CS & IT ENGINEERING

COMPUTER NETWORKS

Medium Access Control

Lecture No-02

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TOPICS TO BE COVERED

Multiple Access Protocols Part-2

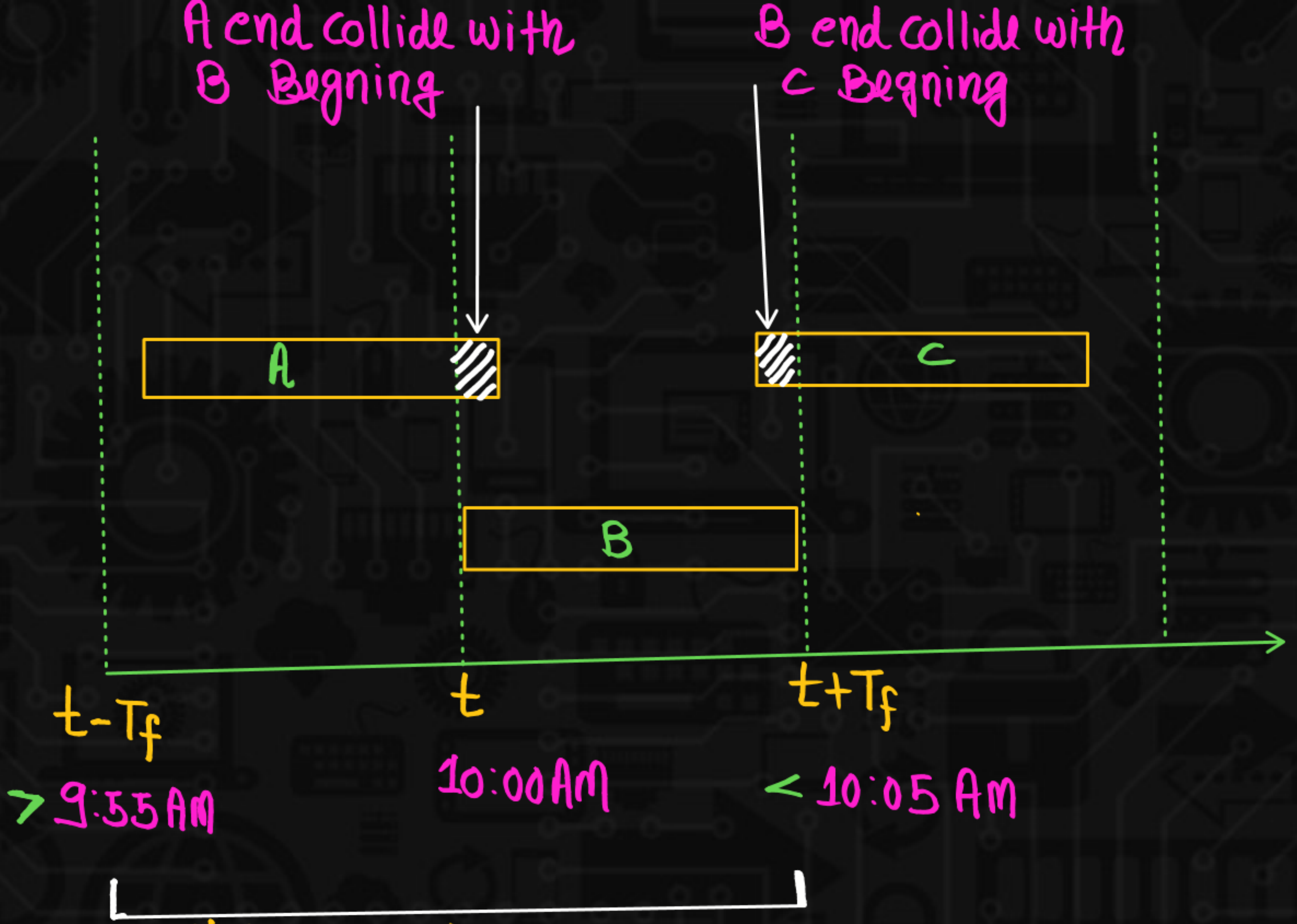
Vulnerable Time

For

Pure ALOHA

Vulnerable time for Pure ALOHA

Vulnerable time is the range of time where collision take place.



