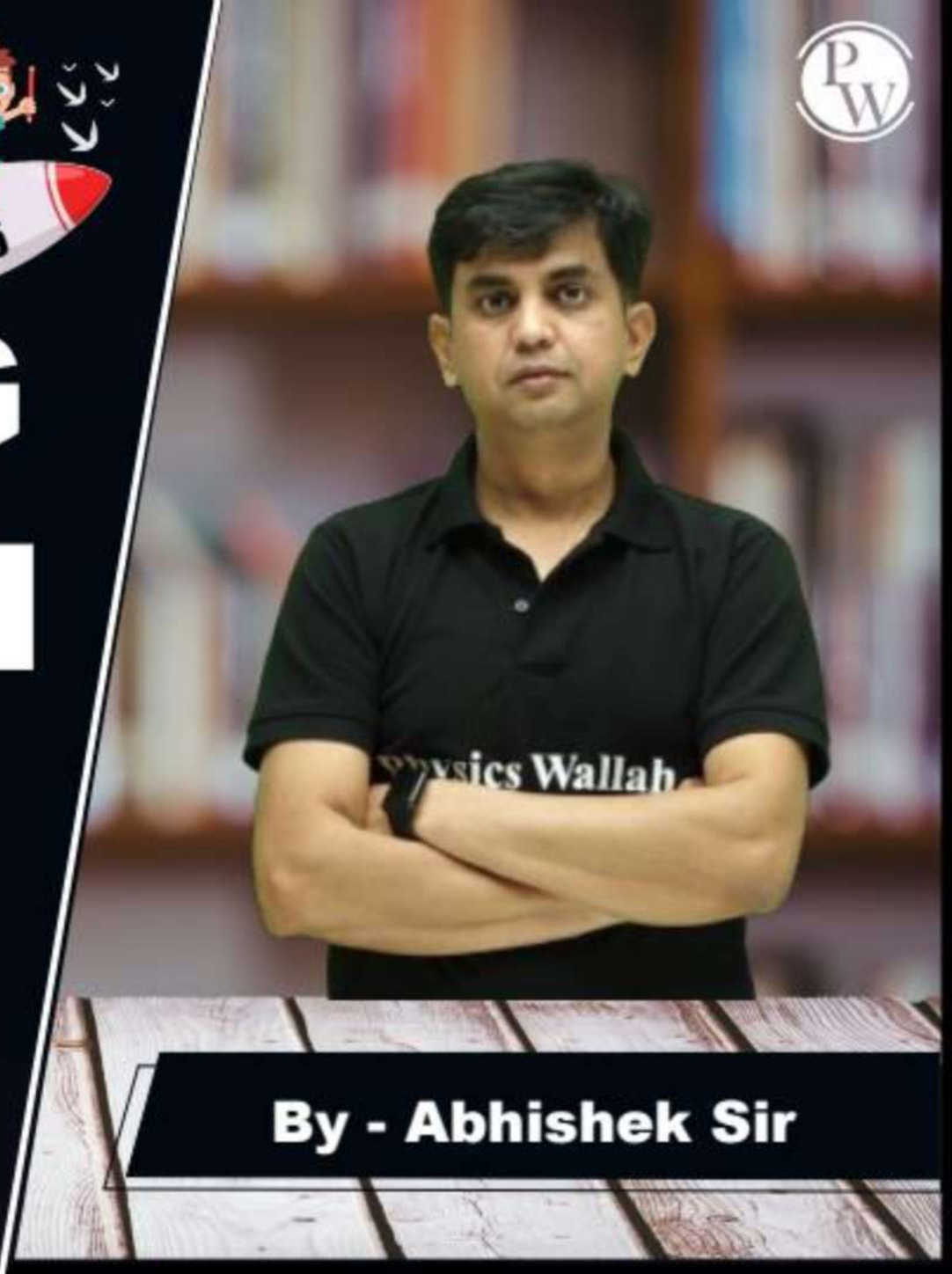
CS & IT ENGINEERING

Computer Network

IPv4 Addressing

Lecture No. - 08



Recap of Previous Lecture

Topic CIDR

Topic Supernetting

Topics to be Covered

- Topic: Supernetting
- Topic: ARP
- Topic: NAT

ABOUT ME

Hello, I'm Abhishek

- GATE CS AIR - 96
- M.Tech (CS) - IIT Kharagpur
- 12 years of GATE CS teaching experience

