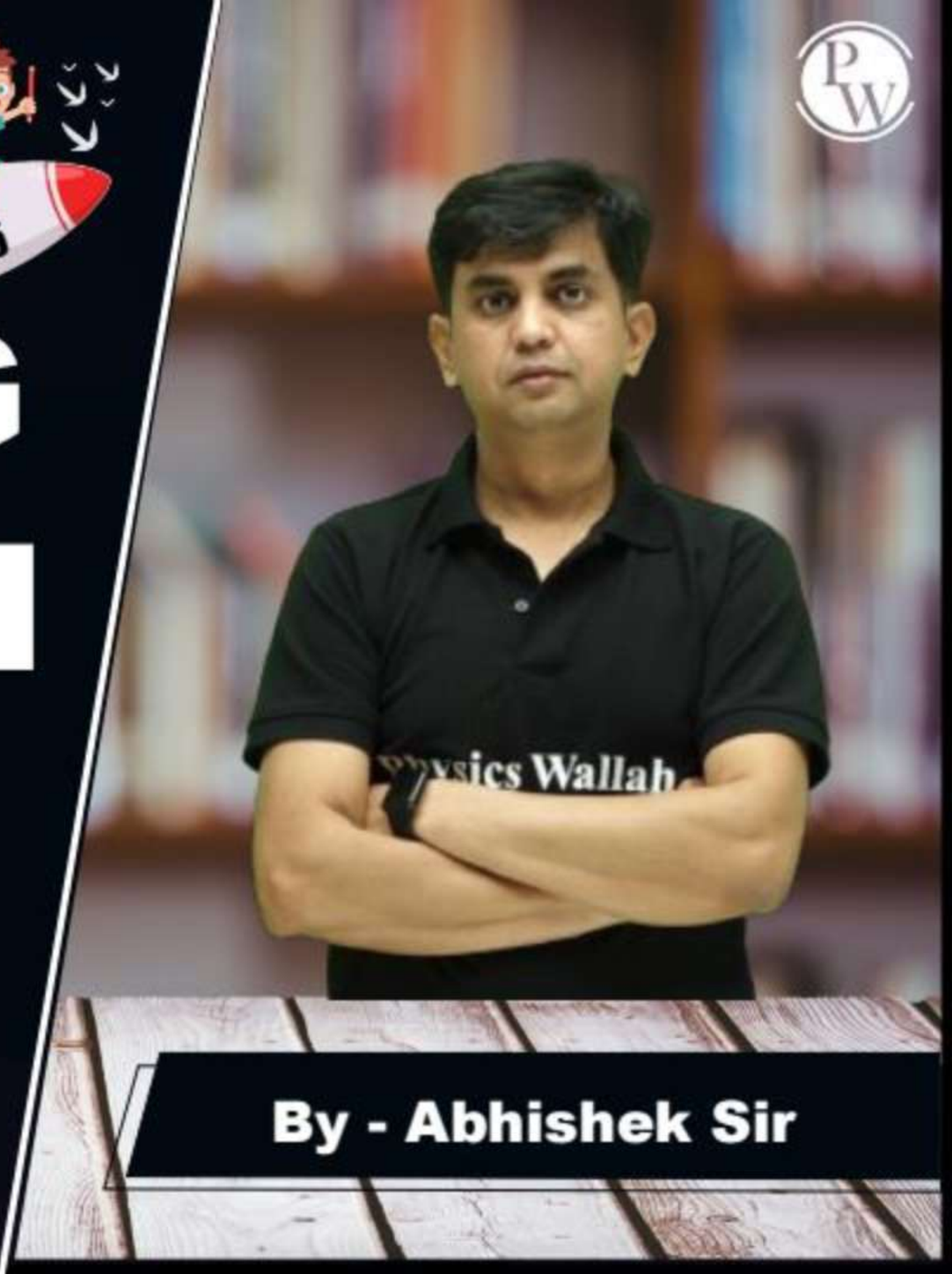
CS & IT ENGINEERING

Computer Network

IPv4 Addressing

Lecture No. - 07



Recap of Previous Lecture

Topic Forwarding Table

Topic CIDR

Topics to be Covered

- Topic CIDR
- Topic Supernetting
- Topic ARP

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. 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 0.0.0.0	0.0.0.0	Eth2

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

[GATE-2004]

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

Ans: A

128 . 75 . 43 . 16
255 . 255 . 255 . 255
---
128 . 75 . 43 . 16

128 . 75 . 43 . 16
255 . 255 . 255 . 128
---
128 . 75 . 43 . 0

16 → 00010000
128 → 10000000
0 ← 00000000

192 . 12 . 17 . 10
255 . 255 . 255 . 255
---
192 . 12 . 17 . 10

#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 _____ .

