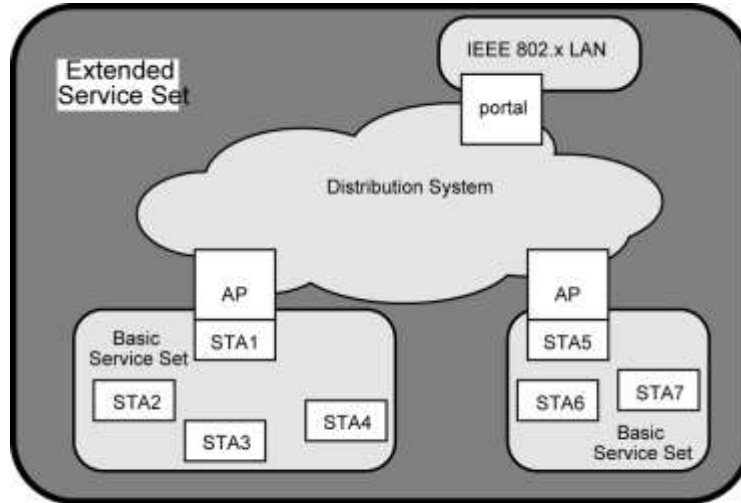


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STA = station
AP = access point

--- 4 marks

- Smallest building block is basic service set (BSS)
 - Number of stations
 - Same MAC protocol
 - Competing for access to same shared wireless medium
- May be isolated or connect to backbone distribution system (DS) through access point (AP)
 - AP functions as bridge
- MAC protocol may be distributed or controlled by central coordination function in AP
- BSS generally corresponds to cell
- DS can be switch, wired network, or wireless network

BSS Configuration

- Simplest: each station belongs to single BSS
 - Within range only of other stations within BSS
- Can have two BSSs overlap
 - Station could participate in more than one BSS
- Association between station and BSS dynamic
 - Stations may turn off, come within range, and go out of range

Extended Service Set (ESS)

- Two or more BSS interconnected by DS
 - Typically, DS is wired backbone but can be any network
- Appears as single logical LAN to LLC



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2. An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP wants to distribute these blocks to customers as follows: Design the subnets
- The first group has 200 medium-size businesses, each need 128 addresses. Find the range of 200th subnet
 - The second group has 400 small businesses, each need 16 addresses. Find the range of 400th subnet
 - The third group has 2048 households, each need 4 addresses. Find the range of 2048th subnet

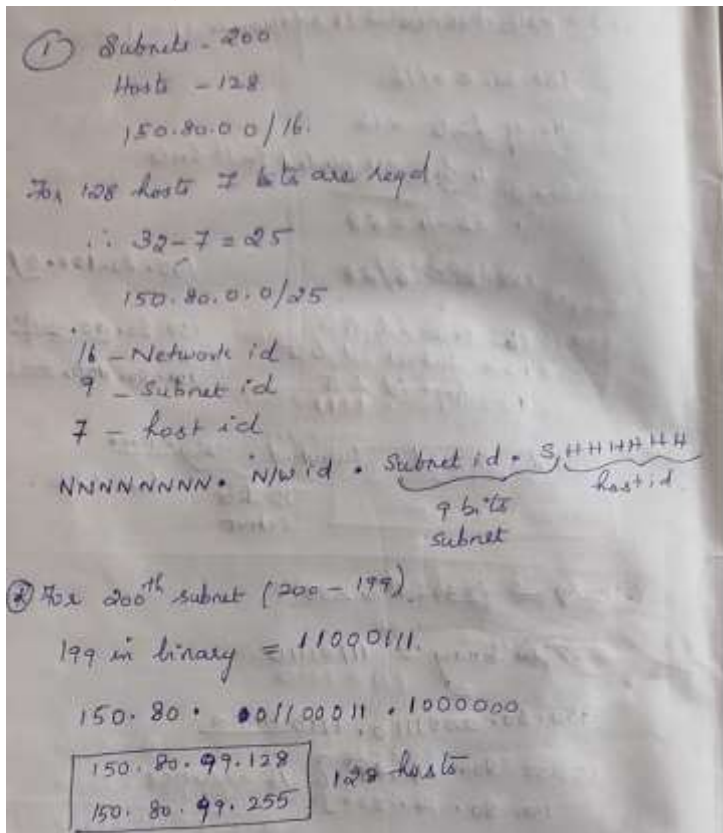
Design the subnets. Find out how many addresses are still available after these allocations

