

13/7/21

## CHAPTER - 6

### COMPUTER NETWORKS

#### ★ NETWORK

A network is an interconnected collection of autonomous computers. Two computers are said to be interconnected if they are capable of exchanging information.

#### • NEED FOR NETWORKING

- a) To share computer files.
- b) To share computer peripherals.
- c) To enable different computers to communicate with each other.
- d) To improve communication speed and accuracy.
- e) To reduce cost of transfer.

#### • COMPONENTS OF NETWORK

- 1) ~~Nodes~~ (workstations)
- 2) Server
- 3) Network Interface Unit (NIC)

#### • ADVANTAGES OF COMPUTER NETWORKS

##### (a) RESOURCE USAGE

The primary use of a network is to share among users programs / applications, data and peripheral devices connected to the network.

##### (b) IMPROVED COMMUNICATION

A computer network enables fast, reliable and secure communication between users. It saves time and offers easy communication methods.

##### (c) REDUCED COMMUNICATION COST

Sharing resources also reduces communication cost.



#### (d) RELIABILITY OF DATA

Data can be copied and stored on multiple computers. If the data gets corrupted, a copy of the same data can also be accessed from another workstation.

#### (e) CENTRAL STORAGE OF DATA

Files can be stored on a central node (the file server) that can be shared and made available to each and every user in an organization.

#### • DISADVANTAGES OF COMPUTER NETWORKS

It

#### (a) COST OF SET-UP AND MAINTENANCE

It is difficult to set up larger networks as the systems on a network are sophisticated and complex to run, and they have very high maintenance cost.

#### (b) THREAT TO DATA SECURITY

Unauthorised access to data leading to data theft or data corruption, computer viruses, worms, malware, phishing, etc. are some of the threats to network security.

#### ★ EVOLUTION OF NETWORK

#### • ARPANET (ADVANCED RESEARCH PROJECT AGENCY NETWORK)

ARPANET, which was jointly designed and named by the Advanced Research Projects Agency (ARPA) and US Department of Defence (DoD), was the first network and came into existence in 1969. It was a project that connected a handful of computers at different universities and US DoD for sharing of data.

#### • NSFNET (NATIONAL SCIENCE FEDERATION NETWORK)

In the mid-80's, another federal agency, NSFNET, created a



new network which was more capable than ARPANET. Its main aim was to use network only for academic research and not for any private business activity.

- **INTERNET**

In the 1990's, internet, which is a network of networks, came into existence. The internet has evolved from ARPANET. The computers are connected through World Wide Web that comprises a large network and shares a common communication protocol (TCP/IP).

- **INTER SPACE**

Interspace is a software that allows multiple users in a client-server environment to communicate with each other by sending and receiving data of various types such as data files, video, audio and textual data in a 3-D environment.

- ★ **ELEMENTARY TERMINOLOGY OF NETWORKS**

- **NODES (WORKSTATIONS)**

The computers that are attached to a network and are seeking to share resources, e.g., PC, smartphones, laptops, etc.

- **SERVER**

A computer that facilitates sharing of data, software and hardware resources on the network.

- **NETWORK INTERFACE UNIT (NIU) (MAC ADDRESS)**

An interpreter that helps in establishing communication between the server and the client.

- **IP ADDRESS**

Every machine on a TCP/IP network has a unique identifying



number called an IP Address. It is provided by ISP.

### • DOMAIN NAME

It is a way to identify and locate the computers connected to the internet. It must be unique.

## ★ COMPONENTS OF DATA COMMUNICATION

- SENDER
- RECEIVER
- MESSAGE
- TRANSMISSION MEDIUM

Physical path through which the data flows from sender to receiver

- PROTOCOL
- Set of rules that governs data transmission

## ★ MODES OF DATA TRANSMISSION

### (a) ANALOG OR BROADBAND TRANSMISSION

The signal is a radio frequency signal or analog, i.e., it can consist of continuous electrical waves that are of varying amplitudes.

### (b) DIGITAL OR BASEBAND TRANSMISSION

The signal is a group of discrete electrical units which is transmitted in rapid succession.

### (c) PARALLEL COMMUNICATION

When data is transmitted through multiple wires, with each wire carrying each bit, it is called parallel communication.

### (d) SERIAL COMMUNICATION

When bits are sent one after another in a series along a wire,



it is called serial communication.

## (e) SYNCHRONOUS OR ASYNCHRONOUS TRANSMISSION

(i) In synchronous transmission, the sender first sends control characters to the receiver and then sends the actual data.

Faster; Costly and complex set-up required

(ii) In asynchronous transmission, data is preceded and succeeded by a start bit and stop bit respectively.

Slower; ~~Slower than~~ hardware required is simple and cheap

## ★ NETWORK SWITCHING

Various switching techniques are used to transfer packets of data from one port of a node to another till they reach the destination.

A switched network is made up of a series of interconnected nodes called switches.

### • CIRCUIT SWITCHING

(a) Circuit switching provides end-to-end connection between two computers.

It is established usually in a telephone network where one person is making a call and another is receiving a call.

(b) In this technique, the entire link remains dedicated, which guarantees the full bandwidth of the link and no other user can use it even if the path remains idle.

