

CS & IT ENGINEERING



Computer Network

MAC Layer

Lecture No. - 06



By - Abhishek Sir



Recap of Previous Lecture



Topic

CSMA/CD

Topic

Ethernet





Topics to be Covered



Topic

Ethernet Bridging



ABOUT ME



Hello, I'm **Abhishek**

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- 12 years of GATE CS teaching experience

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#Q. Consider an Ethernet segment with a transmission speed of 10^8 bits/sec and a maximum segment length of 500 meters. If the speed of propagation of the signal in the medium is 2×10^8 meters/sec, then the minimum frame size (in bits) required for collision detection is _____.

[GATE-2024, Set-2, 2-Mark]

CSMA/CD

$$t_x \geq 2t_p$$

min^m Frame Size

$$t_x = 2t_p$$

Ans = 500

Solution :

$$= (2 t_p) * Bandwidth$$

Minimum frame size = $2 * (\underline{\text{Distance}} / \underline{\text{Signal Speed}}) * \text{Bandwidth}$

$$= \cancel{2} * (\underbrace{500 \text{ meters}} / \underbrace{2 \times 10^8 \text{ meters/sec}}) * \underbrace{10^8 \text{ bits/sec}}$$

$$= \underbrace{500 \text{ bits}}$$

#Q. Determine the maximum length of the cable (in km) for transmitting data at a rate of 500 Mbps in an Ethernet LAN with frames of size 10,000 bits. Assume the signal speed in the cable to be 2,00,000 km/s.

[GATE 2013]

- (A) 1
- ✓ (B) 2
- (C) 2.5
- (D) 5

$$t_x = 2 t_p$$

$$\frac{\text{Frame Size}}{\text{Bandwidth}} = 2 * \left(\frac{\text{Distance}}{\text{Signal speed}} \right)$$

Ans: B

Solution :

$$\begin{aligned}
 \text{Maximum Distance} &= (\text{Frame size} / \text{Bandwidth}) * (\text{Signal Speed} / 2) \\
 &= (10000 \text{ bits} / 500 \text{ Mbps}) * (200000 \text{ km/sec}) / 2 \\
 &= (10^4 \text{ bits} / 5 * 10^8 \text{ bits/sec}) * (2 * 10^5 \text{ km/sec}) / 2 \\
 &= 2 \text{ km}
 \end{aligned}$$

#Q. A and B are the only two stations on an Ethernet. Each has a steady queue of frames to send. Both A and B attempt to transmit a frame, collide, and A wins the first backoff race. At the end of this successful transmission by A, both A and B attempt to transmit and collide. The probability that A wins the second backoff race is:

[GATE 2004]

(A) 0.5

☒ (B) 0.625

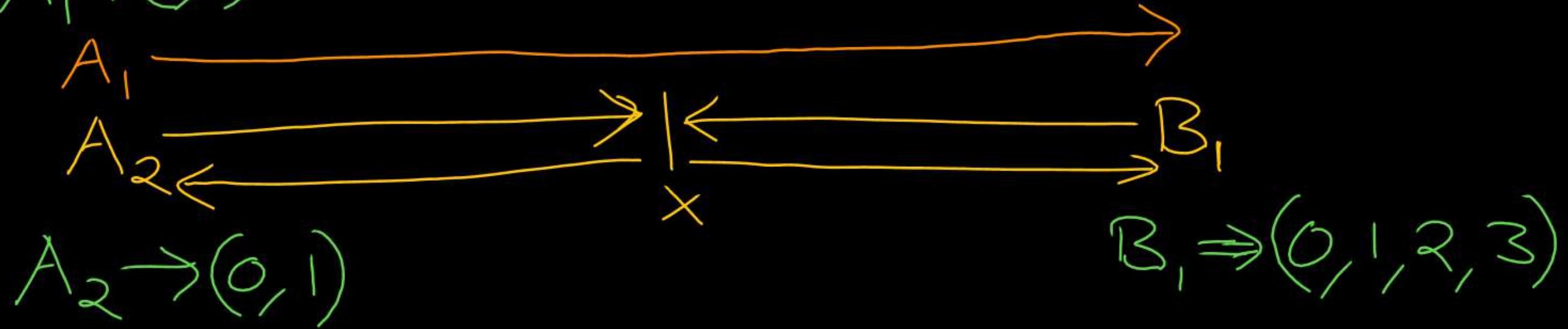
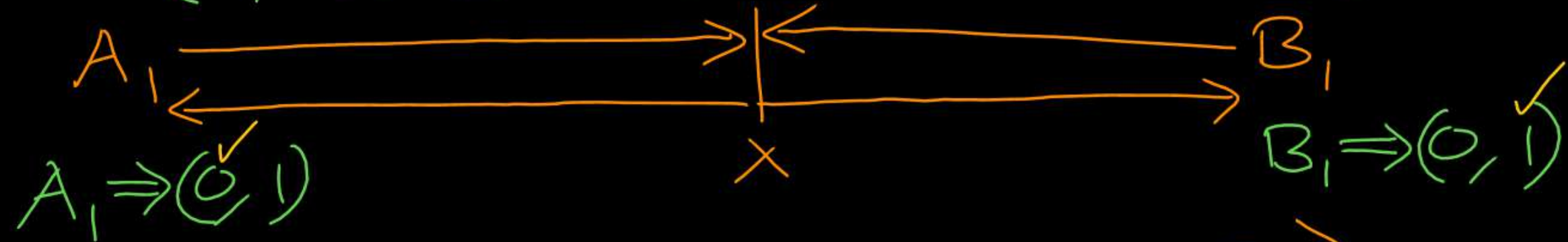
(C) 0.75