Telegram Link : https://t.me/abhisheksirCS_PW

#Q. An organization requires a range of IP address to assign one to each of its 1500 computers. The organization has approached an Internet Service Provider (ISP) for this task. The ISP uses CIDR and serves the requests from the available IP address space "202 . 61 . 0 . 0 / 17". The ISP wants to assign an address space to the organization which will minimize the number of routing entries in the ISP's router using route aggregation. Which of the following address spaces are potential candidates from which the ISP can allot any one of the organization?

I. 202 . 61 . 84 . 0 / 21
II. 202 . 61 . 104 . 0 / 21
III. 202 . 61 . 64 . 0 / 21
IV. 202 . 61 . 144 . 0 / 21

No. of Host in the org. = 1500
Host ID size = $\lceil \log_2(1500) \rceil$ bits
= 11 bit

IIT-D H.W.

[GATE 2020, 2-Marks]

(A) I and II only
(B) II and III only
(C) III and IV on
(D) I and IV only

Ans: B

Available IP Address Range → 202.61.0.0/17

202.61.00000000.00000000/17

202.61.0-------.-------/17

Prefix (17 bit) — Host ID (15 bit)

Org. Address :-

202.61.0----.000.00000000/21

17 bit (prefix) — 4 bit — Host ID (11 bit)

84 → 01010100

104 → 01101000

64 → 01000000

144 → 10010000

Topic : Supernetting

→ Prefix (Route) Aggregation

→ Combining (logically) smaller networks into single large network

→ Allow more efficient routing

→ Reduces the number of entries in routing table

→ All the Networks should be contiguous
[Block of addresses having contiguous prefixes]

Topic : Supernetting

Example 1 : Suppose network id field size are 6 bits and host id field size are 2 bits. Consider following Network Addresses of networks, what should be the supernet address?

Net. Add.$_1$: 10100000/6

Net. Add.$_2$: 10100100/6

Net. Add.$_3$: 10101000/6

Net. Add.$_4$: 10101100/6

10100000/5

10101000/5

Supernet Address : 10100000/4

Topic : Supernetting

Net Add$_{14}$: 10100000/4

Example 1 :

Net. Add$_{12}$: 10100000/5

Net. Add.$_1$: **10100000/6**
1010 0001
1010 0010
1010 0011

Net. Add.$_2$: **10100100/6**
1010 0101
1010 0110
1010 0111

Net. Add$_{34}$: 10101000/5

Net. Add.$_3$: **10101000/6**
1010 1001
1010 1010
1010 1011

Net. Add.$_4$: **10101100/6**
1010 1101
1010 1110
1010 1111

Topic : Supernetting

Example 2 :- Consider following Network Addresses of networks. What should be supernet address ?

150 . 125 . 160 . 0 / 23

150 . 125 . 162 . 0 / 23

150 . 125 . 164 . 0 / 23

150 . 125 . 166 . 0 / 23

Supernet Address : ?

Topic : Supernetting

Example 2 :-

Prefix 23 bit

9 bit Host ID

150 . 125 . 1 0 1 0 0 0 0 . 0 0 0 0 0 0 0 0 / 23

150 . 125 . 1 0 1 0 0 0 1 0 . 0 0 0 0 0 0 0 0 / 23

150 . 125 . 1 0 1 0 0 1 0 0 . 0 0 0 0 0 0 0 0 / 23

150 . 125 . 1 0 1 0 0 1 1 0 . 0 0 0 0 0 0 0 0 / 23

Supernet Address : 150 . 125 . 160 . 0 / 21

150 . 125 . 1 0 1 0 0 0 0 0 . 0 0 0 0 0 0 0 0 / 21

Topic : Supernetting

Example 3 :- Consider following Network Addresses of networks.