### • PACKET SWITCHING

(a) In this technique, the entire data is divided into small fragments called packets. Each packet has a source address as well as destination address (IP Address) for being transmitted.

(b) As there is no direct connection established between the sender and the receiver, each packet follows different routes and, therefore, the



the packets are delivered in a random order. It is the TCP protocol which then arranges all received packets in a sequential order.

### • MESSAGE SWITCHING

- (a) In message switching, the sender sends the data to a switching office first, which is then stored in its buffer. It then checks the available link and, if it is free, the data is relayed to another switching office. This process goes on until the data is sent to the destination.
- (b) It is also called store and forward switching technique.

### → DIFFERENCE BETWEEN CIRCUIT SWITCHING AND PACKET SWITCHING

CIRCUIT SWITCHING	PACKET SWITCHING
(a) Reserves the required bandwidth in advance.	(a) Uses bandwidth as and when required.
(b) Fast technology.	(b) Slow technology.
(c) Requires a dedicated path.	(c) Can use any dynamic path.
(d) If path is overloaded, the call is blocked and communication is delayed.	(d) Packets are allocated to different paths.
(e) The message is received in the same order as it is originally sent.	(e) Packets are sent in random order and received in random order.

### ★ DATA COMMUNICATION TERMINOLOGIES

- 1. CHANNEL:** A channel is a communication path through which the data is transmitted from the sender device to the receiver device.
- 2. BAUD:** The number of changes in a signal per second is known as baud. It is the measuring unit of the data transfer rate.



3. **BITS PER SECOND**: It is the measuring unit of speed at which data transfer takes place.
4. **BANDWIDTH**: The amount of data that can be passed along a communication channel in a given period of time (1 second) is termed as bandwidth. It is the difference between the highest and lowest frequencies allowed on a transmission media.
5. **DATA AND SIGNALS**: Data are entities that are stored in the form of 0's and 1's in the computer. Signals are the electric or electromagnetic encoding of data and are used to transmit data.
6. **COMMUNICATION / TRANSMISSION MEDIA**: It is a means of communication or access set up between two organizations to exchange data.
7. **DATA TRANSFER RATE**: It is the amount of data transferred in one direction over a link divided by the time taken to transfer it in bits per second (bps).

### ★ NETWORK DEVICES

1. **MODEM**: A MODEM (Modulator DEModulator) is an electronic device that ~~enables a computer to~~ converts digital signals into analog signals and vice versa.
2. **RJ-45 CONNECTOR**: The RJ-45 (Registered Jack) <sup>eight-wire</sup> connectors are the plug-in devices used in networking and telecommunications applications. They are used primarily for connecting LANs, particularly Ethernet.
3. **ETHERNET CARD**: It is a hardware device that helps in the connection of nodes within a network. Ethernet card is also known as a network card, network adapter or NIC.



4. **HUB**: A hub is a hardware device used to connect several computers together with different ports. The problem with hub is that it is not an intelligent device. It shares bandwidth with all the attached devices and broadcasts the data. It cannot filter the data and causes unnecessary traffic jams.

5. **SWITCH**: A switch (switching hub) is a network device which is used to interconnect computers or devices on a network. It filters and forwards data packets only to one or more devices for which the packet is intended across a network.

**NOTE** → The main difference hub and switch is that hub replicates what it ~~received~~ receives on one port onto all the other ports, while switch keeps a record of the MAC addresses of the devices attached to it.

6. **BRIDGE**: A bridge is a device that works on the physical layer as well as on data link layer. A network bridge connects multiple network segments (LANs) at the data link layer (layer 2) of the OSI model.

An important advantage of using a bridge is that it is a smarter hub as it can filter network traffic on the basis of the MAC addresses.

6. **GATEWAY**: A gateway is a device that connects dissimilar networks. It establishes an intelligent connection between a local area network and external networks with completely different structures.

7. **REPEATER**: Repeater is a device that amplifies a signal that is transmitted across the network so that the signal is received in the same way as it is sent.



8. **ROUTER**: A router is a networking device that forwards data packets from the source machine to the destination machine over a network by using the shortest path.

9. **Wi-Fi CARD**: A Wi-Fi card is either an internal or external Local Area Network adapter with a built-in wireless radio and antenna. A Wi-Fi card is used in a desktop computer that enables a user to establish an internet connection.

## \* TYPES OF NETWORKS

### 1. CLIENT - SERVER NETWORK

In client-server network, multiple clients or workstations are connected to at least one central server. A server is a powerful computer with all applications and hardware installed in it and client is a computer which seeks any resource from another computer.

### 2. PEER - TO - PEER NETWORK

In peer-to-peer network, all nodes in the network have equivalent capability and function as both client and server. In this network, all workstations are connected together for sharing devices, information or data. This network is ideal for small networks where there is no need of dedicated servers.

• On the basis of geographical spread, networks may be classified as:

### 1. PERSONAL AREA NETWORK (PAN)

PANs are small networks used to establish communication between a computer and other handheld devices in the proximity of up to 10 metres using wired USB connectivity or wireless systems like Bluetooth or Infrared.