(D) 1.0

Ans: B

$A (A_1 A_2 A_3 \dots)$

$B (B_1 B_2 B_3 \dots)$



A_2	B_1	Result
0	0	Again collected
1	1	
0	1	A win
0	2	
0	3	
1	2	
1	3	B win
1	0	

$$\boxed{\text{Ans} = \frac{5}{8}} = 0.625$$

#Q. In an Ethernet local area network, which one of the following statements is TRUE?

[GATE 2016]

- ☒ (A) A station stops to sense the channel once it starts transmitting a frame. FALSE
- ☒ (B) The purpose of the jamming signal is to pad the frames that are smaller than the minimum frame size. FALSE
- ☒ (C) A station continues to transmit the packet even after the collision is detected. FALSE
- ☒ (D) The exponential backoff mechanism reduces the probability of collision on retransmissions. TRUE



Topic : LAN Standards



- IEEE 802.3 : Ethernet [Bus Topology => CSMA/CD]
- IEEE 802.4 : Token Bus [Bus Topology => Token]
- IEEE 802.5 : Token Ring [Ring Topology => Token]
- IEEE 802.11 : Wireless [Wi-Fi => CSMA/CA]

#Q. Which of the following statements is TRUE about CSMA/CD?

[GATE 2005]

- ~~(A)~~ IEEE 802.11 wireless LAN runs ^{CSMA/CA} CSMA/CD protocol. FALSE
- ~~(B)~~ Ethernet is not based on CSMA/CD protocol. FALSE
- ✓ (C) CSMA/CD is not suitable for a high propagation delay network like satellite network. TRUE
- ~~(D)~~ There is no contention in a CSMA/CD network. FALSE

Ans: C



Topic : Networking Devices



→ Physical Layer : Layer - 1 Device
[Repeater and Hub]

→ Data Link Layer : Layer - 2 Device
[Bridge / Switch]

→ Network Layer : Layer - 3 Device
[Router]

→ Application Layer : Layer - 7 Device
[Gateway]



Topic : Repeater



- Physical Layer [Layer - 1 Device]
- Two port device
- Signal Regenerator
[Regenerate the signal into output link]
- One bit delay
[Bit by bit forwarding]



Topic : Repeater



End-to-end delay for one packet from Host A to Host B

$$= t_x + t_{p1} + \left[(1 \text{ bit}) / \text{Bandwidth} \right] + t_{p2}$$
$$= [t_x + t_{p1} + t_{p2}]$$



