# INTRODUCTION TO COMPUTER NETWORK

**Introduction to Networks:**

A group of two or more similar things or people interconnected with each other is called network

- **Types of networks**
  - Social network
  - Mobile network
  - Network of computers
  - Airlines, railway, banks, hospitals networks
- A computer network is an interconnection among two or more computers or computing devices which allows computers to share data and resources among each other.
- Apart from computers, networks include networking devices like switch, router, modem, etc. Networking devices are used to connect multiple computers in different settings.

**Types of Networks**

- various types of computer networks ranging from network of handheld devices (like mobile phones or tablets) connected through Wi-Fi or Bluetooth within a single room to the millions of computers spread across the globe.
- computer networks are broadly categorised as:

  - LAN (Local Area Network)
  - MAN (Metropolitan Area Network)
  - WAN (Wide Area Network)

- ❖ **Local Area Network (LAN):**
  - It is a network that connects computers, mobile phones, tablet, mouse, printer, etc., placed at a limited distance.

- The geographical area covered by a LAN can range from a single room, a floor, an office having one or more buildings in the same premise, laboratory, a school, college, or university campus
- Connected with wires, Ethernet cables, fibre optics or Wi-Fi
- LANs provide the short-range communication with the high-speed data transfer rates
- Can be extended up to 1 km
- Data transfer from 10 Mbps to 1000 Mbps (Mbps- Megabits per Second)

❖ **Metropolitan Area Network (MAN)**

- Metropolitan Area Network (MAN) is an extended form of LAN which covers a larger geographical area like a city or a town.
- Data transfer rate is less than LAN
- E.g.: Cable TV Network, Cable based broadband internet
- Can be extended up to 30-40 kms
- many LANs are connected together to form MAN
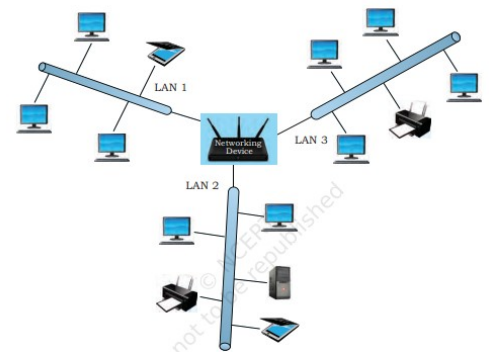
❖ **Wide Area Network (WAN)**

- connects computers and others LANs and MANs, which are spread across different geographical locations of a country or in different countries or continents
- The Internet is the largest WAN that connects billions of computers, smartphones and millions of LANs from different continents.

LAN 1 - India      Internet      LAN 1 - France
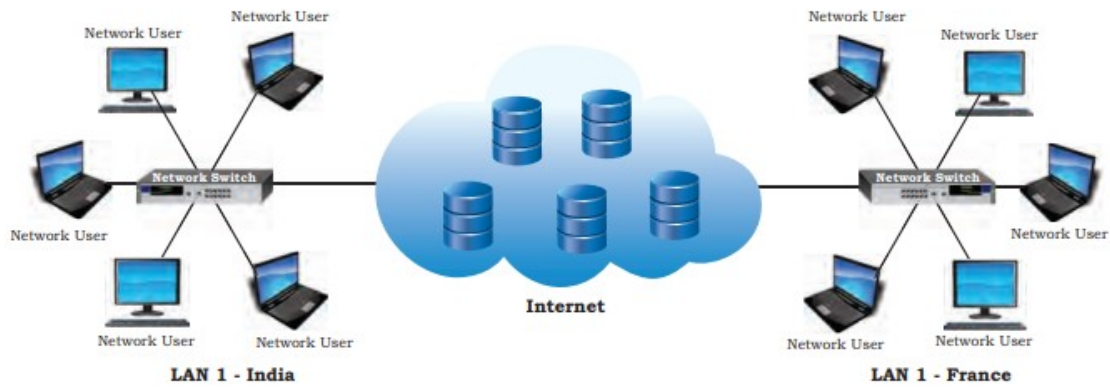
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❖ **PAN (Personal Area Network):** A PAN is a network of local devices for personal network. A PAN can be set up using guided media (USB cable) or unguided media (Bluetooth, Infrared).



