It the previous class we have introduced the concept of subnet.

Subnet mask   class wise:

Class A
In decimal
255.0.0.0
In Binary
11111111.00000000.00000000.00000000

Class B
In decimal
255.255.0.0
In Binary
11111111.11111111.00000000.00000000

Class C
In decimal
255.255.0.0
In Binary
11111111.11111111.11111111.00000000

Question A router receives a packet with the destination address 131.24.67.32.

1. Show how the router finds the network address of the packet.

2. How router is going to do direct broad casting?

3. How many numbers of hosts are possible?

Answer

Step 1: First find the class of the address Class B

Default mask 255.255.0.0

Step 2: Bitwise AND operation
First convert IP address to binary

IP Address	10000011	.	00011000	.	01000011	.	00100000
Default Subnet Mask	11111111	.	11111111	.	00000000	.	00000000
Bit wise AND operation	10000011	.	00011000	.	00000000	.	00000000

Bitwise AND operation gives us Network address.

Network Address 131. 24. 0. 0

Answer 2.

There are two type of broad cast address Limited and Direct

Limited broad cast : when we want to broadcast in our own network

Limited broadcast address: 255.255.255.255

Direct broadcast address:
When packet from another network is to be broadcasted in your network,

IP Address	10000011	.	00011000	.	01000011	.	00100000
Default Subnet Mask compliments.	00000000	.	00000000	.	11111111	.	11111111
Bit wise OR operation	10000011	.	00011000	.	11111111	.	11111111

Broadcast Address 131. 24. 255. 255

Question A router receives a packet with the destination address 131.24.67.32/20
Show how the router finds the network address of the packet.

Answer
Step 1 : First find Default mask

It is / 20 so

Default mask DM = 11111111.1111111.11110000.00000000

255.255.240.0

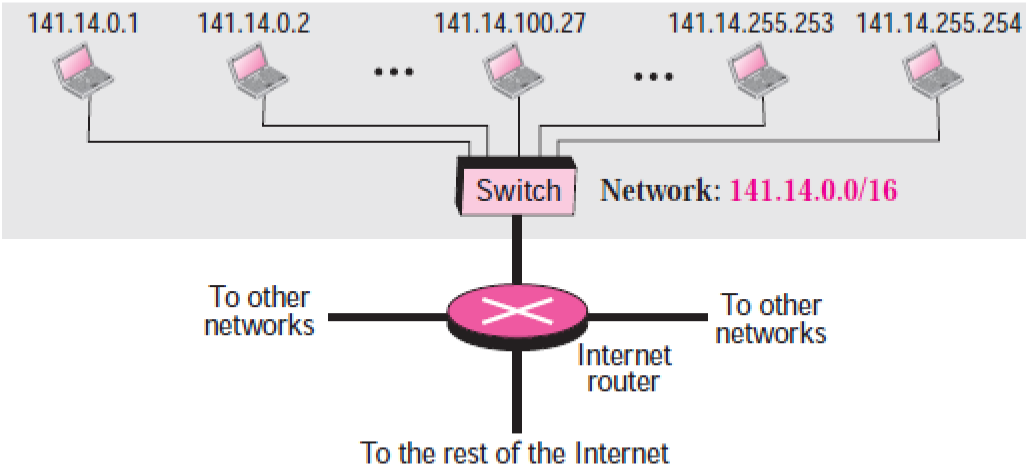
Step 2: Bitwise AND operation

Destination Address	131.	24.	67.	32
Default mask	255.	255.	240.	0

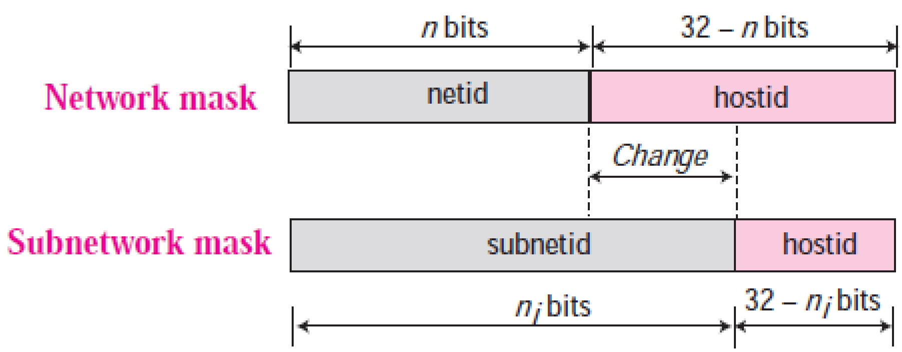
Destination Address	10000011.	00011000.	01000011.	00100000
Default mask	11111111.	11111111.	11110000.	00000000

Bitwise AND operation	11111111.	11111111.	01000000.	00000000
Network Address	131.	24.	64.	0

Question 3: Given an Network address 141.14.0.0 /16 as in figure below:



The network can belong to a university campus with four different schools (buildings). How will you divide the network into four subnetworks? Such that after Subnetting, each school has its own subnetworks, but still the whole campus is one network.



