AIW Numerical:

Type 1: Finding first and last address

1. What is the first and last address of 192.168.1.0/24?

   /24 -> 2^8 hosts = 256 hosts

   Complete address range = 192.168.1.0 to 192.168.1.255

   So, the first address is **192.168.1.0**
   The last address is **192.168.1.255**

   Note: If usable address asked, then first usable address is 192.168.1.1 and last usable address is 192.168.1.254

2. What is the first and last address of 172.16.10.0/26?

   /26 -> 2^6 hosts = 64 hosts

   Complete address range = 172.16.10.0 to 172.16.10.63

   So, the first address is **172.16.10.0**
   The last address is **172.16.10.63**

   Note: If usable address asked, then first usable address is 172.16.10.1 and last usable address is 172.16.10.62

3. Find the first and last address of 156.14.12.0/22?

   /22 -> 2^{10} hosts = 1024 hosts

   Complete address range = 156.14.12.0 to 156.14.15.255

   i.e. 156.14.12.0 to 156.14.12.255
       156.14.13.0 to 156.14.13.255
       156.14.14.0 to 156.14.14.255
       156.14.15.0 to 156.14.15.255

   So, the first address is **156.14.12.0**
   The last address is **156.14.15.255**

Type 2: IP Aggregation

Question 1: What is the aggregated address of following IP addresses?

192.168.1.0/26

192.168.1.64/26

192.168.1.128/26

192.168.1.192/26

Answer:

The complete range IP addresses of above networks:

 192.168.1.0/26=> 192.168.1.0 to 192.168.1.127 (64 hosts)

192.168.1.64/26=> 192.168.1.64 to 192.168.1.127 (64 hosts)

192.168.1.128/26=> 192.168.1.128 to 192.168.1.191 (64 hosts)

192.168.1.192/26=> 192.168.1.192 to 192.168.1.255 (64 hosts)

As we can see, the total IP address range of all four networks is:

192.168.1.0 to 192.168.1.255 (total 256 hosts)

So, this can be written as: 192.168.1.0/24

Question 2:

```
 IP              SUBNET           NEXT HOP
> 129.10.112.0   255.255.255.0     R1
> 129.10.80.0    255.255.255.0     R1
> 129.10.0.0     255.255.0.0       R2
> 129.10.63.0    255.255.255.0     R4
> 129.10.63.0    255.255.255.0     R4
> 129.10.64.0    255.255.192.0     R3
> 129.10.65.0    255.255.255.0     R4
> 129.10.66.0    255.255.255.0     R4
```

What is the proper method to aggregate these entries into the minimum number of entries?

First, separate the entries by next hop. You have to summarize them separately:

```
IP              SUBNET           NEXT HOP
129.10.112.0    255.255.255.0     R1
129.10.80.0     255.255.255.0     R1

129.10.0.0      255.255.0.0       R2

129.10.64.0     255.255.192.0     R3

129.10.63.0     255.255.255.0     R4
129.10.63.0     255.255.255.0     R4
```

```
129.10.65.0    255.255.255.0    R4
129.10.66.0    255.255.255.0    R4
```
Then for each next hop, convert all the network addresses to binary. Here is just the first one:

```
10000001.00001010.01110000.00000000 = 129.10.112.0
10000001.00001010.01010000.00000000 = 129.10.80.0
```
Now find all the identical digits, starting from the left. In this case, the digits are all the same up to the 18th position. So your new mask is /18. Now, using either address and the /18 mask, find the network address by ANDing the address and the mask:

```
10000001.00001010.01110000.00000000 = 129.10.112.0
11111111.11111111.11000000.00000000 = /18 (255.255.192.0)
-----------------------------------
10000001.00001010.01000000.00000000 = 129.10.64.0 /18
```
So the best summarization of the first two routes is 129.10.64.0/18.

