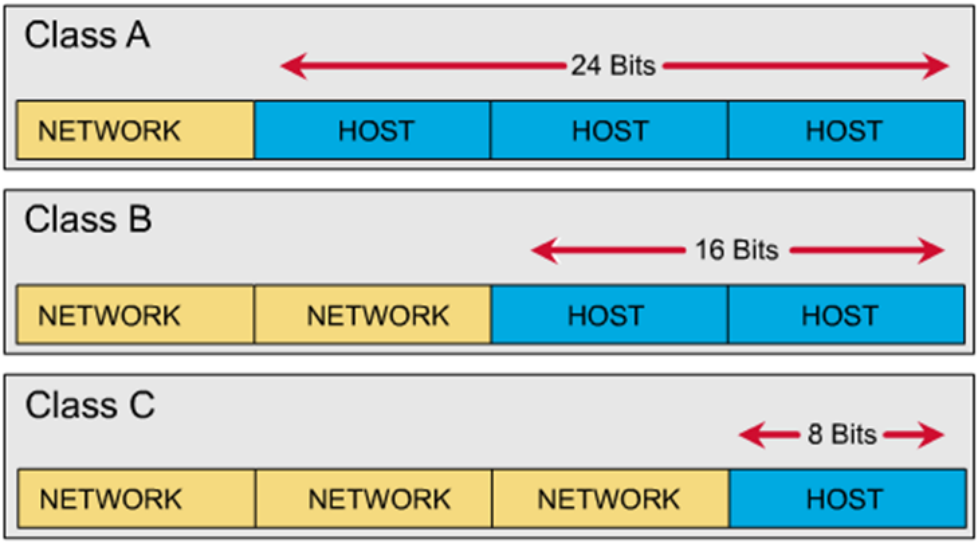
Computer Networks
2nd Year, 1st Semester

Tutorial 2

1) State the three types of addresses, operating layer and number of bits used to represent the address used in TCP/IP.
    - **IP addresses operate at the Network Layer (Layer 3) of the OSI model.**
        - **IPv4 addresses are 32 bits & IPv6 addresses are 128 bits.**
    - **MAC addresses operate at the Data Link Layer (Layer 2) of the OSI model.**
        - **MAC addresses are 48 bits.**
    - **Port numbers operate at the Transport Layer (Layer 4) of the OSI model.**
        - **Port numbers are 16 bits.**
2) What is the version of the current IP addressing scheme and the version of the next IP addressing scheme that will be using in the future?
    - **Current scheme – IP version 4**
    - **Next generation scheme – IP version 6**

3) For IP addresses in each class show network bits and host bits by a diagram.

Table 1



4) Write down the ranges of the IP address classes.

Address Class	Range of the first octet
Class A	**0 – 127**
Class B	**128 – 191**
Class C	**192 – 223**
Class D	**224 – 239**

5) Write the class, net ID and the host ID of the following addresses.

IP Address	Class	Net ID	Host ID	Network address	Broadcast Address	Subnet Mask
101.2.3.4	**A**	**101**	**2.3.4**	**101.0.0.0**	**101.255.255.255**	**255.0.0.0**
200.20.10.5	**C**	**200.20.10**	**5**	**200.20.10.0**	**200.20.10.255**	**255.255.255.0**
192.168.16.100	**C**	**192.168.16**	**100**	**192.168.16.0**	**192.168.16.255**	**255.255.255.0**
25.10.100.200	**A**	**25**	**10.100.200**	**25.0.0.0**	**25.255.255.255**	**255.0.0.0**
180.2.150.2	**B**	**180.2**	**150.2**	**180.2.0.0**	**180.2.255.255**	**255.255.0.0**

6) Find the network address and the subnet mask for the following IP addresses.
   - 172.19.67.3 **- 172.19.0.0** **- 255.255.0.0**
   - 205.90.46.234 **- 205.90.46.0** **- 255.255.255.0**
   - 123.65.89.0 **- 123.0.0.0** **- 255.0.0.0**