## 2. LOCAL AREA NETWORK (LAN)

LAN is a privately owned computer network covering a small geographical area, like a home, office or a building, such as a school. It can cover an area spread over a few metres to a radius of a few kilometres. A LAN can be set up using wired media, or wireless media. If a LAN is set up using unguided media, it is known as WLAN (wireless LAN).

## 3. METROPOLITAN AREA NETWORKING (MAN)

MAN is larger than a LAN and can cover a city and its surroundings areas. A MAN usually interconnects a number of LANs and individual computers. All types of communication media (guided and unguided) are used to set up a MAN.

## 4. WIDE AREA NETWORK (WAN)

WAN is a telecommunication network. This type of network spreads over a large geographical area across countries and continents. ~~WANs~~ Internet is the largest WAN that connects billions of computers, smartphones and millions of LANs from different continents. All types of communication media (guided and unguided) are used to set up a WAN.

### → DIFFERENCE BETWEEN LAN AND WAN

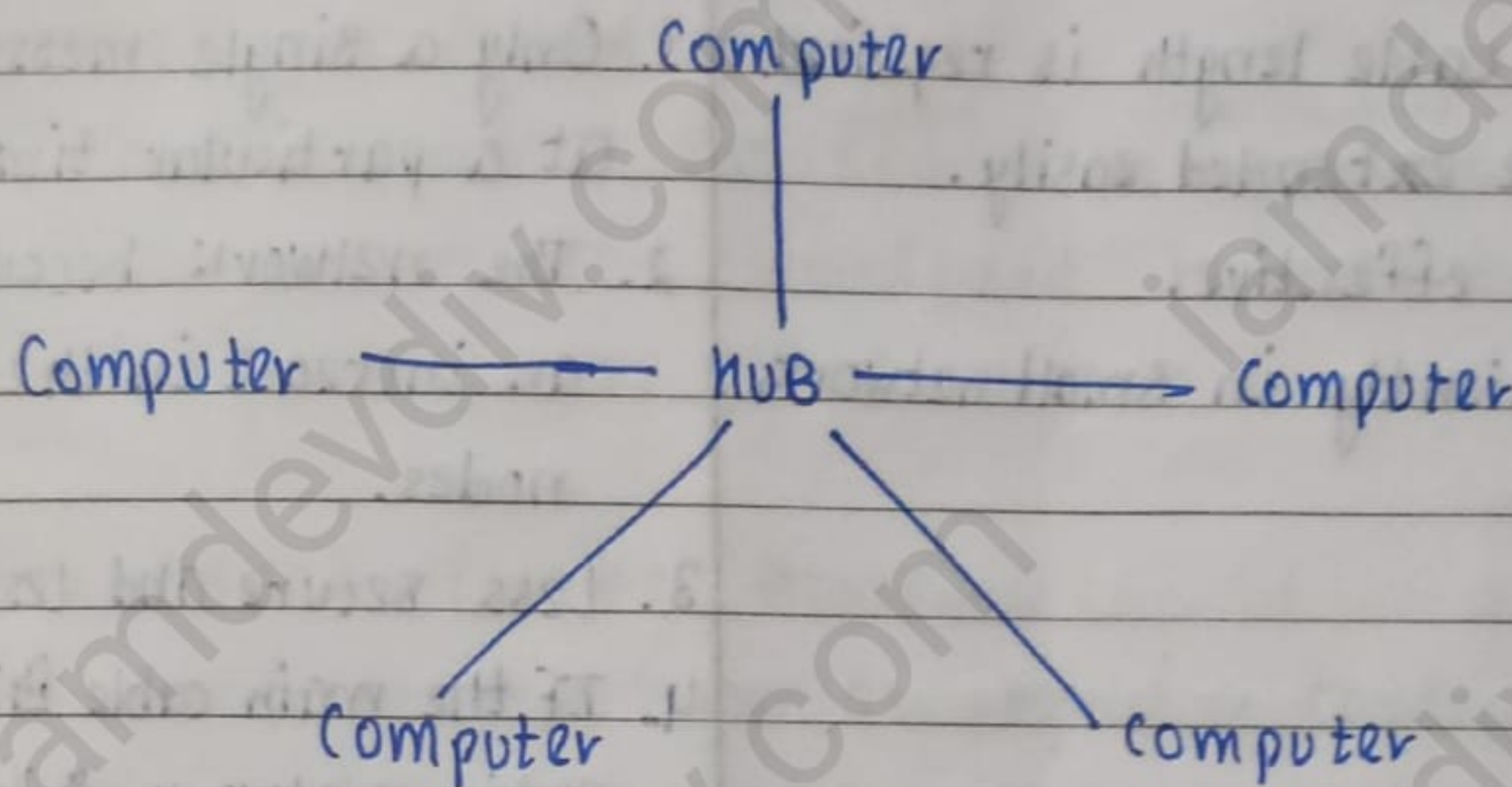
	LAN	WAN
1.	Distance between nodes is limited. There is an upper limit approx. 10 Kms and lower limit 1 Km.	1. There is no limit of distance between the nodes.
2.	Speed: 1 to 10 mbps	2. Speed - less than 1 mbps
3.	Error rate is 1000 times lower than WAN.	3. Error rate is higher.