Question 3:
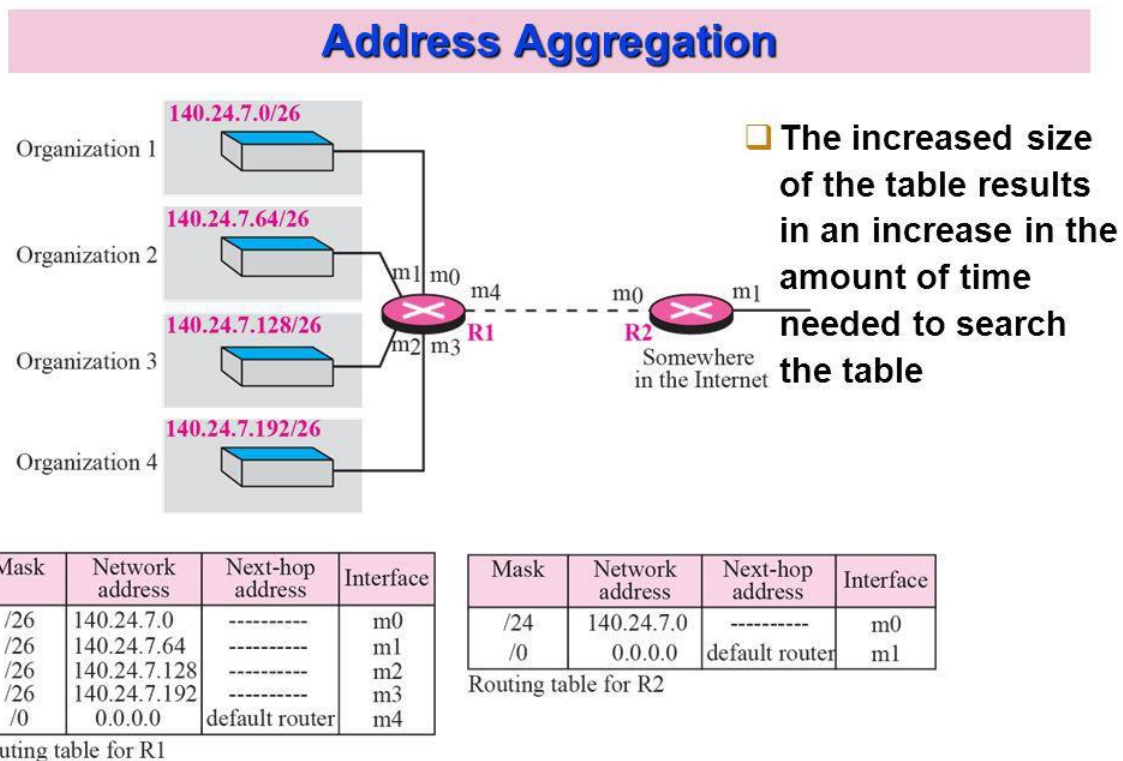
Type 3: IPv6 address abbreviation

Abbreviation Rules:

Rule 1: Discard leading zero (es)

That address can be shortened because the addressing scheme allows the omission of any leading zero, as well as any sequences consisting only of zeroes.

E.g.: FE80:CD00:0000:0CDE:1257:0000:211E:729C

Here's the short version:

FE80:CD00:0:CDE:1257:0:211E:729C

Rule 2: If two of more blocks contain consecutive zeroes, omit them all and replace with double colon sign **::**

2001:0000:3238:DFE1:63:0000:0000:FEFB

can be written as

2001:0000:3238:DFE1:63::FEFB

The IPv6 addressing architecture allows you use the two-colon (::) notation to represent contiguous 16-bit fields of zeros.

Q. Use the IPv6 abbreviation rules to give the following address in its shortest form:
FE80:CD00:0000:0000:0257:0000:211E:729C

Solution: The abbreviated form is:
FE80:CD00::257:0:211E:729C

Type 4: Packet Fragmentation

a) **With IP Options**
1. Assume a link layer protocol, called Newnet with MTU 1600 bytes. A TCP segment with 7540 bytes of user data is to be sent over Newnet link. There are 20 bytes IP options field involved. How many IP fragments are transmitted and what is the offset and IP payload length of each fragment?

Given,

Packet size: 7540 bytes

20 bytes   7520 bytes

MTU: 1600 bytes
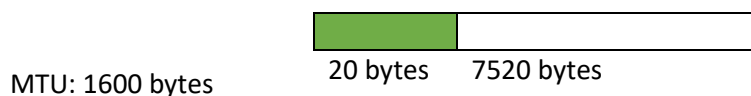
(20 bytes header + 1580 bytes data)

Data bytes should be in multiple of 8. So, consider 1576 bytes data in each packet.

No. of fragments = 7520/1576 = 4.775 => 5

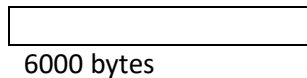| Fragments	Payback length	Flag	Offset
1	1576	1	0
2	1576	1	197
3	1576	1	394
4	1576	1	591
5	1216	0	788

b) **Without IP Options**

2. Assume a link layer protocol, called Newnet with MTU 1400 bytes. A TCP segment with 6000 bytes of user data is to be sent over Newnet link. There are no IP options field involved. How many IP fragments are transmitted and what is the offset and IP payload length of each fragment?

