

# Computer Network

*The rapid evolution of technology has fundamentally transformed the way we communicate, share information, and connect with the world. At the heart of this revolution lies the intricate world of computer networks—an essential backbone of our modern digital society. Whether it's sending an email, streaming a video, or conducting a virtual meeting, computer networks make it all possible. This book, “Understanding Computer Networks,” is designed to guide readers through the complex yet fascinating world of networking.*

*This book is intended for students, professionals, and anyone who wishes to gain a solid foundation in computer networks. It covers a wide range of topics, from the basics of networking concepts to advanced protocols, network security, and the latest trends in the field. The content is structured to provide a balanced mix of theory and practical knowledge, ensuring that readers not only understand the fundamental concepts but can also apply them in real-world scenarios.*

## **Key features of this book include:**

**Comprehensive Coverage:** *The book delves into all critical aspects of computer networks, including network models, protocols, routing, switching, wireless communication, and network security. Each chapter is crafted to build upon the last, providing a clear progression from basic concepts to advanced topics.*

**Practical Examples and Case Studies:** *Real-world examples and case studies are included to demonstrate the practical application of networking principles. These insights help bridge the gap between theory and practice, making the learning experience more engaging and relevant.*

**Illustrations and Diagrams:** *To aid understanding, the book includes numerous diagrams and illustrations that visually represent complex networking concepts. These visual aids are designed to enhance comprehension and retention of key ideas.*

**Hands-on Exercises and Lab Work:** *Learning by doing is a crucial aspect of mastering computer networks. This book includes hands-on exercises and lab work that encourage readers to experiment and apply what they have learned.*

**Focus on Current Trends:** *The networking landscape is constantly evolving. This book highlights current trends such as cloud computing, the Internet of Things (IoT), network automation, and 5G, preparing readers for the future of networking.*

*In writing this book, the goal was to create a comprehensive resource that is accessible, engaging, and practical. I have drawn on my experience as an educator and network professional to present the material in a way that is both informative and easy to understand.*

*I hope this book will serve as a valuable resource for anyone seeking to deepen their knowledge of computer networks. Whether you are a student preparing for exams, a professional looking to expand your skills, or an enthusiast eager to explore the world of networking, this book is for you. I extend my gratitude to all who have contributed to the development of this book, including my colleagues, reviewers, and students whose feedback has been invaluable. I am confident that “Understanding Computer Networks” will equip you with the knowledge and skills needed to navigate and excel in the dynamic world of computer networking.*