Personal Area Network (PAN)
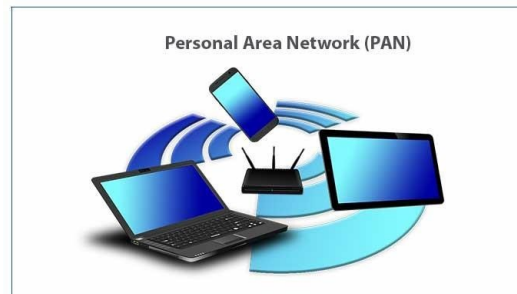
**Network Devices:**

To communicate data through different transmission media and to configure networks with different functionality, we require different devices like Modem, Hub, Switch, Repeater, Router, Gateway, etc.

**Modem:**

- stands for 'MOdulator DEMolulator
- device used for conversion between analog signals and digital bits.
- modems connected to both the source and destination nodes

- The modem at the sender's end acts as a modulator that converts the digital data into analog signals. The modem at the receiver's end acts as a demodulator that converts the analog signals into digital data for the destination node
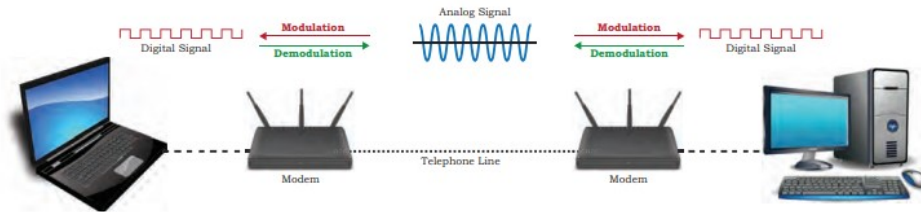


## Ethernet Card

- Also known as Network Interface Card (NIC card in short) is a network adaptor used to set up a wired network.
- interface between computer and the network
- circuit board mounted on the motherboard of a computer
- Ethernet cable connects the computer to the network through NIC.
- Data transfer between 10Mbps to 1 Gbps
- Each NIC has a MAC address, which helps in uniquely identifying the computer on the network.

## Repeater

- Data are carried in the form of signals over the cable
- Signals lose their strength beyond 100 m limit and become weak.
- The weakened signal appearing on the cable is regenerated and put back on the cable by a repeater

## Hub

- An Ethernet hub is a network device used to connect different devices through wires.
- Data arriving on any of the lines are sent out on all the others.

- The limitation of hub is that if data from two devices come at the same time, they will collide
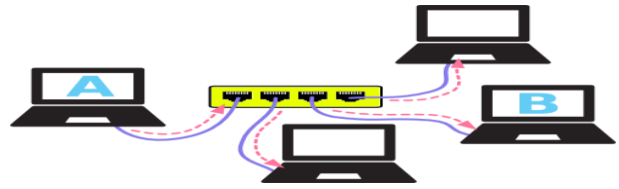
Passive Hub: This **type** of does not amplify or boost the signal. Itdoes not manipulate or view the traffic that crosses it.
Active Hub: It amplifies the incoming signal before passing it to the otherports.

## Switch

- Like a hub, a network switch is used to connect multiple computers or communicating devices.
- When data arrives, the switch extracts the destination address from the data packet and looks it up in a table to see where to send the packet. Thus, it sends signals to only selected devices instead of sending to all.
- can forward multiple packets at the same time
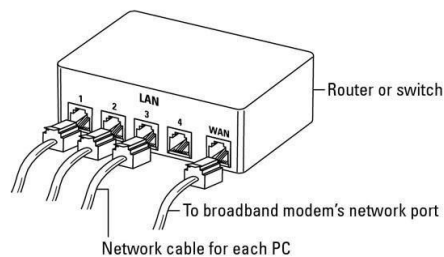
## Difference between Hub and Switch

1. The main difference between hub and switch is that hub replicates what it receives on one port ontoall the other ports while switch keeps a record of the MAC addresses of the devices attached to it and forwards data packets onto the ports for which it is addressed across a network, that's why switch is intelligent Hub.

## Router

- A network device that can receive the data, analyse it and transmit it to other networks.
- Compared to a hub or a switch, a router has advanced capabilities as it can analyse the data being carried over a network, decide or alter how it is packaged, and send it to another network of a different type.
- A router can be wired or wireless.
- A wireless router can provide Wi-Fi access to smartphones and other devices.
- Wi-Fi routers perform the dual task of a router and a modem/switch
- It connects to incoming broadband lines, from ISP (Internet Service Provider), and converts them to digital data for computing devices to process.
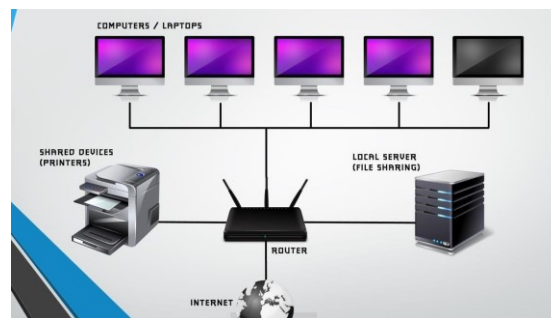