7) State the type of the following IP addresses.
   a. 172.16.25.9 **- Private IP Address (Class B)**
   b. 192.168.89.0 **- Private IP Address (Class C)**
   c. 127.0.0.90 **- Loopback Address**
   d. 255.255.255.0 **- Subnet Mask (Class C)**
   e. 255.255.255.255 **- Limited Broadcast Address**
   f. 0.0.26.8 **- Specific Host on this Network (Class B)**

8. What are two main components of an IP address?
   - **Network Identifier: This part of the IP address identifies the specific network to which a device is connected. It helps routers and other networking devices to determine where to send data within a network or across networks.**
   - **Host Identifier: This part of the IP address identifies the individual device (host) within the network. It distinguishes one device from another within the same network.**

9. Analyze the following IP addresses.

Find out which of the following addresses belong to the same network (no sub -netting / classful IP addressing). Explain why.

- **123.4.6.2** **123.4.78.9** 132.14.56.12 **123.4.0.0**
- **10.0.0.1** **10.1.1.1** **10.1.2.2** 11.0.0.1
- 172.16.16.16 172.17.16.16 **173.16.16.16** **173.16.16.20**

10. You are given the network address 180.150.0.0; you are required to have 5 subnets. What is the minimum number of Host Bits can you take in to the Network Bits for this purpose? Write down the addresses of 5 subnets. (Write in binary where necessary). Write the subnet mask for the network.

To determine the minimum number of host bits needed to create 5 subnets from the given network address (180.150.0.0), we can use the following steps:

i. **Identify the default class of the given network address.**
ii. **Determine the number of bits required to represent 5 subnets.**
iii. **Determine the subnet mask based on the number of bits allocated for subnetting.**
iv. **Calculate the subnet addresses.**

Given the network address 180.150.0.0 falls within the Class B range (128-191), we start with 16 network bits (default for Class B).

To create 5 subnets, we need at least 3 bits because $2^3 = 8$, which is greater than 5 but $2^2 = 4$, which is not sufficient. Therefore, we need to borrow 3 host bits for subnetting.

So, our new subnet mask will have 16 (original network bits) + 3 (borrowed bits) = 19 network bits.

Subnet Mask:
11111111.11111111.11100000.00000000
(255.255.224.0 in decimal)

Subnet Addresses:

Subnet 0: 180.150.0.0/19

Network Address: 180.150.0.0
Broadcast Address: 180.150.31.255
Usable IP Range: 180.150.0.1 to 180.150.31.254

Subnet 1: 180.150.32.0/19

Network Address: 180.150.32.0
Broadcast Address: 180.150.63.255
Usable IP Range: 180.150.32.1 to 180.150.63.254

Subnet 2: 180.150.64.0/19

Network Address: 180.150.64.0
Broadcast Address: 180.150.95.255
Usable IP Range: 180.150.64.1 to 180.150.95.254

Subnet 3: 180.150.96.0/19

Network Address: 180.150.96.0
Broadcast Address: 180.150.127.255

Usable IP Range: 180.150.96.1 to 180.150.127.254

Subnet 4: 180.150.128.0/19

Network Address: 180.150.128.0
Broadcast Address: 180.150.159.255
Usable IP Range: 180.150.128.1 to 180.150.159.254

11. A company is granted the network address 203.80.64.0 The company needs six subnets. Design the subnets and subnet mask. Also write the first 2 and last 2 IP addresses of the hosts in each of those subnets.

To create six subnets from the network address 203.80.64.0/24, we need to borrow enough bits from the host portion to accommodate at least 6 subnets. Since 6 subnets require at least 3 bits ($2^3 = 8$), we will borrow 3 bits. [/27]

The subnet mask: 255.255.255.224
The subnet size: $2^5 = 32$ addresses per subnet

Subnet Addresses:
Subnet 0:

First two IPs: 203.80.64.0 (Network Address), 203.80.64.1
Last two IPs: 203.80.64.30, 203.80.64.31 (Broadcast Address)

Subnet 1:

First two IPs: 203.80.64.32 (Network Address), 203.80.64.33
Last two IPs: 203.80.64.62, 203.80.64.63 (Broadcast Address)