## ★ NETWORK TOPOLOGIES

Topology is a way of connecting devices with each other either physically or logically. Two or more devices make a link and two or more links form a topology.

### 1. STAR TOPOLOGY



In star topology, each communicating device is connected to a central controller called hub or switch. The devices in star topology send and receive data indirectly; the data passes to and from the hub.

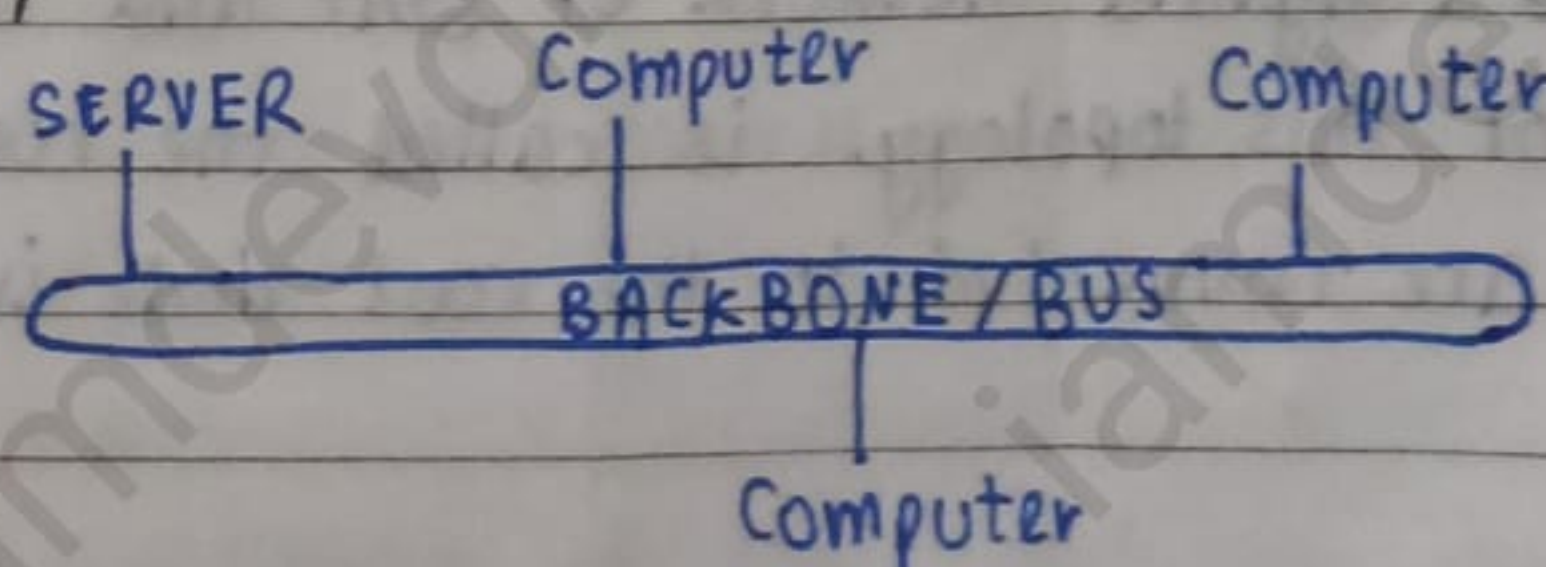
#### ADVANTAGES

1. Fault detection is easy.
2. Easy to install.
3. Failure of a single node will not bring down the entire network.
4. High speed network.
5. Highly reliable and secure.

#### DISADVANTAGES

1. Requires more cable length than bus topology.
2. If the hub/switch fails, the entire network fails.
3. Installation and maintenance is expensive.

### 2. BUS TOPOLOGY





In this topology, each node in the network is connected to a common transmission medium called the bus. The data transmitted from a node travels throughout the entire length of the bus in both directions and it can be received by any node connected to the bus.