## Gateway

- A gateway is a device that connects dissimilar networks (Networks with different software and hardware configurations and with different transmission protocol).
- Gateway serves as the entry and exit point of a network, as all data coming in or going out of a network must first pass through the gateway in order to use routing paths.
- also maintain information about the host network's internal connection paths and the identified paths of other remote networks.
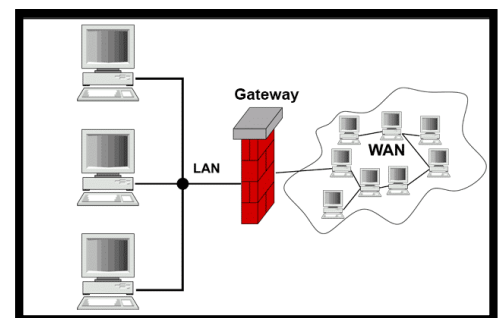
- it can be implemented as software, hardware, or a combination of both because network gateway is placed at the edge of a network and the firewall is usually integrated with it.

## Network Topologies

- The arrangement of computers and other peripherals in a network is called its topology. Some common topologies are as follows:

## 1 Mesh Topology

- each communicating device is connected with every other device in the network
- can handle large amounts of traffic since multiple nodes can transmit data simultaneously
- if any node gets down doesn't affect other nodes
- secure than other topologies as each cable carries different data
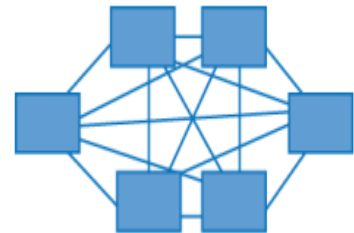
### Disadvantages:

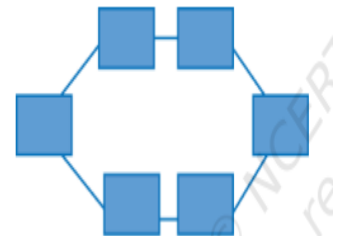- wiring is complex and cabling cost is high in creating such networks
- there are many redundant or unutilised connections

## 2 Ring Topology

- each node is connected to two other devices, one each on either side
- The link in a ring topology is unidirectional
- Failure of one node breaks down the network

## 3 Bus Topology

- each communicating device connects to a transmission medium, known as bus

- data transmitted in both directions
- data can be received by any of the nodes of network
- single backbone wire /bus used to connect computers so cheaper and easy to maintain
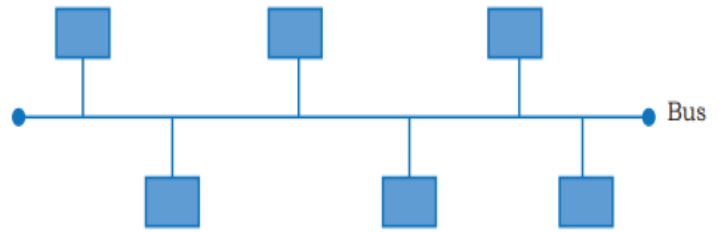
**Disadvantages:**

- less secure
- less reliable

## 4 Star Topology

- each communicating device is connected to a central node, which is a networking device like a hub or a switch

**Advantages:**

- ☐ Easy to troubleshoot
- ☐ very effective, efficient and fast
- ☐ A single node failure does not affect the entire network.
- ☐ Fault detection and removal of faulty parts is easier.
- ☐ In case a workstation fails, the network is not affected.

**Disadvantages: -**

- ☐ Difficult to expand. Longer cable is required.
- ☐ The cost of the hub and the longer cables makes it expensive over others.
- ☐ In case hub fails, the entire network stop working.

## 5 Tree or Hybrid Topology

- It is a hierarchical topology, in which there are multiple branches and each branch can have one or more basic topologies like star, ring and bus.
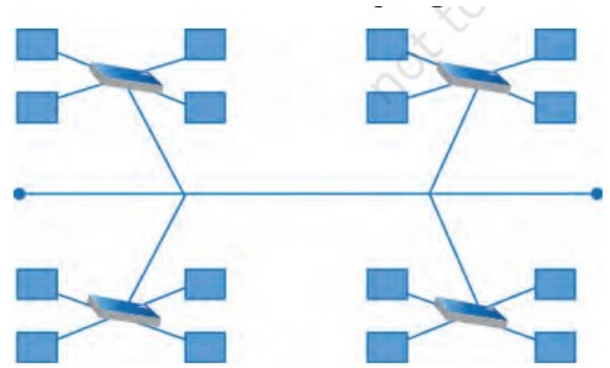
### Features of Tree Topology

- Ideal if workstations are located in groups.
- Used in Wide Area Network.

