

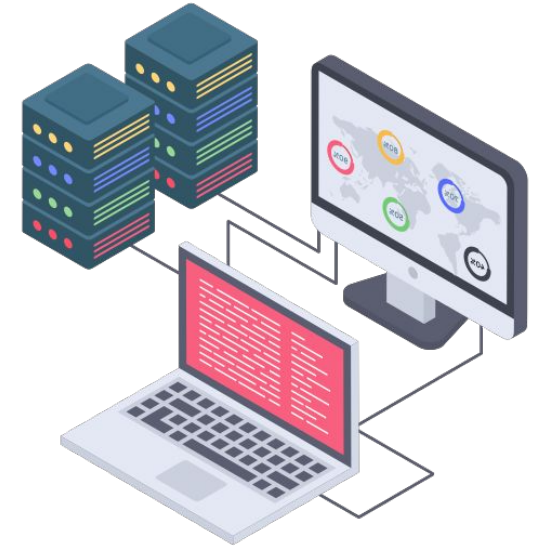
Basic of Computer Networking





Concept to be covered in class:

- Introduction to Computer Networking
- Computer Network Types
- What are IP Addresses/ MAC Addresses/Socket Addresses?
- Types of IP Address
- Classes of IPv4 Address
- Subnetting
- Routing
- Real Life Application of Computer Network



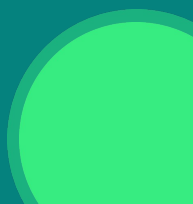
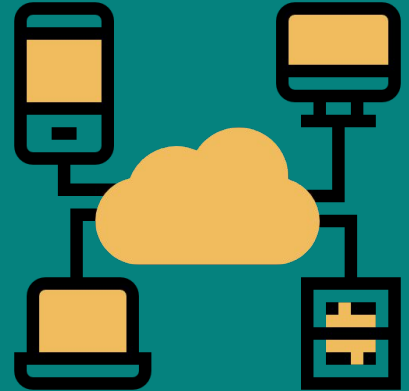


What is Computer Networking?

A computer network is a group of interconnected computing devices that follows certain set of protocols to exchange the data and share resources. These devices follow certain rules called as communication protocols so that information can be shared physically or using wireless technologies.

The basic building blocks of computer networking are nodes and links. A node can be data communicator equipment (DCE) like modem, switch, hubs or data terminal equipment (DTE). A link is a transmission media that connects two different nodes. It can be physical, like cable wires or optical fibers, or free space.

In networking, nodes are required to follow rules and protocols that helps in defining the sending and receiving of data with the help of links. It provides the specifications for the network's physical components, functional organization, protocols, and procedures.

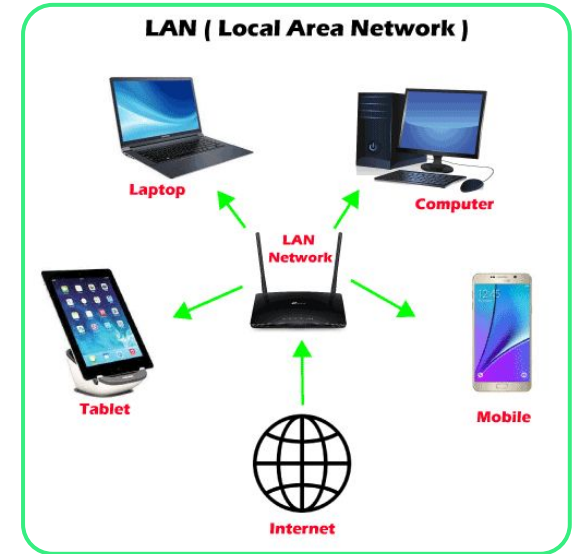




Computer Network Types

There are many types of Computer network. Below mentioned are the ones which are frequently used:

- LAN (local area network): A LAN is used to connect computers/devices over a short distance like home, offices. LANs are privately owned and managed. Ethernet LAN is the commonly used one.
- WLAN (wireless local area network): A WLAN is used to connect various computers/devices over a wireless network. The only difference is that in WLAN, it is done wirelessly and in LAN, devices are connected using wires. It usually involves WIFI router, wireless access point for devices.