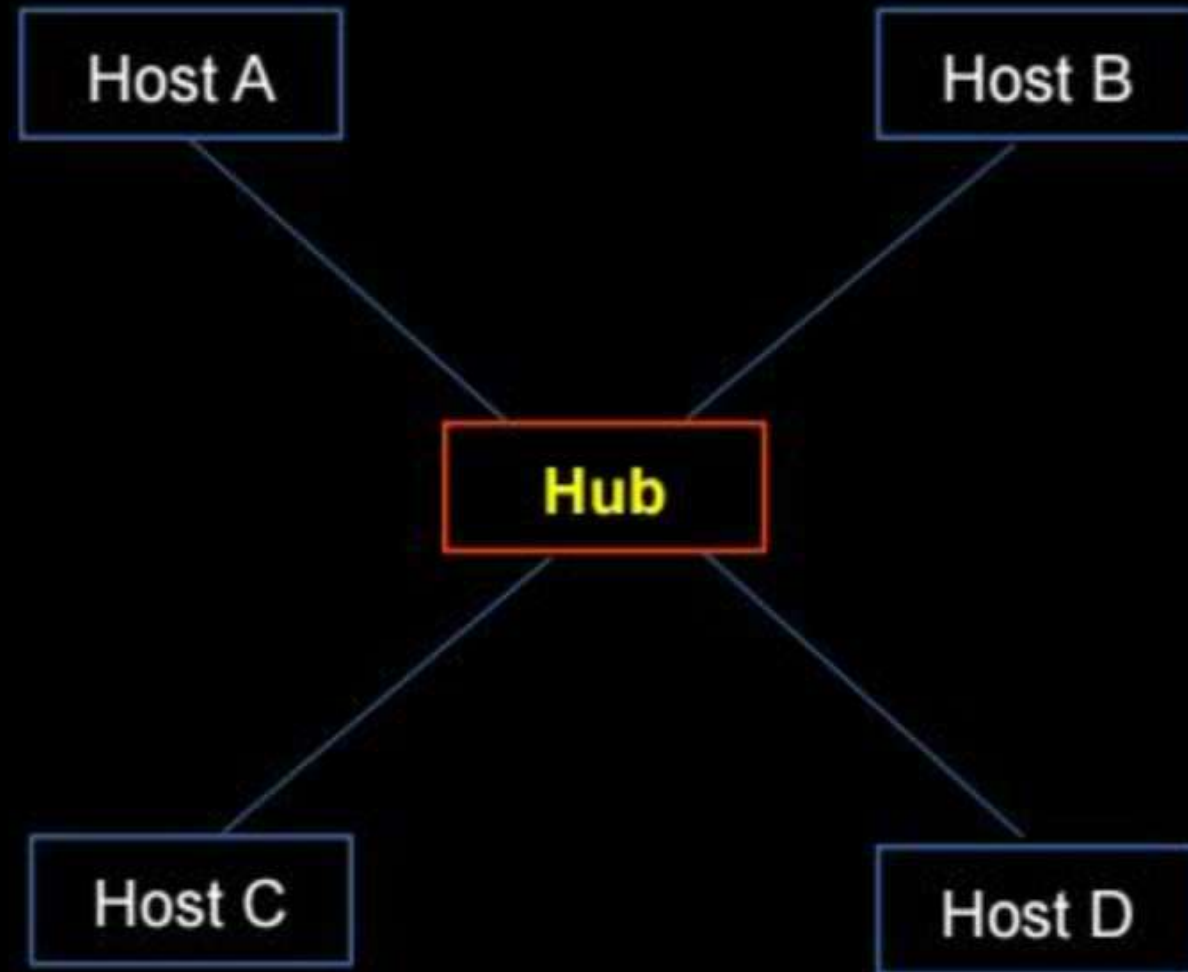
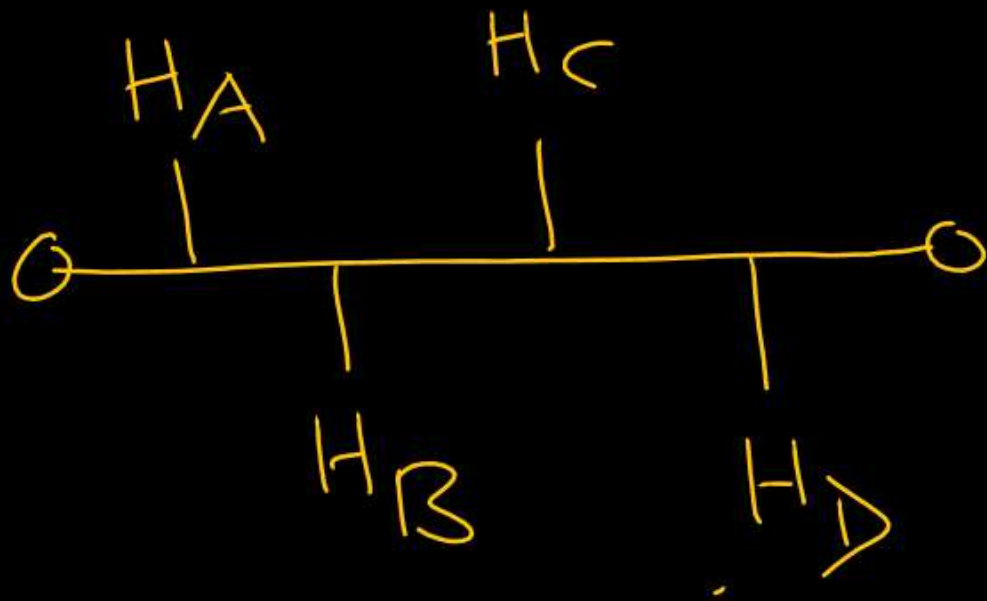
Topic : Hub