210 . 192 . 0 . 0 / 13

210 . 200 . 0 . 0 / 13

210 . 208 . 0 . 0 / 13

210 . 216 . 0 . 0 / 13

Supernet Address : ?

Topic : Supernetting

Example 3 :-

Host ID 19 bit

210.110 00 000.00000000.00000000 / 13

210.110 01 000.00000000.00000000 / 13

210.110 10 000.00000000.00000000 / 13

210.110 11 000.00000000.00000000 / 13

Supernet Address : 210.192.0.0 / 11

210.110 00 000.00000000.00000000 / 11

Host ID 21 bit

Topic : Supernetting

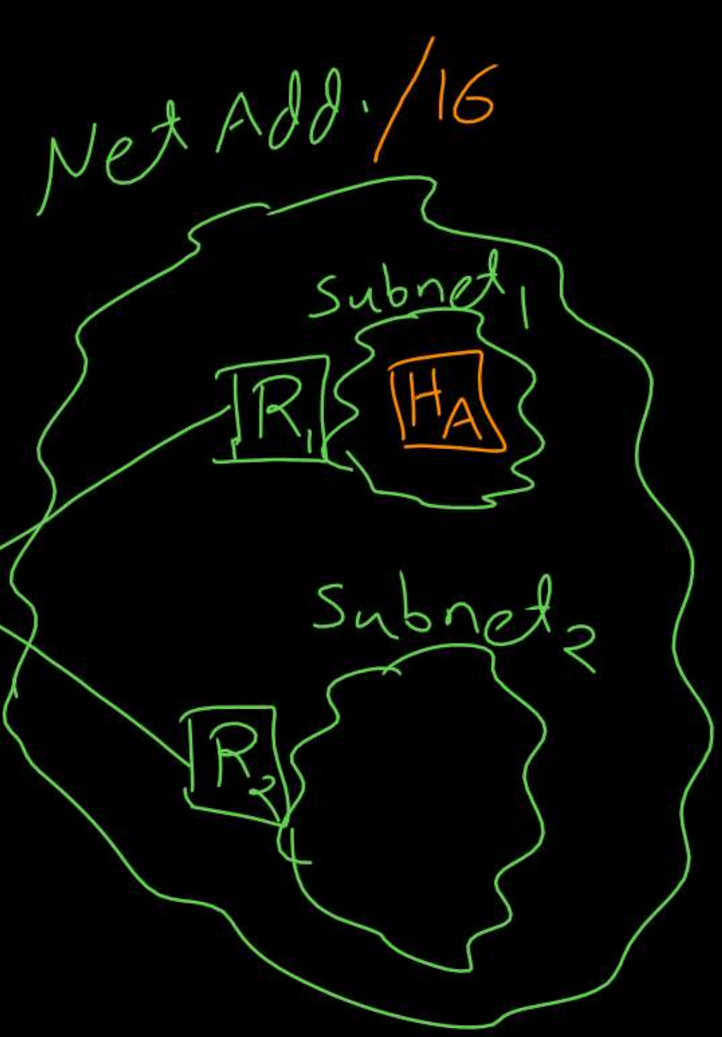
Example 4 :- Consider following Network Addresses of networks.