Ans = 1

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

131. 23 .151.76

255.255. 0. 0

---

131. 23. 0. 0

23 → 00010111

254 → 11111110

22 ← 00010110

131. 23 .151.76

255.254. 0. 0

---

131. 22. 0. 0

#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 _____ .

Ans: 3

[GATE-2023, 2-Mark]

200.150.68.118

255.255.255.224

200.150.68.96

118 → 01110110

224 → 11100000

96 ← 01100000

200.150.68.118

255.255.255.0

200.150.68.0

#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

Ans = 2 * 20
= 40

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 _____.

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

```
  10.   1.   1.  16
255.255.255.128
-----------------
  10.   1.   1.   0
```

Not via R_2

```
  10.   1.   1.  72
255.255.255.128
-----------------
  10.   1.   1.   0
```

Not via R_2

25 bit Mask	26 bit Mask	
10. 1. 1.132	10. 1. 1.132	Via R_2 ①
255.255.255.128	255.255.255.192	
10. 1. 1.128	10. 1. 1.128	
10. 1. 1.191	10. 1. 1.191	Via R_2 ②
255.255.255.128	255.255.255.192	
10. 1. 1.128	10. 1. 1.128	
10. 1. 1.205	10. 1. 1.205	Via R_4
255.255.255.128	255.255.255.192	
10. 1. 1.128	10. 1. 1.192	

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'

#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?

A. 155 . 220 . 195 . 144 / 27

B. 155 . 220 . 195 . 160 / 27

C. 155 . 220 . 195 . 192 / 27

D. 155 . 220 . 195 . 200 / 27

144 → 10010000
160 → 10100000
192 → 11000000
200 → 11001000

Available IP Address :-

155.220.195.0/24

155.220.195.--------/24

24 bit prefix

Org :- Net Add

155.220.195.--- 00000/27

24 bit 3 bit

27 bit prefix

Ans = B & C

#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]

IIT-D

(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

Ans: A

CIDR based available IP address space : 245 . 248 . 128 . 0 / 20

245 . 248 . 1000 ---------- / 20

20 bit prefix

12 bit HostID

Org.-A Network Address : 245 . 248 . 128 . 0 / 21

245 . 248 . 1000 0 000 . 00000000 / 21

11 bit hostID

Org.-B Network Address : 245 . 248 . 136 . 0 / 22

245 . 248 . 1000 1 0 00 . 00000000 / 22

10 bit hostID

ISP available Address Space : 245 . 248 . 140 . 0 / 22

245 . 248 . 1000 1 1 00 . 00000000 / 22

Ans:

① 245.248.128.0/21
245.248.136.0/22

---

② 245.248.128.0/21
245.248.140.0/22

---

③ 245.248.136.0/21
245.248.128.0/22 ✓ ⟹ option A

---

④ 245.248.136.0/21
245.248.132.0/22

CIDR based available IP address space : 245 . 248 . 128 . 0 / 20

245 . 248 . 1 0 0 0 _ _ _ _ . _ _ _ _ _ _ _ _ / 20

Org.-A Network Address : 245 . 248 . 136 . 0 / 21

245 . 248 . 1 0 0 0 1 0 0 0 . 0 0 0 0 0 0 0 0 / 21

Org.-B Network Address : 245 . 248 . 128 . 0 / 22

245 . 248 . 1 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 / 22

ISP available Address Space : 245 . 248 . 132 . 0 / 22

245 . 248 . 1 0 0 0 0 1 0 0 . 0 0 0 0 0 0 0 0 / 22

#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

H.W.

[GATE 2020, 2-Marks]

IIT-D

(A) I and II only

(B) II and III only

(C) III and IV on

(D) I and IV only

#Q. Which one of the following CIDR prefixes exactly represents the range of IP addresses 10 . 12 . 2 . 0 to 10 . 12 . 3 . 255 ?