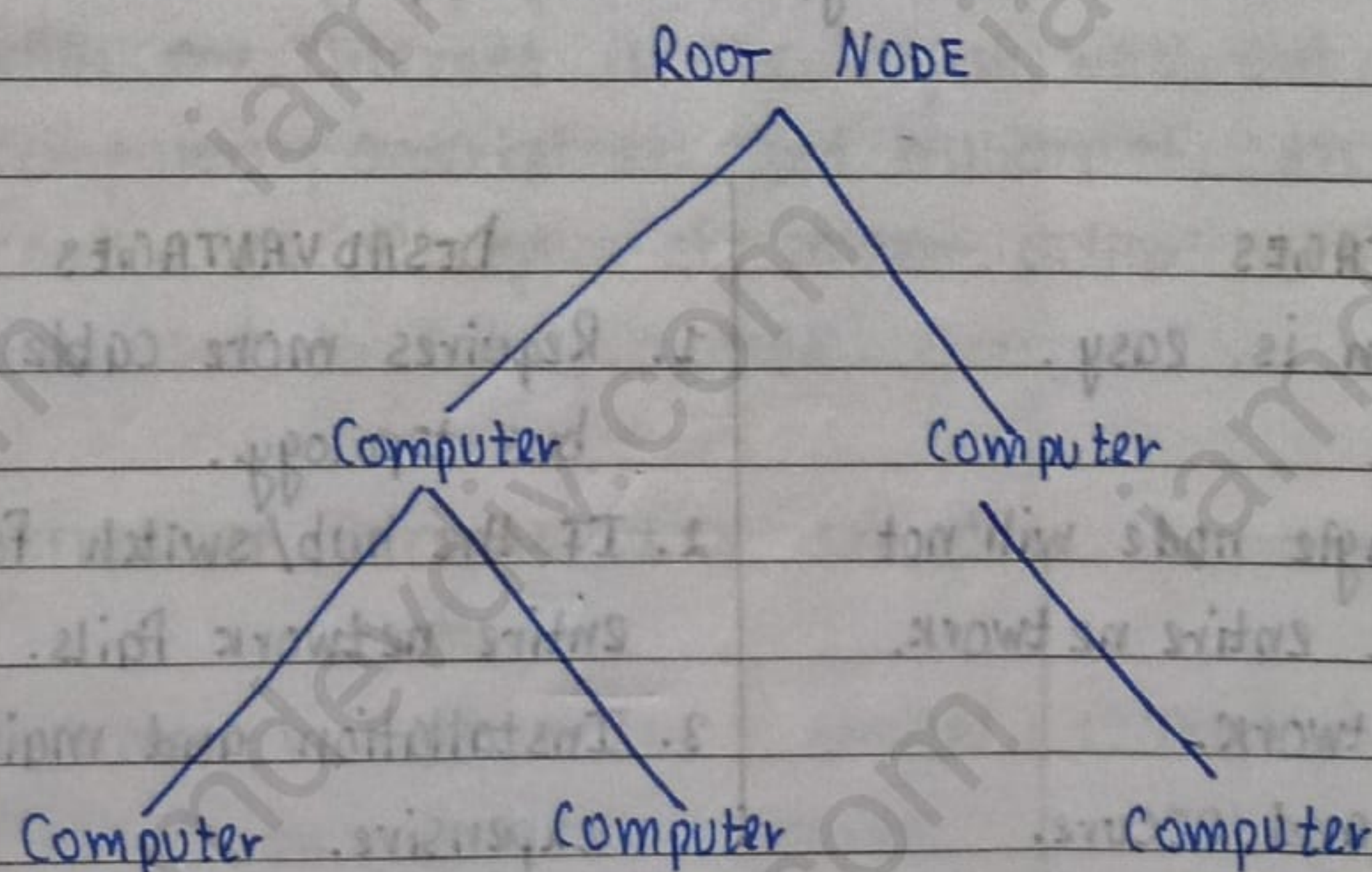
### ADVANTAGES

1. Very short cable length is required.
2. It can be extended easily.
3. It is cost effective.
4. Works efficiently in small networks.

### DISADVANTAGES

1. Only a single message can travel at a particular time.
2. The network becomes slow with an increase in the number of nodes.
3. Less secure and less reliable.
4. If the main cable fails, then the entire network fails.
5. Fault detection is difficult.

### 3. TREE TOPOLOGY



Tree topology is a hybrid network of star and bus topologies. The central node of this topology is called the root node and all the other nodes are connected to the root node in a hierarchical manner.



## ADVANTAGES

1. Failure of a single node will not affect the entire network.
2. Easily extendable.
3. Fault detection is easy.

## DISADVANTAGES

1. Installation is difficult.
2. Long cables are required.
3. If the main cable fails, the entire network will fail.

## ★ COMMUNICATION MEDIA

Communication media is also known as transmission media through which data or signal is transferred between two communication devices through wires or without wires.

## • GUIDED MEDIA (WIRED MEDIA)

Guided media are also known as physical or conducted media. These media use wires for transmitting data. Various wires connections are twisted pair wire, coaxial cable and fibre optic cable.

## 1. TWISTED PAIR CABLE

The twisted pair cable is a transmission medium consisting of two insulated wires arranged in a regular spiral pattern.

Example: Telephone wires



## ADVANTAGES

1. It is simple.
2. It is physically flexible.
3. It can be easily connected.
4. It has low weight.
5. It is very inexpensive.
6. It is easy to install and maintain.

## DISADVANTAGES

1. It is incapable <sup>of</sup> carrying a signal over long distances without the use of repeaters.
2. It unsuitable for broadband application.