Given,

Packet size: 6000 bytes

6000 bytes

MTU: 1400 bytes

Data bytes should be in multiple of 8. 1400 is divisible by 8. So we can transmit 1400 bytes in each packet

No. of fragments = 6000/1400 = 4.28 => 5

Fragments	Payback length	Flag	Offset
1	1400	1	0

2	1400	1	175
3	1400	1	350
4	1400	1	525
5	400	0	700

IPv6 Subnetting:

128 bits

Network	Subnet	Host
48 bits	**16 bits**	**64 bits**

e.g. 2001:2A1:CAD:0000::/64

2001:2A1:CAD => Network Portion

0000 => Subnet portion

0000 0000 0000 0000 =0000

0000 0000 0000 0001 =0001

0000 0000 0000 0010 =0002

0000 0000 0000 0011 =0003

0000 0000 0000 0100 =0004

.

.

.

0000 0000 0000 1111 =000F

.

.

1111 1111 1111 1111 =FFFF

Problem 1:

2000:ACAD:1234:6600::/56, find first 4 & last 4 subnets.

Solution: 56 bits network portion

Lets expand 6600

0110 0110 <mark>0000 0000</mark>

Subnet portion: 0000 0000

Possible subnets: 2^8=256

Let us find first 4 subnets:

66 <mark>0000 0000</mark> =>6600

66 <mark>0000 0001</mark> =>6601

66 <mark>0000 0010</mark> =>6602

66 <mark>0000 0011</mark> =>6603

i.e.

2000:ACAD:1234:6600::/64

2000:ACAD:1234:6601::/64

2000:ACAD:1234:6602::/64

2000:ACAD:1234:6603::/64

Let us find last four subnets:

66 <mark>1111 1100</mark> =>66FC

66 <mark>1111 1101</mark> =>66FD

66 <mark>1111 1110</mark> =>66FE

66 <mark>1111 1111</mark> =>66FF

i.e.

2000:ACAD:1234:66FC::/64

2000:ACAD:1234:66FD::/64

2000:ACAD:1234:66FE::/64

2000:ACAD:1234:66FF::/64

Last:

1111 =>F

1110 =>E

1101 =>D

1100 =>C

1011 =>B

1010 =>A

1001 =>9

1000 =>8

0111 =>7

0110 =>6

0101 =>5

0100 =>4

0011 =>3

0010 =>2

0001 =>1

0000 =>0

Problem 2:

Identify the first six /49 address blocks out of ABCD::/32

Solution:

49-32=17, total possible subnets=2^170

ABCD: 0000:<mark>0000 0000 0000 0000: 0</mark> 000 0000 0000 0000::/49

ABCD:0000: <mark>0000 0000 0000 0000: 1</mark> 000 0000 0000 0000::/49

ABCD: 0000:<mark>0000 0000 0000 0001: 0</mark> 000 0000 0000 0000::/49

ABCD: 0000:<mark>0000 0000 0000 0001: 1</mark> 000 0000 0000 0000::/49

ABCD: 0000:<mark>0000 0000 0000 0010: 0</mark> 000 0000 0000 0000::/49

ABCD: 0000:<mark>0000 0000 0000 0010: 1</mark> 000 0000 0000 0000::/49

So,

ABCD:0000:0000:0000::/49

ABCD:0000:0000:8000::/49

ABCD:0000:0001:0000::/49

ABCD:0000:0001:8000::/49

ABCD:0000:0002:0000::/49

ABCD:0000:0002:8000::/49

Problem 3:

Identify the first eight address blocks out of 2001:ACAD:1234:1230::/60.

Solution:

64-60=4

2001:ACAD:1234:123<mark>0</mark>::/60

2001: ACAD:1234: 0001 0010 0011 <mark>0000</mark>::/64

Total possible subnets: 2^4=16

The first eight address blocks are:

2001: ACAD:1234: 123 <mark>0000</mark>::/64 => 2001: ACAD:1234: 1230::/64

2001: ACAD:1234: 123 <mark>0001</mark>::/64 =>2001: ACAD:1234: 1231::/64

2001: ACAD:1234: 123 <mark>0010</mark>::/64 => 2001: ACAD:1234: 1232::/64

2001: ACAD:1234: 123 <mark>0011</mark>::/64 => 2001: ACAD:1234: 1233::/64

2001: ACAD:1234: 123 <mark>0100</mark>::/64 =>2001: ACAD:1234: 1234::/64

2001: ACAD:1234: 123 <mark>0101</mark>::/64 =>2001: ACAD:1234: 1235::/64

2001: ACAD:1234: 123 <mark>0110</mark>::/64 =>2001: ACAD:1234: 1236::/64

2001: ACAD:1234: 123 <mark>0111</mark>::/64 =>2001: ACAD:1234: 1237::/64

Problem 4:

Identify the first six /42 blocks out of ABCD:EFAB::/32

Solution:

Bits to be varied: 42-32=10

Total possible subnets: 2^10

ABCD:EFAB: <mark>0000 0000 00</mark> 00 0000::/42

The first six /42 blocks are:

ABCD:EFAB: 0000 0000 00 00 0000::/42 => ABCD:EFAB:0000::/42

ABCD:EFAB: 0000 0000 01 00 0000::/42 => ABCD:EFAB:0040::/42

ABCD:EFAB: 0000 0000 10 00 0000::/42 => ABCD:EFAB:0080::/42

ABCD:EFAB: 0000 0000 11 00 0000::/42 => ABCD:EFAB:00C0::/42

ABCD:EFAB: 0000 0001 00 00 0000::/42 => ABCD:EFAB:0100::/42

ABCD:EFAB: 0000 0001 01 00 0000::/42 => ABCD:EFAB:0140::/42

IPv4 Subnetting:

Question 1: VLSM

The administrator has three different departments with different number of hosts. Sales department has 100 computers, Purchase department has 50 computers, Accounts has 25 computers and Management has 5 computers. How should the administrator perform the subnetting?

Solution:

The given network address is: 192.168.1.0/24

Given requirement in descending order is:

> Sales 100
>
> Purchase 50
>
> Accounts 25
>
> Management 5

The complete range of the address in the above provided network is:

192.168.1.0 to 192.168.1.255

Divide the given network consisting 256 hosts into 2 networks with 128 hosts each:

192.168.1.0-192.168.1.127   (192.168.1.0/25)

192.168.1.128-192.168.1.255   (192.168.1.128/25)

The largest network requirement is of 100 hosts for Sales department. For this, we need to assign subnetwork with 128 hosts.

Let us assign the first divided subnetwork 192.168.1.0/25 to Sales Department.

We now have remaining subnetwork 192.168.1.128/25.

Dividing this subnetwork, two subnetworks with 64 hosts each are formed.

192.168.1.128 to 192.168.1.191   (192.168.1.128/26)

192.168.1.192 to 192.168.1.255   (192.168.1.192/26)

Our second network requirement is of 50 hosts for Purchase department. We need to assign subnetwork consisting of 64 hosts.

Assigning 192.168.1.128/26 to Purchase department.

The remaining subnetwork available is 192.168.192/26.

Dividing this subnetwork, two subnetworks with 32 hosts each are formed.

192.168.1.192 to 192.168.1.223   (192.168.1.192/27)

192.168.1.224 to 192.168.1.255   (192.168.1.224/27)

The third largest requirement is of 25 hosts for Account department.

Assigning 192.168.1.192/27 to Account Department.

Remaining subnetwork is 192.168.1.224/27

Dividing this subnetwork, two subnetworks with 16 hosts each are formed.

192.168.1.224 to 192.168.1.239   (192.168.1.224/28)

192.168.1.240 to 192.168.1.255   (192.168.1.240/28)

Our fourth network requirement is of 5 hosts for Management department. We need to assign subnetwork consisting of 8 hosts, which is sufficient.

So, again dividing the subnetwork 192.168.1.240/28, two subnetworks with 8 hosts each are formed.

192.168.1.240 to 192.168.1.247   (192.168.1.240/29)

192.168.1.248 to 192.168.1.255   (192.168.1.248/29)

Our fourth network requirement is of 5 hosts for Management department. We need to assign subnetwork consisting of 8 hosts.

We can Assign either of the subnetwork to Management department.

Summarizing the subnetting results,

Network Name	Network ID	Subnet mask	No. of usable hosts	Usable Host ID Range	Broadcast address
Sales	192.168.1.0	/25	126	192.168.1.1 to 192.168.1.126	192.168.1.127
Purchase	192.168.1.128	/26	62	192.168.129 to 192.168.1.190	192.168.1.191
Account	192.168.1.192	/27	30	192.168.1.193 to 192.168.1.222	192.168.1.223

Management	192.168.1.240	/29	6	192.168.1.241 to 192.168.1.246	192.168.1.247
Unused	192.168.1.224/28 (192.168.1.224 to 192.168.1.239)				
Unused	192.168.1.247/29 (192.168.1.247 to 192.168.1.255)				

Question 2: FLSM

. If you are given a network 210.25.23.0 with the subnet mask 255.255.255.0, assign the networks to four different departments with 50 hosts each.

Ans: The complete range of the address in the above provided network is:

210.25.23.0 to 210.25.23.255

Total no of hosts available: 256 hosts

Each subnetwork requires 50 usable hosts. So, we need to assign n/w with 64 hosts each to the four departments.

