Tag: Time Division Multiplexing Problems

Time Division Multiplexing | Access Control

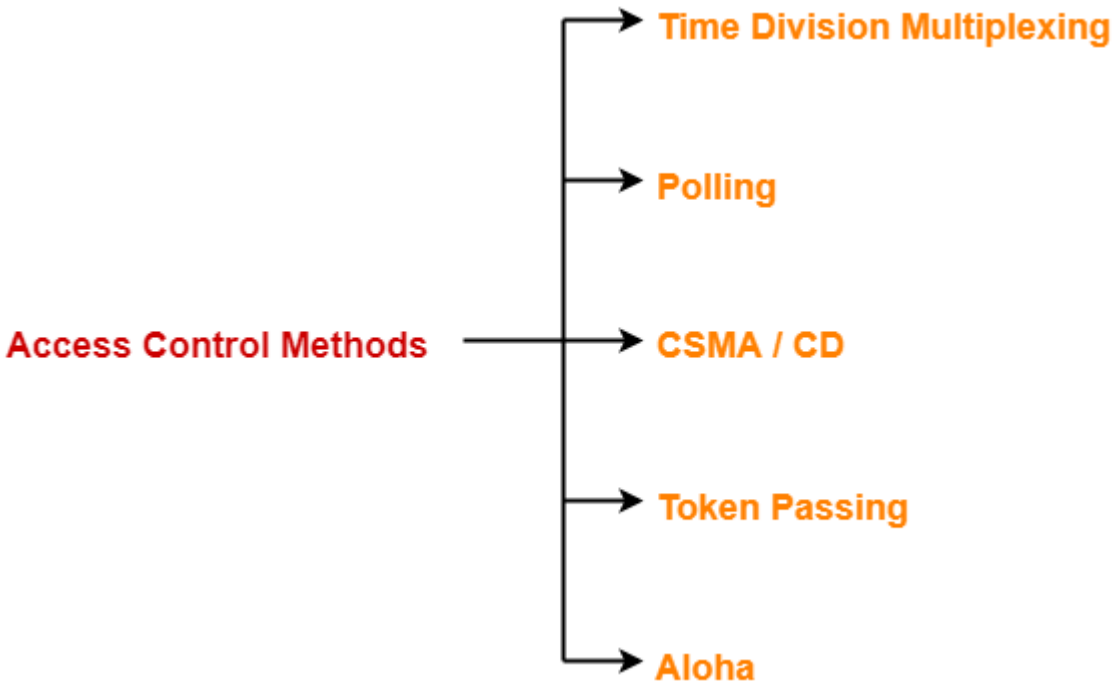
Computer Networks

Access Control in Networking-

Before you go through this article, make sure that you have gone through the previous article on **Access Control**.

We have discussed-

- Access Control is a mechanism that controls the access of stations to the transmission link.
- Broadcast links require the access control mechanism.
- There are various access control methods-



1. Time Division Multiplexing
2. Polling
3. CSMA / CD
4. Token Passing
5. Aloha

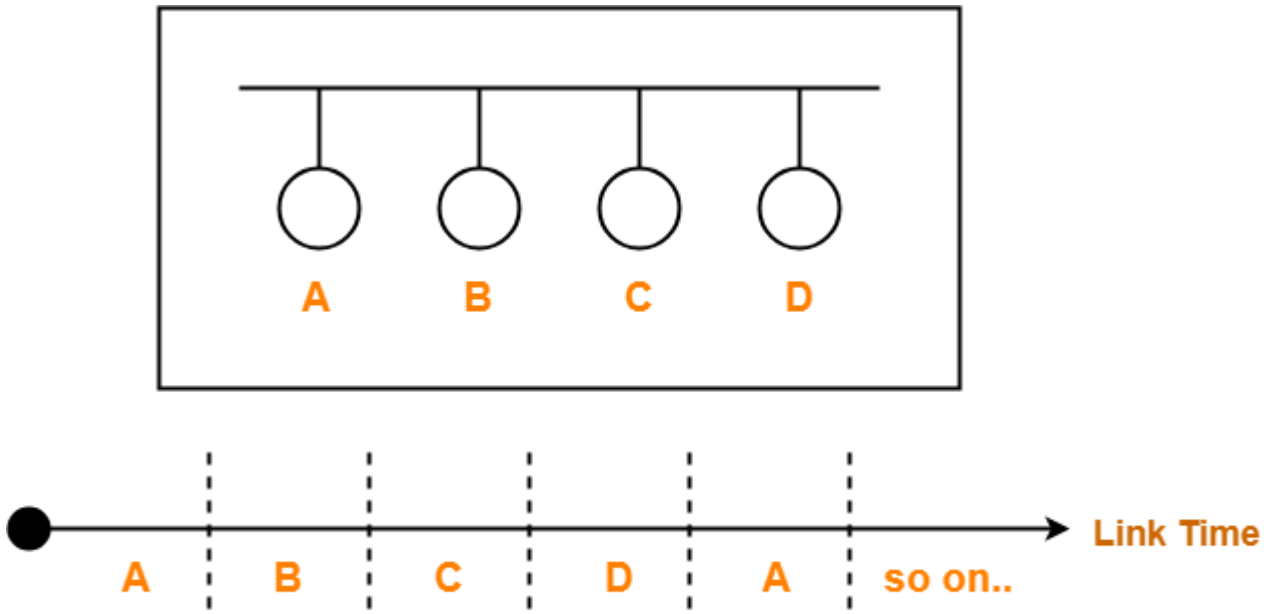
In this article, we will discuss about Time Division Multiplexing (TDM).