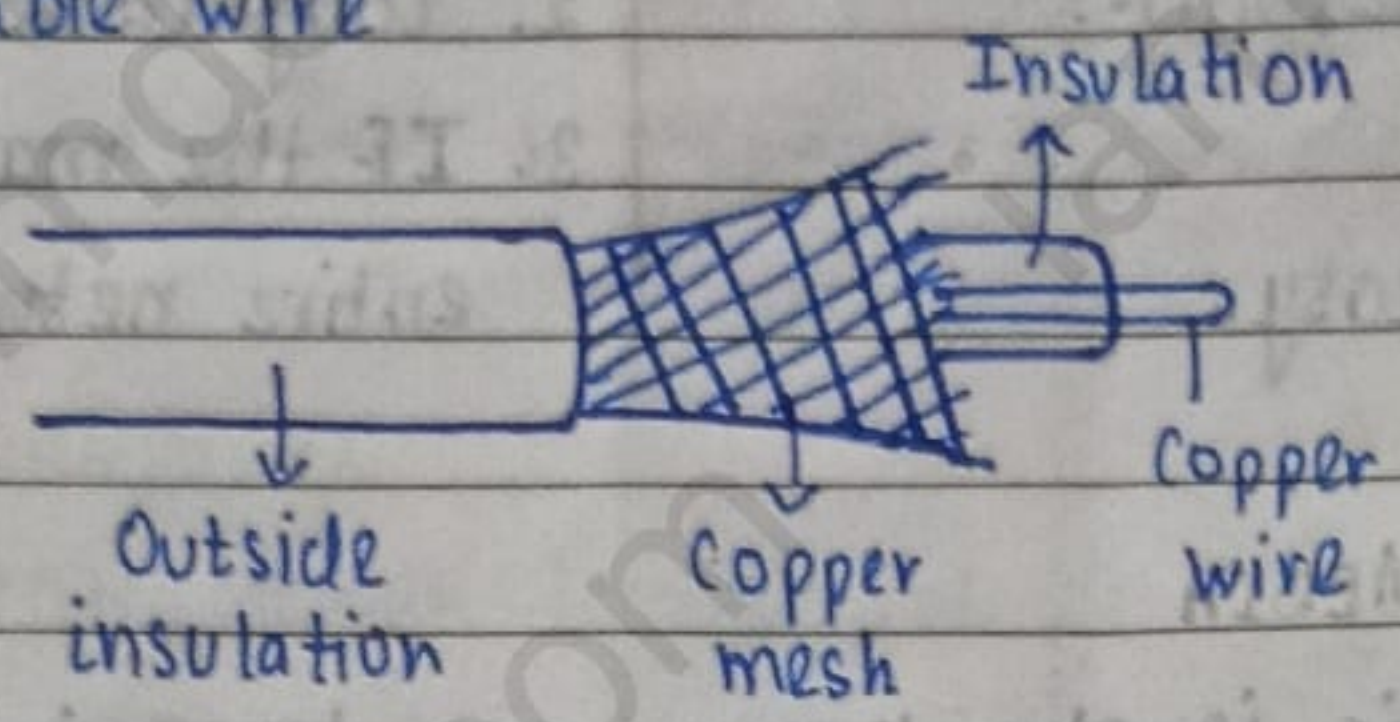
## 2. COAXIAL CABLE

coaxial cable consisting of one conductor, usually a small copper tube



or wire, within an insulated from another conductor of large diameter, usually copper tubing or copper braid.

Example: Cable wire



**ADVANTAGES**

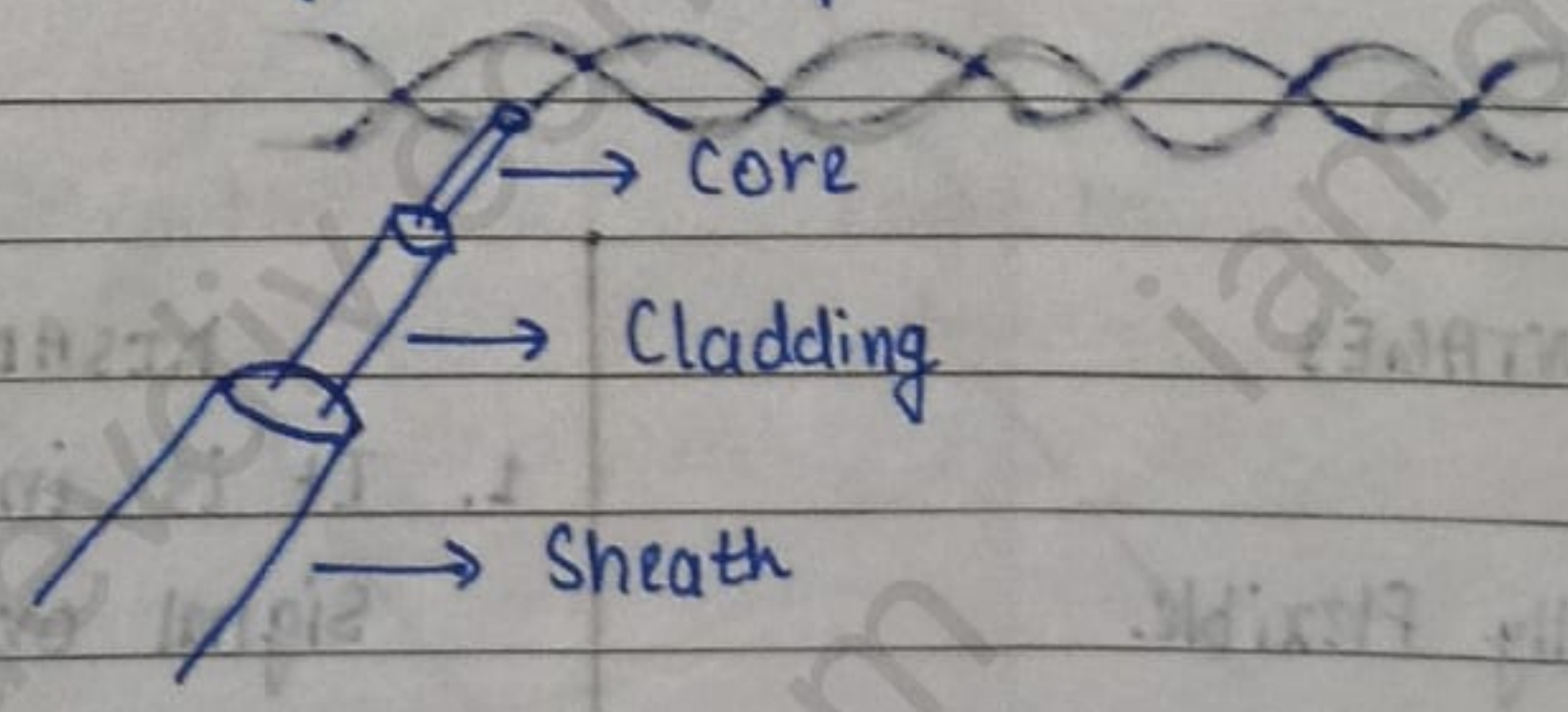
1. Data transmission better than twisted pair.
2. Can be used for broadband transmission i.e. several channels can be transmitted simultaneously.
3. Offer higher bandwidths (range of frequency) upto 400 MBPS.