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

(A) 10 . 12 . 2 . 0 / 23

(B) 10 . 12 . 2 . 0 / 24

(C) 10 . 12 . 0 . 0 / 22

(D) 10 . 12 . 2 . 0 / 22

Ans : A

First IP → 10.12.2.0 : 10.12.00000010.00000000

Last IP → 10.12.3.255 : 10.12.00000011.11111111

23 bit prefix | 9 bit host ID

CIDR Prefixes : 10.12.00000010.000000000/23

Network Address : 10.12.2.0/23

Topic : Supernetting

→ Prefix (Route) Aggregation

→ Combining (logically) smaller networks into single large network

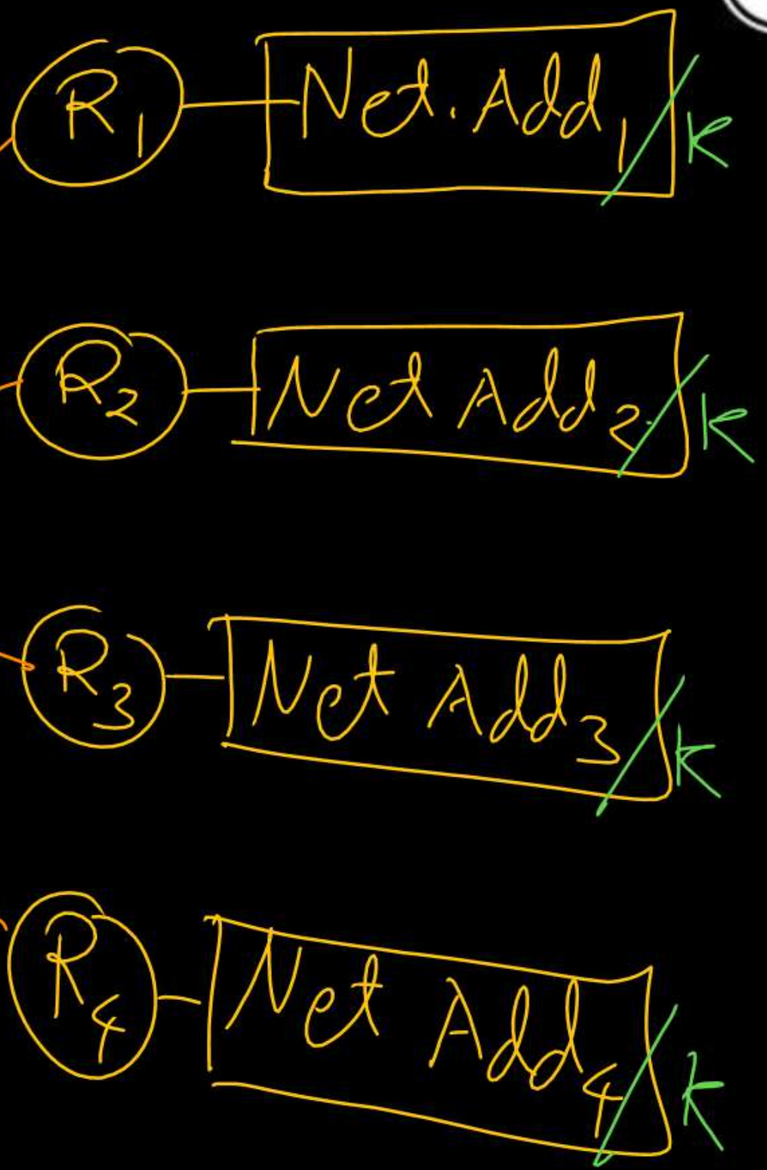
→ Allow more efficient routing

→ Reduces the number of entries in routing table

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

[R_x] Routing Table

Dest.	Interface	Next Hop
Supernet Add.	3	R_Y



[R_x] Routing Table

Dest.	Interface	Next Hop
N.A$_1$/k	3	R_Y
NA$_2$/k	3	R_Y
NA$_3$/k	3	R_Y
NA$_4$/k	3	R_Y

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

CIDR prefix ⇒ 10100000/4
Supernet Add.

Example 1 :

Net. Add.$_1$:

1 0 1 0 0 0 0 0 / 6	
1 0 1 0	0 0 0 1
1 0 1 0	0 0 1 0
1 0 1 0	0 0 1 1

Net. Add.$_2$:

1 0 1 0 0 1 0 0 / 6	
1 0 1 0	0 1 0 1
1 0 1 0	0 1 1 0
1 0 1 0	0 1 1 1

Net. Add.$_3$:

1 0 1 0 1 0 0 0 / 6	
1 0 1 0	1 0 0 1
1 0 1 0	1 0 1 0
1 0 1 0	1 0 1 1

Net. Add.$_4$:

1 0 1 0 1 1 0 0 / 6	
1 0 1 0	1 1 0 1
1 0 1 0	1 1 1 0
1 0 1 0	1 1 1 1

Topic : Supernetting

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

H.W.

150 . 125 . 160 . 0 / 23

150 . 125 . 162 . 0 / 23

150 . 125 . 164 . 0 / 23

150 . 125 . 166 . 0 / 23

Supernet Address :

2 mins Summary

Topic CIDR

Topic Supernetting

Topic [illegible]

THANK - YOU