10 . 90 . 0 . 0 / 16

10 . 90 . 64 . 0 / 18

10 . 90 . 192 . 0 / 18

Supernet Address :



R_x [Routing Table]

Dest.	Next Hop
Net Add. /16	R_3
Sub. Add$_1$ /18	R_3
Sub. Add$_2$ /18	R_3

Topic : Supernetting

Example 4 :-

10 . 90 . 00000000 . 00000000 / 16

16 bit

10 . 90 . 01000000 . 00000000 / 18

10 . 90 . 11000000 . 00000000 / 18

Supernet Address : 10 . 90 . 0 . 0 / 16

10 . 90 . 00000000 . 00000000 / 16

#Q. Consider routing table of an organization's router shown below :

Subnet Number	Subnet Mask	Next Hop
12 . 20 . 164 . 0	255 . 255 . 252 . 0	R1
12 . 20 . 170 . 0	255 . 255 . 254 . 0	R2
12 . 20 . 168 . 0	255 . 255 . 254 . 0	Interface 0
12 . 20 . 166 . 0	255 . 255 . 254 . 0	Interface 1
Default		R3

Which of the following prefixes in CIDR notation can be collectively used to correctly aggregate all of the subnets in the routing table ?

[GATE-2022, 2-Mark]

H.W.