**DISADVANTAGES**

1. Expensive compared to twisted pair.

**3. OPTICAL FIBRES**

A thin filament of glass or other transparent material, through which a signal-encoded light beam may be transmitted.



**ADVANTAGES**

1. It guarantees secure transmission and has a very high transmission capacity.
2. Can be used for broadband transmission.

**DISADVANTAGES**

1. Connection losses are common problems.
2. They are the most expensive of all the cables.
3. Installation problem.



## • UNGUIDED MEDIA (WIRELESS MEDIA)

A transmission media that does not require the use of cables for transmission of data is known as unguided media. The transmission takes place through various types of electromagnetic waves, such as radio waves, microwaves, infrared waves, etc.

### 1. MICROWAVES

Microwave signals are used to transmit data without the use of cables. The microwave signals are similar to radio and television signals and are used for long distance communication.

The main advantage of the microwave transmission is that building two towers is ~~easier~~ cheaper than laying cable or fibre.

The disadvantage is that signals from antenna may split up and propagate in different paths to the receiving antenna.

### 2. RADIOWAVES

The transmission making use of radio frequencies is termed as radio-wave transmission. When certain radio frequencies are allotted to private businesses for direct voice communication, they can make use of it for private business purposes.

#### ADVANTAGES

1. Best in hilly area.
2. Inexpensive.
3. High speed

#### DISADVANTAGES

1. Insecure communication.
2. Susceptible to weather effects like rains, thunder and storms etc.

### 3. INFRARED

The type of transmission that uses infrared light to send data is known as infrared transmission. The data is transmitted through air and can propagate in the open space; however, it cannot penetrate the walls of the room.



## ADVANTAGES

## DISADVANTAGES

- |  |   |
|--|---|
| 1. It is a secure medium of transmitting data. | 1. It can work only for short distances.                                  |
| 2. It is a cheap mode of transmission.         | 2. It cannot penetrate walls and is affected by distance, noise and heat. |

## ★ NETWORK PROTOCOLS

A protocol is an agreement between the communicating parties on how communication is to proceed. Protocol means a set of rules that governs a network.

## • TYPES OF PROTOCOLS

## (a) TCP (TRANSMISSION CONTROL PROTOCOL)

TCP enables two hosts to establish a connection and exchange streams of data. TCP works with the Internet Protocol (IP), which defines how computers send packets of data to each other. The packets are delivered in random order and TCP at the receiver side collects all packets and arranges them in a sequential order.

## (b) IP (INTERNET PROTOCOL)

It is responsible for delivering packets from the source host to the destination host based on the IP addresses mentioned in the packet headers. IP forwards each packet based on a four byte destination address (the IP number).

## (c) FTP (FILE TRANSFER PROTOCOL)

FTP is the simplest and most secure way to exchange files over the internet. FTP is most commonly used to download a file from a server using the internet or to upload a file to a server.



(d) PPP (POINT-TO-POINT PROTOCOL)

PPP is the most commonly used data link protocol. It is a protocol used to establish a direct connection between two nodes. It can provide connection authentication, transmission encryption and compression. It is used to connect the home PC to the server of ISP.

(e) SMTP (SIMPLE MAIL TRANSFER PROTOCOL)

SMTP is used for sending email messages to other networks or computers. It handles only outgoing messages and not incoming messages. SMTP does not create messages; rather it helps in forwarding messages between client servers.

(f) POP3 (POST OFFICE PROTOCOL 3)

The POP3 is a simple and standard method to access mailbox and download messages to the local computers. The user can receive messages with the help of POP protocol.

