**Unit-4 Problems**

**IP Addressing**

1. Rewrite the following IP addresses using binary notation:

**a.** 110.11.5.88 **b.** 12.74.16.18 **c.** 201.24.44.32

**Answer:**

a. 01101110 00001011 00000101 01011000  
b. 00001100 01001010 00010000 00010010  
c. 11001001 00011000 00101100 00100000

2. Rewrite the following IP addresses using dotted-decimal notation:

a. 01011110 10110000 01110101 00010101

b. 10001001 10001110 11010000 00110001

c. 01010111 10000100 00110111 00001111

**Answer:**

a. 94.176.117.21  
b. 137.142.208.49  
c. 86.132.55.15

3. Find the class of the following classful IP addresses:

**a**. 130.34.54.12 b. 200.34.2.1 c. 245.34.2.8

**Answer:**

a. 130 is between 128 and 191 => Class B  
b. 200 is between 192 and 223 => Class C  
c. 245 is between 240 and 254 => Class E

4. Find the class of the following classful IP addresses:

a. 01110111 11110011 10000111 11011101

b. 11101111 11000000 11110000 00011101

c. 11011111 10110000 00011111 01011101

**Answer:**

a.) First byte begins with 0 => Class A  
b.) First byte begins with 1110 => Class D-  
c.) First byte begins with 110 => Class C

1. In classless addressing, what is the size of the block (N) if the value of the prefix length (n) is one of the following?

a. n = 0 b. n = 14 c. n = 32

**Answer:**

a.) N = 2(32 - 0) = 232  
b.) N = 2(32 - 14) = 218  
c.) N = 2(32 - 32) = 1

1. Change each of the following prefix lengths to a mask in dotted-decimal notation:

a. n = 0 b. n = 14 c. n = 30

**Answer:**

a.) 00000000 00000000 00000000 00000000 = 0.0.0.0  
b.) 11111111 11111100 00000000 00000000 = 255.252.0.0  
c.) 11111111 11111111 11111111 11111100 = 255.255.255.252

1. Change each of the following masks to a prefix length:

a. 255.224.0.0 b. 255.240.0.0 c. 255.255.255.128

**Answer:**

Convert to binary and count the number of bits before the first 0:  
a.) 11111111 11100000 0... => n = 11  
b.) 11111111 11110000 0... => n = 12  
c.) 11111111 11111111 11111111 10000000 => n = 25

1. Which of the following cannot be a mask in CIDR?

a. 255.225.0.0 b. 255.192.0.0

**Answer:**

Convert to binary and find any one’s comes after a zero. If it is so then it cannot be a mask.   
'a' cannot be a mask

‘b’ can be a mask

9. Write the IP address 222.1.1.20 mask 255.255.255.192 in CIDR notation

Answer:

Decimal 192 =11000000

So we write: 222.1.1.20/26

1. Write the IP address 135.1.­­­­­­­1.25 mask 255.255. 248.0 in CIDR notation

Answer:

Decimal 248 =11111000

So we write:135.1.1.25/21

1. You have been allocated a class C network address of 211.1.1.0 and are using the default subnet mask of 255.255.255.0 how may hosts can you have?

Answer:

Class C address has 8 bits for the host which will give 2^8 = 256 hosts

1. Your router has the following IP address on Ethernet0: 172.16.2.1/23. Which of the following can be valid host IDs on the LAN interface attached to the router?
2. 172.16.1.100
3. 172.16.1.198
4. 172.16.2.255
5. 172.16.3.0

Answer:

Starting address for LAN interface attached to router is: 172.16.2.0

Ending address for LAN interface attached to router is: 172.16.3.255

Option c and d address only lies in the above range

So correct answer is Option c and d

1. What is the maximum number of IP addresses that can be assigned to hosts on a local subnet that uses the 255.255.255.224 subnet mask?

Answer:

224 in binary: 11100000

So Maximum number of hosts = 32

12. Each of the following addresses belongs to a block. Find the first and the last address in each block.

a. 14.12.72.8/24 b. 200.107.16.17/18 c. 70.110.19.17/16

**Answer:**

a.

* + - 1. : 00001110 00001100 01001000 00001000

First Address: 00001110 00001100 01001000 00000000 = 14.12.72.0

Last Address: 00001110 00001100 01001000 11111111 = 14.12.72.255

b.