- WAN (wide area network): a WAN helps in connecting computers over a wide area, such as country to country or even one continent to another continent. The internet is the largest known WAN that connects billion of computers.
- MAN (metropolitan area network): MANs are typically more extensively larger than LANs they are smaller than WANs. Cities and various entities are connected together via MAN.
- PAN (personal area network): A PAN is a network that serves one person. It helps in connecting devices to share the data, sync content. For example, if you have an iPhone and a Mac, it shares and sync data continuously between these devices. These devices are connected using Bluetooth, Wi-Fi etc.
- SAN (storage area network): A SAN is a high speed network that helps in providing access to block-level storage that can be shared network or cloud storage which can be used as storage drive.
- CAN (campus area network): A CAN is also called as a corporate area network. It is generally used for the various sites such as colleges, universities, and business campuses.
- VPN (virtual private network): A VPN is an encrypted channel that helps in connection between two network endpoints. It helps in securing the data by keeping the user's identity and access credentials to protect it from the hackers.





What are IP Addresses/ MAC Addresses/Socket Addresses?

IP Addresses:

An IP address is a unique number that is assigned to every device which are connected to a network that uses the Internet Protocol for communication. For example, if someone wants to send the package to us at via mail, then the person need to have the home address so that the package can be delivered to us. Similarly, if I download something from the internet or requesting something on internet, the IP address will make sure that the data is delivered to my computer. To send the data from one device to another, the data include a header where IP address of the sending and receiving devices are mentioned so that data is delivered correctly.



The IP address are represented as string of numbers that are separated by periods. They are expressed as set of 4 numbers, for example 192.155.1.1. Every set in the IP address range from 0 to 255, that means the IP address ranges from 0.0.0.0 to 255.255.255.255.





MAC Addresses

MAC Addresses:

Media Access Control address is a physical address that is assigned to the device during manufacturing. It is a 48 bit hardware number which is embedded in Network Interface Card (NIC). This address is unique to every device which suggests that no two devices can have the same MAC Address.

MAC Address of the device can be found by using command line and with the help of below commands:

Command for UNIX/Linux OS - *ifconfig -a*
ip link list
ip address show

Command for Windows OS - *ipconfig /all*

MacOS - *TCP/IP Control Panel*

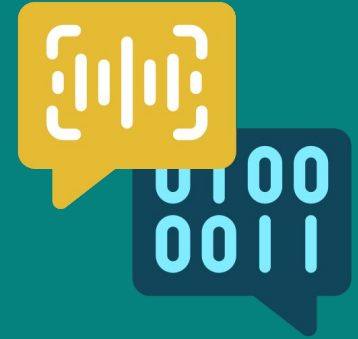




Socket Addresses

Socket Addresses:

IP address is used to identify the various devices connected to the network, but socket addresses are used to identify the various application/services that are running on the particular device. For example, if you are running two different browsers where on one browser, you have opened the gmail and on the other tab, yahoo is there. With the help of socket address, the correct request is passed to two different applications. Thus, socket address helps in process to process communication with the use of IP address and the port number which is randomly given to the application.





Types of IP Address

IP address is of two types:

1. **IPv4:** This is Internet protocol version 4. It consist of 4 set of numbers that are separated by period. Each set is called octet and hence, there are 4 octet and the sequence starts with the first octet from the left. For the computer to understand, these 4 set of numbers are converted to binary numbers. So, in total IPv4 consist of 32 bits of binary digits. And there will be around a total of (2^{32}) which is 4,294,967,296 devices can be assigned with the IPv4 address.
2. **IPv6:** This is the Internet protocol version 6 to connect to more devices as IPv4 is only able to connect to 4 billion devices. IPv6 is a group of 8 hexadecimal numbers that are separated by colons. In total consists of 128 bits of binary numbers which helps in connecting with many devices which are quite good in number than IPv4. For example, IPv6 can be written as 2011:0bd9:75c5:0000:0000:6b4e:0150:8492





Classes of IPv4

Classes of IP address helps in identifying the address from the 4.3 billion addresses that are available in the IPv4 addresses. It helps in organizing the IP addresses in numeric order and hence, they are classified into 5 different classes. There are five different classes A,B,C,D and E and each class defines some range of IP addresses which suggest the number of devices which can be connected on the network.