(g) TELNET (REMOTE LOGIN)

Telnet protocol allows a user to communicate with a remote machine. A user who is logging in to their own system can also get access to log on to ~~computer~~ another user system and perform various functions such as accessing files from or sharing files to the remote system.

(h) HTTP (HYPER TEXT TRANSFER PROTOCOL)

HTTP is used to transfer all files and other data (collectively called resources) from one computer to another on the World Wide Web. This protocol is used to transfer hypertext documents over the internet.

(i) HTTPS (HYPER TEXT TRANSFER PROTOCOL SECURE)

It is a protocol for securing communication between two systems, e.g., the browser and the web server. HTTP transfers data between the browser and the web server in the hypertext format, whereas https



transfers data in the encrypted format.

#### (d) VoIP (VOICE OVER INTERNET PROTOCOL)

VoIP is a technology that allows you to make voice calls using a broadband Internet connection instead of a regular (or analog) phone line.

Some common features:

audio calls; video calls; voice mail; instant messaging; team chats.

### ★ INTRODUCTION TO WEB SERVICES

#### 1. WWW (WORLD WIDE WEB)

WWW is an information service that can be used for sending and receiving information over the internet through interlinked hypertext documents. Web pages may contain text, images, videos and other multimedia components as well as web navigation features consisting of hyperlinks.

#### 2. HYPER TEXT MARKUP LANGUAGE (HTML)

HTML is a language that is used to create web pages which are then displayed by web browsers. This language tells the browser how to display text, pictures and links on the screen.

#### 3. XML (EXTENSIBLE MARKUP LANGUAGE)

Extensible Markup language is a text-based Markup Language that allows the user to create their own tags to store data in a structured format. In XML, the tags are not predefined; rather, they are created by the user for their own purpose.

#### 4. DOMAIN NAMES

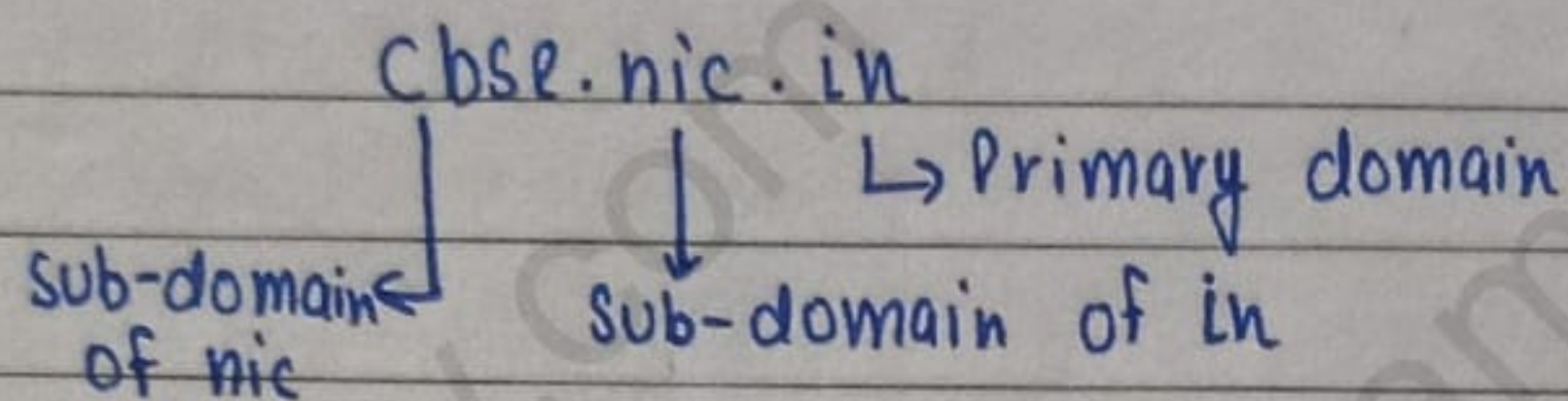
To communicate over the internet, we can use IP addresses. But it is not possible to remember the IP address of a particular website



or computer every time. Domain names make it easier to resolve IP addresses into names, for example, `cbse.nic.in`, `google.com`, etc.

A domain name consists of the following parts:

- a) Top-level domain or primary domain name
- b) Sub-domain name



## 5. URL (UNIFORM RESOURCE LOCATOR)

URL helps in locating a particular website or a web page, for example, `https://www.iamdevdiv.com` is a URL for a specific website.

## 6. WEBSITE

A website is a collection of various web pages, images, videos, audios or other kinds of digital assets that are hosted on one or several web servers. The first page of a website is known as home page.

A web page is an electronic document/page designed using HTML. It displays information in textual or graphical form.

## 7. WEB BROWSER

It is a software that helps in accessing web pages, and, thus, is called web client. It helps the user to navigate through the World Wide Web and display web pages.

## 8. WEB SERVER

A web server is a server that stores web pages and when a web client sends any request to a server, the server responds to the request and displays the requested web pages.

## 9. WEB HOSTING



Web hosting is a service which is provided by companies to its clients to allow them to construct their own websites which are accessible to the internet users via World Wide Web. Such companies are known as web hosts.