

Networking and the Internet

Computer network:

A computer network is an interconnection of two or more computers that are able to exchange information. The computers may be connected via any data communication link, like copper wires, optical fibers, communication satellites, or radio links. The computers connected to the network may be personal computers or large main frames. The computers in a network may be located in a room, building, city, country, or anywhere in the world.

Internet:

Internet is defined as an interconnection of networks. Internet allows computers on different kinds of networks to interact with each other. Any two computers, often having different software and hardware, can exchange information over the Internet, as long as they obey the technical rules of Internet communication. The exchange of information may be among connected computers located anywhere, like military and research institutions, different kinds of organizations, banks, educational institutions (elementary schools, high schools, colleges), public libraries, commercial sectors etc.

Network Types:

Computer network is broadly classified into three types—(1) Local Area Network (LAN), (2) Metropolitan Area Network (MAN), and (3) Wide Area Network (WAN). The different network types are distinguished from each other based on the following characteristics:

- Size of the network
- Transmission Technology
- Networking Topology

The size of the network refers to the area over which the network is spread. Transmission technology refers to the transmission media used to connect computers on the network and the transmission protocols used for connecting. Network topology refers to the arrangement of computers on the network or the shape of the network. The following subsections discuss the three types of networks and their characteristics.

Local Area Network:

LAN (Figure below) is a computer network widely used for local communication. LAN connects computers in a small area like a room, building, office or a campus spread up to a few kilometers. They are privately owned networks, with a purpose to share resources and to exchange information.

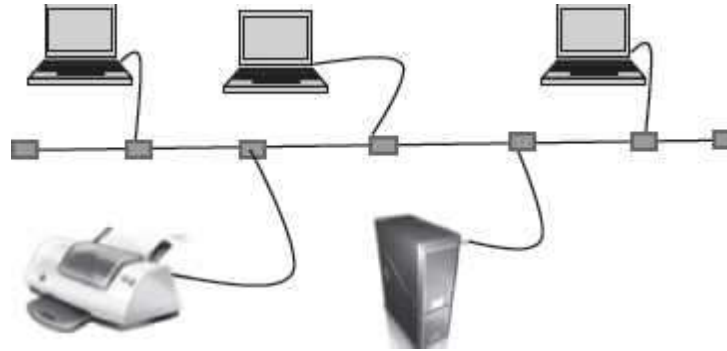


Figure: LAN

The computers in a LAN are generally connected using cables. LAN is different from other types of network since they share the network. The different computers connected to a LAN take turns to send data packets over the cables connecting them. This requires coordination of the use of the network. Some of the transmission protocols used in LAN are Ethernet, Token bus, and FDDI ring.

Star, Bus, and Ring are some of the common LAN networking topologies. LAN runs at a speed of 10 Mbps to 100 Mbps and has low delays. A LAN based on Wi-Fi wireless network technology is called Wireless Local Area Network (WLAN).

Metropolitan Area Network:

MAN (Figure below) is a computer network spread over a city. Cable television network is an example of MAN. The computers in a MAN are connected using coaxial cables or fiber optic cables. MAN also connects several LAN spread over a city.