Since we are using FLSM, the divided networks will be of same size. The given network consists of 256 hosts which needs to be divided into four subnetworks with 64 hosts each.

The process is as follows:

First of all, divide the given network range into four equal parts.

210.25.23.0 to 210.25.23.63   (210.25.23.0/26)

210.25.23.64 to 210.25.23.127   (210.25.23.64/26)

210.25.23.128 to 210.25.23.191   (210.25.23.128/26)

210.25.23.192 to 210.25.23.255   (210.25.23.192/26)

Now, as per the requirement, there are four networks required and we can assign the above networks to each of the four departments.

Network Name	Network ID	Subnet mask	No. of usable hosts	Usable Host ID Range	Broadcast address
Dept 1	210.25.23.0	/26	62	210.25.23.1 to 210.25.23.62	210.25.23.63
Dept 2	210.25.23.64	/26	62	210.25.23.65 to 210.25.23.126	210.25.23.127

Dept 3	210.25.23.128	/26	62	210.25.23.129 to 210.25.23.190	210.25.23.191
Dept 4	210.25.23.192	/26	62	210.25.23.193 to 210.25.23.254	210.25.23.255

Question 3: FLSM

Suppose you are network administrator with provided network 172.16.0.0/24. You need to manage the entire n/w by dividing into subnetworks so that each of the Development, Sales, Reception, HR and Production. How would you do so?

Ans: Provided network: 172.16.0.0/24. Here, /24 indicates 256 hosts are contained in the given network.

There are five departments to address the networks with. So, we divide the given network into 8 networks. 256/8 = 32

Each of the 8 subnetworks will contain 32 hosts each. The divided networks will be:

172.16.0.0 to 172.16.0.31   (172.16.0.0/27)

172.16.0.32 to 172.16.0.63   (172.16.0.32/27)

172.16.0.64 to 172.16.0.95   (172.16.0.64/27)

172.16.0.96 to 172.168.0.127   (172.16.0.96/27)

172.16.0.128 to 172.16.0.159   (172.16.0.128/27)

172.16.0.160 to 172.16.0.191   (172.16.0.160/27)

172.16.0.192 to 172.16.0.223   (172.16.0.192/27)

172.16.0.224 to 172.16.0.255)   (172.16.0.224/27)

Now, we can assign 5 of the above 8 subnetworks to the departments of our requirement.

The result will be as follows:

Network Name	Network ID	Subnet mask	No. of usable hosts	Usable Host ID Range	Broadcast address
Development	172.16.0.0	/27	30	172.16.0.1 to 172.16.0.30	172.16.0.31
Sales	172.16.0.32	/27	30	172.16.0.33 to 172.16.0.62	172.16.0.63
Reception	172.16.0.64	/27	30	172.16.0.65 to 172.16.0.94	172.16.0.95

HR	172.16.0.96	/27	30	172.16.0.97 to 172.168.0.126	172.168.0.127
Production	172.16.0.128	/27	30	172.16.0.129 to 172.16.0.158	172.16.0.159
Unused	172.16.0.160 to 172.16.0.191			(172.16.0.160/27)	
Unused	172.16.0.192 to 172.16.0.223			(172.16.0.192/27)	
Unused	172.16.0.224 to 172.16.0.255)			(172.16.0.224/27)	

Question 4: VLSM

If you are assigned an IP address 92.16.1.0/24 and plans to deploy CIDR. Here are some requirements which you have to fulfill for Subnet A= 120 hosts, Subnet B=60 hosts, Subnet C=30 hosts, Subnet D= 10 hosts, Subnet E= 5. You are also required to calculate subnet mask, range, netid, broadcast id for each subnet.

Ans: The given network address is: 92.16.1.0/24

Given requirement in descending order is:

       Subnet A: 120

       Subnet B: 60

       Subnet C: 30

       Subnet D: 10

       Subnet E: 5

The complete range of the address in the above provided network is:

92.16.1.0 to 92.16.1.255

The largest network requirement is of 120 hosts for Subnet A. For this, we need to assign subnetwork with 128 hosts.

Divide the given network consisting 256 hosts into 2 networks with 128 hosts each:

92.16.1.0-92.16.1.127   (92.16.1.0/25)

92.16.1.128-92.16.1.255   (92.16.1.128/25)

Let us assign the first divided subnetwork 92.16.1.0/25 to Subnet A.

We now have remaining subnetwork 92.16.1.128/25.

Our second network requirement is of 60 hosts for Subnet B. We need to assign subnetwork consisting of 64 hosts.

Dividing this subnetwork, two subnetworks with 64 hosts each are formed.