Subnet 2:

First two IPs: 203.80.64.64 (Network Address), 203.80.64.65
Last two IPs: 203.80.64.94, 203.80.64.95 (Broadcast Address)

Subnet 3:

First two IPs: 203.80.64.96 (Network Address), 203.80.64.97
Last two IPs: 203.80.64.126, 203.80.64.127 (Broadcast Address)

Subnet 4:

First two IPs: 203.80.64.128 (Network Address), 203.80.64.129
Last two IPs: 203.80.64.158, 203.80.64.159 (Broadcast Address)

Subnet 5:

First two IPs: 203.80.64.160 (Network Address), 203.80.64.161
Last two IPs: 203.80.64.190, 203.80.64.191 (Broadcast Address)

12. Show the 8 subnets obtained by subnetting the address 172.16.0.0/16 , the resulting subnet mask, the corresponding broadcast addresses, and the range of valid host addresses.

To subnet the address 172.16.0.0/16 into 8 subnets, we need to borrow 3 bits from the host portion of the address to create 8 subnets. This will give us a subnet mask of /19 (16 + 3 = 19).

Here are the details for each subnet:
Subnet 0:

Subnet address : 172.16.0.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.31.255
Valid host range : 172.16.0.1 to 172.16.31.254

Subnet 1:

Subnet address : 172.16.32.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.63.255
Valid host range : 172.16.32.1 to 172.16.63.254

Subnet 2:

Subnet address : 172.16.64.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.95.255
Valid host range : 172.16.64.1 to 172.16.95.254

Subnet 3:

Subnet address : 172.16.96.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.127.255
Valid host range : 172.16.96.1 to 172.16.127.254

Subnet 4:

Subnet address : 172.16.128.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.159.255
Valid host range : 172.16.128.1 to 172.16.159.254

Subnet 5:

Subnet address : 172.16.160.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.191.255
Valid host range : 172.16.160.1 to 172.16.191.254

Subnet 6:

Subnet address : 172.16.192.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.223.255
Valid host range : 172.16.192.1 to 172.16.223.254

Subnet 7:

Subnet address : 172.16.224.0
Subnet mask : 255.255.224.0
Broadcast address : 172.16.255.255
Valid host range : 172.16.224.1 to 172.16.255.254

13. An organization is granted the block 211.17.180.0 in class C. The administrator wants to create 32 subnets.

I. Find the subnet mask and the number of addresses in each subnet.

To create 32 subnets from the given block 211.17.180.0 in class C, we need to borrow enough bits from the host portion of the IP address to accommodate at least 32 subnets. Since $2^5 = 32$, we need to borrow 5 bits to create 32 subnets. [3 bits are remaining as the host bits]

Subnet Mask: /29 OR 255.255.255.248
Number of addresses in each subnet: $2^3 = 8$ addresses

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

First subnet (Subnet 0):

Subnet address : 211.17.180.0/29
First usable address : 211.17.180.1/29
Last usable address : 211.17.180.6/29
Broadcast address : 211.17.180.7/29

III. Find the first and the last address in the last subnet (subnet 31)

Last subnet (subnet 31):

Subnet address : 211.17.180.248/29
First usable address : 211.17.180.249/29
Last usable address : 211.17.180.254/29
Broadcast address : 211.17.180.255/29

14. Compute the sub-network address for the following IP addresses, given the subnet mask,
    a. 201.14.78.65 255.255.255.224

       To compute the sub-network address for the given IP address (201.14.78.65) with the subnet mask 255.255.255.224 (/27), we need to perform a bitwise AND operation between the IP address and the subnet mask.