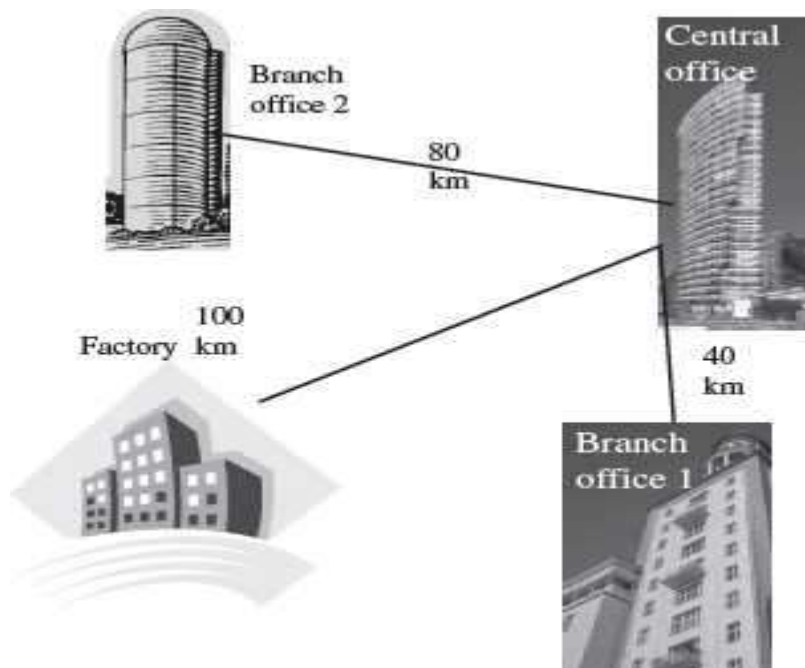


Figure: MAN

Wide Area Network

WAN is a network that connects computers over long distances like cities, countries, continents, or worldwide (Figure 9.21). WAN uses public, leased, or private communication links to spread over long distances. WAN uses telephone lines, satellite link, and radio link to connect. The need to be able to connect any number of computers at any number of sites, results in WAN technologies to be different from the LAN technologies. WAN network must be able to grow itself. Internet is a common example of WAN.

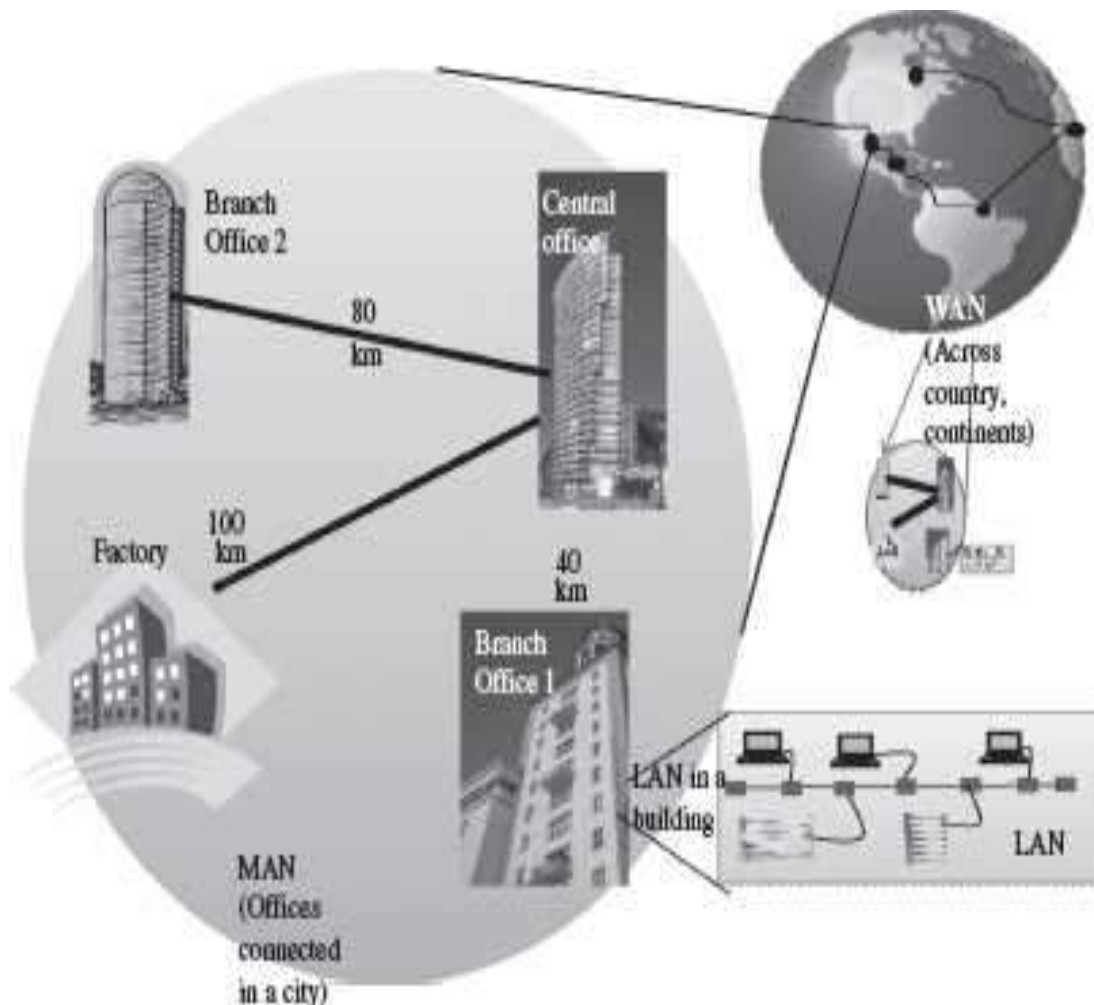


Figure: WAN

Computer network topologies:

A network topology refers to the arrangement of different elements (nodes, links, etc.) in a computer network. It defines how these elements connect with each other, and it has a significant impact on the performance and functionality of the network.

