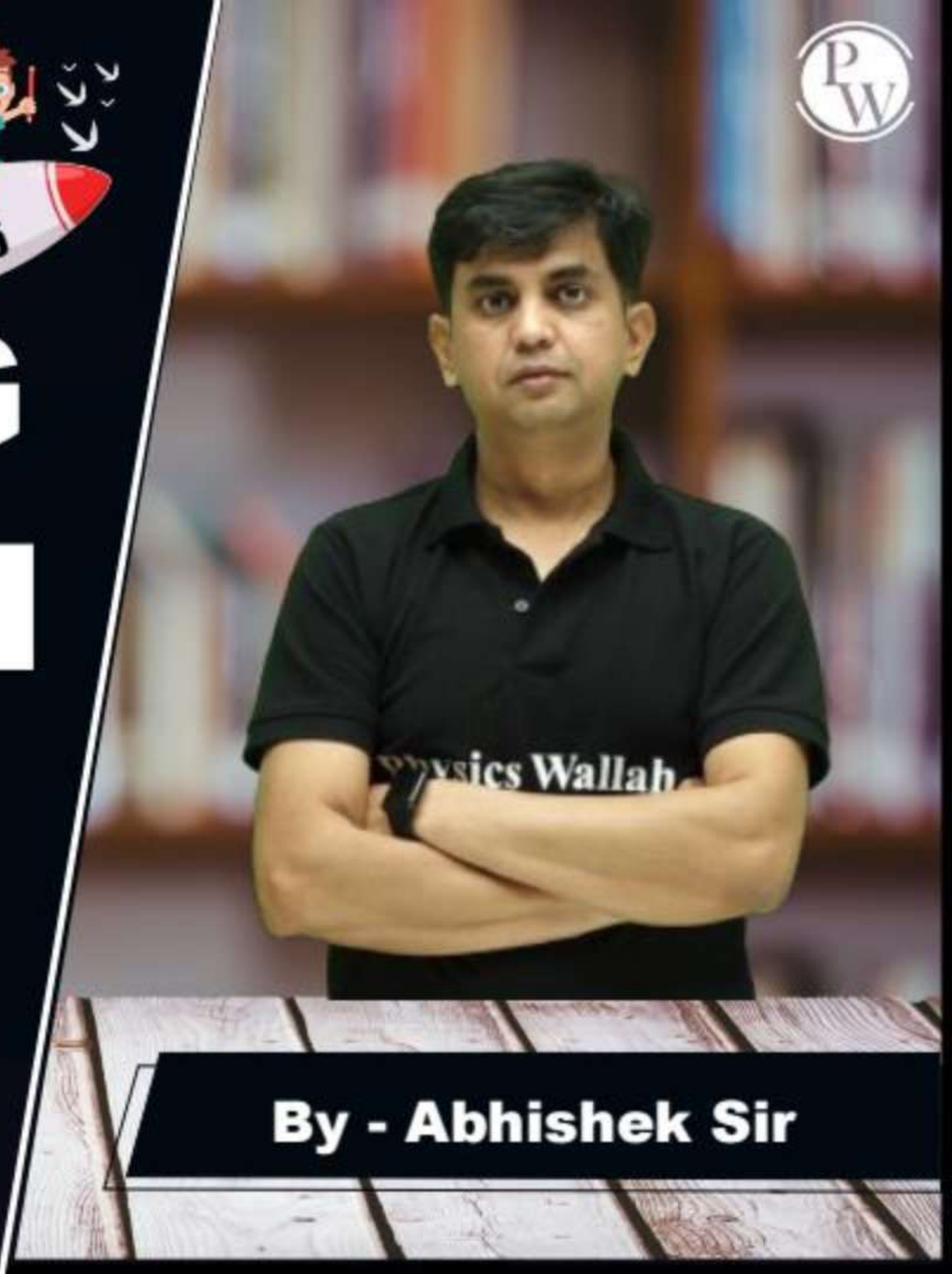
CS & IT ENGINEERING

Computer Network

IPv4 Addressing

Lecture No. - 06



Recap of Previous Lecture

Topic Subnetting

Topic VLSM

Topic Forwarding Table

Topics to be Covered

- Topic: Forwarding Table (Routing Table)
- Topic: CIDR
- Topic: Supernetting

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

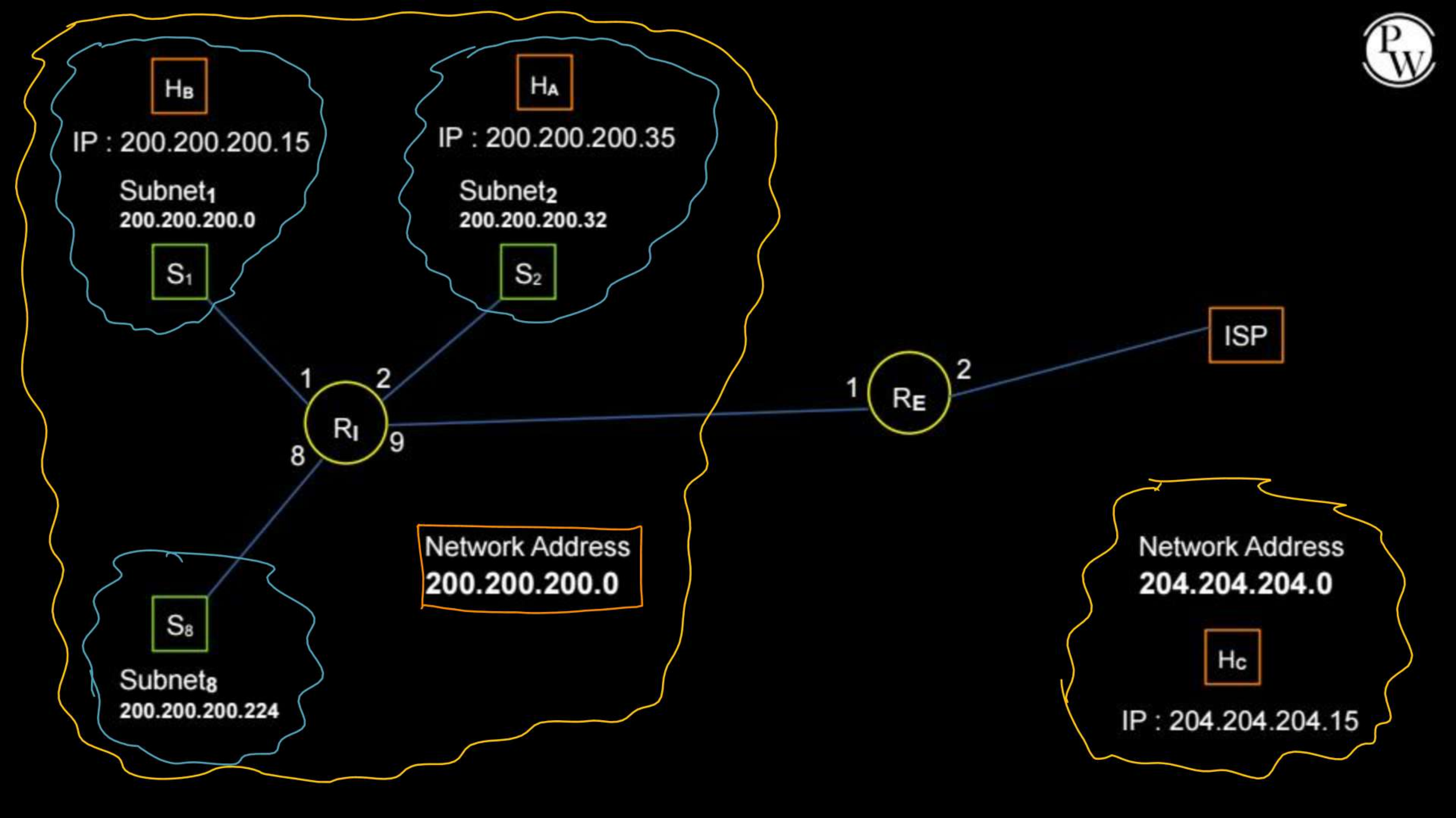
Class C Network :-

Network Address	:	200 . 200 . 200 . 0
Default Netmask	:	255 . 255 . 255 . 0

After 3-bit subnetting :-

Subnet Mask	:	255 . 255 . 255 . 224

1st Subnet Address	:	200 . 200 . 200 . 0
2nd Subnet Address	:	200 . 200 . 200 . 32
3rd Subnet Address	:	200 . 200 . 200 . 64
4th Subnet Address	:	200 . 200 . 200 . 96
5th Subnet Address	:	200 . 200 . 200 . 128
6th Subnet Address	:	200 . 200 . 200 . 160
7th Subnet Address	:	200 . 200 . 200 . 192
8th Subnet Address	:	200 . 200 . 200 . 224