92.16.1.128 to 92.16.1.191 (92.16.1.128/26)

92.16.1.192 to 92.16.1.255 (92.16.1.192/26)

Assigning 92.16.1.128/26 to Subnet B.

The remaining subnetwork available is 92.16.1.192/26.

The third largest requirement is of 30 hosts for Subnet C.

Dividing this subnetwork, two subnetworks with 32 hosts each are formed.

92.16.1.192 to 92.16.1.223 (92.16.1.192/27)

92.16.1.224 to 92.16.1.255 (92.16.1.224/27)

Assigning 92.16.1.192/27 to Subnet C.

Remaining subnetwork is 92.16.1.224/27

Our fourth network requirement is of 10 hosts for Subnet D. We need to assign subnetwork consisting of 16 hosts.

Dividing this subnetwork, two subnetworks with 16 hosts each are formed.

92.16.1.224 to 92.16.1.239 (92.16.1.224/28)

92.16.1.240 to 92.16.1.255 (92.16.1.240/28)

Assigning 92.16.1.224/28 to Subnet D.

Remaining subnetwork is 92.16.1.240/28

Our fifth network requirement is of 5 hosts for Subnet E. We need to assign subnetwork consisting of 8 hosts.

So, again dividing the subnetwork 92.16.1.240/28, two subnetworks with 8 hosts each are formed.

92.16.1.240 to 92.16.1.247 (92.16.1.240/29)

92.16.1.248 to 92.16.1.255 (92.16.1.248/29)

We can Assign either of the subnetwork to Subnet E. Let us assign 92.16.1.240/29 to Subnet E.

Summarizing the subnetting results,

Network Name	Network ID	Subnet mask	No. of usable hosts	Usable Host ID Range	Broadcast address
Subnet A	92.16.1.0	/25	126	92.16.1.1 to 92.16.1.126	92.16.1.127

Subnet B	92.16.1.128	/26	62	92.16.129 to 92.16.1.190	92.16.1.191
Subnet C	92.16.1.192	/27	30	92.16.1.193 to 92.16.1.222	92.16.1.223
Subnet D	92.16.1.224	/28	14	92.16.1.225 to 92.16.1.238	92.16.1.239
Subnet E	92.16.1.240	/29	6	92.16.1.241 to 92.16.1.246	92.16.1.247
Unused	92.16.1.248/29 (92.16.1.248 to 92.16.1.255)				

Note:

1. Network: 192.168.0.0/24, 2^8, 256 hosts

   Total Range: 192.168.0.0 to 192.168.0.255

2. Network: 192.168.1.0/25, 2^7, 128 hosts
   Total Range: 192.168.1.0 to 192.168.1.127

3. Network: 192.168.3.0/26, 2^6, 64 hosts
   Total Range: 192.168.3.0 to 192.168.3.63

4. Network: 192.168.0.0/23, 2^9, 512 hosts
   Total Range: 192.168.0.0 to 192.168.0.255, 192.168.1.0 to 192.168.1.255

5. Network: 192.168.1.0/23, 2^9, 512 hosts
   Total Range: 192.168.1.0 to 192.168.1.255, 192.168.2.0 to 192.168.2.255

6. Network: 172.16.10.0/23, 2^9, 512 hosts
   Total Range: 172.16.10.0 to 172.16.10.255, 172.16.11.0 to 172.168.11.255

7. Network: 172.16.10.0/22, 2^10, 1024 hosts
   Total Range: 172.16.10.0 to 172.16.10.255
                    172.16.11.0 to 172.16.11.255
                    172.16.12.0 to 172.16.12.255
                    172.16.13.0 to 172.16.13.255

8. Network: 172.16.10.0/21, 2^11, 2048 hosts
   Total Range: 172.16.10.0 to 172.16.10.255
                    172.16.11.0 to 172.16.11.255
                    172.16.12.0 to 172.16.12.255
                    172.16.13.0 to 172.16.13.255
                    172.16.14.0 to 172.16.14.255
                    172.16.15.0 to 172.16.15.255
                    172.16.16.0 to 172.16.16.255

172.16.17.0 to 172.16.17.255

Question 5: VLSM

Given Network: 192.168.0.0/23

Requirement:

A: 128 hosts, B: 64 hosts, C: 31 hosts, D: 15 hosts

Solution: Total Range= 192.168.0.0 to 192.168.0.255 (192.168.0.0/24)

192.168.1.0 to 192.168.1.255 (192.168.1.0/24)

A-> 128 hosts, need to assign n/w of 256 hosts

Let us assign: 192.168.0.0/24

B-> 64 hosts, need to assign n/w of 128 hosts

Divide 192.168.1.0/24,

192.168.1.0 to 192.168.1.127   (192.168.1.0/25)

192.168.1.128 to 192.168.1.255 (192.168.1.128/25)

Assign 192.168.1.0/25 to B.