There are different types of network topologies that are used in a network. The network topologies in the structure or the layout of the different devices and computers connected to the network. The topologies commonly used in LAN are—Bus topology, Star topology, and Ring topology.

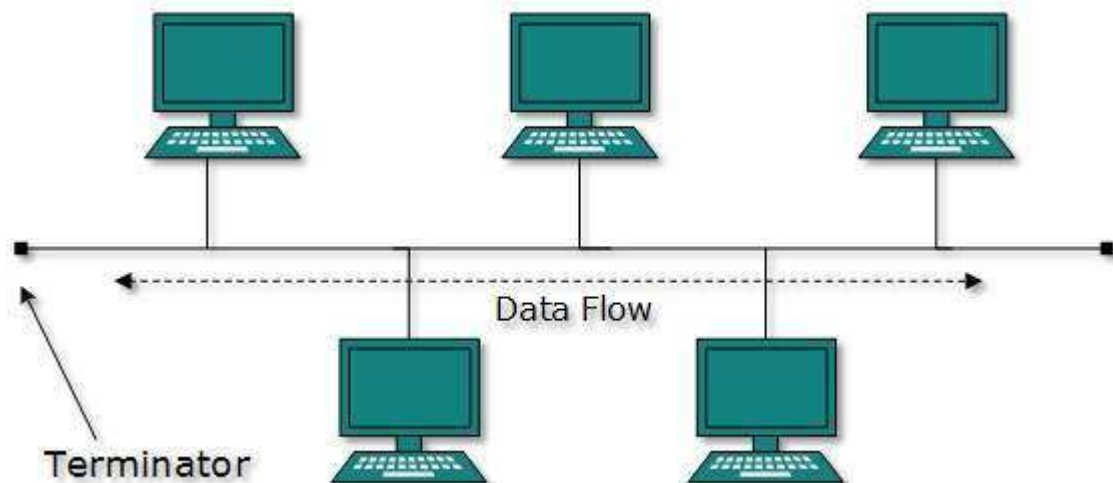
Bus Topology: In a bus topology or linear topology, the nodes are connected to a central cable called bus. In bus topology, a bus is a single continuous cable. Transmission from any node travels the length of the bus in both directions and can be received by all the other nodes in the network. The bus has terminators at either ends which absorb the signal, removing it from the bus.

Advantages of bus topology: Some of its advantages are as follow:

1. It is quite simple and reliable.
2. It is quite easy to set up and expand up to a certain limit.
3. Failure of one node does not affect the rest of the network.
4. The cost of installation and expansion is very less.

Disadvantages of bus topology: Some of its advantages are as follow:

1. It offers limited flexibility for change.
2. The signal on the bus must be strong enough to reach the receiver if not then repeaters might have to be used to amplify the signal.
3. Fault detection is difficult as it is to be performed at many points on the network.
4. As each node is directly connected to the central bus, there has to be some way of deciding which node can use the network at a given time.



Star topology: In a star topology, all the nodes are connected to a central system called switch or a hub. This network device forwards the data from its source computer to its final destination. The switch or hub controls the communication on the network.

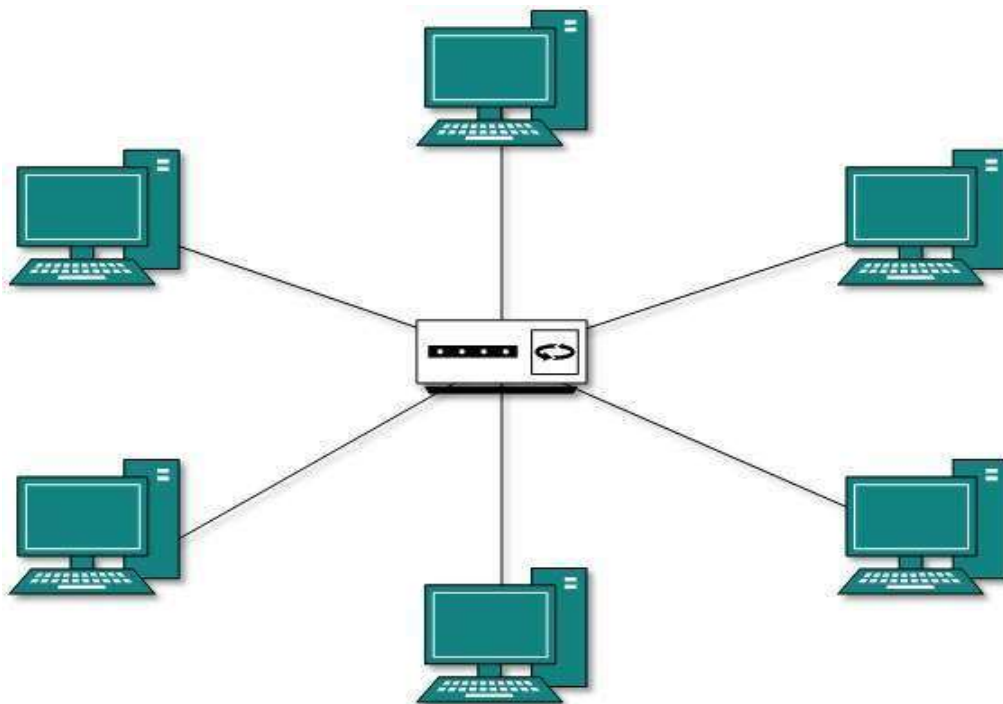
Advantages of star topology: Some of its advantages are as follow:

1. If any one of the local computers fails, the remaining portion of the network remains unaffected.

2. Fault detection is easier.
3. Access protocols used in the star topology are very simple.
4. Devices can be added or removed without disturbing the network.
5. They work well under heavy loading.

Disadvantages of star topology: Some of its advantages are as follow:

1. The system crucially depends on the central switch or hub. If it fails, the entire goes down.
2. The cost of installation is high as each node is connected to the central switch or hub.
3. Performance is totally based on the central switch or hub.



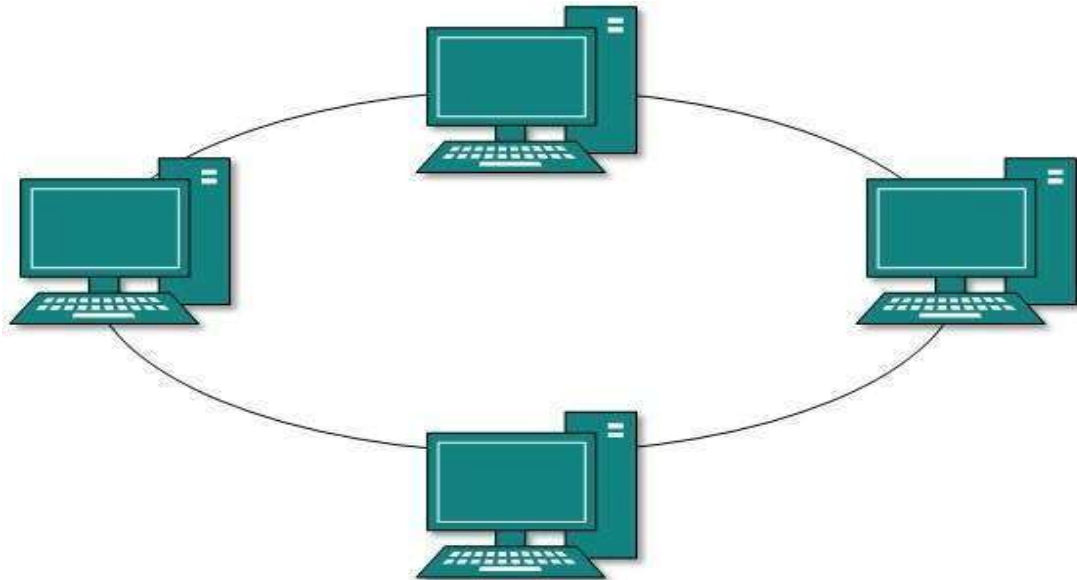
Ring Topology: In ring topology, the nodes are connected to a close loop so that each device is connected to two other devices, one on either side. The computers in a ring topology are connected in the shape of a closed ring. Data travels in only one direction in a ring. Each computer passes the data to the next one on the line automatically.

Advantages of ring topology: Some of its advantages are as follow:

1. The ring topology works well where there is no central site computer system.
2. It is more reliable than star topology.
3. The possibility of collision is minimal in ring topology.
4. The cost of installation and expansion is very less.

Disadvantages of ring topology: Some of its advantages are as follow:

1. The ring topology requires more complicated control software.
2. Failure of one node result in the failure of the entire network.
3. Troubleshooting or fault detection is difficult in ring topology.
4. Addition of nodes in between or removal of nodes can disturb the whole network.
5. Communication delay is directly proportional to the number of nodes in the network.