HB
IP : 200.200.200.15
Subnet1
200.200.200.0
S1
HA
IP : 200.200.200.35
Subnet2
200.200.200.32
S2
1
2
RI
8
9
S8
Subnet8
200.200.200.224
Network Address
200.200.200.0
1
RE
2
ISP
Network Address
204.204.204.0
Hc
IP : 204.204.204.15

Topic : Forwarding Table

Router (R_E) forwarding table / Routing Table

Network Address	Network Mask	Interface ID	Next Hop
200 . 200 . 200 . 0	255. 255 . 255 . 0	1	R_I
Default		2	ISP

Topic : Forwarding Table

Router (R_I) forwarding table

Destination Mask

Subnet Address	Subnet Mask	Interface ID	Next Hop
200 . 200 . 200 . 0	255 . 255 . 255 . 224	1	On Link
200 . 200 . 200 . 32	255 . 255 . 255 . 224	2	On Link
200 . 200 . 200 . 64	255 . 255 . 255 . 224	3	On Link
200 . 200 . 200 . 224	255 . 255 . 255 . 224	8	On Link
Default		9	R_E

Topic : Forwarding Table

CASE I :

Source IP Address : 200 . 200 . 200 . 35 [H_A]

Destination IP Address : 200 . 200 . 200 . 15 [H_B]

Router	Interface ID	Next Hop
R_I	1	ON Link

Router$_I$:-

200 . 200 . 200 . 15
255 . 255 . 255 . 224
⇒ 200 . 200 . 200 . 0

Host$_A$:-

IP : 200 . 200 . 200 . 35
Mask : 255 . 255 . 255 . 224
NetID : 200 . 200 . 200 . 32

200 . 200 . 200 . 15
255 . 255 . 255 . 224
200 . 200 . 200 . 0

H_A → Default [R_I]

Topic : Forwarding Table

CASE II :

Source IP Address : 200 . 200 . 200 . 35 [H_A]

Destination IP Address : 204 . 204 . 204 . 15 [H_C]

Router	Interface ID	Next Hop
R_I	9	R_E
R_E	2	ISP

R_I :-

204.204.204.15
255.255.255.224
204.

R_E :-

204.204.204.15
255.255.255.0
204

Host A :-

IP: 200.200.200.35
255.255.255.224
200.200.200.32

204.204.204.15
255.255.255.224
204

$H_A \rightarrow$ Default [R_I]

Topic : Forwarding Table

CASE III :

Source IP Address : 204 . 204 . 204 . 15 [H_C]

Destination IP Address : 200 . 200 . 200 . 35 [H_A]