       Here's the process:

       IP address: 201.14.78.65 -> 11001001.00001110.01001110.01000001
       Subnet mask: 255.255.255.224 -> 11111111.11111111.11111111.11100000

       Sub-network address: 11001001.00001110.01001110.01000000 → **201.14.78.64**

    b. 180.25.21.172 255.255.255.192 → **180.25.21.128**
    c. 18.250.31.14 255.254.0.0 → **18.250.0.0**
    d. 10.30.36.12 255.255.255.0 → **10.30.36.0**
    e. 10.6.24.20 255.255.240.0 → **10.6.16.0**

15. Compute the available number of sub networks and possible host addresses in each subnet.
    g. The subnet mask for a class C network is 255.255.255.192

       Subnet mask for a class C network: 255.255.255.192 (or /26 in CIDR notation)

       Number of subnet bits: 2 (26 - 24 = 2)
       Number of possible subnets: 2^2 = 4 subnets
       Number of host bits: 6 (since 32 - 26 = 6 bits are used for the hosts)
       Number of possible host addresses per subnet: 2^6 - 2 = 62 (subtracting 2 for network address and broadcast address)

    h. The subnet mask for a class B network is 255.255.224.0

       Subnet mask for a class B network: 255.255.224.0 (or /19 in CIDR notation)

       Number of subnet bits: 3 (19 - 16 = 3)
       Number of possible subnets: 2^3 = 8 subnets
       Number of host bits: 13 (since 32 - 19 = 13 bits are used for the hosts)
       Number of possible host addresses per subnet: 2^{13} - 2 = 8190 (subtracting 2 for network address and broadcast address)

    i. The subnet mask for a class C network is 255.255.255.248

       Subnet mask for a class C network: 255.255.255.248 (or /29 in CIDR notation)

       Number of subnet bits: 5 (29 - 24 = 5)
       Number of possible subnets: 2^5 = 32 subnets
       Number of host bits: 3 (since 32 - 29 = 3 bits are used for the hosts)
       Number of possible host addresses per subnet: 2^3 - 2 = 6 (subtracting 2 for network address and broadcast address)

j. The subnet mask for a class A network is 255.255.248.0

Subnet mask for a class A network: 255.255.248.0 (or /21 in CIDR notation)

Number of subnet bits: 13 (21 - 8 = 13)
Number of possible subnets: $2^{13} = 8192$
Number of host bits: 11 (since 32 - 21 = 11 bits are used for the hosts)
Number of possible host addresses per subnet: $2^{11} - 2 = 2046$ (subtracting 2 for network address and broadcast address)

16. RH company has 9 branches in Colombo district. The company network has the network address of 152.16.0.0.

a. Write subnet addresses which can be given to the branches.

Since RH company has 9 branches, we can allocate subnets for each branch. We need to calculate the number of bits required to accommodate at least 9 subnets. Since $2^4 = 16$, we need 4 bits for subnetting.

Subnet mask for the branches: /20 (16 + 4 = 20)

Total number of subnets:16 subnets

Subnet addresses for each branch:

Subnet 0 (Branch 1) → 152.16.0.0/20
Subnet 1 (Branch 2) → 152.16.16.0/20
Subnet 2 (Branch 3) → 152.16.32.0/20
Subnet 3 (Branch 4) → 152.16.48.0/20
Subnet 4 (Branch 5) → 152.16.64.0/20
Subnet 5 (Branch 6) → 152.16.80.0/20
Subnet 6 (Branch 7) → 152.16.96.0/20
Subnet 7 (Branch 8) → 152.16.112.0/20
Subnet 8 (Branch 9) → 152.16.128.0/20

b. How many hosts can be existed in a branch?

Since we have a subnet mask of /20, we have 12 bits for hosts (32 - 20 = 12). This gives us $2^{12} - 2 = 4094$ hosts per subnet (minus 2 for the network and broadcast addresses).

c. Calculate the total number of available hosts in all the branches.

Total number of available hosts in all branches = 4094 * 9 = 36,846 hosts.

d. Write the 10^{th} available IP address of the 5^{th} branch.

For the 5th branch (152.16.64.0/20), the first available IP address is 152.16.64.1. The 10th available IP address would be 152.16.64.10.

e. Write the last 4 IP addresses of the 9th branch.

For the 9th branch (152.16.128.0/20), the last IP address of the subnet would be the broadcast address. Since we have 4094 hosts per subnet, the broadcast address would be 152.16.143.255. So, the last 4 IP addresses would be:

152.16.143.252

152.16.143.253

152.16.143.254

152.16.143.255