- Physical Layer [Layer - 1 Device]
- Multipoint repeater
- Regenerate the signal into all connected links, except incoming link [Broadcasting device]
- One bit delay [Bit by bit forwarding]

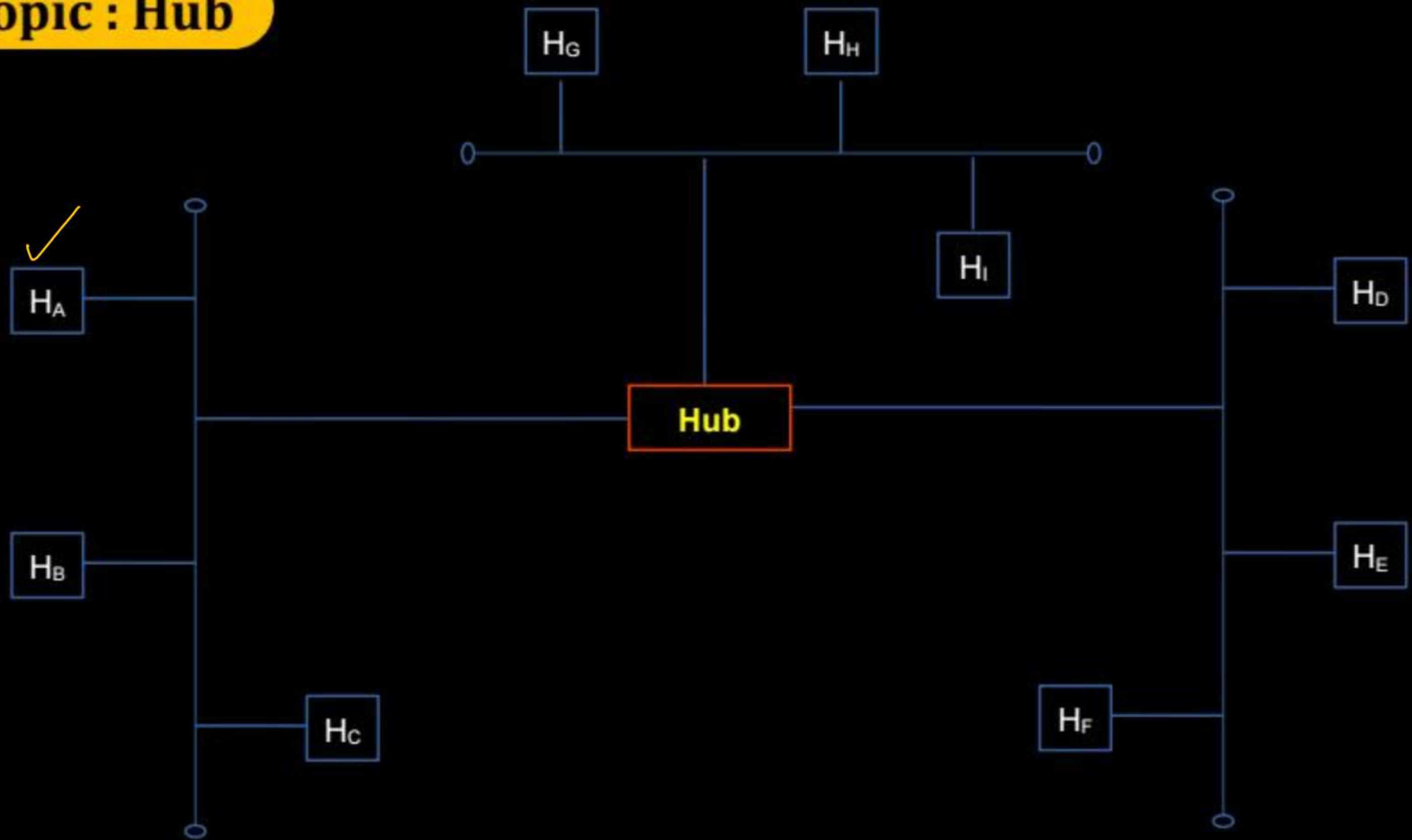


Topic : Hub





Topic : Hub



Source MAC Address = Host A MAC Address

CASE I : ✓

Destination MAC Address = Host C MAC Address

CASE II :