Router	Interface ID	Next Hop
R_E	1	R_I
R_I	2	On Link

$H_C \rightarrow \ldots . ISP$

$ISP \rightarrow R_E$

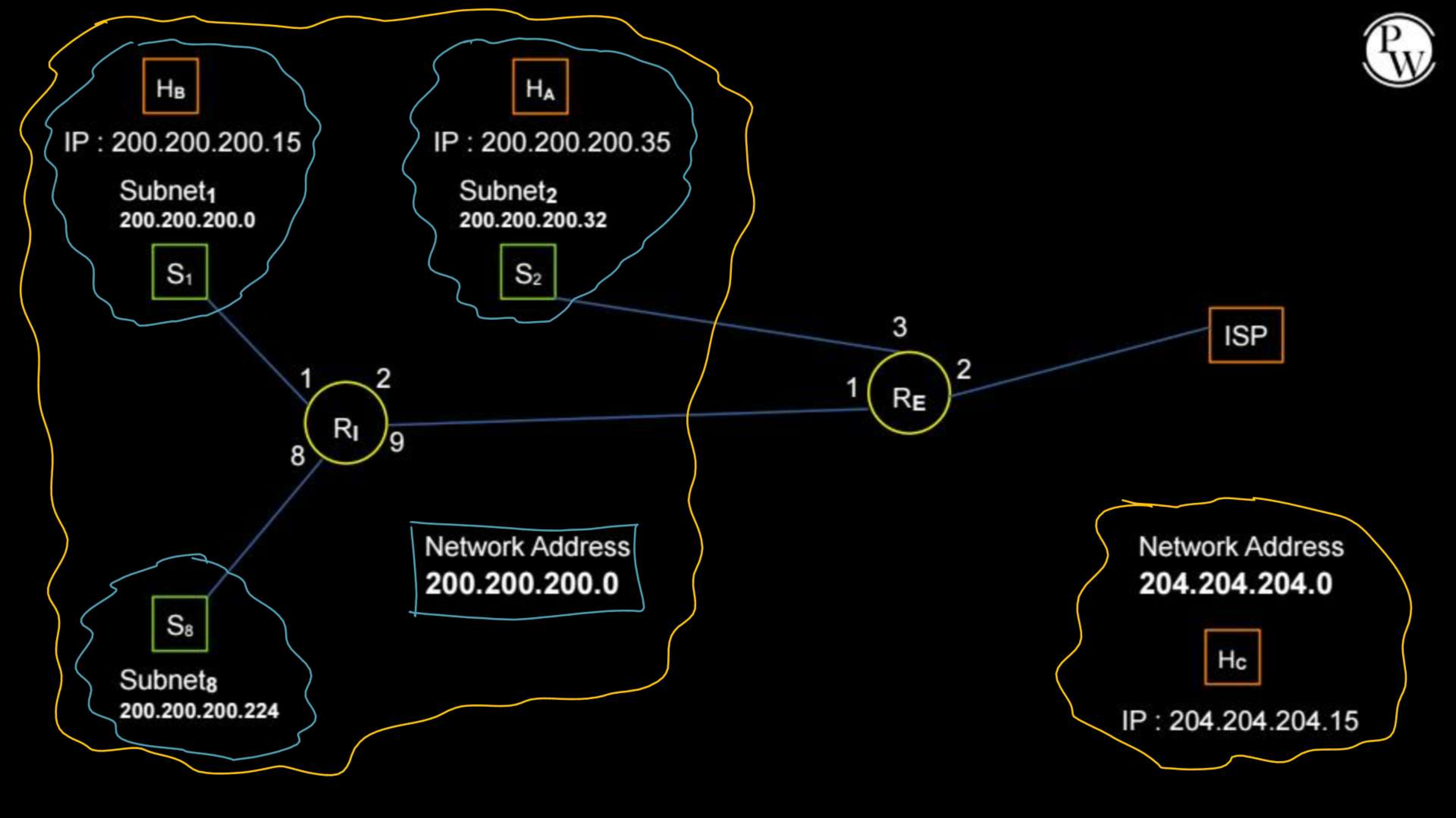
R_E :-

200 . 200 . 200 . 35
255 . 255 . 255 . 0
---
200 . 200 . 200 . 0

$R_E \rightarrow R_I$

R_I :-

200 . 200 . 200 . 35
255 . 255 . 255 . 224
---
200 . 200 . 200 . 32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Network Address
200.200.200.0
S8
Subnet8
200.200.200.224
Network Address
204.204.204.0
Hc
IP : 204.204.204.15