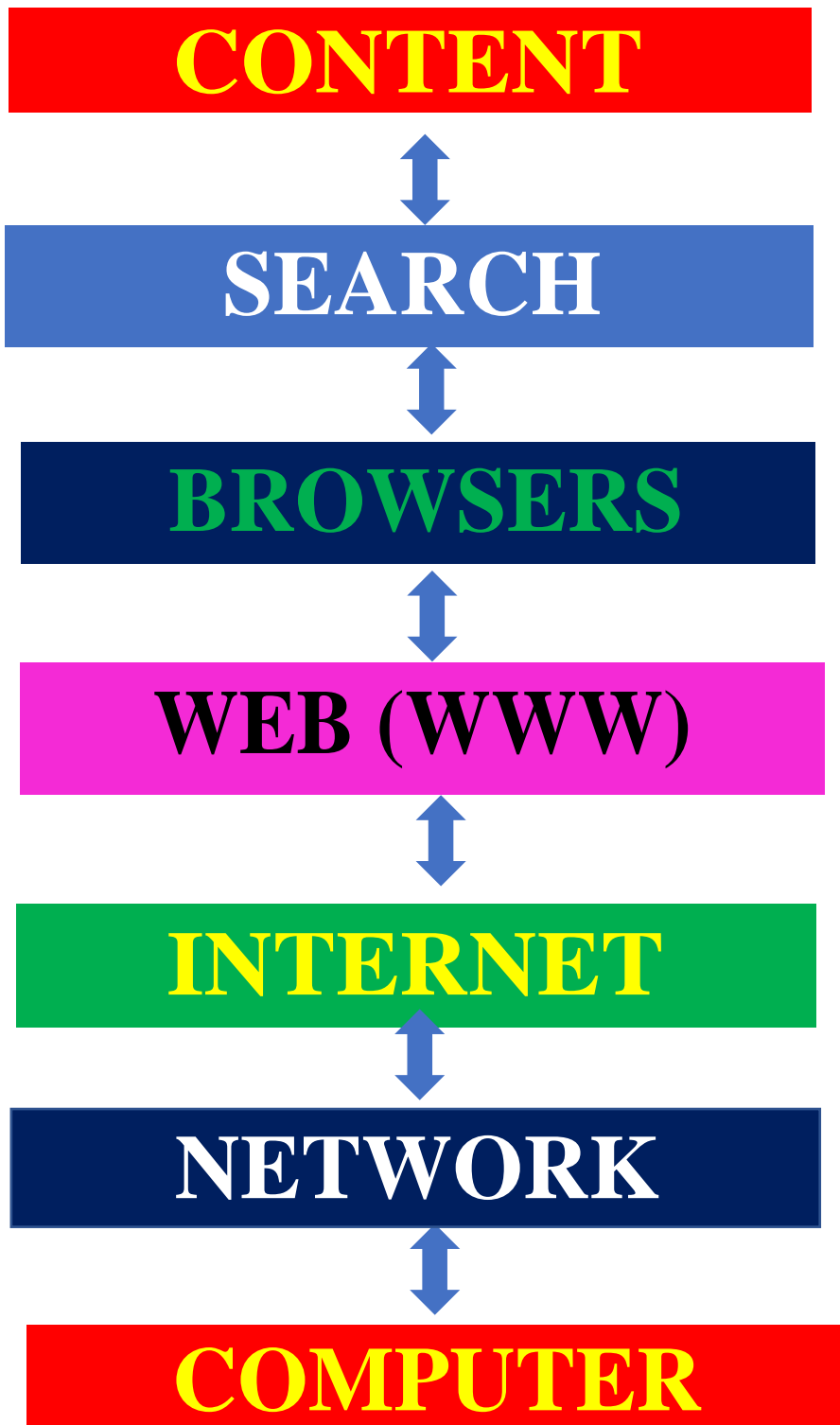
**Happy learning!**



Author  
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## Index

S. No:	Topic Name	Page No:
1	Overview	3
2.	What is Network?	4
3	What is Network Device?	5
4	Types of Networks	6
5	Network Topology	7
6	Network Protocols	8
7	Transmission modes	9
8	OSI Model	10
9	TCP/IP Model	11
10	Network Address and Ip Address	12
11	MAC Address	13
12	subnet and CIDR	14
13	Domain Name and DNS	15
14	Port Number	16
15	What is Internet?	17
16	What is WWW?	18
17	Search Engine	19
18	How website Works?	20
19	What is server and web server?	21
20	HTTP AND HTTPS	22
21	Uniform Resource Locator (URL)	23
22	Dynamic Host Configuration Protocol (DHCP)	24
23	Difference Between POP3 and IMAP	25
24	FTP, SFTP & TFTP	25



**Definition:** - Network is a group of computers which are connected to each other.

**Discover:** - US DOD, ARPANET (advance Research projects agency networks)

**Use:** - sharing data from one device to another device. or one place to another place.

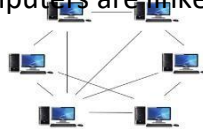
**Types:** - 1.PAN 2.LAN 3.MAN 4.WAN 5.GAN

**Device:** - Hardware devices are used to connect or make a network.

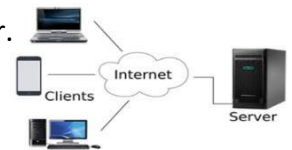
**Architecture:** - It is physical & logical design of the software, hardware, & protocols.

Types: - 1. Peer-To-Peer network 2. Client/Server network.

**Peer-To-Peer network:** - all the computers are linked together with equal privilege and responsibilities for processing the data.



**Client/server network:** - these types of networks are designed for end users called clients, to access the resources from a central computer known as Server.