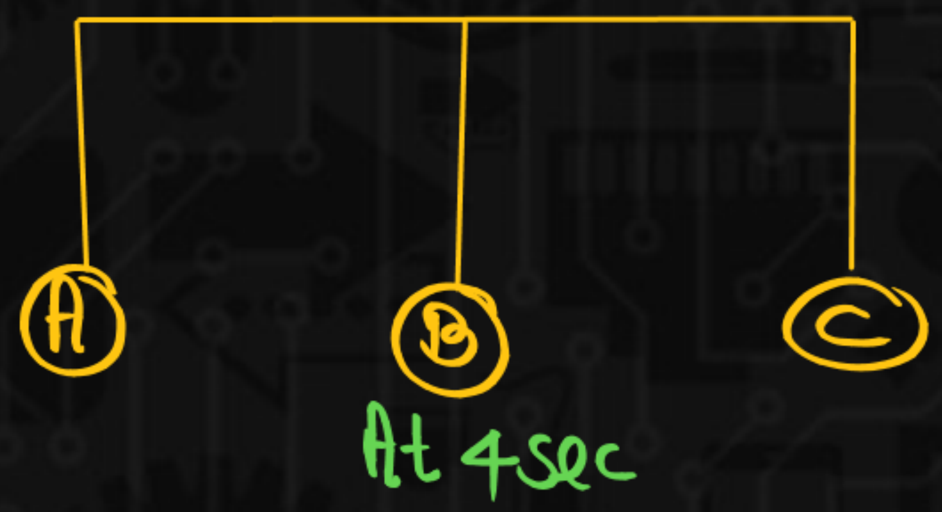
Vulnerable time = 10min

$\boxed{\text{Vulnerable time For Pure Aloha} = 2 * T_f}$

Transmission time For single Frame $(T_f) = \dfrac{\text{Frame size}}{\text{Bandwidth}} = \dfrac{L}{B}$

Assume transmission time of single Frame = 5 min

2.