### Advantages of Tree Topology

- Extension of bus and star topologies.
- Expansion of nodes is possible and easy.
- Easily managed and maintained.

## The Internet

- it is the global network of computing devices including desktop, laptop, servers, tablets, mobile phones, other handheld devices as well as peripheral devices such as printers, scanners, etc.
- also consists of networking devices such as routers, switches, gateways, etc.

- The Internet provides a capability so powerful and general that it can be used for almost any purpose that depends on information, and it is accessible by every individual who connects to one of its associated networks.

## Applications of Internet:

Following are some of the broad areas or services provided through Internet:

• The World Wide Web (WWW)

- Electronic mail (Email)
- Chat
- Voice Over Internet Protocol (VoIP)

## 1 The World Wide Web (WWW)

- It is an ocean of information, stored in the form of trillions of interlinked web pages and web resources
- a British computer scientist invented the revolutionary World Wide Web in 1990 by defining three fundamental technologies that lead to creation of web:
- **HTML — Hyper Text Markup Language**
  - language which is used to design standardised Web Pages so that the Web contents can be read and understood from any computer across the globe
- **URI — Uniform Resource Identifier**
  - unique identifier to identify a resource located on the web
  - **URL:** - **URL** stands for Uniform Resource Locator. A URL is nothing more than the address of a given unique resource on the Web or address of a website. The URL is an address that matches users to a specific resource online, such as webpage.
  - Example-   http://www.cbse.nic.in



**Domain Name**
http://www.ncert.nic.in/textbook/textbook.htm
**URL**

- **HTTP — The Hyper Text Transfer Protocol**
  - set of rules which is used to retrieve linked web pages across the web
  - more secure and advanced version is HTTPS.

## 2 Electronic Mail (Email)

- It is one of the ways of sending and receiving message(s) using the Internet.
- can be sent anytime to any number of recipients at anywhere
- To use email service, one needs to register with an email service provider by creating a mail account. These services may be free or paid.
- Some of the popular email service providers are Google (Gmail), Yahoo (yahoo mail), Microsoft (outlook), etc.

## Application of Internet

## Web 2.0:

The term web 2.0 is used to refer to a new generation of websites that are supposed to let people to publish and share information online. It aims to encourage the sharing of information and views, creativity that can be consume by the other users. E.g.: YouTube

## The Main characteristics of web 2.0 are:

- ✓ Makes web more interactive through online social media web- based forums, communities, social networking sites.
- ✓ It is a website design and development world which aim to encourage sharing of information and views, creativity and user interactivity between the users.
- ✓ Video sharing possible in the websites

**Web 3.0:** It refers to the $3^{rd}$ Generation of web where user will iteract by using artificial intelligence and with 3-D portals.

Web 3.0

keywords and numbers. supports semantic web which improves web technologies to create, connect and share content through the intelligent search and the analysis based on the meaning of the words, instead of on the

### 3 Chat

- Chatting or Instant Messaging (IM) over the Internet means communicating to people at different geographic locations in real time through text message(s).
- With ever increasing internet speed, it is now possible to send image, document, audio, video as well through instant messengers. I
- Applications such as WhatsApp, Slack, Skype, Yahoo Messenger, Google Talk, Facebook Messenger, Google Hangout, etc., are examples of instant messengers.

### 4 VoIP

- Voice over Internet Protocol - allows us to have voice call (telephone service) over the Internet
- VoIP works on the simple principle of converting the analogue voice signals into digital and then transmitting them over the broadband line.

These services are either free or very economical

- VoIP call(s) can be received and made using IP phones from any place having Internet access.

**Advantage of VoIP:**

- ✓ Save a lot of money.
- ✓ More than two people can communicate or speak.
- ✓ Supports great audio transfer.
- ✓ Provide conferencing facility.
- ✓ can transfer text, image, video along with voice

**Disadvantages of VoIP:**

- ✓ Reliable Internet connection required.
- ✓ No location tracking for emergency calls.