Topic : Forwarding Table

Router (R_E) Updated forwarding table

Network Address	Network Mask	Interface ID	Next Hop
200 . 200 . 200 . 0	255 . 255 . 255 . 0	1	R_I
200 . 200 . 200 . 32	255 . 255 . 255 . 224	3	On Link
0 . 0 . 0 . 0 [Default]	0 . 0 . 0 . 0	2	ISP

Topic : Forwarding Table

Router (R_I) Updated forwarding table

Subnet Address	Subnet Mask	Interface ID	Next Hop
200 . 200 . 200 . 0	255 . 255 . 255 . 224	1	On Link
200 . 200 . 200 . 64	255 . 255 . 255 . 224	3	On Link
200 . 200 . 200 . 224	255 . 255 . 255 . 224	8	On Link
Default		9	R_E

Topic : Forwarding Table

CASE IV :

Source IP Address : 204 . 204 . 204 . 15 [H_C]

Destination IP Address : 200 . 200 . 200 . 35 [H_A]

Router	Interface ID	Next Hop
R_E	3	on link

$H_C \rightarrow \ldots\ldots ISP$

$ISP \rightarrow R_E$

R_E :-

200.200.200.35
255.255.255.0
200.200.200.0 ✓

200.200.200.35
[255.255.255.224]
200.200.200.32 ✓

✓

200.200.200.35
0.0.0.0
0.0.0.0 ✓

Topic : Longest Prefix Match

→ Router chooses more specific option over generic one

→ Router chooses the matched entry in which more number of ones in netmask

#Q. A router uses following routing table : [Forwarding Table]

Destination	Mask	Interface	Next Hop
144 . 16 . 0 . 0	255 . 255 . 0 . 0	Eth0	
144 . 16 . 64 . 0	255 . 255 . 224 . 0	Eth1	
144 . 16 . 68 . 0	255 . 255 . 255 . 0	Eth2 ✓	
144 . 16 . 68 . 64	255 . 255 . 255 . 224	Eth3 ✗	

A packet bearing a destination address 144 . 16 . 68 . 117 arrive at the router. On which interface will it be forwarded ?

[GATE-2006]

(A) Eth0
(B) Eth1
(C) Eth2
(D) Eth3

Ans: C

144 . 16 . 68 . 117

255 . 255 . 255 . 224

---

144 . 16 . 68 . 96

Not matched

---

144 . 16 . 68 . 117

255 . 255 . 255 . 0

---

144 . 16 . 68 . 0

117 → 01110101

224 → 11100000

96 ← 01100000

#Q. The routing table of a router shown below :

Destination	Subnet Mask	Interface
128 . 75 . 43 . 0	255 . 255 . 255 . 0	Eth0
128 . 75 . 43 . 0	255 . 255 . 255 . 128	Eth1
192 . 12 . 17 . 5	255 . 255 . 255 . 255	Eth3
Default		Eth2

On which interfaces will the router forward packets addressed to destinations 128 . 75 . 43 . 16 and 192 . 12 . 17 . 10 respectively ?

[GATE-2004]

H. W.

(A) Eth1 and Eth2
(B) Eth0 and Eth2
(C) Eth0 and Eth3
(D) Eth1 and Eth3

#Q. An IP router implementing Classless Inter-domain Routing (CIDR) receives a packet with address 131 . 23 . 151 . 76 . The router's routing table has the following entries :

.

Prefix	Output Interface
131 . 16 . 0 . 0 / 12	3
131 . 28 . 0 . 0 / 14	5
131 . 19 . 0 . 0 / 16	2
131 . 22 . 0 . 0 / 15	1

The identifier of the output interface on which this packet will be forwarded is _____ .

[GATE-2014, Set-3, 2-Mark]

H.W.

#Q. The forwarding table of a router is shown below.

Subnet Number	Subnet Mask	Interface ID
200 . 150 . 0 . 0	255 . 255 . 0 . 0	1
200 . 150 . 64 . 0	255 . 255 . 224 . 0	2
200 . 150 . 68 . 0	255 . 255 . 255 . 0	3
200 . 150 . 68 . 64	255 . 255 . 255 . 224	4
Default		0

A packet addressed to a destination address 200.150.68.118 arrives at the router. It will be forwarded to the interface with ID _____ .

