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	PRACTICAL EXPERIMENT INSTRUCTION SHEET		
	EXPERIMENT TITLE: **IP Addressing Techniques**		
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IP ADDRESSING TECHNIQUES

01. AIM :

To study Network IP and IP Addressing Techniques.

02. FACILITIES : ~~~

03. SCOPE :

The experiment covers the study of IP addressing (IPv4 and IPv6), understanding IP classes, subnetting, and CIDR. It demonstrates how IP addressing impacts network communication and efficient use of address spaces.

04 THEORY:

What is an IP Address?

Imagine every device on the internet as a house. For you to send a letter to a friend living in one of these houses, you need their home address. In the digital world, this home address is what we call an **IP (Internet Protocol) Address**.

An **IP address**, or **Internet Protocol address**, is a unique string of numbers separated by periods (IPv4) or colons (IPv6) assigned to each device connected to a computer network that uses the Internet Protocol for communication. It serves as an identifier that allows devices to send and receive data over the network, ensuring that this data reaches the correct destination.

Types of IP Addresses:

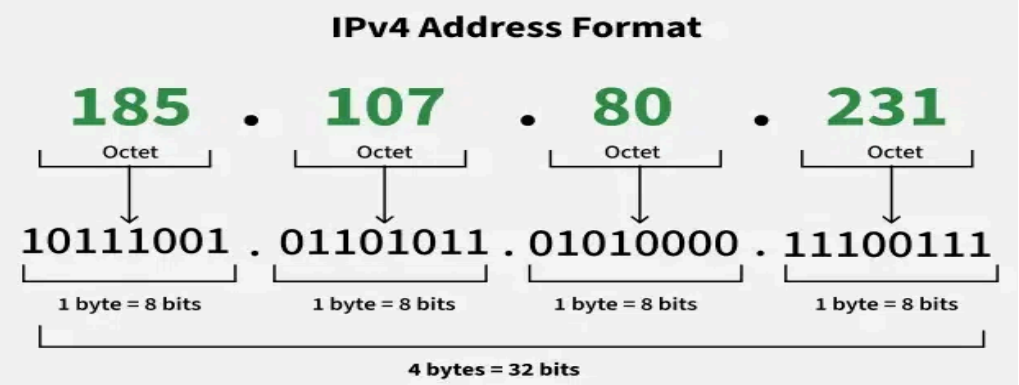
1. IPv4:

This is the most common form of IP Address. It consists of four sets of numbers separated by dots. For example, 192.158.1.38. Each set of numbers can range from 0 to 255. This format can support over 4 billion unique addresses. Here's how the structure is broken down:

- **Four Octets:** Each octet represents eight bits, or a byte, and can take a value from 0 to 255. This range is derived from the possible combinations of eight bits (2^8 = 256 combinations).
- **Example of IPv4 Address:** 192.168.1.1
  - **192** is the first octet
  - **168** is the second octet

- **1** is the third octet
- **1** is the fourth octet

Each part of the IP address can indicate various aspects of the network configuration, from the network itself to the specific device within that network. In most cases, the network part of the address is represented by the first one to three octets, while the remaining section identifies the host (device).



2. IPv6:

IPv6 was designed by the Internet Engineering Task Force (IETF) in December 1998 with the purpose of superseding IPv4 due to the global exponentially growing internet of users.

IPv6 stands for Internet Protocol version 6. IPv6 is the new version of Internet Protocol, which is way better than IPv4 in terms of complexity and efficiency. IPv6 is written as a group of 8 hexadecimal numbers separated by colon (:). It can be written as 128 bits of 0s and 1s.

3. Public IP Addresses:

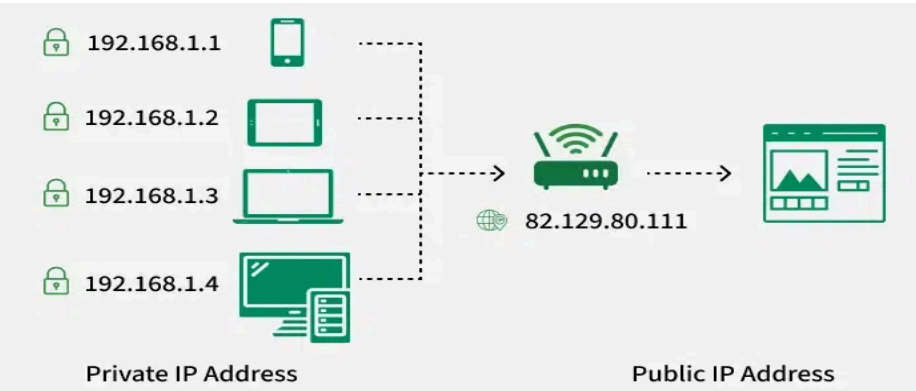
A Public IP address is assigned to every device that directly accesses the internet. This address is unique across the entire internet. Here are the key characteristics and uses of public IP addresses:

- **Uniqueness:** Each public IP address is globally unique. No two devices on the internet can have the same public IP address at the same time.
- **Accessibility:** Devices with a public IP address can be accessed directly from anywhere on the internet, assuming no firewall or security settings block the access.
- **Assigned by ISPs:** Public IP addresses are assigned by Internet Service Providers (ISPs). When you connect to the internet through an ISP, your device or router receives a public IP address.

4. Private IP Addresses:

Private IP addresses are used within private networks (such as home networks, office networks, etc.) and are not routable on the internet. This means that devices with private IP addresses cannot directly communicate with devices on the internet without a translating mechanism like a router performing Network Address Translation (NAT). Key features include:

- **Not globally unique:** Private IP addresses are only required to be unique within their own network. Different private networks can use the same range of IP addresses without conflict.
- **Local communication:** These addresses are used for communication between devices within the same network. They cannot be used to communicate directly with devices on the internet.
- **Defined ranges:** The Internet Assigned Numbers Authority (IANA) has reserved specific IP address ranges for private use:
  - **IPv4:** 10.0.0.0 to 10.255.255.255, 172.16.0.0 to 172.31.255.255, 192.168.0.0 to 192.168.255.255
  - **IPv6:** Addresses starting with FD or FC



Classes of IPv4 Address

There are around 4.3 billion IPv4 addresses and managing all those addresses without any classification is next to impossible. For easier management and assignment IP addresses are organized in numeric order and divided into the following 5 classes:

- **Class A** (1.0.0.0 to 127.255.255.255):
  - Used for very large networks (like multinational companies).
  - Supports up to 16 million hosts per network.
  - **Example**: 10.0.0.1 (Private IP in this class).
- **Class B** (128.0.0.0 to 191.255.255.255):
  - Used for medium-sized networks, such as large organizations.
  - Supports up to 65,000 hosts per network.
  - **Example**: 172.16.0.1 (Private IP in this class).
- **Class C** (192.0.0.0 to 223.255.255.255):
  - Used for smaller networks, like small businesses or home networks.
  - Supports up to 254 hosts per network.
  - **Example**: 192.168.1.1 (Private IP in this class).
- **Class D** (224.0.0.0 to 239.255.255.255):
  - Reserved for multicast groups (used to send data to multiple devices at once).
  - Not used for traditional devices or networks.
- **Class E** (240.0.0.0 to 255.255.255.255):
  - Reserved for experimental purposes and future use.

IP Class	Address Range	Maximum number of networks
Class A	1-126	126 (27-2)
Class B	128-191	16384
Class C	192-223	2097152
Class D	224-239	Reserve for multitasking
Class E	240-254	Reserved for Research and development

IP Addressing Techniques:

1. Static IP Addresses:

A Static IP address is an IP address that does not change frequently or constantly; it is reserved for a specific computer or device. This type of IP address does not dynamically change with time, but will only change through an action done by the user or the network administrator. Assigning Static IP address is common in servers, network devices or any device that has to have a fixed address that can be accessed from a distance.

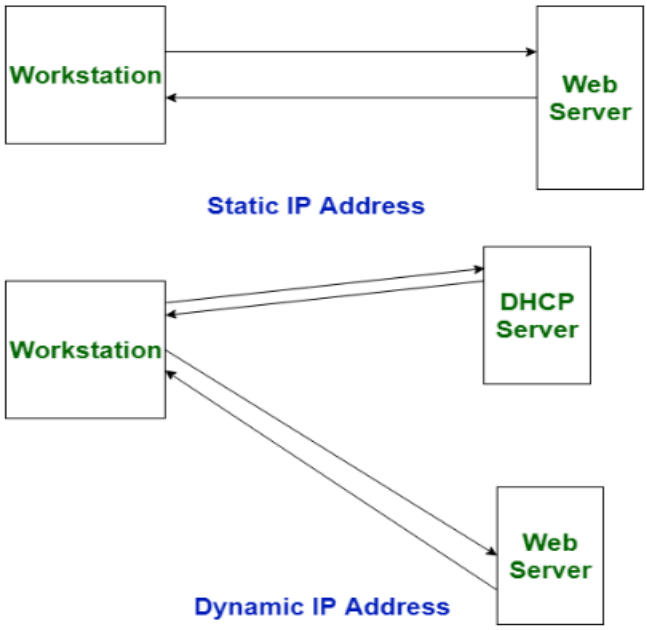
Static IP addresses are especially important in cases where a device has to be quickly found over the internet on a permanent basis.