Time Division Multiplexing-

In Time Division Multiplexing (TDM),

- Time of the link is divided into fixed size intervals called as **time slots** or **time slices**.
- Time slots are allocated to the stations in **Round Robin** manner.
- Each station transmit its data during the time slot allocated to it.
- In case, station does not have any data to send, its time slot goes waste.

Example-



Time Division Multiplexing

Size Of Time Slots-

The size of each time slot is kept such that each station gets sufficient time for the following tasks-

- To put its data packet on to the transmission link
- Last bit of the packet is able to get out of the transmission link

Thus,

Size of each time slot = $T_t + T_p$

where-

- Tt = Transmission delay
- Tp = Propagation delay

NOTE-

To keep the size of time slots constant,

- We have assumed that all the stations want to send the packets of same size.
- This keeps T_t constant for all the stations.
- We have considered the worst case when both the stations are present at the two extreme ends.
- This ensures T_p will be maximum and all the stations will get sufficient time to propagate their data.

Efficiency-

Efficiency (η) = Useful Time / Total Time

- Useful time = Transmission delay of data packet = T_t
- Useless time = Propagation delay of data packet = T_p

Thus,

$$\text{Efficiency } (\eta) = \frac{T_t}{T_t + T_p}$$

OR

$$\text{Efficiency } (\eta) = \frac{1}{1 + a} \quad \text{where } a = \frac{T_p}{T_t}$$

Important Formulas-

- Size of each time slot in Time Division Multiplexing = $T_t + T_p$
- Efficiency (η) = 1 / (1+a) where a = T_p / T_t
- Effective Bandwidth / Bandwidth Utilization / Throughput = Efficiency(η) x Bandwidth
- Maximum Available Effective Bandwidth = Total number of stations x Bandwidth requirement of 1 station

Disadvantage-

- If any station does not have the data to send during its time slot, then its time slot goes waste.
- This reduces the efficiency.
- This time slot could have been allotted to some other station willing to send data.

PRACTICE PROBLEM BASED ON TIME DIVISION MULTIPLEXING (TDM)-

Problem-

If transmission delay and propagation delay of a packet in Time Division Multiplexing is 1 msec each at 4 Mbps bandwidth, then-

1. Find the efficiency.
2. Find the effective bandwidth.
3. How many maximum stations can be connected to the network if each station requires 2 Kbps bandwidth?

Solution-

Given-

- Transmission delay (T_t) = 1msec
- Propagation delay (T_p) = 1msec
- Bandwidth = 4 Mbps

Part-01:

For a TDM Network,

$$\text{Efficiency } (\eta) = 1 / 1+a \text{ where } a = T_p / T_t$$

Calculating Value Of 'a'-

$a = T_p / T_t$

$a = 1 \text{ msec} / 1 \text{ msec}$

$a = 1$

Calculating Efficiency-

Efficiency (η)

$= 1 / (1+a)$

$= 1 / (1 + 1)$

$= 1 / 2$

$= 0.5$

$= 50\%$

Part-02:

We know-

Effective Bandwidth = Efficiency (η) x Bandwidth

Thus,

Effective Bandwidth

= 0.5 x 4 Mbps

= 2 Mbps

Part-03:

We know-

Maximum Effective Bandwidth = Total number of stations x Bandwidth requirement of 1 station

Let the total number of stations that can be connected be N.

Then, we have-

2 Mbps = N x 2 Kbps

N = 1000

Thus, maximum 1000 stations can be connected.

To gain better understanding about Time Division Multiplexing (TDM),

Watch this Video Lecture

Next Article- **Polling | Access Control Method**

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