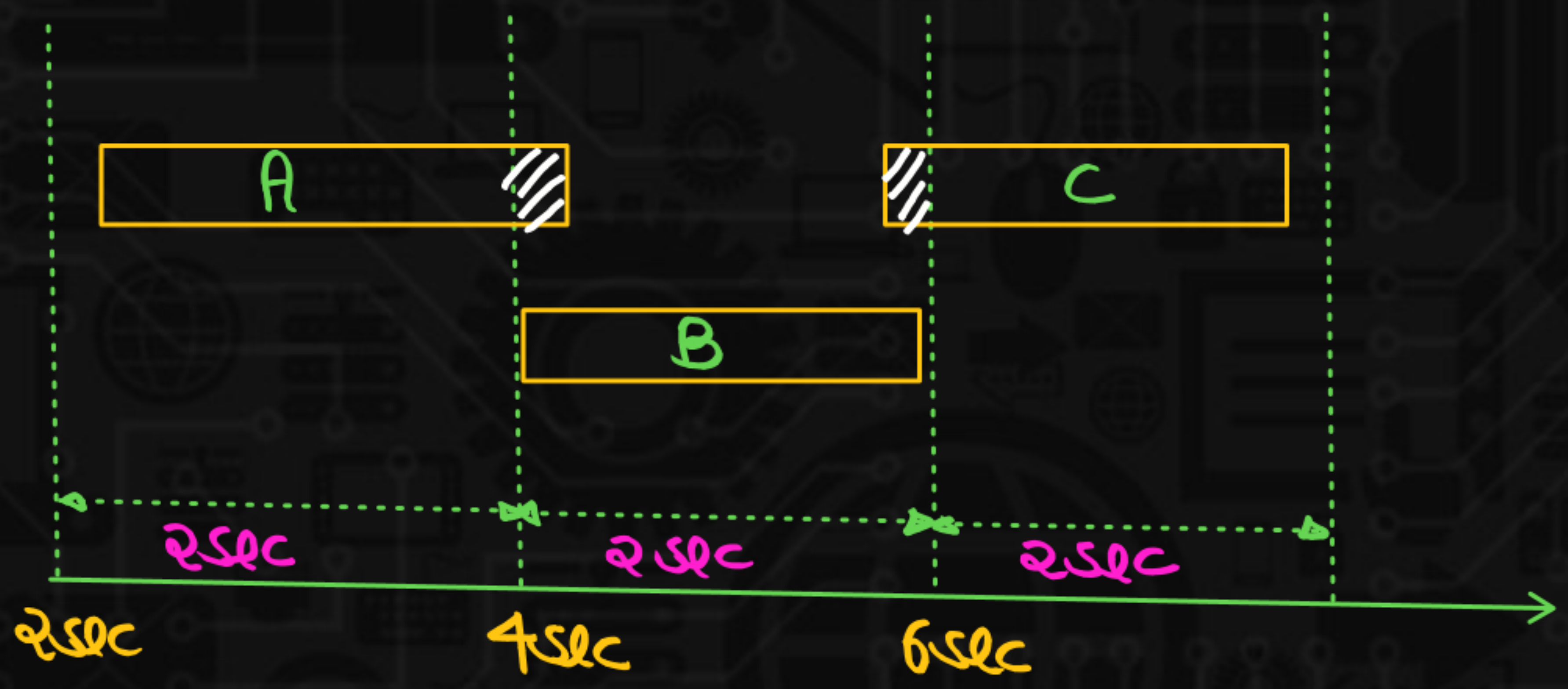


Assume $T_f = 2sec$

A start 2.1sec

A → 2.1 sec to 4.1sec

c start at 5.9sec



2sec —— 6sec

Vulnerable time = 4sec

$$\boxed{\text{Vulnerable time} = 2 * T_f}$$

Throughput Of Pure ALOHA

Throughput Of Pure ALOHA

$e = 2.7182$

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

G = Number of frames generated by n/w in $\boxed{\text{one Frame transmission time}}$

For Maximum Throughput

- We put $\frac{ds}{dG} = 0$
- Maximum value of s occurs at $\boxed{G = \frac{1}{2}}$
- Substituting G = ½ in the above equation we get
- Maximum throughput of pure aloha

$$= \frac{1}{2} \times e^{-\cancel{2} \times \frac{1}{\cancel{2}}} \qquad = \frac{1}{2e} \qquad = 0.184$$

So maximum throughput of pure aloha = 18.4%

Note

① If 1000 Frames are generated by n/w in one Frame transmission time then maximum 184 frames will be delivered successfully.

② $S_{max} \rightarrow G = \frac{1}{2}$

(i) one Half Frame should be generated in one Frame transmission time to Achieve maximum throughput

OR

(ii) one Frame should be generated in two transmission time to Achieve maximum throughput. Vulnerable time $= 2 \times T_f$

Note

- If one frame is generated by the network in two frame transmission time then in this situation we will achieve maximum throughput
- $\boxed{\text{Vulnerable time } 2T_F}$ is basically representing if one frame is generated by the network in two frame transmission time then there will be no collision. if there is no collision then we will achieve maximum throughput

Example:

A pure aloha network transmits 200 bit frames on a shared channel of 200 kbps. What is the throughput if the system(all station together) produces

Q.1) 1000 Frames generated by n/w in 1sec

Q.2) 500 Frames generated by n/w in 1sec

Q.3) 250 Frames generated by n/w in 1sec

NOTE: Throughput is defined as average number of frames successfully transmitted per second)

Frame size = 200 bits

Bandwidth = 200 Kbps

$$\text{Transmission time} = \frac{\text{Frame size}}{\text{Bandwidth}} = \frac{200 \text{ bits}}{200 * 10^3 \text{ bits/sec}} = 10^{-3} \text{ sec} = 1 \text{ msec}$$

Sol^n Q.1

$1\,sec \longrightarrow 1000$ Frames

$1\,msec = 10^{-3}\,sec \longrightarrow \cancel{1000} * \cancel{10^{-3}}$ Frame

$G = 1$ [No. of Frames generated by the n/w in one Frame transmission time]

Throughput $S = G * e^{-2G}$

$= 1 * e^{-2*1}$

$= \frac{1}{e^2} = 0.135$

Throughput $= 13.5\,\%$

Avg Number of Frames Successfully transmitted Per sec $= 1000 * 0.135$

$= 135$

$\boxed{\text{Sol}^n \text{ Q.2}}$

$1\ sec \longrightarrow 500\ Frames$

$1msec = 10^{-3} sec \longrightarrow 5\cancel{0}\cancel{0} * 10^{-\cancel{3}}\ Frames$