Destination MAC Address = Host D MAC Address

CASE III :

Destination MAC Address = Broadcast MAC Address [FF:FF:FF:FF:FF:FF]



Topic : Hub



→ Entire LAN has same broadcast domain ✓

→ Not collision domain separator

[Entire LAN has same collision domain]

Collision domain : Place where collision can occur



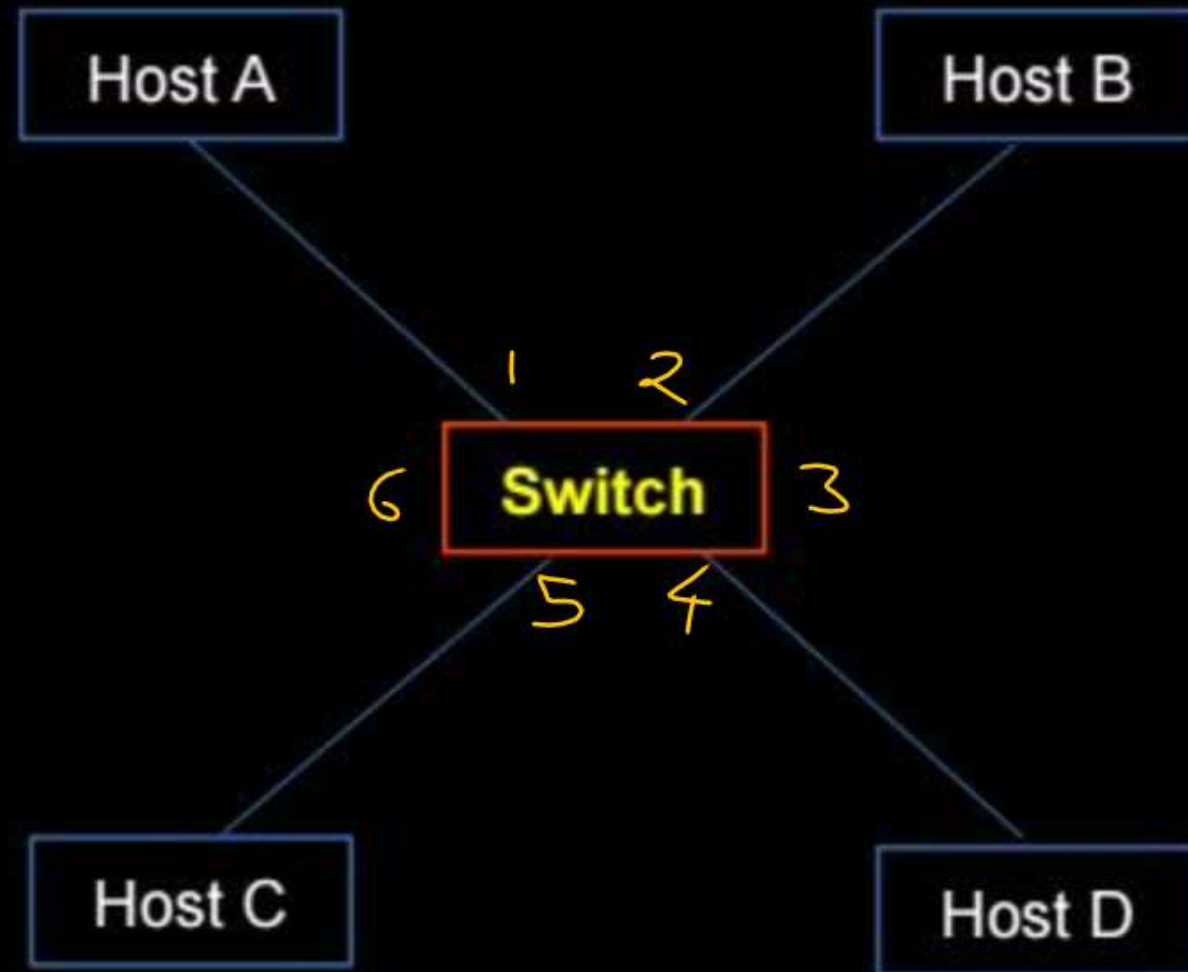
Topic : Switch



- Data Link Layer [Layer - 2 Device]
- Old Name : Bridge
[Multiport Bridge]
- Store and Forward
[Store, Process and Forward]
- Switching Table [Forwarding table]
[Forwarding based on Destination MAC Address]