SOLUTION:

For 128 addresses we use /25 mask. 255.255.255.128

- Group 1 has 200 medium size businesses
- | | |
|-------------------------------------|----------|
| 150.80.0.0 /25 to 150.80.0.127/25 | Subnet 1 |
| 150.80.0.128 /25 to 150.80.0.255/25 | Subnet 2 |
| 150.80.1.0 /25 to 150.80.1.127/25 | Subnet 3 |
| 150.80.1.128 /25 to 150.80.1.255/25 | Subnet 4 |

.....-->



150.80.99.128 /25 to 150.80.99.255 Last --200th Subnet
 Next address is 150.80.100.0



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SLOT: D2+TD2

ii Group 2 has 400 small businesses, each needs 16 addresses.....we use /28 mask or 255.255.255.240

150.80.100.0 /28 to 150.80.100.15/28 Subnet 1
 150.80.100.16 /28 to 150.80.100.31/28 Subnet 2
 150.80.100.32 /28 to 150.80.100.47/28 Subnet 3
 150.80.100.48 /28 to 150.80.100.63/28 Subnet 4
 150.80.100.64/28 to 150.80.100.79/28 Subnet 5
 150.80.100.80 /28 to 150.80.100.95/28 Subnet 6
 150.80.100.96/28 to 150.80.100.111/28 Subnet 7
 150.80.100.112/28 to 150.80.100.127/28 Subnet 8
 150.80.100.128/28 to 150.80.100.143/28 Subnet 9
 150.80.100.144/28 to 150.80.100.159/28 Subnet 10
 150.80.100.160/28 to 150.80.100.175/28 Subnet 11
 150.80.100.176/28 to 150.80.100.191/28 Subnet 12
 150.80.100.192/28 to 150.80.100.207/28 Subnet 13
 150.80.100.208/28 to 150.80.100.223/28 Subnet 14
 150.80.100.224/28 to 150.80.100.239/28 Subnet 15
 150.80.100.240/28 to 150.80.100.255/28 Subnet 16

.....

150.80.124.240 /28 to 150.80.124.255 /28 Subnet 400
 Next address is 150.80.125.0

1 st subnet
 Binary equivalent of 100 = 1100100
 150.80. 01100100 .00000000 (150.80.100.0)
 First address
 150.80.100.0/28
 Last address
 150.80. 01100100 .00001111
 150.80.100.15/28

Last Subnet
 400 th network First address 150.80.124.240/28
 Last address 150.80.124.255/28

c. The third group has 2048 households, each need 4 addresses. Find the range of 2048th subnet

255.255.255.252
 150.80.125.0 /30 to 150.80.125.3 /30 Subnet 1
 150.80.125.4 /30 to 150.80.125.7 /30 Subnet 2
 150.80.125.8 /30 to 150.80.125.11 /30 Subnet 3
 150.80.125.12 /30 to 150.80.125.15 /30 Subnet 4
 150.80.125.16 /30 to 150.80.125.19 /30 Subnet 5

.....



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SLOT: D2+TD2

<p>150.80.125.252 /30 to 150.80.125.255 /30 Subnet 64</p> <p>150.80.126.0 /30 to 150.80.126.3 /30 Subnet 65</p> <p>.....</p> <p>150.80.126.252/30 to 150.80.126.255 /30</p> <p>150.80.155.0 /30 to 150.80.155.3 /30</p> <p>.....</p> <p>150.80.155.252 /30 to 150.80.155.255 /30 Subnet 1984 (31*64=1984)</p> <p>150.80.156.0 /30 to 150.80.156.3 /30 Subnet 1985</p> <p>150.80.156.60 /30 to 150.80.156.63 /30 Subnet 2000</p> <p>Subnet 2048</p> <p>150.80.156.252/30 to 150.80.156.255/30</p> <p>Next address available from 150.80.156.64</p> <p>Number of granted addresses ---65536</p> <p>Number of allocated addresses--- 40192(200*128+400*16+2048*4)</p> <p>Number of available addresses---25344</p> <p>We have used 40192 addresses out of 65536 addresses. 25344 addresses remain available</p>	
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3. a. Consider an IP packet with a length 4500 bytes that includes a 20-byte IPv4 header and a 40-byte TCP header. The packet is forwarded to an IPV4 router that supports a Maximum Transmission unit MTU of 600 bytes. Assume that the length of the header in all the outgoing fragments of this packet is 20 bytes. Assume that the fragmentation offset value store in the first fragment is 0. What is the fragmentation offset stored in the third fragment?