$= 5 * 10^{-1}$

$= \frac{5}{10} = \frac{1}{2}\ Frame$

$G = \frac{1}{2}$

throughput $S = G * e^{-2G}$

$= \frac{1}{2} * e^{-2*\frac{1}{2}}$

$= \frac{1}{2e} = 0.184$

Throughput = 18.4 %

Avg No. of Frames successfully transmitted per sec $= 500 * 0.184$

$= 92$

$\boxed{\text{Sol}^n\ Q.3}$

$$G = \frac{1}{4}$$

Throughput $S = 0.152$

Throughput $= 15.2\ \%$

Avg. No. of Frames successfully Transmitted $= 250 * 0.152 = 38$

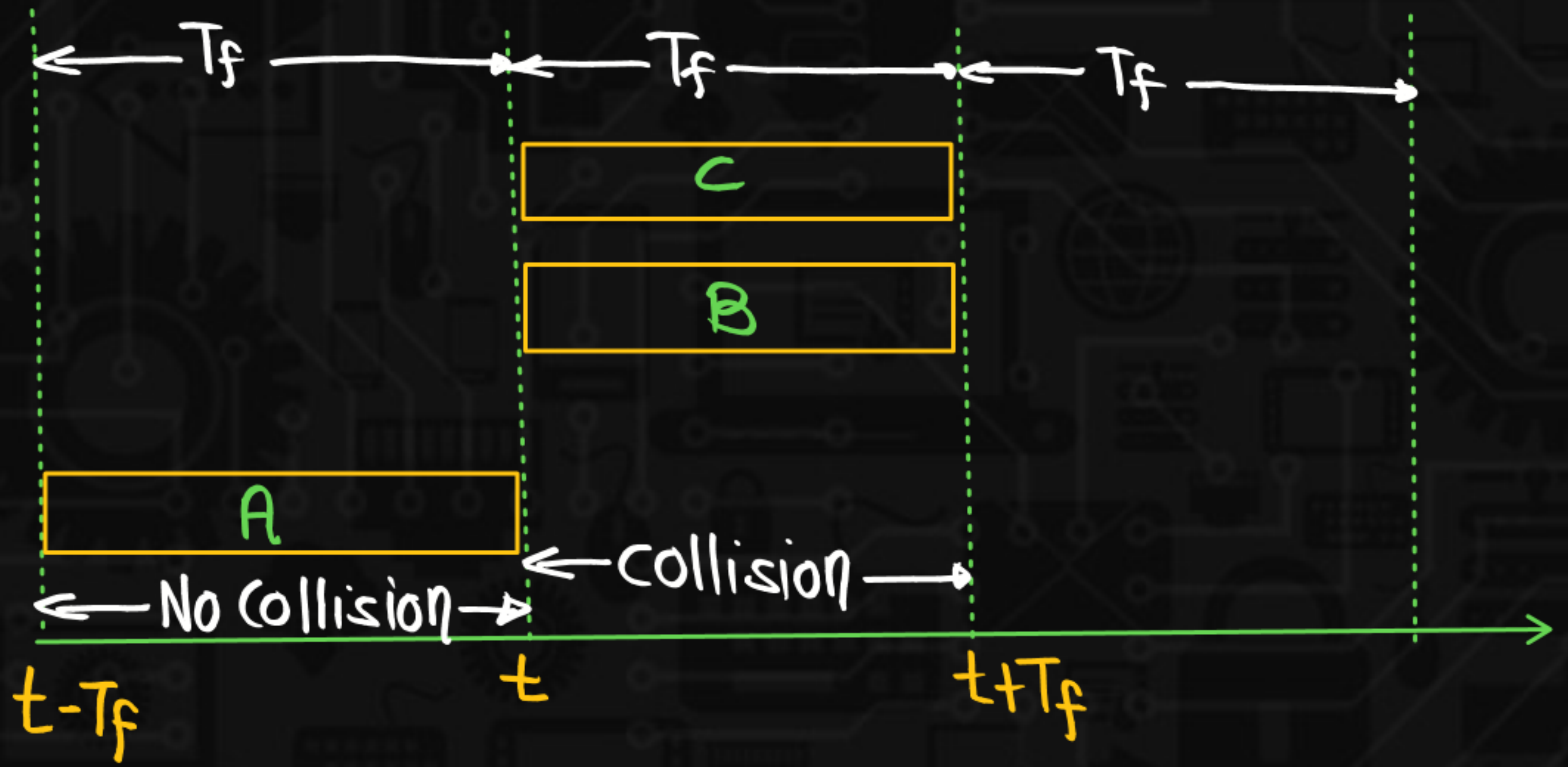
Slotted ALOHA

Slotted ALOHA

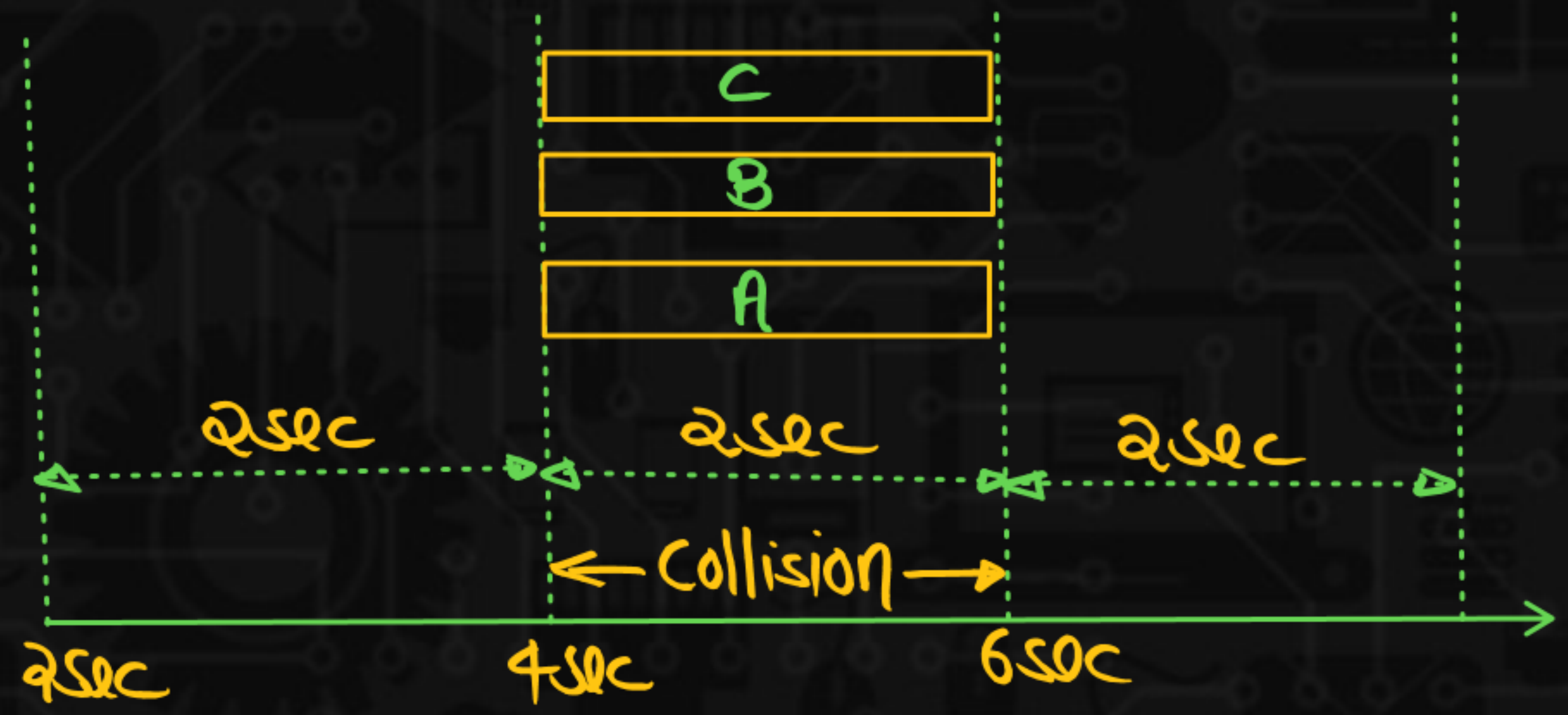
- Slotted aloha divides the time of shared channel into discrete intervals called as time slot (time slot = Transmission time For one frame).
- Any station can transmit its data in any time slot.
- The only condition is that station must start its transmission from the Beginning of time slat.
- If the Beginning of the slot is missed, then station has to wait until the beginning of next time slot.
- A collision may occur if two or more stations try to transmit data at the beginning of the same time slot.