200.107.16.17: 11001000 01101011 00010000 00010001

First Address: 11001000 01101011 00000000 00000000 = 200.107.0.0

Last Address: 11001000 01101011 00111111 11111111 = 200.107.63.255

c.

70.110.19.17: 01000110 00010011 00010011 00010001

First Address: 01000110 00010011 00000000 00000000 = 70.110.0.0

Last Address: 01000110 00010011 11111111 11111111 = 70.110.255.255

13. An ISP is granted the block 80.70.56.0/21. The ISP needs to allocate addresses for two organizations each with 500 addresses, two organizations each with 250 addresses, and three organizations each with 50 addresses.

a. Find the number and range of addresses in the ISP block.

b. Find the range of addresses for each organization and the range of unallocated addresses.

**Answer:**

1. **Number of addresses and range of addresses in ISP block**:

Given classless address = 80.70.56.0/21

From the above address Prefix length, n=21

Number of addresses, N= 232-21 = 211 = 2048 addresses

First Address (80.70.56.0): 01010000 01000110 00111000 00000000

Last Address (80.70.63.255): 01010000 01000110 00111111 11111111

1. **Range of addresses for each organization**:

**1st organization**:

1st organization needs 500 addresses which is not power of 2. So 512 addresses will be allocated. So number of addresses, N = 512

Prefix Length, n = 23

First address: 01010000 01000110 00111000 00000000 (80.70.56.0/23)

Last address: 01010000 01000110 00111001 11111111 (80.70.57.255/23)

**2nd organization**:

2nd organization needs 500 addresses which is not power of 2. So 512 addresses will be allocated. So number of addresses, N = 512

Prefix Length, n = 23

First address: 01010000 01000110 00111010 00000000 (80.70.58.0/23)

Last address: 01010000 01000110 00111011 11111111 (80.70.59.255/23)

**3rd organization**:

3rd organization needs 250 addresses which is not power of 2. So 256 addresses will be allocated. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 00111100 00000000 (80.70.60.0/24)

Last address: 01010000 01000110 00111100 11111111 (80.70.60.255/24)

**4th organization**:

4th organization needs 250 addresses which is not power of 2. So 256 addresses will be allocated. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 00111101 00000000 (80.70.61.0/24)

Last address: 01010000 01000110 00111101 11111111 (80.70.61.255/24)

**5th organization**:

5th organization needs 50 addresses which is not power of 2. So 64 addresses will be allocated. So number of addresses, N = 64

Prefix Length, n = 26

First address: 01010000 01000110 00111110 00000000 (80.70.62.0/26)

Last address: 01010000 01000110 00111110 00111111 (80.70.62.63/26)

**6th organization**:

6th organization needs 50 addresses which is not power of 2. So 64 addresses will be allocated. So number of addresses, N = 64

Prefix Length, n = 26

First address: 01010000 01000110 00111110 01000000 (80.70.62.64/26)

Last address: 01010000 01000110 00111110 01111111 (80.70.62.127/26)

**7th organization**:

7th organization needs 50 addresses which is not power of 2. So 64 addresses will be allocated. So number of addresses, N = 64

Prefix Length, n = 26

First address: 01010000 01000110 00111110 10000000 (80.70.62.128/26)

Last address: 01010000 01000110 00111110 10111111 (80.70.62.191/26)

Total allocated addresses= 512+512+256+256+64+64+64=1728 address

Unallocated addresses= 2048-1728 = 320 addresses

Unallocated address range = 80.70.62.192 to 80.70.63.255

14. An ISP is granted the block 16.12.64.0/20. The ISP needs to allocate addresses for 8 organizations, each with 256 addresses.

a. Find the number and range of addresses in the ISP block.

b. Find the range of addresses for each organization and the range of unallocated addresses.

**Answer:**

1. **Number of addresses and range of addresses in ISP block**:

Given classless address = 16.12.64.0/20

From the above address Prefix length, n=20

Number of addresses, N= 232-20 = 212 = 4096 addresses

First Address (16.12.64.0/20): 00010000 00001110 01000000 00000000

Last Address (16.12.79.255/20): 00010000 00001110 01001111 11111111

1. **Range of addresses for each organization**:

**1st organization**:

1st organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000000 00000000 (16.12.64.0/24)

Last address: 01010000 01000110 01000000 11111111 (16.12.64.255/24)

**2nd organization**:

2nd organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000001 00000000 (16.12.65.0/24)