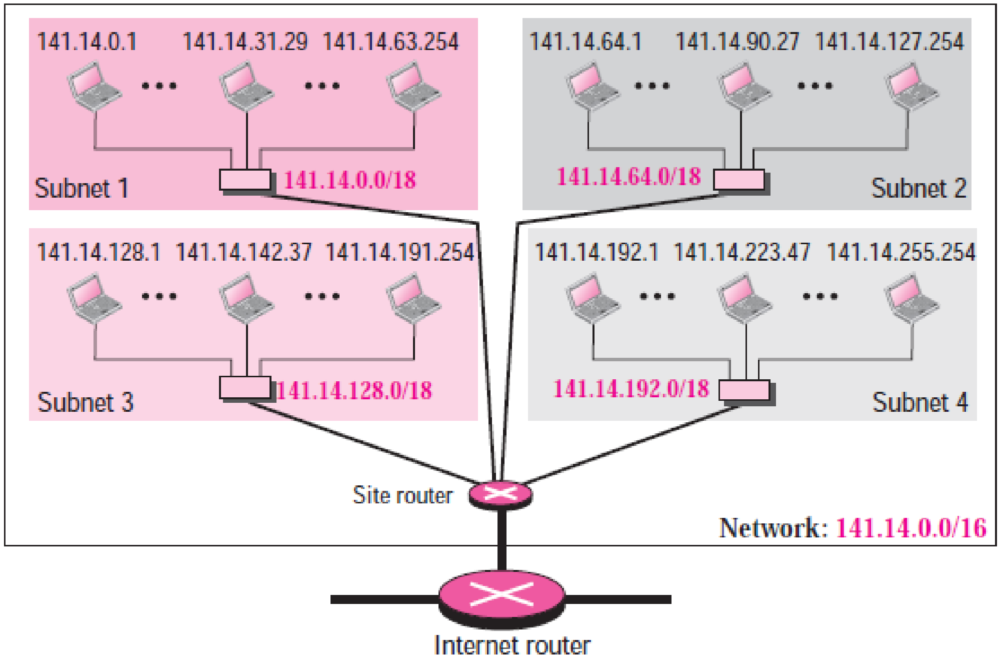
Solution:

Given Data:	Required Host Bits
Given Network Bits GNB = 16 Given Host Bits CHB = 32 -16 = 16 No. of Subnets = 4 $2^n=4$, so $n = 2$ Required Network Bits CNB = GNB + n = 16 + 2 = 18	RHB = GHB - n = 16 – 2 = 14 Total No of possible Hosts in a subnetwork $H = 2^{RHB} - 2 = 2^{14} - 2 = 16382$ (minus 2 because two addresses are reserved for Subnet IP and Broadcast IP) Default mask /16 = 11111111.11111111.00000000.00000000 =255.255.0.0 Required Mask /18 = 11111111.11111111.11000000.00000000 =255.255.192.0

Compare subnet masks from Right to left $\leftarrow$ 255. 255. 0. 0 255. 255. 192. 0 3rd Octet is not matching So Subtract it from 256 D = 256 - 192 = 64 So Third Octet of the address will change be 64	

	Subnet 0	Subnet1	Subnet 2	Subnet 3
Network ID	141.14.0.0	141.14.64.0	141.14.128.0	141.14.192.0
First Host	141.14.0.1	141.14.64.1	141.14..128.1	141.14.192.1
	141.14.0.2	141.14.64.2	141.14.128.2	141.14.192.2
	141.14.1.0			
Broadcast Id	141.14. 63.255	141.14.127.255	141.14.191.255	141.14.255.255

.


