precedes the data frames of stations that were sent in that time interval.

=> The number of slots in reservation frame are equal to the no of stations in the system. Each slot belongs to a station.

=> Whenever a station needs to send the data frame, then the station makes a reservation in its own slot of reservation frame.

=> The stations that have made reservations can send their data after the reservation frame

Example Diagram



(ii) Polling

Polling work with topologies in which one device is designated as a primary station and the other devices are secondary station.

=> All data exchanges must be made through the primary device.

=> The primary device control the link and all the secondary device follows its instructions.

=> It is upto the primary device to determine which device is allowed to use the channel at a given time.

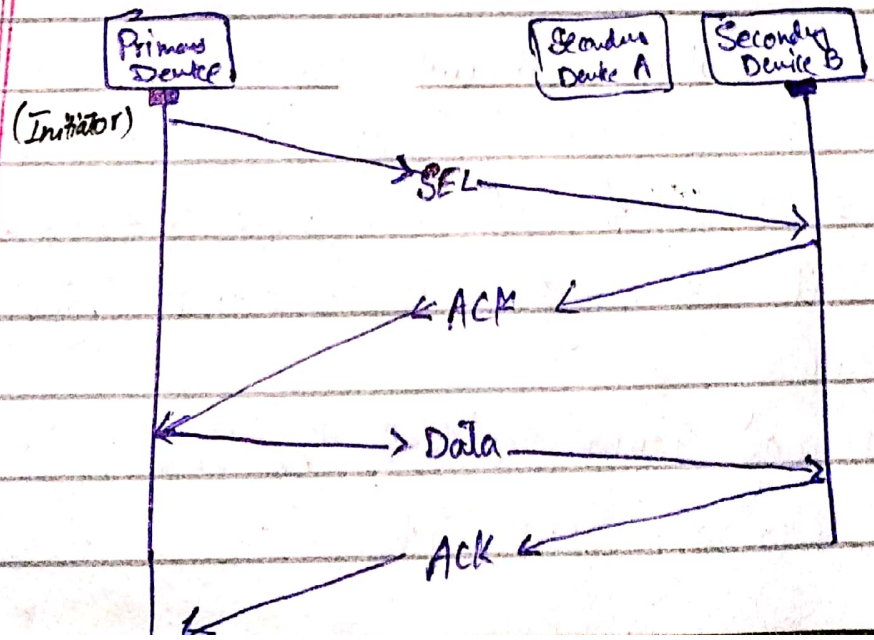
=> Two main Functions in Polling

(i) Select Function

Select function is used whenever the primary device has something to send.

=> Primary device controls the link, so it know when the link is available.
=> If it has something to send, the determines whether the targeted secondary device is prepared to recieve.
=> Primary device creates and transmit a select (SEL) frame and wait for an acknowledgements signals from the secondary ~~storage~~ station's that shows its ready status.

Diagram for SEL Function



(ii) Poll Function

If the primary device wants to receive data, it ask the secondaries if they have anything to send, this is called poll function.

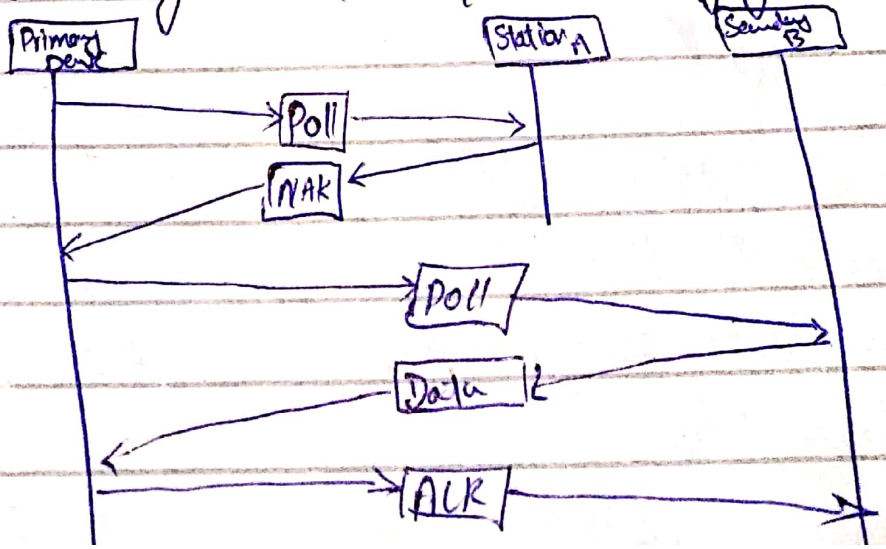
=> The poll function is used when primary device tries and ready to receive transmissions from the secondary devices.

=> When primary device ready to receive, it ask (poll) each device one by one, if it have anything to send.

=> When a secondary device is approached by primary device, it responds with a NAK frame if it has nothing to send or responds with a Data frame if it wants to transmit data.

=> If primary recieves a NAK frame, it polls the next secondary device

=> If primary device recieves a data frame from secondary device, it returns an acknowledgment (ACK) frame, verifying its receipt.



(iii) Token Passing

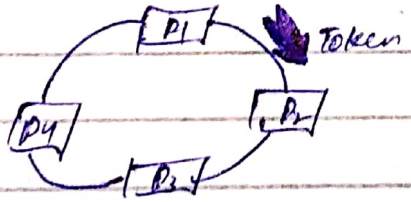
In token passing, all the stations are organized in the form of a logical ring

=> Each station has a predecessor and a successor station. The station that has the access of channel now is called current station.

=> A speciall bit pattern circulates from one station to the next station in predefined order, that bit is commonly known as a token.

=> The station passessing the token has the right to access the channel and to send its data

=> When station wants to send data, it wait untill it gets the token. Once it gets the token, it holds it and sends all the data. When that station has no more data to send, it passes the token to the next logical station in the station ring



=> If station don't have data to send, it simply pases the token to the next station

=> It has Delay limitation

Delay is the time difference b/w a packet ready for transmission and when it is transmitted.