Calculation

Packet Length = 4500B

IP Payload = 4500 - 20 = 4480B

MTU = 600B

MTU Payload = 600B - 20B = 580B

But payload should be multiple of 8 so number nearest to 580 and multiple of 8 is 576, so MTU payload = 576B

IP Packet size = 576 + 20B = 596B

Size of Offset = 576 / 8 = 72

First fragment offset = 0

Second fragment offset = 72

Third fragment offset = 144

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For Further reference

Fragment	First fragmen t	Second	Third	Fourth	Fifth	Sixth	Seventh	Eight
Range	0-575	576-1151	1152-1727	1728-2303	2304-2879	2880-3455	3456-4031	4032-4479
Total length	576+20	576+20	576+20	576+20	576+20	576+20	576+20	448+20
MF	1	1	1	1	1	1	1	0
offset	0	72	144	216	288	360	432	504

b. A CEO of a company needs a privacy in maintaining the number of hosts for his company to the public network with a single IP address. What is the networking technology required for the above and explain the same?

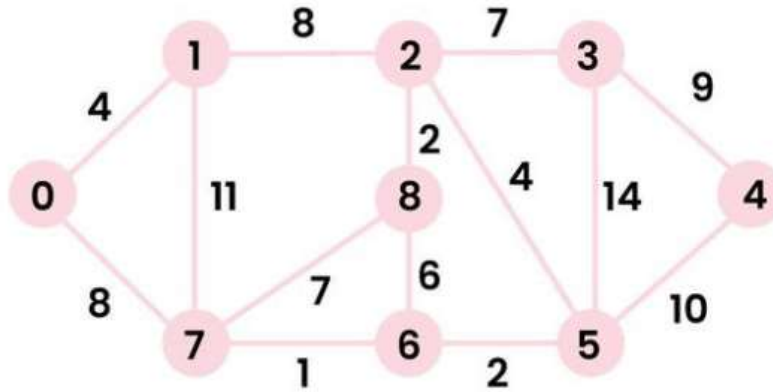
Network Address Translation -- To be explained

3



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4. Perform Dijkstra algorithm to find the shortest path for Node 0 and Node 4



Solution
For Node 0

Start	0	1	2	3	4	5	6	7	8
0	4, 0	4, 0	∞	∞	∞	∞	∞	8, 0	∞
0, 1	-	-	12, 1	∞	∞	∞	∞	8, 0	∞
0, 1, 7	-	-	12, 1	∞	∞	∞	9, 7	-	15, 7
0, 1, 2, 6	-	-	12, 1	∞	∞	11, 6	-	-	15, 7
0, 1, 7, 6, 5	-	-	12, 1	∞	21, 5	-	-	-	15, 7
0, 1, 7, 6, 5, 2	-	-	-	19, 2	21, 5	-	-	-	14, 2
0, 1, 7, 6, 5, 2, 8	-	-	-	19, 2	21, 5	-	-	-	-
0, 1, 7, 6, 5, 2, 8, 3	-	-	-	-	21, 5	-	-	-	-
0, 1, 7, 6, 5, 2, 8, 3, 4	-	-	-	-	-	-	-	-	-
		4, 0	12, 1	19, 2	21, 5	11, 6	9, 7	8, 0	14, 2

$0 \rightarrow 1 = 4$
 $0 \rightarrow 1 \rightarrow 2 = 8$
 $0 \rightarrow 1 \rightarrow 2 \rightarrow 3 = 19$
 $0 \rightarrow 7 \rightarrow 6 \rightarrow 5 \rightarrow 4 = 21$