- **Class A:** Class A are used where large number of hosts are involved. It allows to use 126 networks with the use of first octet of the network ID. Here, the first digit of the octet is always 0. This means
 - The IP address ranges from 00000001 - 01111111 (1-127) which means the value lies from 1.0.0.0 to 127.255.255.255. Whereas 127.0.0.0 is reserved for loopback addresses. Class A has
 - 0NNNNNNN.HHHHHHHH.HHHHHHHH.HHHHHHHH , where there are 126 networks as 0.0.0.0 and 127.0.0.0 are not used and $16777214 (2^{24} - 2)$ hosts.
- **Class B:** Class B is used for medium to large network. It allows us to use 16384 with the use of first two octet for the network ID. It refers the first two bit of the octet and which is set to 10. This means
 - The IP address ranged from 10000000 - 10111111 (128-191) which means the value lies from 128.0.0.0 to 191.255.255.255. Class B has 10NNNNNNN.NNNNNNNN.HHHHHHHH.HHHHHHHH, where there are 16384 (2^{14}) networks and 65534 ($2^{16} - 2$) number of hosts available.





- **Class C:** Class C is used for small local area network. It helps to connect 2 million networks by using the first three octet of the IP address. Here, the first three digits of the first octet are set to 110. This means
 - The IP address ranged from 11000000 - 11011111 (192-223) which means the value of IP addresses ranges from 192.0.0.0 to 223.255.255.255. Class C has 110NNNNN.NNNNNNNN.NNNNNNNN.HHHHHHHH where there are (2^{21}) networks and 254 (2^8-2) hosts.
- **Class D:** Class D is used for multicasting which means sending the data from one host to thousands of host with the use of internet at the same time. It sets the first four bits of the octet to 1110. This means
 - The IP address ranged from 11100000 -11101111 (224 - 239) which means the value of IP address ranged from 224.0.0.0 to 239.255.255.255
- **Class E:** These IP addresses are not allocated to the hosts and not available for any general usage, but are only used for Research and Development purpose and ranges from 255.0.0.0 to 255.255.255.255.





Subnetting

Subnetting is a process of dividing the bigger network to smaller network. It segments the IP addresses into smaller, interconnected network to minimise traffic and hence, increasing the speed.

Each subnet created allows communication with in the connected devices and routers are used for the communication between subnets. The size of subnet can vary from organization to organization and remains private to the organization.

For example, IPv4 class address 193.1.2.0 is a class C IPv4 where, the first three octet are for the network and the last octet are for the host ID. 193.1.2 is a Network ID prefix and 0 is the Host ID prefix. In Subnetting, if you want to divide the network into 2 parts, then take the first bit of the host ID and make all the other bits to 0 and then 1, which will create the first part of IP address and the other ones will create the second part.

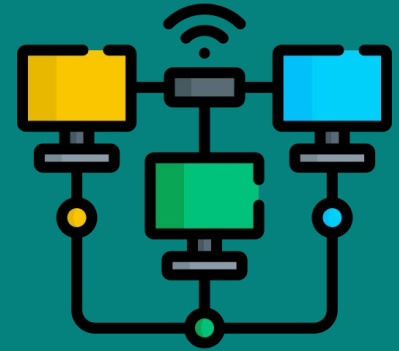




Subnetting(Cntd)

For Subnet 1, 193.1.2.00000000 till the host becomes 1, which is 193.1.2.01111111 which is 193.1.2.0 to 193.1.2.127 as first bit is reserved for the subnetting. Also, 193.1.2.0 is used as Subnet ID and 193.1.2.127 which is the last IP is used as broadcast address always.

For Subnet 2, 193.1.2.10000000 is the first address as this is the second subnet and it will range to once all the host ID becomes 1 which is 193.1.2.11111111 as first bit is reserved for subnetting. Hence, it ranges from 193.1.2.128 is the start address of the subnet 2 and 193.1.2.255 is the last address. 193.1.2.255 is also the broadcast address. 193.1.2.128 is also the subnet ID.





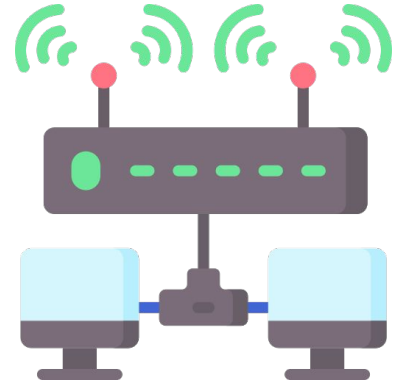
Routing

Routing is a process of selecting optimal path that helps in delivery of packets from source to the destination. Routing is performed by Routers. The routing protocols helps in determining the best path through which packets can be transferred. It involves calculation of various metrics like hop count, bandwidth, delay which might come up, traffic on the current path which can affect the decision making. The routing algorithm maintain the routing table for the path determination.