Topic : Switch





Topic : Switch



Two types of switch :

1. Static

- > Non-adaptive
- > Manual update

2. Dynamic

- > Adaptive
- > Self learning
- > Plug-and-play



Topic : Switching Table

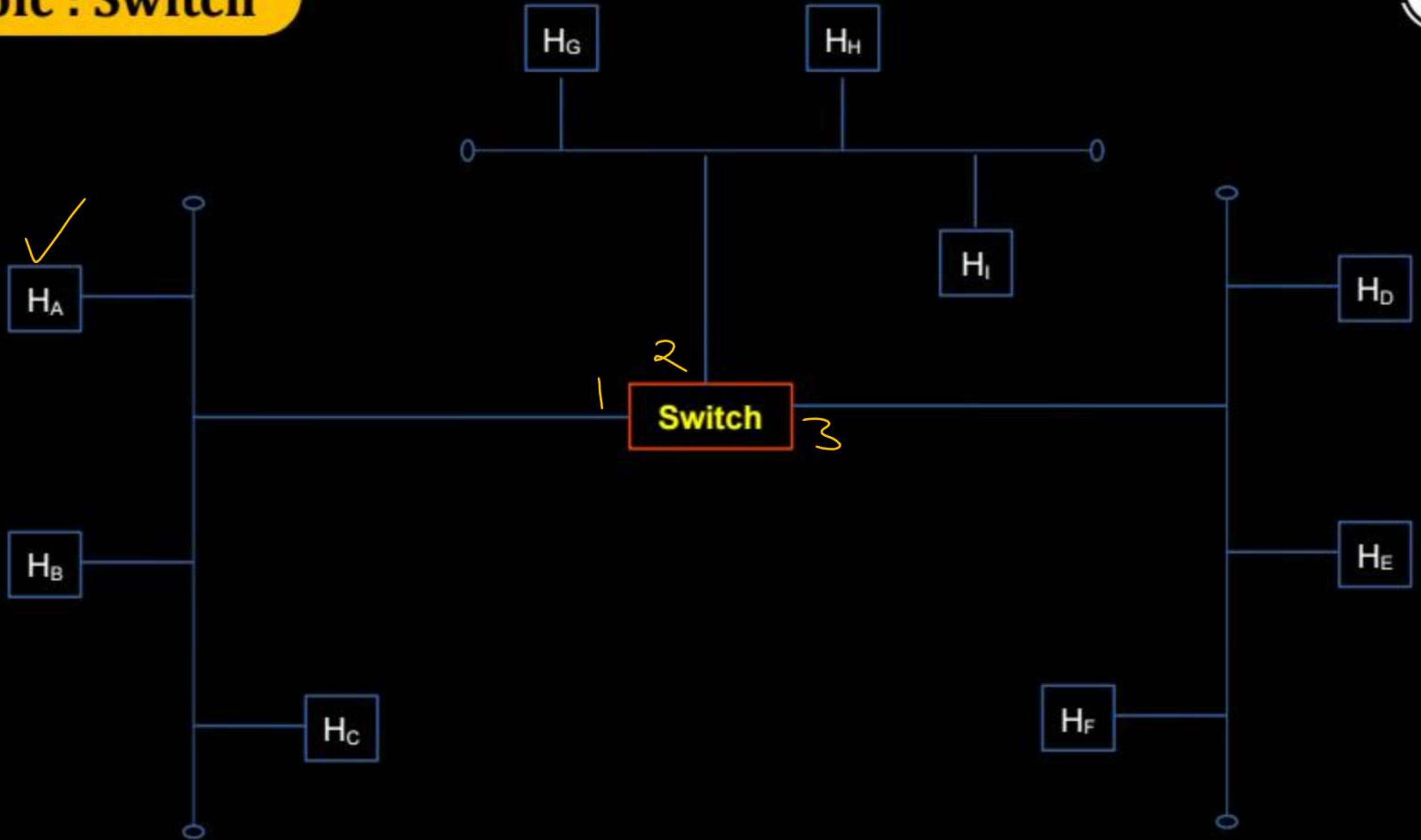


<u>MAC Address</u>	<u>Interface</u>	<u>TTL</u>
$H_A(MAC)$	1	
$H_D(MAC)$	4	
<u>FF:FF:FF:FF:FF:FF</u>	<u>Broadcast</u>	Infinite
<u>Default</u>	<u>Broadcast</u>	Infinite