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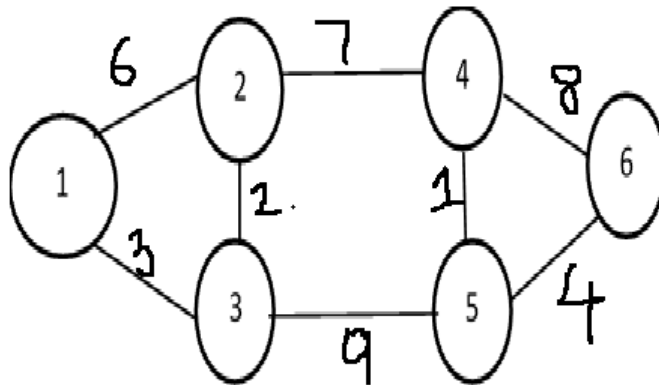
Start	4	0	1	2	3	5	6	7	8
4	-	∞	∞	∞	9, 4	10, 4	∞	∞	∞
4, 9	-	∞	∞	16, 3	-	10, 4	∞	∞	∞
4, 9, 10	-	∞	∞	14, 5	-	-	12, 5	∞	∞
4, 9, 10, 6	-	∞	∞	14, 5	-	-	-	13, 6	18, 6
4, 9, 10, 6, 7	-	21, 7	24, 7	14, 5	-	-	-	-	16, 2
4, 9, 10, 6, 7, 2	-	21, 7	22, 2	-	-	-	-	-	-
4, 9, 10, 6, 7, 2, 8	-	21, 7	22, 2	-	-	-	-	-	-
4, 9, 10, 6, 7, 2, 8, 5	-	21, 7	22, 2	14, 5	9, 4	10, 4	12, 5	13, 6	16, 2

4 → 0 = 21	4 → 5 → 6 → 7 → 0
4 → 1 = 22	4 → 5 → 2 → 1
4 → 2 = 14	4 → 5 → 2
4 → 3 = 9	4 → 3
4 → 5 = 10	4 → 5
4 → 6 = 12	4 → 5 → 6
4 → 7 = 13	4 → 5 → 6
4 → 8 = 16	4 → 5 → 2 → 8

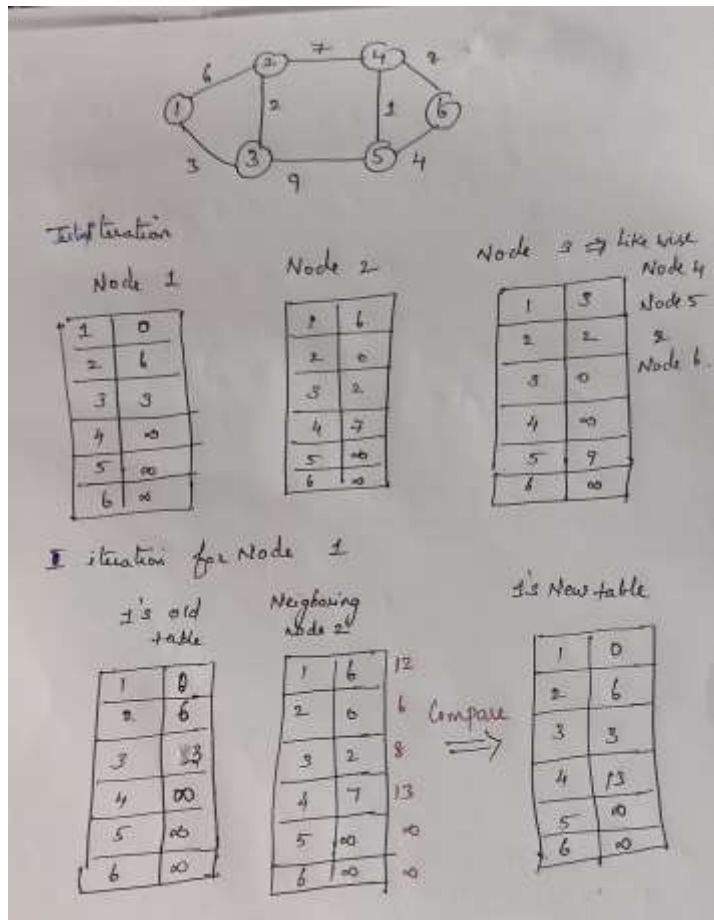
5. Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the diagram

