Computer Network Lab

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Introduction to IP address:

1. **IP Address**:

   - Each Network Interface Card (NIC) in a PC is assigned a unique IP address.
   - The IP address is assigned by the network administrator.
   - No two PCs on the same network can have the same IP address.

2. **MAC Address (Physical Address)**:

   - Each NIC has a built-in, unique MAC address.
   - The MAC address consists of an Organizationally Unique Identifier (OUI) indicating the vendor and a unique serial number.
   - MAC addresses are essential for local network communication and are hardcoded into the NIC's hardware.

3. **Format of IP Address:**

   - IPv4 addresses consist of four parts, following the pattern w.x.y.z.
   - Each part has 8 binary bits, and the decimal values can range from 0 to 255.

4. **IP Address Classes:**

   - IPv4 addresses are divided into different classes, which determine the maximum number of hosts per network ID.
   - Only three classes are used for network connectivity, as shown in the table below.
   - The class of an IP address is determined by the order of the bits in the first octet of the address.

Class	First Octet Range	Network ID Bits	Host ID Bits	Number of Networks	Number of Hosts
A	0.0.0.0 to 127.255.255.255	8 bits	24 bits	$2^8 = 256$	$2^{24} - 2 = 16,777,214$
B	128.0.0.0 to 191.255.255.255	16 bits	16 bits	$2^{16} = 65,536$	$2^{16} - 2 = 65,534$
C	192.0.0.0 to 223.255.255.255	24 bits	8 bits	$2^{24} = 16,777,216$	$2^8 - 2 = 254$

Table 1: IPv4 Address Classes

   - The Network ID identifies the network, and the Host ID identifies a machine on the network.
   - For each class, two IP addresses are reserved: one with all host bits set to 0 (represents the network ID) and one with all host bits set to 1 (reserved for Direct Broadcast Address).
     - **Class A:**
       * Network ID: 10.0.0.0 (All host bits are set to 0)
       * Direct Broadcast Address: 10.255.255.255 (All host bits are set to 1)
     - **Class B:**
       * Network ID: 172.16.0.0 (All host bits are set to 0)

          * Direct Broadcast Address: 172.16.255.255 (All host bits are set to 1)
  - **Class C:**
    * Network ID: 192.168.1.0 (All host bits are set to 0)
    * Direct Broadcast Address: 192.168.1.255 (All host bits are set to 1)

5. **How to Identify IP Class:**

   - The class of an IP address can be identified from its first octet:
     - If the first octet begins with 0, it's a Class A network.
     - If the first octet begins with 10, it's a Class B network.
     - If the first octet begins with 110, it's a Class C network.
     - If the first octet begins with 1110, it's a Class D network.
     - If the first octet begins with 1111, it's a Class E network.

6. **Default Subnet Masks:**

   - Default subnet masks are used to identify the network part from the host part.
   - For each class, the default subnet masks are as follows:
     - Class A: 255.0.0.0
     - Class B: 255.255.0.0
     - Class C: 255.255.255.0

7. **Invalid IP Addresses:**

   - If the network part is all 0s, the address belongs to class A. But this is an invalid IP address because for an IP address, all the network or host part should not be all 1s or all 0s.
     - 0.0.0.0 is not valid. Routers use it internally.
   - If the network part is all 1s, this address belongs to class E. But due to the presence of all 1s, it is not valid. This represents a broadcast to all networks.
     - 255.255.255.255 is not valid.
   - If the host part is all 0s, this represents a network address. This is not a valid IP address.
   - If the host part is all 1s, this represents a broadcast address. This is not a valid IP address.
   - 127.0.0.0 network address is used for loop-back testing. This will help you to check the network card of your own PC (localhost).

8. **IP Adress Classes:**

   - The validity of an IP address is also based on the subnet mask used.

Class	Address Range	Subnet Masking	Application
Class A	-	-	Used for a large number of hosts.
Class B	-	-	Used for medium-sized networks.
Class C	-	-	Used for local area networks.

Table 2: IP Address Classes and Applications