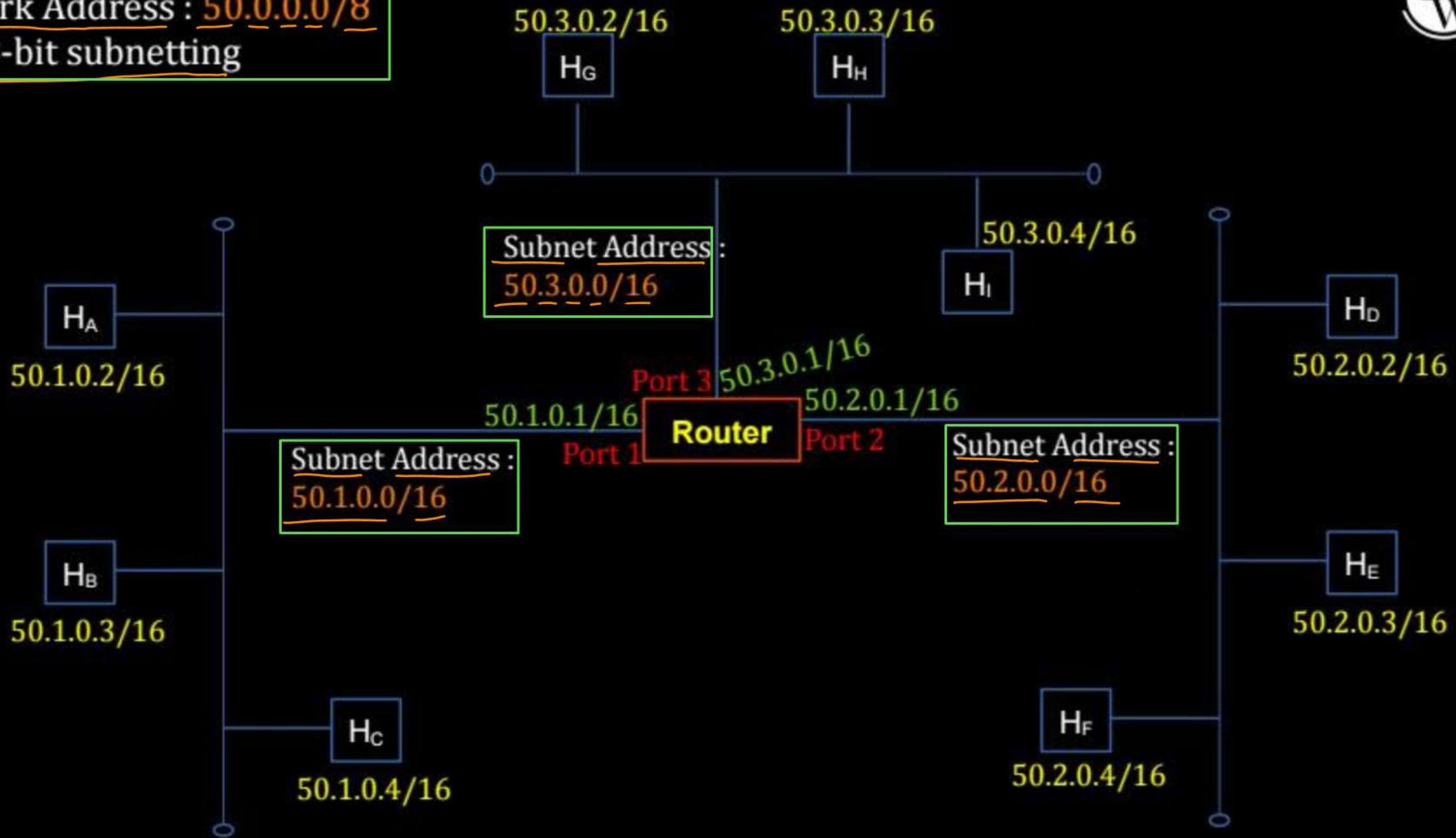
(A) 12 . 20 . 164 . 0 / 20

(B) 12 . 20 . 164 . 0 / 22

(C) 12 . 20 . 164 . 0 / 21

(D) 12 . 20 . 168 . 0 / 22

Network Address : 50.0.0.0/8
With 8-bit subnetting



Host A, IPv4 Configuration :-

IPv4 Address : 50 . 1 . 0 . 2

Subnet Mask : 16 or 255 . 255 . 0 . 0

Default Gateway : 50 . 1 . 0 . 1

Router forwarding table

Subnet Address	Interface ID	Next Hop
50 . 1 . 0 . 0 / 16	1	On Link
50 . 2 . 0 . 0 / 16	2	On Link
50 . 3 . 0 . 0 / 16	3	On Link

CASE I :

Source IP Address	:	50 . 1 . 0 . 2
Destination IP Address	:	50 . 1 . 0 . 3

H_A

H_B

→ Host A (source host) finds destination host IP (Host B) belongs to same subnet ✓

→ Host A uses ARP Protocol to find MAC Address of destination host

→ Host A send frame to Host B
[The frame encapsulates the IP datagram]

Source MAC Address	:	Host A MAC Address
Destination MAC Address	:	Host B MAC Address

CASE II :

Source IP Address : 50 . 1 . 0 . 2 H_A

Destination IP Address : 50 . 2 . 0 . 2 H_D

IP Datagram

→ Host A (source host) finds destination host IP (Host D) belongs to different subnet

→ Host A uses ARP Protocol to find MAC Address of default gateway [50 . 1 . 0 . 1]

→ Host A send frame to Router

[The frame encapsulates the IP datagram]

Source MAC Address : Host A MAC Address

Destination MAC Address : Router MAC Address

Frame

CASE II :

Source IP Address	:	50 . 1 . 0 . 2
Destination IP Address	:	50 . 2 . 0 . 2

→ Router receives the IP datagram

→ Finds destination host IP (Host D) belongs to subnet connected via port 2

→ Router uses ARP Protocol to find MAC Address of destination host [50.2.0.2]

→ Router send frame to Host D
[The frame encapsulates the IP datagram]

Source MAC Address	:	Router MAC Address
Destination MAC Address	:	Host D MAC Address

Frame 2

#Q. Host X has IP address 192 . 168 . 1 . 97 and is connected through two routers R1 and R2 to another host Y with IP address 192 . 168 . 1 . 80, Router R1 has IP addresses 192 . 168 . 1 . 135 and 192 . 168 . 1 . 110, R2 has IP addresses 192 . 168 . 1 . 67 and 192 . 168 . 1 . 155, the netmask used in the network is 255 . 255 . 255 . 224;

Which IP address should X configure its gateway as?

IISC
[GATE-2008]
H.W.

(A) 192 . 168 . 1 . 67

(B) 192 . 168 . 1 . 110

(C) 192 . 168 . 1 . 135

(D) 192 . 168 . 1 . 155

#Q. Given the information in previous question, how many distinct subnets are guaranteed to already exist in the network?

IISC
[GATE-2008]
H.W.