There are 3 types of routing:

- 1. Static routing:** Static routing is a routing where the data is manually added by the administrator. Here the decision is not made on the topology of the network or not any condition.
Advantages:
 - It has very less load on the CPU of the routers, hence any cheap router can be used.
 - Also, this is more secure as the control is major on the administrator end.Disadvantages:
 - Hectic for the administrator to maintain routing for large routes.
 - Administrator expertise are required on the topologies.
 - Default Routing:

This is a routing where all the packets are sent to some default router, it does not matter if the packet belong to the particular network or not. It is used when there is a single exit point. The default route is used if specific route is not mentioned in the routing table to transfer the data from one address to another.





Dynamic Routing:

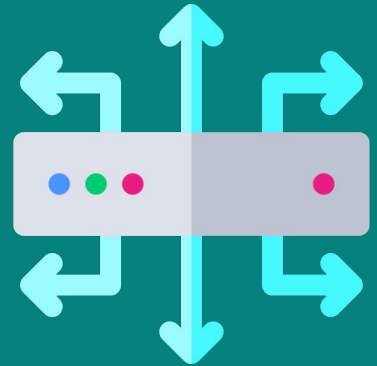
Dynamic Routing is a process where the routes are added to the routing table automatically according to the current state. It uses various protocol to continuously update the routing table. RIP and OSPF are the two routing protocols that are used generally in the dynamic routing.

Advantages:

- It is easier to configure.
- It provides the best route in case there is a change in the condition or topology.
- Administrator has to worry less for maintaining the routing table.

Disadvantages:

- It is less secured.
- It uses more bandwidth and has more load on the CPU.

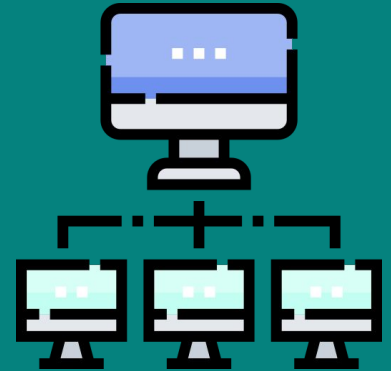




Real Life Application of Computer Networks

When a web page is searched on the web, there is computer networking involved as the internet is used to access the Web page.

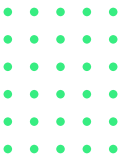
An user enter the URL into the browser and the request is created in the system. For the browser to send request that requires an IP address to connect to the device/network. These domain names are mapped to the IP addresses which are the true location of the domain's computers. The IP address can be either fetched from DNS resolver that helps in providing the IP Address which helps the request to send to particular domain. Once, the IP address is identified, the request is sent from the browser to get the data. Once the device responds then with the help of socket addressing, the particular IP address of the client is identified along with the port from which the request is received. Then, the HTTP response is displayed on the browser. If there is success of the HTTP response, the page will be displayed with the status code 200 and if there is an error retrieving the document, the error message is shown accordingly.





MCQ

1. Which of the following is a range of class A of IPv4?
 - a. 0.0.0.0 to 223.255.255.255.
 - b. 0.0.0.0 to 192.0.0.0
 - c. **0.0.0.0 to 127.255.255.255**
 - d. 0.0.0.0 to 128.0.0.0
2. An/Arouting scheme is designed to change the routes based on conditions.
 - a. static routing
 - b. fixed alternative routing
 - c. standard routing
 - d. **dynamic routing**
3. What is the uses of subnetting?
 - a. **It divides one large network into several smaller ones**
 - b. It divides network into network classes
 - c. It speeds up the speed of network
 - d. None of above





MCQ

4. The length of an IPv6 address is?

- a) 64 bits
- b) 128 bits**
- c) 256 bits
- d) 32 bits

5. The term LAN stands for?

- a) Local Area Net
- b) Local Area Network**
- c) Local Array Network
- d) Local Array Net