Remaining: 192.168.1.128/25

C->31 hosts, need to assign n/w of 64 hosts

Divide 192.168.1.128/25,

192.168.1.128 to 192.168.1.191   (192.168.1.128/26)

192.168.1.192 to 192.168.1.255   (192.168.1.192/26)

Assign 192.168.1.128/26 to C.

Remaining: 192.168.1.192/26

D-> 15 hosts, need to assign n/w of 32 hosts

Divide 192.168.1.192/26,

192.168.1.192 to 192.168.1.223   (192.168.1.192/27)

192.168.1.224 to 192.168.1.255   (192.168.1.224/27)

Assign 192.168.1.192/27 to D

Unused: 192.168.1.224/27

Need to tabulate like in previous examples.

Conversion of IP Multicast Address to Ethernet Multicast Address:

Mapping IP multicast to Ethernet:

For mapping IP Multicast addresses to Ethernet Addresses, the lower 23 bits of a Class D IP Address are copied to one of the IANA (Internet Assigned Numbers Authority) Designated Ethernet Addresses.

Note: A key IANA function is the global coordination of the Internet Protocol addressing systems, commonly known as IP Addresses.

Ethernet addresses reserved for this purpose are in the range of 01:00:53:00:00:00 through 01:00:5e:7f:ff:ff. Ethernet Addresses have a 48 bit address field (Source and Destination 48 bits each one). Expressed in hexadecimal numbering, the first 24 bits of an Ethernet multicast address are 01:00:5e, this indicates the frame as multicast, the next bit in the Ethernet address is always 0, leaving 23 bit for the multicast address.

Multicast MAC Address Format 23-BIT

IP Address

Multicast IP Address
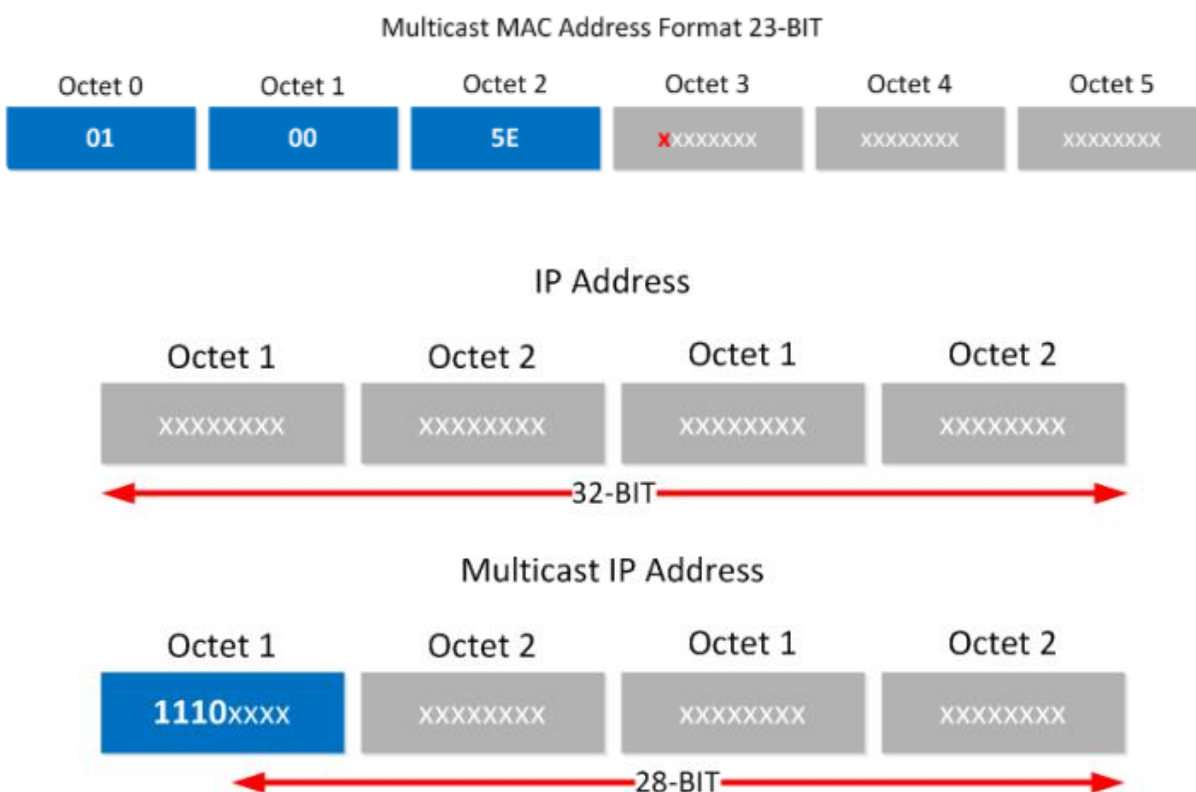
Because IP Multicast groups are 28 bits (1110XXXX XXXXXXXX XXXXXXXX XXXXXXXX) long and there are only 23 bits available the mapping cannot be one to one, so only 23 low order bits of the multicast group ID are mapped onto the Ethernet address. The 5 higher order bit remain in the multicast group are ignored.
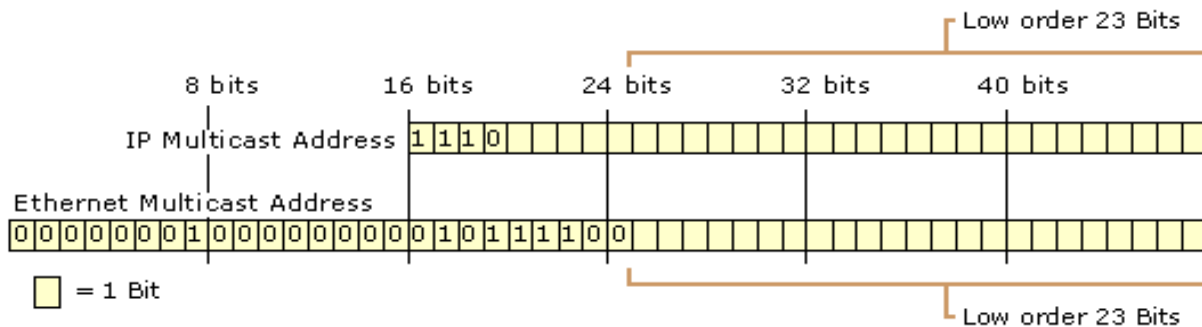
This means that we have to map multiple Multicast IP addresses to the same Multicast MAC address. We don't have enough MAC addresses to give each multicast IP address its own MAC address. We miss 5 bits of mapping information: 2^5 = 32. This means we will map 32 multicast IP addresses to 1 multicast MAC address.