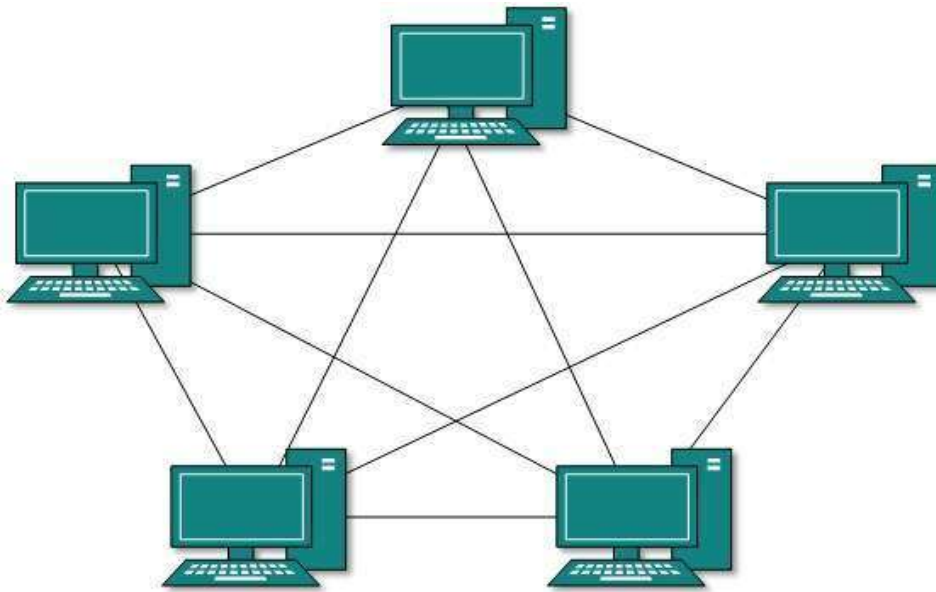
Mesh Topology: In mesh topology, every device is connected to another device via dedicated channel, dynamically and non-hierarchically. Routers are used to provide the best and most efficient data path for effective communication. In the event of a hardware failure, many routes are available to continue the network communication process.

Advantages of mesh topology: Some of its advantages are as follow:

1. It is robust and secure.
2. Fault detection is easier.
3. It provides privacy due to dedicated channels connected dynamically.
4. Data is reliable because data is transferred among the devices through dedicated channels or links.

Disadvantages of mesh topology: Some of its advantages are as follow:

1. Installation and configuration is difficult.
2. Cost of cables is high as bulk wiring is required.
3. Suitable of less number of devices.



Tree Topology: Tree Topology is a combination of bus and star topology in which many nodes are connected with each other like the branches of a tree. It is the simplest form in which the hub or switch devices are directly connected to the tree bus. Data transmission takes place in the same way as in the bus topology that is when the signal reaches the end of the transmission medium, it is absorbed by the terminators. Tree topology is best suited for applications which have a hierarchical flow of data and control.

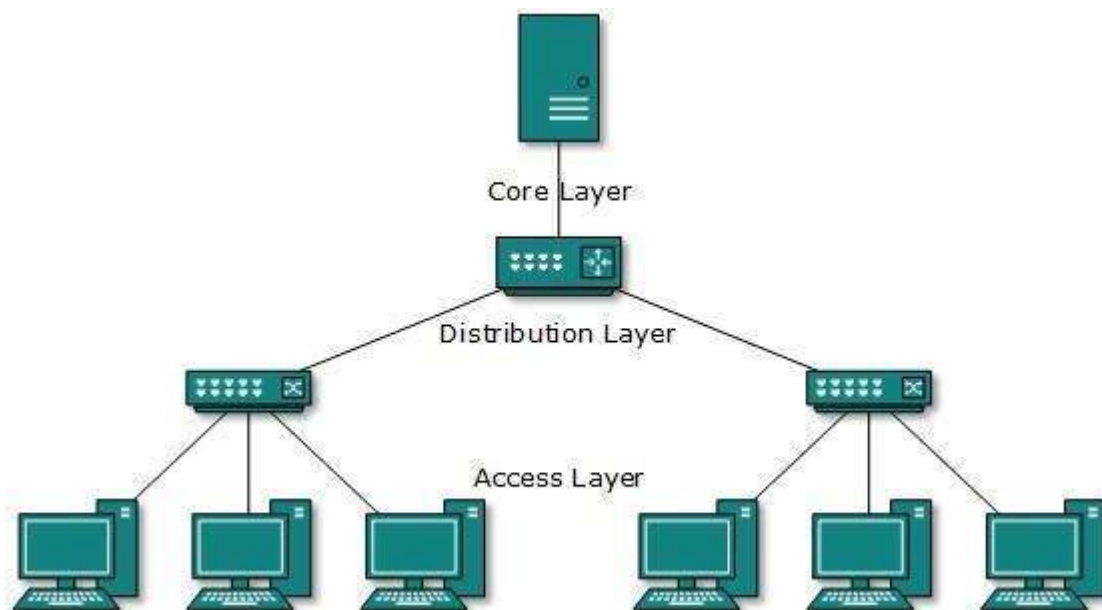
Advantages of tree topology: Some of its advantages are as follow:

1. It is highly flexible and its future expandability of the network is much better than bus topology.
2. Centralized monitoring makes users to control and manage a larger network easily.
3. It is easy to reconfigure the tree topology.
4. It reduces network traffic.
5. As tree topology is a large network all, computers have better access to the network.
6. In tree topology each computer is connected to the hub and also each part of a network is connected to the main cable providing point to point connection.
7. Tree topology is supported by many hardware and software vendors.
8. The signals that are transmitted by the root nodes are received by all the computers at the same time

Disadvantages of tree topology: Some of its advantages are as follow:

1. In tree topology if the backbone of the entire network breaks both part of the network might not communicate to each other but a part of the network continues to communicate alone.
2. Tree topology is difficult to configure because of its size. Wiring big size network is difficult.

3. The cost of installation and expansion is high.



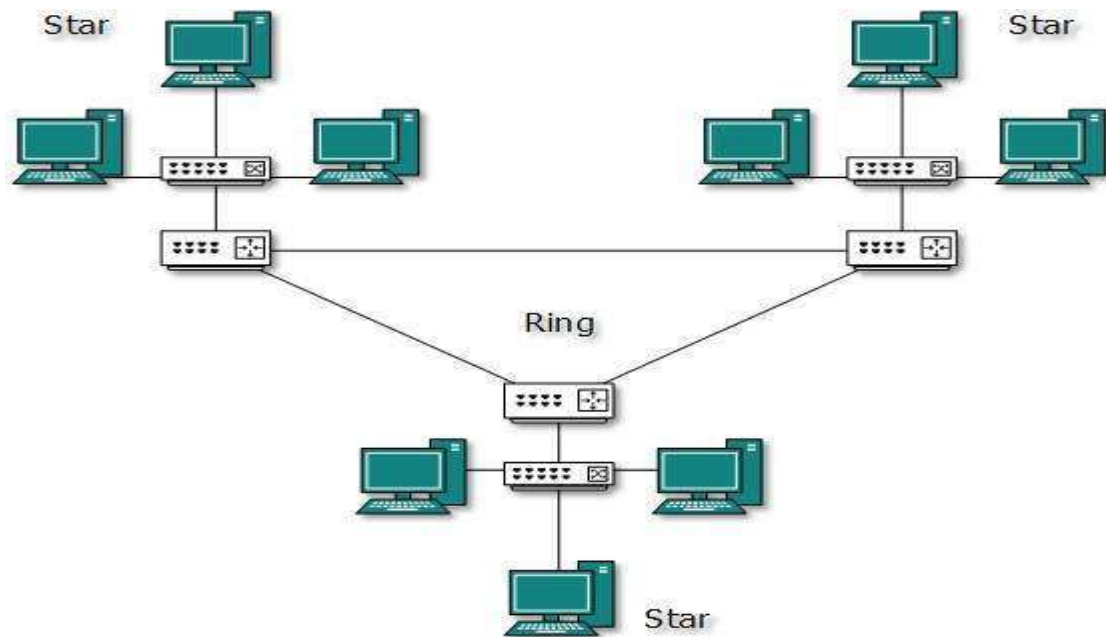
Hybrid Topology: A hybrid topology is a type of network topology that uses two or more other network topologies, including bus topology, mesh topology, ring topology, star topology, and tree topology. This is a scalable topology which can be expanded easily. It is reliable one but at the same it is a costly topology.

Advantages of hybrid topology: Some of its advantages are as follow:

1. It is effective and reliable.
2. Fault detection is easy.
3. Failure of one node does not affect the rest of the network.
4. It is flexible and its future expandability of the network is possible.
5. It is scalable as it offers integration of new hardware components.

Disadvantages of hybrid topology: Some of its advantages are as follow:

1. Network Processing on hybrid topology is quite complicated.
2. Installation and configuration is difficult.
3. The cost of installation and expansion is high.