TTL: Time to Live



Topic : Switch



Source MAC Address = Host A MAC Address

CASE I : ✓

Destination MAC Address = Host C MAC Address

CASE II : ✓

Destination MAC Address = Host D MAC Address

CASE III :

Destination MAC Address = Broadcast MAC Address [FF:FF:FF:FF:FF:FF]



Topic : Switch



- Entire LAN has same broadcast domain
- Collision domain separator
[Different LANs have different collision domain]

#Q. Which of the following statements is FALSE regarding a bridge?

[GATE 2005]

- (A) Bridge is a layer 2 device TRUE
- (B) Bridge reduces collision domain TRUE
- (C) Bridge is used to connect two or more LAN segments TRUE
- ✓ (D) Bridge reduces broadcast domain FALSE

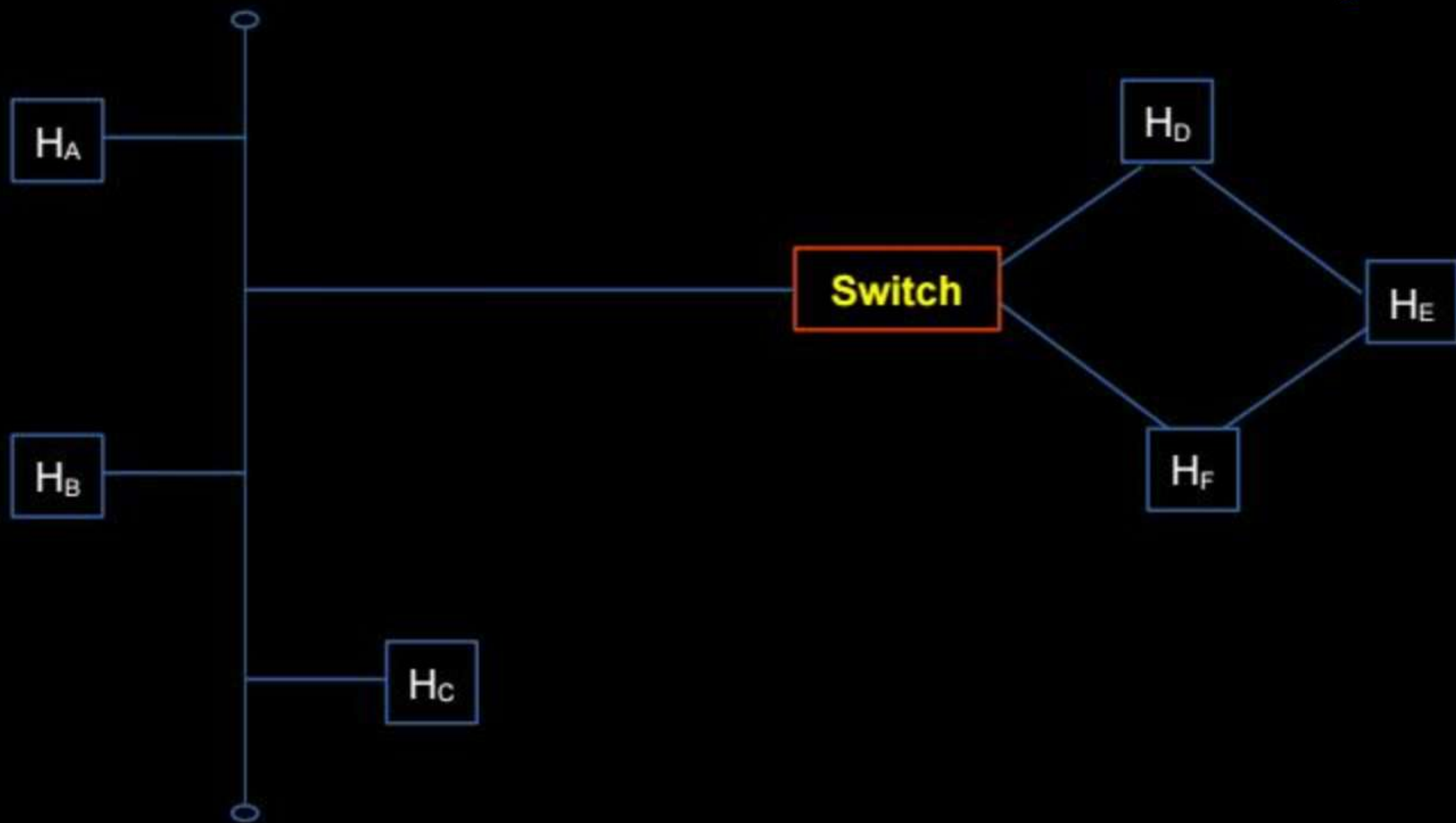
Ans: D



Topic : Switch