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- i. All the routers use the distance vector routing algorithm to update the routing table. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. Show the routing tables for Router 1 with first and second iteration, also tabulate the final routing table. (7 marks)



Initial Iteration

Node 1

1	0
2	6
3	3
4	∞
5	∞
6	∞

Node 2

1	6
2	0
3	2
4	7
5	∞
6	∞

Node 3 ⇒ like wise

1	3
2	2
3	0
4	∞
5	9
6	∞

Node 4

1	∞
2	∞
3	∞
4	0
5	1
6	8

Node 5

1	∞
2	∞
3	∞
4	∞
5	0
6	4

Node 6

1	∞
2	∞
3	∞
4	∞
5	∞
6	0

II iteration for Node 1

1's old table

1	0
2	6
3	3
4	∞
5	∞
6	∞

Neighbouring node 2's

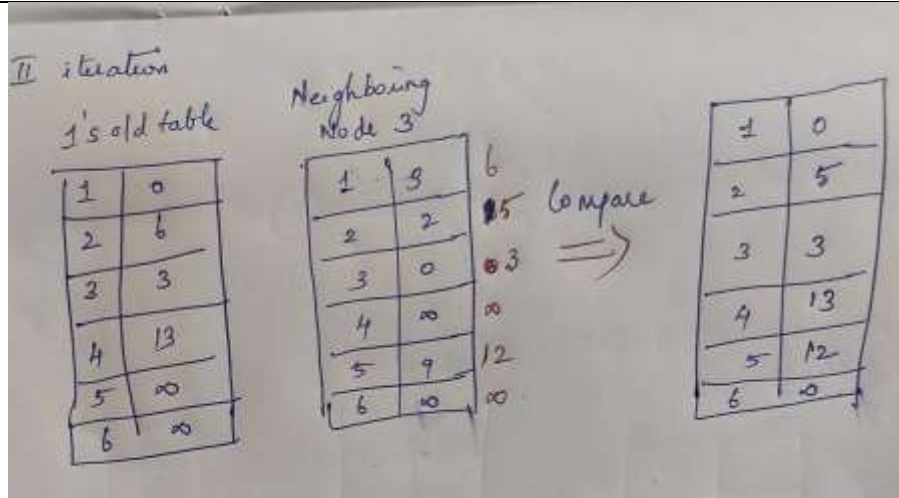
1	6	12
2	0	6
3	2	8
4	7	13
5	∞	∞
6	∞	∞

Compare ⇒

1's New table

1	0
2	6
3	3
4	13
5	∞
6	∞

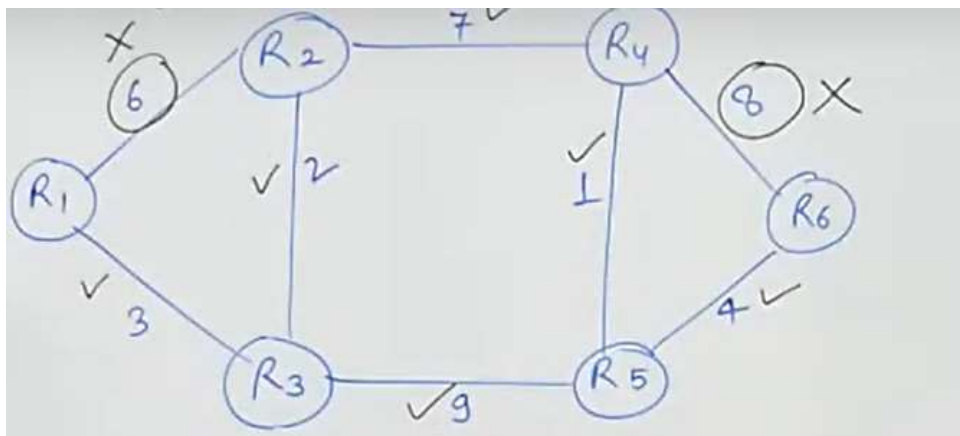
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For Router 1

Destination	Cost	Next hop
1	0	
2	5	3
3	3	3
4	12	3
5	12	3
6	16	3,5

ii. How many links in the network will never be used for carrying data? State reasons for the same (3 marks)



R1 to R2 with distance 6 and R4 to R6 with distance 8 will be never used for carrying data as it incurs a more distance and there exists alternate paths with lesser distance