Point to Point Topology: In a point to point topology there are only two nodes which are connected with each other via a dedicated link. It's the simplest layout for any network, and it is pretty easy to visualize. Data transfer can take place using half duplex (Transmission of signals in both directions but not simultaneously) and full duplex (Transmission of signals in both directions simultaneously).

Advantages of point to point topology: Some of its advantages are as follow:

1. Very easy to set up.
2. Best suitable for very small network.
3. Fault detection is easy.
4. Easy to maintain the layout with two nodes.

Disadvantages of point to point topology: Some of its advantages are as follow:

1. It offers no flexibility or expansion.
2. Not suitable for more than two nodes.
3. Failure of one node result in the failure of the entire network.

World Wide Web: WWW (also called as Web) is a large scale, online store of information. It is a system of creating, organizing, and linking of documents. Information is stored on WWW as a collection of documents that are interconnected with each other via links. The interconnected documents may be located on one or more than one computer, worldwide, thus, the name world wide web. The features of WWW and terms linked to WWW are given below—

1. The documents on web are created in hypertext format. Hypertext facilitates linking of documents.
2. The language used to create a hypertext format document is Hyper-Text Markup Language (HTML). HTML allows the designer of the document to include text, pictures, video, images, sound, graphics, movies etc., and also to link contents on the same document or different documents using a hyperlink.
3. The hypertext format document is transferred on the Web using Hyper-Text Transfer Protocol (HTTP).
4. A single hypertext document is called a Web page.
5. A group of related web pages is called a Web site. A web site displays related information on a specific topic.
6. The first web page or main page of a website is called Homepage.
7. The web pages are stored on the Internet on the Web Server. Web servers are host computers
8. That can store thousands of web pages.
9. The process of storing a web page on a web server is called uploading.
10. The process of retrieving a web page from a web server onto the user's computer is downloading.
11. The web pages stored on web server on the Internet, can be viewed from the user's computer using a tool called Web browser.

Web browser: Web Browser (or browser) is a software program that extracts information on user request from the Internet and presents it as a web page to the user. It is also referred to as the user interface of the web. Some of the popular web browsers are—Internet Explorer from Microsoft, Mosaic browser, Google's chrome, and Netscape Navigator from Netscape Inc. Some of the browser icons are shown in figure below.

Browsers are of two types—graphical browser and text-based browser. Graphical browsers provide a graphical user interface where the user can jump from one web page to the other by clicking on the hyperlink (displayed in blue color with underline) on a web page. Internet Explorer, Chrome and Mosaic are examples of graphical browsers.



Text browsers are used on computers that do not support graphics. Lynx is a text browser.

The process of using browser to view information on the Internet is known as Browsing or Surfing. During browsing, the user can navigate from one web page to another using URLs, hyperlinks, browser navigation tools like forward and back button, bookmarks etc.

Web pages: A web page or webpage is a document, commonly written in HTML (hypertext markup language) viewed in an Internet browser. A web page can be accessed by entering a URL (uniform resource locator) address into a browser's address bar. A web page may contain text, graphics, and hyperlinks to other web pages and files.

A web page provides information to viewers, including pictures or videos to help illustrate important topics. A web page may also be used as a method to sell products or services to viewers. Multiple web pages make up a website.

WWW Development Languages (HTML): HTML, Dynamic HTML (DHTML), and eXtensible Markup Language (XML) are some of the programming languages used to design and develop the web pages. You can also use software like Dreamweaver, Microsoft Front page, or your common word processor, which have the ability to save your document as a web page, for designing and development of the web pages.

HTML is a descriptive language that uses tags or element to convert text into hypertext. HTML allows embedding of text, images, sound, graphics etc., and, also hyperlinks, to link to other web pages. HTML can include or load scripts written in languages such as Javascript.

Uniform Resource Locator (URL): A web page on the Internet is uniquely identified by its address, called URL. URL is the address on the Internet at which the web page resides. The user uses this address to get a web page from the Internet. The general form of URL is: protocol://address/path

where,

1. protocol defines the method used to access the web page, e.g., http, ftp, news etc.
2. address is the Internet address of the server where the web page resides. It contains the service (e.g. www) and the domain name (e.g. google.com), and
3. path is the location of web page on the server.

To access documents on WWW, the HTTP protocol is used. An example of a URL is, <http://www.dsc.com/mainpage>

where, http is the protocol, www.dsc.com is the address, and mainpage is the path.

