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DEPARTMENT OF COMPUTER ENGINEERING

COURSE: Computer Network (CN)

PRACTICAL EXERCISE : 01

# Introduction to Computer Network and IP Address

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# AIM:

Introduction to Computer Network and IP Address

# THEORY:

**Computer Network :** A computer network can be defined as an interconnection of multiple devices, also known as hosts, that are connected using multiple paths for the purpose of sending/receiving data or media.

The properties of the computer networks are:

- Scope
- Scalability
- Robustness
- Self-configuration and optimisation
- Migration
- Determinism

## Importance of Computer Network:

There are several reasons why computer networking is essential to a business, institution or individual. These benefits include:

### Cut back on costs

One can cut back on costs and allow for efficient use of resources. Hardware is the priciest resource in technology. Computer networks reduce your hardware costs significantly.

### Boost storage capacity and volume

Computer networks pools their entire data to a central data storage server. This data is accessible to your employees. The data can be used to gain insights on how to boost a company's productivity. With a central server, the company can lower the number of storage servers needed and increase the efficiency of operations.

### Optimize convenience and flexibility

Computer networks enable flexible operations. The data is not stored in a local server making it accessible with internet connectivity. Also, the data can be accessed from any device. This enhances free movement while accessing the data from anywhere.

**Network Topology :** A network topology can be defined as the layout arrangement of the different devices in a network.

Common examples include: Bus, Star, Mesh, Ring, and Daisy chain whose structure is described in the figure below.

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### Network Number :

It refers to a 32-bit number that represents a network and it can't be assigned as IP address of a host.

### Network Address :

It is basically another term for the network number itself.

### Broadcast Address :

It refers to a 32-bit number that is used to address all hosts in the network. It can't be assigned as an IP address of a host.

**OSI :** OSI stands for Open Systems Interconnection. It is a reference model that specifies standards for communications protocols and also the functionalities of each layer.

**Protocol :** A protocol is the set of rules or algorithms which define the way how two entities can communicate across the network and there exists different protocol defined at each layer of the OSI model. Few of such protocols are TCP, IP, UDP, ARP, DHCP, FTP and so on.

## Unique Identifiers of Network

Following are the unique identifiers of a computer network:

### IP Address (Internet Protocol Address)

IP address is also known as the Logical Address. The IP Address is the network address of the system across the network.

To identify each device in the world-wide-web, the Internet Assigned Numbers Authority (IANA) assigns an IPV4 (Version 4) address as a unique identifier to each device on the Internet.

The length of an IPv4 address is 32-bits. The length of an IPv6 address is 128-bits.

#### Types of IP addresses

The IP addresses can be classified into two. They are listed below.

1) Static IP addresses

2) Dynamic IP addresses

## Static IP Addresses

As the name indicates, the static IP addresses usually never change but they may be changed as a result of network administration. They serve as a permanent Internet address and provide a simple and reliable way for the communication.

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From the static IP address of a system, we can get many details such as the continent, country, region and city in which a computer is located,

The Internet Service Provider (ISP) that serves that particular computer and non-technical information such as precise latitude and longitude of the country, and the locale of the computer. There are many websites providing IP address lookups.

## Dynamic IP Addresses

Dynamic IP address are the second category. These are temporary IP addresses.

These IP addresses are assigned to a computer when they get connected to the Internet each time.

They are actually borrowed from a pool of IP addresses, shared over various computers. Since limited number of static IP addresses are available, ISPs usually reserve the portion of their assigned addresses for sharing among their subscribers in this way.

Static IP addresses are considered as less secure than dynamic IP addresses because they are easier to track.

## IP Version 4 and IP Version 6

The two versions of IP addresses currently running are IP versions 4 (IPv4) and IP versions 6 (IPv6). There are many features with these two versions.

## IP Version 6:

The IPv6 is the most recent version of Internet Protocol. As the Internet is growing rapidly, there is a global shortage for IPv4.

IPv6 was developed by the Internet Engineering Task Force (IETF). IPv6 is intended to replace the IPv4.

IPv6 uses a 128-bit address and it allows 2128 i.e. approximately 3.4×1038 addresses. The actual number is slightly smaller as some ranges are reserved for special use or not used.

The IPv6 addresses are represented by 8 groups of four hexadecimal digits with the groups being supported by colons. An example is given below:

Eg: 2001:0db8:0000:0042:0000:8a2e:0370:7334

### The features of IPv6:

The main features of the IPv6 are listed below.

1) IPv6 provides better end-to-end connectivity than IPv4.

2) Comparatively faster routing.

3) IPv6 offers ease of administration than IPv4.

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4) More security for applications and networks.

5) It provides better Multicast and Anycast abilities.

6) Better mobility features than IPv4.

7) IPv6 follows the key design principles of IPv4 and so that the transition from IPv4 to IPv6 is smoother.

These are the key features of the IPv6 when compared to the IPv4. However, IPv6 has not become popular as IPv4.

## IP Version 4

IP Version 4 (IPv4) was defined in 1981. It has not undergone much changes from that time. Unfortunately, there is a need of IP addresses more than IPv4 could supply.