[GATE-2023, 2-Mark]

H.W.

#Q. Consider the entries shown below in the forwarding table of an IP router. Each entry consists of an IP prefix and the corresponding next hop router for packets whose destination IP address matches the prefix. The notation "/N" in a prefix indicates a subnet mask with the most significant N bits set to 1.

Prefix	Next hop router
10 . 1 . 1 . 0 / 24	R1
10 . 1 . 1 . 128 / 25	R2
10 . 1 . 1 . 64 / 26	R3
10 . 1 . 1 . 192 / 26	R4

This router forwards 20 packets each to 5 hosts. The IP addresses of the hosts are 10.1.1.16, 10.1.1.72, 10.1.1.132, 10.1.1.191, and 10.1.1.205 . The number of packets forwarded via the next hop router R2 is _____ .

H. W.

[GATE-2024, Set-1, 2-Mark]

Topic : CIDR

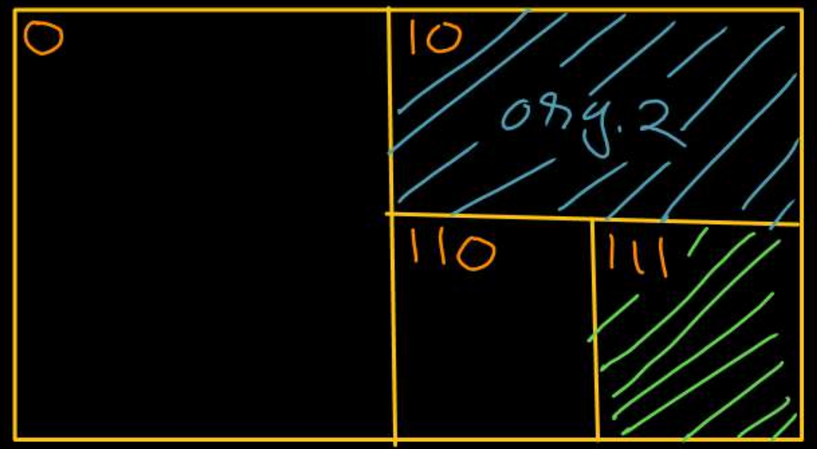
→ CIDR : Classless Inter-Domain Routing

→ IP Address allocation method for IP routing

→ Based on Variable-length subnet masking (VLSM)

→ Allows flexibility in creating 'supernets'

24 bit prefix
8 bit
ISP :- Host ID



org2 ⇒ 40 host
[Prefix + 10] R6
6 bit Host ID

Cust : org ⇒ 30 host
Prefix + 111 R7
32 IP
Host ID ⇒ 5 bit

#Q. An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it : "155 . 220 . 195 . 0 / 24". An organization request to ISP for range of IP address for its 30 hosts. Which of the following is/are can be a valid (network address) allocation?

H.W.

A. 155 . 220 . 195 . 144 / 27

B. 155 . 220 . 195 . 160 / 27

C. 155 . 220 . 195 . 192 / 27

D. 155 . 220 . 195 . 200 / 27

#Q. An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it : "245 . 248 . 128 . 0/ 20". The ISP wants to give half of this chunk of addresses to Organization A, and a quarter to Organization B, while retaining the remaining with itself. Which of the following is a valid allocation of addresses to A and B?

[GATE 2012, 2-Marks]

H.W.

(A) 245 . 248 . 136 . 0 / 21 and 245 . 248 . 128 . 0 / 22

(B) 245 . 248 . 128 . 0 / 21 and 245 . 248 . 128 . 0 / 22

(C) 245 . 248 . 132 . 0 / 22 and 245 . 248 . 132 . 0 / 21

(D) 245 . 248 . 136 . 0 / 24 and 245 . 248 . 132 . 0 / 21

2 mins Summary

Topic Forwarding Table

Topic CIDR

Topic Supernetting

THANK - YOU