Internet Service Providers: Internet Service Provider (ISP) is a company offering access to internet. It is the gateway to the internet and everything that you do online. Internet service provider can be organized in various forms, such as commercial, community-owned, non-profit, and other privately owned. Internet service typically provided by ISPs can include internet access, internet transit, domain name registration, web hosting, etc... They offer various services:

- Internet Access
- Domain name registration
- Dial-up access
- Leased line access etc....

Example: NTC, Ncell, Via-net, World Link etc....

Electronic mail: Electronic mail (E-mail) is an electronic message transmitted over a network from one user to another. E-mail is a text-based mail consisting of lines of text, and can include attachments such as audio messages, pictures and documents. The features of e-mail are as follows:

1. E-mail can be sent to one person or more than one person at the same time.
2. Communicating via e-mail does not require physical presence of the recipient. The recipient can open the e-mail at his/her convenience.
3. Since messages are transmitted electronically, e-mail is a fast way to communicate with the people in your office or to people located in a distant country, as compared to postal system.
4. E-mail messages can be sent at any time of the day.
5. A copy of e-mail message that the sender has sent is available on the senders computer for later reference.
6. In addition to sending messages, e-mail is an ideal method for sending documents already on the computer, as attachments.
7. E-mail has features of the regular postal service. The sender of e-mail gets the e-mail address of the recipient, composes the message and sends it. The recipient of e-mail can read the mail, forward it or reply back. The recipient can also store the e-mail or delete it.

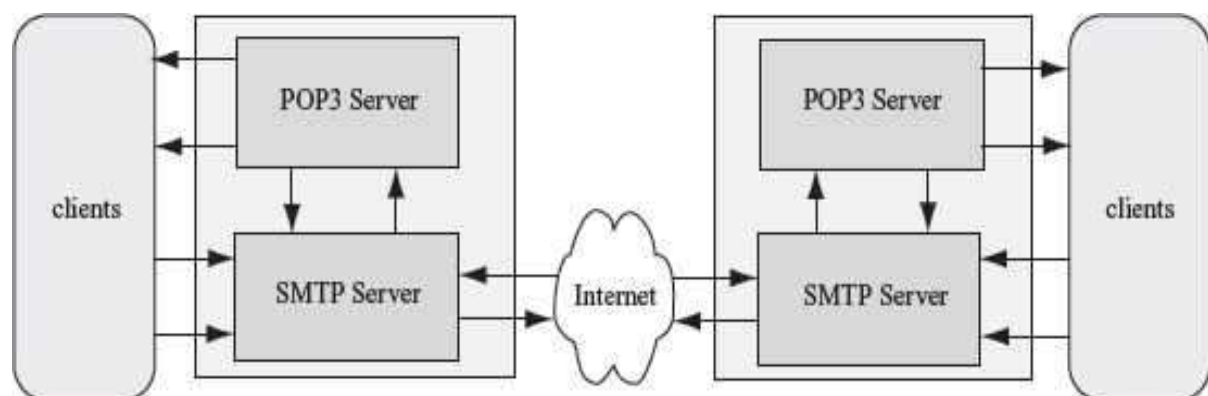


Figure: Interaction between e-mail client and server

HOW A MESSAGE IS BEING SENT?

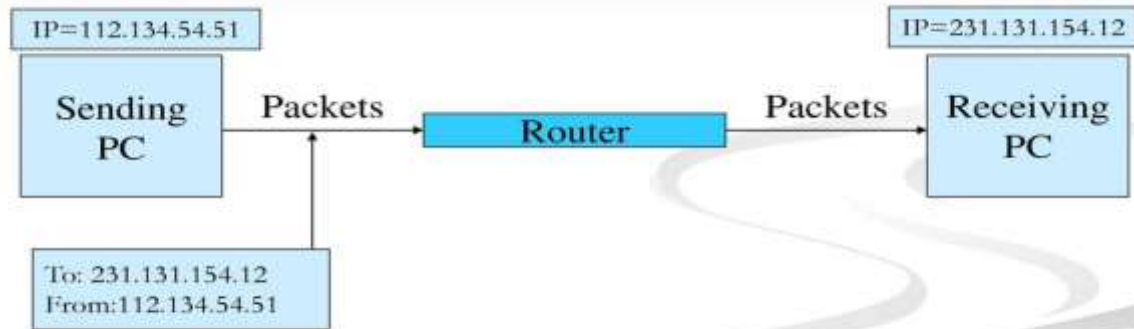


Figure: TCP/IP and Message Transmission