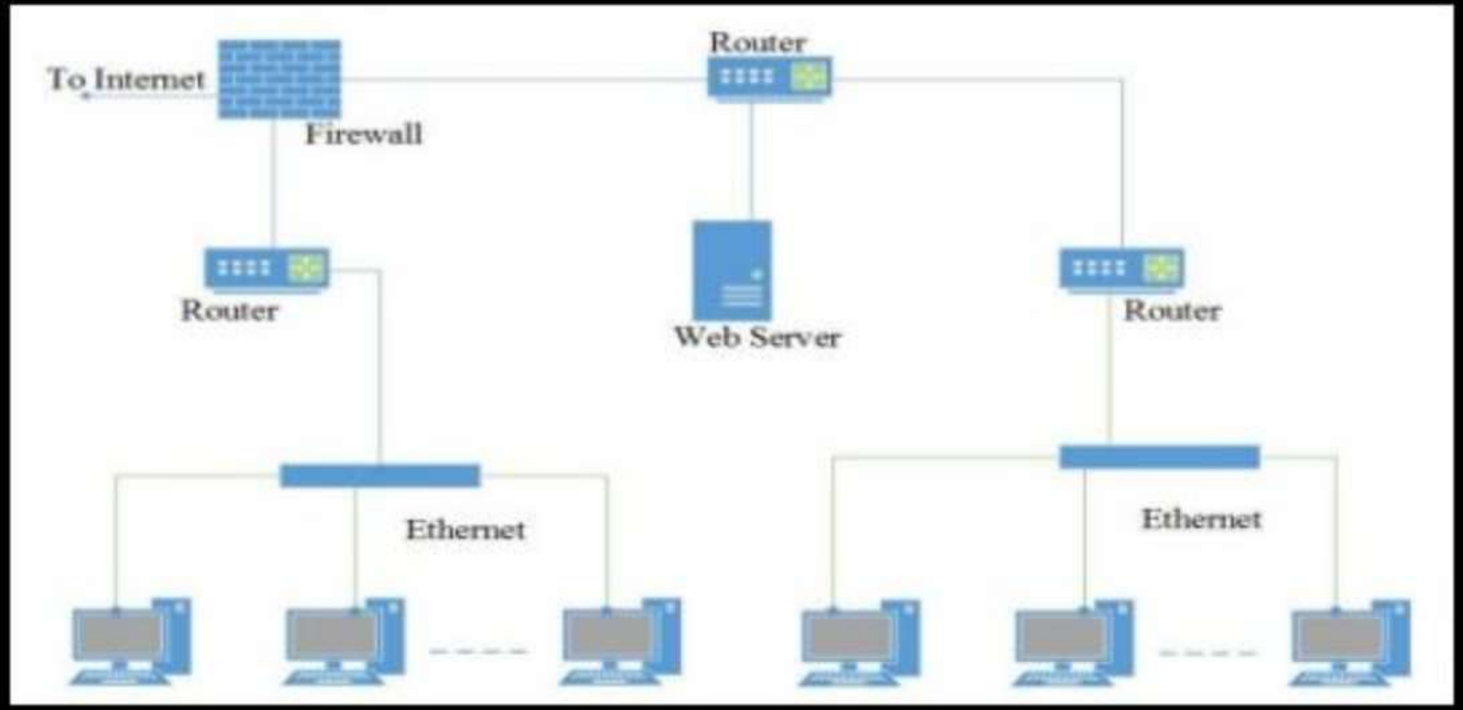
(A) 1

(B) 2

(C) 3

(D) 6

#Q. Consider an enterprise network with two Ethernet segments, a web server and a firewall, connected via three routers as shown below.



What is the number of subnets inside the enterprise network? H.W.

[GATE-2022, 1-Mark]

(A) 3 (B) 12 (C) 6 (D) 8

2 mins Summary

Topic Supernetting

Topic ARP

Topic [redacted]

THANK - YOU