Last address: 01010000 01000110 01000001 11111111 (16.12.65.255/24)

**3rd organization**:

3rd organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000010 00000000 (16.12.66.0/24)

Last address: 01010000 01000110 01000010 11111111 (16.12.66.255/24)

**4th organization**:

4th organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000011 00000000 (16.12.67.0/24)

Last address: 01010000 01000110 01000011 11111111 (16.12.67.255/24)

**5th organization**:

5th organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000100 00000000 (16.12.68.0/24)

Last address: 01010000 01000110 01000100 11111111 (16.12.68.255/24)

**6th organization**:

6th organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 32 − log2N = 24

First address: 01010000 01000110 01000101 00000000 (16.12.69.0/24)

Last address: 01010000 01000110 01000101 11111111 (16.12.69.255/24)

**7th organization**:

7th organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000110 00000000 (16.12.70.0/24)

Last address: 01010000 01000110 01000110 11111111 (16.12.70.255/24)

**8th organization**:

8th organization needs 256 addresses. So number of addresses, N = 256

Prefix Length, n = 24

First address: 01010000 01000110 01000111 00000000 (16.12.71.0/24)

Last address: 01010000 01000110 01000111 11111111 (16.12.71.255/24)

Total allocated addresses= 8\*256= 2048 address

Unallocated addresses= 4096-2048 = 2048 addresses

Unallocated address range = 16.12.72.0 to 16.12.79.255

15. An organization is granted the block 130.56.0.0/16. The administrator wants to create 1024 subnets.

a. Find the number of addresses in each subnet.

b. Find the subnet prefix.

c. Find the first and the last address in the first subnet.

d. Find the first and the last address in the last subnet.

**Answer:**

Given classless address is 130.56.0.0/16

From the given prefix length, n=16

Number of addresses, N = 232-n = 232-16 = 216 = 65536 addresses

**a. Number of addresses in each subnet:**

Total number of addresses = 65536 addresses

Total number of subnets = 1024

Since 1024 subnets has to be created, number of addresses in each subnet, Nsub = 65536 / 1024

= 64 addresses

**b. Find the subnet prefix:**

Number of addresses in each subnet, Nsub = 64

Subnet prefix, nsub = 26

**c. Find the first and the last address in the first subnet.**

First address in first subnet:130.56.0.0/26 (10000010 00111000 00000000 00000000)

Last address in first subnet:130.56.0.63/26 (10000010 00111000 00000000 00111111)

**d. Find the first and the last address in the last subnet.**

First address in first subnet:130.56.255.192/26 (10000010 00111000 11111111 11000000)

Last address in first subnet:130.56.255.255/26 (10000010 00111000 11111111 11111111)

**IP Fragmentation**

1. Suppose a router receives an IP packet containing 600 data bytes and has to forward the packet to a network with maximum transmission unit of 200 byte. What are fragment offset values for divided packets? (Neglect IP header size)

**Solution:**

Given Data size = 600 bytes

Router can forward the data of size 200 bytes only

Number of bytes in each fragment must be multiple of 8.

Offset value is calculated by dividing 1st byte number in every fragment by 8

|  |  |  |
| --- | --- | --- |
| **Fragment No.** | **Bytes range** | **Offset value** |
| Fragment1 | 0 to 199 bytes | 0 (0/8) |
| Fragment2 | 200 to 399 bytes | 25 (200/8) |
| Fragment3 | 400 to 599 bytes | 50 (400/8) |

1. Suppose a router receives an IP packet containing 600 data bytes and has to forward the packet to a network with maximum transmission unit of 150 byte. What are fragment offset values for divided packets? (Neglect IP header size)

**Solution:**

Given Data size = 600 bytes

Router can forward the data of size 150 bytes only

Since by dividing each fragment of 150 bytes, number of bytes in each fragment is not a multiple of 8.

So take the nearest lowest multiple of 8 value (ie) 144. So each fragment size is going to be 144 bytes

|  |  |  |
| --- | --- | --- |
| **Fragment No.** | **Bytes range** | **Offset value** |
| Fragment1 | 0 to 143 bytes | 0 (0/8) |
| Fragment2 | 144 to 287 bytes | 18 (144/8) |
| Fragment3 | 288 to 431 bytes | 36 (288/8) |
| Fragment4 | 432 to 575 bytes | 54 (432/8) |
| Fragment5 | 576 to 599 bytes | 72 (576/8) |