IPv4 uses 32-bit IP address. So the maximum number of IP address is 232—or 4,294,967,296.

This is a little more than four billion IP addresses. An IPv4 address is typically formatted as four 8-bit fields. Each 8-bit field represents a byte of the IPv4 address. As we have seen earlier, each fields will be separated with dots. This method of representing the byte of an IPv4 address is referred to as the dotted-decimal format. The bytes of the IPv4 is further classified into two parts. The network part and the host part.

### Network Part

This part specifies the unique number assigned to your network. It also identifies the class of network assigned. The network part takes two bytes of the IPv4 address.

### Host Part

This is the part of the IPv4 address that you can assign to each host. It uniquely identifies this machine on your network. For all hosts on your network, the network part of the IP address will be the same and host part will be changing.

## IP address and classes

The IP hierarchy contains many classes of the IP addresses. Broadly, the IPv4 addressing system is divided into five classes of IP address. All the five classes are identified by the first octet of the IP address.

The different classes of the IPv4 address are the following:

1) Class A address

2) Class B address

3) Class C address

4) Class D address

5) Class E address

| Address Class | Bit Pattern of First Byte | First Byte Decimal Range | Host Assignment Range in Dotted Decimal |
|---|---|---|---|
| A | 0xxxxxxx | 1 to 127 | 1.0.0.1 to 126.255.255.254 |
| B | 10xxxxxx | 128 to 191 | 128.0.0.1 to 191.255.255.254 |
| C | 110xxxxx | 192 to 223 | 192.0.0.1 to 223.255.255.254 |
| D | 1110xxxx | 224 to 239 | 224.0.0.1 to 239.255.255.254 |
| E | 11110xxx | 240 to 255 | 240.0.0.1 to 255.255.255.255 |

**Fig:** IP addresses and classes

## Class A Address

The first bit of the first octet is always set to zero. So that the first octet ranges from 1 – 127.

The class A address only include IP starting from 1.x.x.x to 126.x.x.x.

The IP range 127.x.x.x is reserved for loop back IP addresses.

The default subnet mask for class A IP address is 255.0.0.0. This means it can have 126 networks (27-2) and 16777214 hosts (224-2).

Class A IP address format is thus: 0NNNNNNN.HHHHHHHH.HHHHHHHH.HHHHHHHH.

## Class B Address

Here the first two bits in the first two bits is set to zero.

Class B IP Addresses range from 128.0.x.x to 191.255.x.x.

The default subnet mask for Class B is 255.255.x.x.

Class B has 16384 (214) Network addresses and 65534 (216-2) Host addresses.

Class B IP address format is: 10NNNNNN.NNNNNNNN.HHHHHHHH.HHHHHHHH

## Class C Address

The first octet of this class has its first 3 bits set to 110.

Class C IP addresses range from 192.0.0.x to 223.255.255.x.

The default subnet mask for Class C is 255.255.255.x.

Class C gives 2097152 (221) Network addresses and 254 (28-2) Host addresses.

Class C IP address format is: 110NNNNN.NNNNNNNN.NNNNNNNN.HHHHHHHH

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### Class D Address

The first four bits of the first octet in class D IP address are set to 1110.

Class D has IP address rage from 224.0.0.0 to 239.255.255.255.

Class D is reserved for Multicasting.

In multicasting data is not intended for a particular host, but multiple ones. That is why there is no need to extract host address from the class D IP addresses.

The Class D does not have any subnet mask.

### Class E Address

The class E IP addresses are reserved for experimental purpose only for R&D or study.

IP addresses in the class E ranges from 240.0.0.0 to 255.255.255.254.

This class too is not equipped with any subnet mask.

## MAC Address (Media Access Control address):

It is also known as physical address.

The MAC Address is the unique identifier of each host and is associated with its NIC (Network Interface Card).

A MAC address is assigned to the NIC at the time of manufacturing.

The length of the MAC address is : 12-nibble/ 6 bytes/ 48 bits

Type “ipconfig/all” in the command prompt and press ‘Enter’, this gives us the MAC address.

## Host Address:

The physical address of a computer in a network. On the Internet, a host address is the IP address of the machine.

## Subnet :

When a bigger network is divided into smaller networks, in order to maintain security, then that is known as **Subnetting**. So, maintenance is easier for smaller networks.

In computer networking, Subnetting is used to divide a large IP network in smaller IP networks known as subnets.

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## Domain Name System

The process of DNS resolution involves converting a hostname (such as www.example.com) into a computer-friendly IP address (such as 192.168.1.1). An IP address is given to each device on the Internet, and that address is necessary to find the appropriate Internet device - like a street address is used to find a particular home. When a user wants to load a webpage, a translation must occur between what a user types into their web browser (example.com) and the machine-friendly address necessary to locate the example.com webpage.

DNS translates domain names to IP addresses so browsers can load Internet resources.

## CONCLUSION:

In this practical assignment, we understand the concept of computer networks and got the basic understanding of IP address, their versions and the classes associated to it.