An example:

Having the following IP Multicast Address 224.192.16.1 convert it to the appropriate Ethernet MAC Representation.

224.   192.   16.   1

11100000.11000000.00010000.00000001

Multicast Ethernet

01:00:5e

00000001.00000000.01011110.0XXXXXXX.XXXXXXXX.XXXXXXXX

11100000.1**1000000.00010000.00000001**

Final=

00000001.00000000.0101 1110.0100 0000.0001 0000.0000 0001

01 00 5 E 4 0 1 0 0 1

01:00:5E:40:10:01

Conversion of MAC Address into IPv6 Address:

Question:

From the following information, convert MAC address into IPv6 address using EUI-64.

MAC Address: 10:0B:0D:10:0A:20

IPv6 n/w ID: 20B4:2001:1A34:ABBA::/64

Also, write down the link local IPv6 address.

Solution:

EUI-Extended Unique Identifier

EUI-64: 64 bit unique interface ID need to be generated

IPv6 Address: 128 bits

64 bits	64 bits
Network Portion	Host portion (interface ID)

To do so, first split the given MAC address into 2 parts (24 bits each)

10:0B:0D   10:0A:20

Insert FFFE into the middle,

10:0B:0D:FF:FE:10:0A:20

Regroup the above for IPv6 format, 4 digits are placed in a group forming 4 groups with 16 bits each.

100B:0DFF:FE10:0A20

Now, flip the 7th bit starting from first position by expanding into binary.

0001 0000 0000 1011:0DFF:FE10:0A20

Flipping 0 to 1,

 0001 0010 0000 1011:0DFF:FE10:0A20

i.e. 120B:0DFF:FE10:0A20

This is the interface or host ID

Network ID is given in the question itself: 20B4:2001:1A34:ABBA::/64

So, the complete IPv6 address will be,

20B4:2001:1A34:ABBA:120B:0DFF:FE10:0A20

Now, we need to find the link local IPv6 address. Link local addresses are the addresses that are used for IPv6 local area networks.

Note that, link local IPv6 addresses always start from FE80:: (i.e. network portion)

We need to append the 64 bit interface ID calculated before to the end of FE80::

So,

FE80::120B:0DFF:FE10:0A20

This is the link local IPv6 address which consists consecutive blocks of zeros represented by ::