141.14.0.1
141.14.31.29
141.14.63.254
Subnet 1
141.14.0.0/18
141.14.64.1
141.14.90.27
141.14.127.254
141.14.64.0/18
Subnet 2
141.14.128.1
141.14.142.37
141.14.191.254
Subnet 3
141.14.128.0/18
141.14.192.1
141.14.223.47
141.14.255.254
141.14.192.0/18
Subnet 4
Site router
Network: 141.14.0.0/16
Internet router

Question: An ISP is granted a block of addresses starting with 190.100.0.0/18. The ISP needs to distribute these addresses to three groups of customers, Design the subblocks and find out how many addresses are still available after these allocations

Answer

Given IP address 190.100.0.0/18

GNB = 18, GHB = 32-18 = 14

Consumer Groups = 3 so $2^n >= 3$ n = 2

Converted Network Bits CNB = GNB + n = 18 +2 = 20 RHB = GHB –n = 14-2 = 12

Total number of hosts per group = $2^{RHB} = 2^{12} - 2 = 4096 - 2 = 4094$

Default Mask : 11111111.11111111.11000000.00000000

Required Mask 11111111.11111111.11110000.00000000

DM = 255.255.192.0

RM = 255.255.240.0

Comparing RM and DM difference is in third octet 256-240 = 16

	Block 0	Block1	Block2
Network ID	190.100.0.0/20	190.100.16.0/20	190.100.32.0/20
First Address	190.100.0.1/20	190.100.16.1/20	190.100.32.1/20
Second Address	190.100.0.2/20	190.100.16.2/20	190.100.32.2/20
Last usable address	190.100.15.254/20	190.100.31.254/20	190.100.47.254/20

Broadcast ID	190.100.15.255/20	190.100.31.255/20	190.100.47.255/20
Total addresses used	4096	4096	4096

Total addresses used = 3X 4096= 12288

Total addresses available = 2^{14}= 16384

Unused addresses = 16384-12288 = 4096 Ans

Question: An ISP is granted a block of addresses starting with 190.100.0.0/16 (65,536 addresses). The ISP needs to distribute these addresses to three groups of customers as follows:

a. The first group has 64 customers; each needs 256 addresses.
b. The second group has 128 customers; each needs 128 addresses.
c. The third group has 128 customers; each needs 64 addresses.

Design the subblocks and find out how many addresses are still available after these allocations.

Question: An ISP is granted a block of addresses starting with 192.168.10.0/27. The ISP needs to distribute these addresses to four groups of customers, Design the subblocks and find out how many addresses are still available after these allocations

GNB = 27 GHB = 5 n = 2 RNB = 29 RHB = 3

DSM -= 11111111.11111111.11111111.11100000

RSM = 11111111.11111111.11111111.11111000

DM = 255.255.255.224

RM = 255.255.255.248

Difference 256-248= 8

	Block0	Block1	Block2	Block3
Network id	192.168.10.0	192.168.10.8	192.168.10.16	192.168.10.24
Broadcast id	192.168.10.7	192.168.10.15	192.168.10.23	192.168.10.31

Question: An ISP is granted a block of addresses starting with 192.168.10.0/24. The ISP needs to distribute these addresses to three groups of customers with 120, 60 and 30 users. Design the subblocks.

Answer

GNB = 24 GHB = 8 Maximum No. of Host = 2^8=256

Check total no. of host is less than 256

Arrange the groups in descending order of no. of Host

Block 0 = 120 host, Block 1 = 60 host, Block 2 = 30 host

DM= 11111111.11111111.11111111.00000000

= 255.255.255.0

	Block 0	Block1	Block2
No. of host required	120	60	30
Converted Host bits	$2^n >= 120$ CHB= 7 CNB=25	$2^n >= 60$ CHB= 6 CNB = 26	$2^n >= 30$ CHB= 5 CNB = 27
Converted Mask	11111111.11111111.11111111.10000000	11111111.11111111.11111111.11000000	11111111.11111111.11111111.11100000
	255.255.255.128 255.255.255.0 Difference 256-128= 128	255.255.255.192 255.255.255.0 Difference 256-192= 64	255.255.255.224 255.255.255.0 Difference = 256 -224 = 32
Network address of Block	192.168.10.0/25	192.168.10.128/26	192.168.10.192/27
Fist address	192.168.10.1	192.168.10.129	192.168.10.193
Second address	192.168.10.2	192.168.10.130	192.168.10.194
Last address	192.168.10.126	192.168.10.190	192.168.10.222
Broadcast address	192.168.10.127	192.168.10.191	192.168.10.223

Public and Private Addresses

Table 19.3 *Addresses for private networks*

Range			*Total*
10.0.0.0	to	10.255.255.255	2^{24}
172.16.0.0	to	172.31.255.255	2^{20}
192.168.0.0	to	192.168.255.255	2^{16}

NAT   network address translation