- **Web Servers:** A website must have one or more static IP addresses to be assigned to the domain and always point to the correct server.

- **Remote Access:** Some of the devices that require a remote connection like the CCTV cameras or a VPN are preferable to be as static as possible.
- **Hosting Servers:** Game or email servers that are in constant use also need a static IP so that the services running in the background remain undisturbed.
- **Secure Communications:** Some devices that participate in secure communications might require static IPs to make the link stable and reliable.

2. Dynamic IP Addresses:

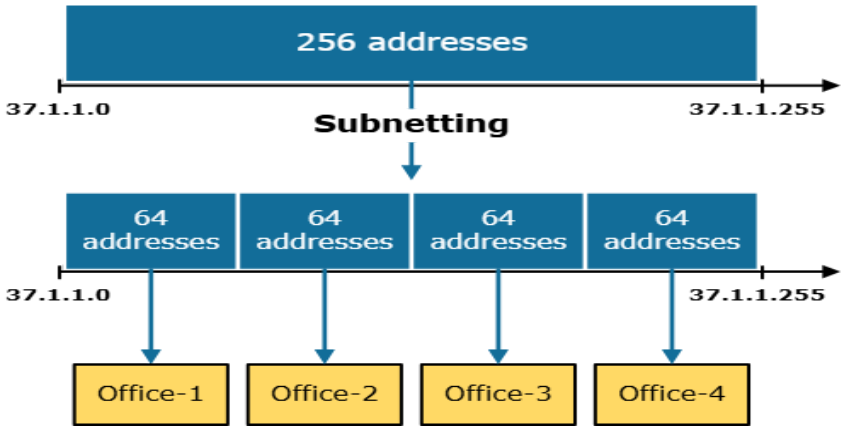
A Dynamic IP address is an IP address which is changed from time to time. In contrast to the static IP, an IPv6 address is obtained by DHCP server – (Dynamic Host Configuration Protocol) automatically. In the DHCP, a host receives an available IP address from the DHCP server for some period of time referred to as the lease time and the IP address given to the host may change.



3. Subnetting:

Subnetting is the technique used to divide an IP address into smaller, more manageable subnetworks. Subnetting helps optimize the use of IP addresses, improve network performance, and increase security by limiting broadcast traffic within smaller network segments.

Subnetting is achieved by modifying the **subnet mask**, which determines how many bits are allocated to the network and host portions of the address. For example, a subnet mask of `255.255.255.0` indicates that the first 24 bits of the IP address are used for the network, and the remaining 8 bits are used for host addresses within the network.



4. CIDR (Classless Inter-Domain Routing):

Classless Inter-Domain Routing (CIDR) is a method of IP address allocation and IP routing that allows for more efficient use of IP addresses. CIDR is based on the idea that IP addresses can be allocated and routed based on their network prefix rather than their class, which was the traditional way of IP address allocation.

CIDR addresses are represented using a slash notation, which specifies the number of bits in the network prefix. For example, an IP address of 192.168.1.0 with a prefix length of 24 would be represented as 192.168.1.0/24. This notation indicates that the first 24 bits of the IP address are the network prefix and the remaining 8 bits are the host identifier.

5. NAT (Network Address Translation):

NAT is a technique used in networking to translate private IP addresses to a single public IP address (or a pool of public IP addresses) for accessing external networks like the Internet. NAT allows multiple devices on a local network to share a single public IP address, enhancing security and conserving public IP address space.

08 CONCLUSION:

The experiment demonstrated the importance of IP addressing, subnetting, and CIDR in network communication. It provided insights into IP address structure, how subnetting divides networks, and how CIDR optimizes address allocation and routing efficiency. These techniques are essential for effective network design and management.

09 VIVA QUESTIONS:

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