Vulnerable time for Slotted ALOHA

Vulnerable time is the range of time where collision take place.



Vulnerable time For slotted Aloha $= T_f$



Assume $T_f = 2sec$

station A → 2.3sec → 4sec

station B → 5.2sec → 6sec

Note

A → 2.3sec
B → 3.1 sec
C → 3.3 sec
} 4sec

Collision Range 4sec → 6sec

Vulnerable time = 2sec

$$\boxed{\text{Vulnerable time} = T_f}$$

Note

① For example $T_f = 2$ sec. and station Has data to send at 2.3 sec then it will send at 4 sec. and station Has data to send at 5.2 sec then it will send at 6 sec

② In sloted Aloha collision can place For example if three station Has data to send at 2.3, 3.1, 3.3 sec then all of them will send at 4 sec.

Throughput Of Slotted ALOHA

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

G = Number of frames generated by n/w in $\boxed{\text{one Frame transmission time}}$

For Maximum Throughput

- We put $\frac{ds}{dG} = 0$
- Maximum value of s occurs at $\boxed{G = 1}$
- Substituting G = 1 in the above equation we get
- Maximum throughput of pure alone

$= 1 \times e^{-1} \qquad = \frac{1}{e} \qquad = 0.368$

So maximum throughput of slotted aloha = $\boxed{36.8\%}$

Note:

(1) If 1000 Frames are generated by the n/w in one Frame transmission time then maximum 368 Frames will be delivered successfully.

Note

$\boxed{S_{max} \rightarrow G = 1}$

- one frame should be generated in one time slot (one frame transmission time) to achieve maximum throughput
- Vulnerable time T_F is basically representing if one frame is generated by the network in one slot time(one frame transmission time) then there will be no collision. if there is no collision then we will achieve maximum throughput

Example:

A slotted aloha network transmits 200 bit frames on a shared channel of 200 kbps. What is the throughput if the system(all station together) produces

Frame size = 200 bits

B = 200 Kbps

Q.1) 1000 Frames generated by n/w in 1sec

Transmission time $= \dfrac{\cancel{200}\ \text{bits}}{\cancel{200} \times 10^3\ \text{bits/sec}}$

Q.2) 500 Frames generated by n/w in 1sec

Ans: 151

$= 10^{-3}$ sec $= 1$ Msec

Q.3) 250 Frames generated by n/w in 1sec

Ans: 49

NOTE: Throughput is defined as average number of frames successfully transmitted per second)

$\boxed{\text{Soln: Q.1}}$

$1\,sec \longrightarrow 1000\ \text{Frames}$

$1\,msec = 10^{-3}\,sec \longrightarrow \cancel{1000} * \cancel{10^{-3}}\ \text{Frame}$

$\longrightarrow 1\ \text{Frame}$

$\boxed{G = 1}$

Throughput $S = G * e^{-G}$

$= 1 * e^{-1}$

$= \frac{1}{e} = 0.368$

Throughput = 36.8%

Avg. No. of Frames successfully transmitted per sec = $1000 * 0.368$

$= 368$

Pure Aloha	Slotted Aloha
(1) Any station transmit the data at any time	Any station can transmit the data at the beginning of any time slot
(2) Vulnerable time in which collision may occur = $2 \times T_f$	Vulnerable time in which collision may occur = T_f
(3) Throughput of pure aloha = $\boxed{G \times e^{-2G}}$	Throughput of slotted Aloha = $\boxed{G \times e^{-G}}$
(4) Maximum throughput s_{max} = 18.4 % (When G = 1/2)	Maximum throughput s_{max} = 36.8 % (When G = 1)
(5) The main Advantage of pure aloha is it simplicity in implementation	The main advantage of slotted aloha is that it reduces the number of collisions to Half and double the throughput of pure aloha


THANK YOU
GW
SOLDIERS !