→ To connect different type of LAN segments minimum “Layer-2 device” required.

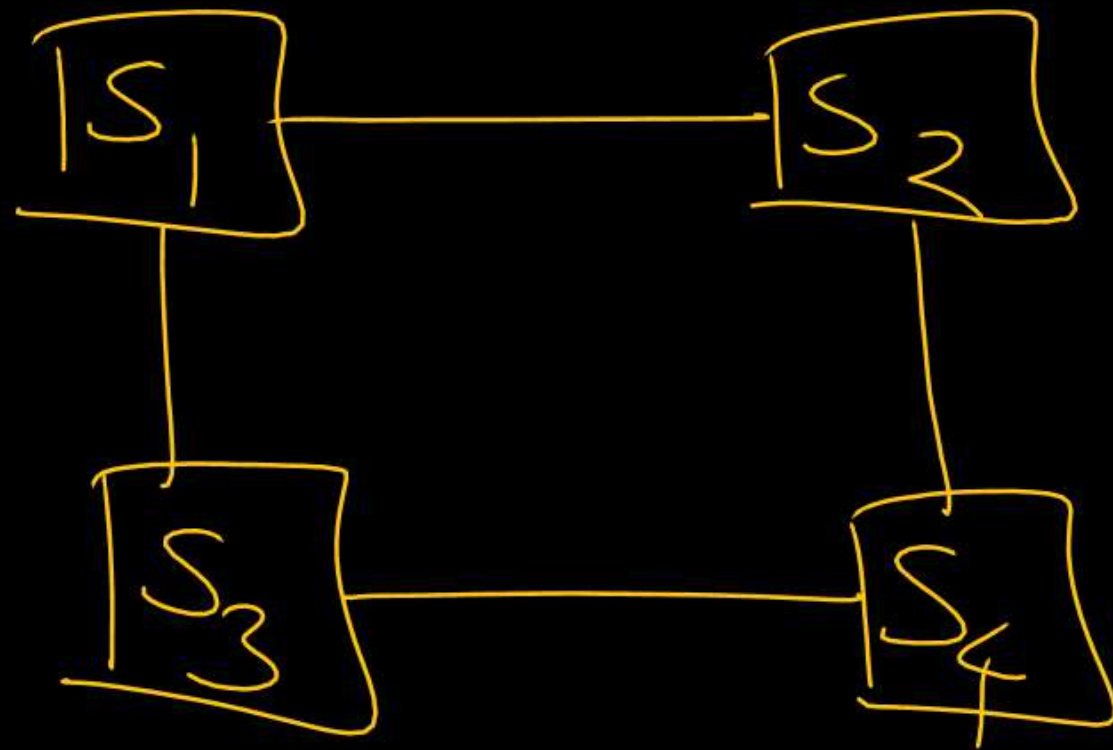




Topic : STP



- Multiple switches inside a network may form circuit (loop)
- To avoid indefinite traversing of frames
switches uses "Spanning Tree Protocol (STP)"



#Q. In a network of LANs connected by bridges, packets are sent from one LAN to another through intermediate bridges. Since more than one path may exist between two LANs, packets may have to be routed through multiple bridges. Why is the spanning tree algorithm used for bridge-routing?

[GATE 2005]

- ☒ (A) For shortest path routing between LANs
- ☒ (B) For avoiding loops in the routing paths
- ☒ (C) For fault tolerance
- ☒ (D) For minimizing collisions

Ans: B



2 mins Summary



Topic

Ethernet Bridging



THANK - YOU