## 7 Website

- A website in general contains information organized in multiple pages about an organization.
- website can be created for a particular purpose, theme or to provide a service
- collection of web pages related through hyperlinks, and saved on a web server

## 1 Purpose of a Website

- to make the information available to people at large
- helps to communicate with people in a specific, transparent and user-friendly manner
- common purposes for which websites are designed are listed below:
- Selling products and delivering services
- Posting and finding information on the internet
- Communicating with each other & Entertainment purposes
- Disseminating contents and software

## 8 Web Page

- A web page (also referred to as a page) is a document on the WWW that is viewed in a web browser.
- structure of a web page is created using HTML (HyperText Markup Language) and CSS (Cascaded Style Sheet).
- contain information in different forms, such as: text in the form of paragraphs, lists, tables, images, audio, video, software application, other interactive content
- The first page of the website is called a home page

❖ **Static and Dynamic Web Pages**
- A static webpage is one whose content always remains static, i.e., does not change for person to person.

- Static web pages are generally written in HTML, JavaScript and/or CSS and have the extension .htm or .html.
- a dynamic web page is one in which the content of the web page can be different for different users.
- Dynamic web pages can be created using various languages such as JavaScript, PHP, ASP.NET, Python, Java, Ruby, etc.
- **Difference between Static and Dynamic webpage: -**

| Static Webpage | Dynamic Webpage |
|---|---|
| The static web pages display the same content each time when someone visits it. | In the dynamic Web pages, thepage content changes according to the user. |
| It takes less time to load over internet. | Dynamic web pages take more time while loading. |
| No Database used. | A database is used in at the server end in a dynamicweb page. |
| Changes rarely. | Changes frequently. |

- **Difference between Website and Webpage: –**

| Website | Webpage |
|---|---|
| 1. A collection of web pages which are grouped together and usually connected together in various ways, often called a "web site" or simply a "site." | A document which can be displayed in a web browser suchas Firefox, Google Chrome, Opera, Microsoft Internet Explorer etc. |

| | |
|---|---|
| 2. Has content about various entity. | Has content about single entity. |
| 3. More development time is required. | Less development time is required. |
| 4. Website address does not depend on Webpage address. | Webpage address depends on Website address. |

### 9 Web Server

- Used to store and deliver the contents of a website to clients such as a browser that request it. A web server can be software or hardware.
- The server needs to be connected to the Internet so that its contents can be made accessible to others.
- The web browser from the client computer sends a request (HTTP request) for a page containing the desired data or service. The web server then accepts, interprets, searches and responds (HTTP response) to the request made by the web browser.
- If the server is not able to locate the page, it sends the error message (Error 404 – page not found) to the client's browser.

❖ **Web Hosting: -**
- online service that enables user to publish website or web application on the internet. When user sign up for a hosting service, basically rent some space on a server on which user can store all the files and data necessary for website to work properly.
- A server is a physical computer that runs without any interruption so that website is available all the time for anyone who wants to see it.

### 11 Browser:
- software application that helps us to view the web page(s).

- Helps to view different contents retrieved from different web servers on the internet
- Mosaic was the first web browser developed by the National Centre for Supercomputing Application (NCSA).
- Mozilla Firefox is an open source web browser which is available free of cost and can be easily downloaded from the Internet.

❖ **Browser Setting**

- Every web browser has got certain settings that define the manner in which the browser will behave. These settings may be with respect to privacy, search engine preferences, download options, auto signature, autofill and autocomplete feature, theme and much more.

## 2 Add-Ons and Plug-ins

- Add-ons and plug-ins are the tools that help to extend and modify the functionality of the browser.
- Both the tools boost the performance of the browser, but are different from each other.
- A plug-in is a complete program or may be a third-party software. For example, Flash and Java are plug-ins. A Flash player is required to play a video in the browser. A plug-in is a software that is installed on the host computer and can be used by the browser for multiple functionalities and can even be used by other applications as well.
- an add-on is not a complete program and so is used to add only a particular functionality to the browser. An add-on is also referred to as extension in some browsers

❖ **<u>Cookies</u>**

- A cookie is a text file, containing a string of information, which is transferred by the website to the browser when we browse it.

- This string of information gets stored in the form of a text file in the browser.

- The information stored is retransmitted to the server to recognize the user, by identifying pages that were visited, choices that were made while browsing various menu(s) on a particular website.

- It helps in customizing the information that will be displayed, for example the choice of language for browsing, allowing the user to auto login, remembering the shopping preference, displaying advertisements of one's interest, etc. Cookies are usually harmless and they can't access information from the hard disk of a user or transmit virus or malware.