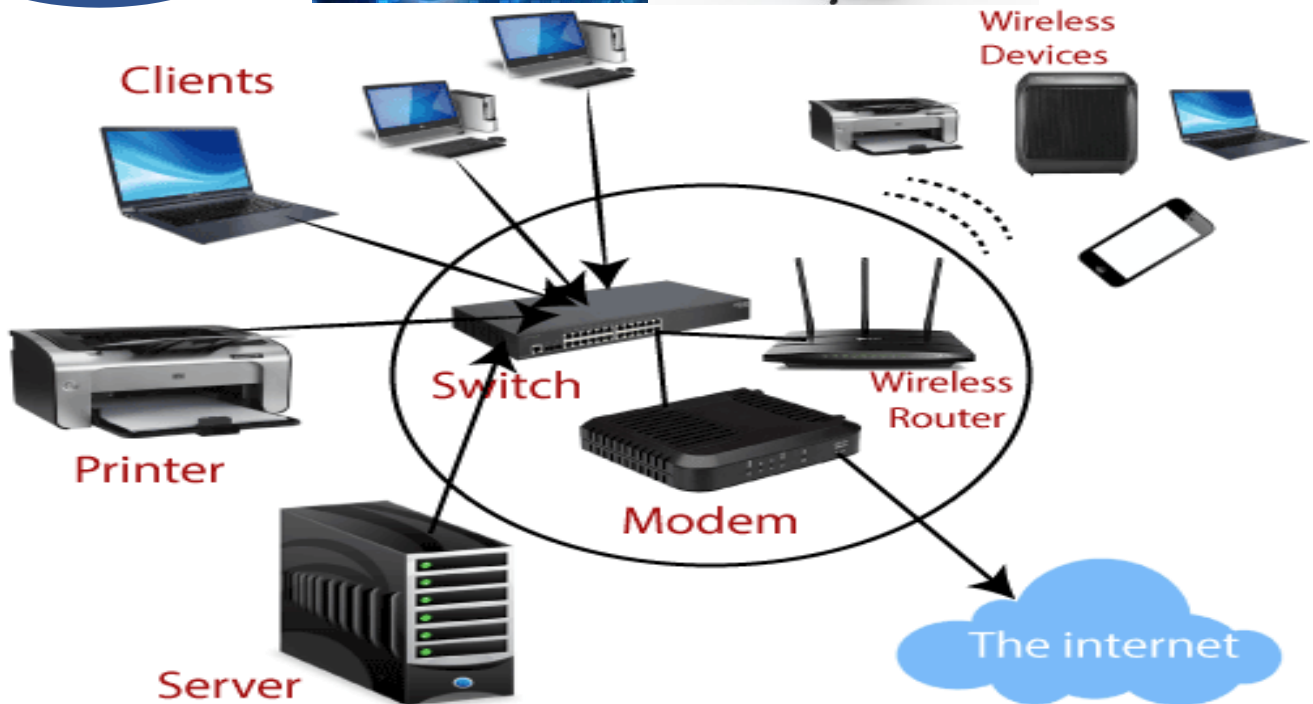
**Components:** - NIC, switch, cable, hub, router, and modem.

**Features:** - Data Sharing, Communication Speed, Backup, Scalability, Reliability, & Security

**Internet:** -it is network of network. Or global System of interconnected computer networks.

**Server:** - it is a main computer of computer network Or Centralised system, a piece of computer hardware or software program.

**“NETWORK”**



**Definition:** - Network devices, or networking hardware, are physical devices

**use:** - Making a Network or it is used to connect to two or more computer.

**Ex:** - NIC, switch, cable, hub, router, Repeater, Bridge Gateway and modem.

**Cable:** - it is transmission media used for transmitting a signal.

**Types:** - 1. Twisted pair cable 2. Coaxial cable 3. Fibre-optic cable

**Hub:** - it is hardware device that divides network connection among multiple devices.

**Types:** 1. Active Hub (need Electricity) 2. Passive Hub (Not need electricity)

**Features:** - LAN Device, less intelligence (Not Store MAC), Broadcast, port, single Collision Domain, Half-Duplex. Layer-1.

**Repeater:** - It is a network device. used to Boost up the weak

**Bridge:** - It is a network device. used to separate LAN into number of sections.

Or used to connect multiple LAN network

**Features:** LAN Device, Intelligent (check source & destination MAC Address), Filter data Traffic, Reduce Traffic (by separate LAN), Port Number, Bridge Table (port & mac) 2 collision Domain, Half Duplex, First Broadcast then Multicast, Layer-2.

**Switch (Multiport Bridge):** - it is network device that connects multiple devices on a computer network.

**Features:** - LAN device, Full duplex mode, Intelligence (Using Port number (8/24/48), MAC address,, CAM Table (Content Accessible Memory), First Broadcast then unicast and multicast (Private Message), Multiple collision Domain, slow [10mbps (Wireless), 100mbps(wired)], Layer-2

**Router:** - it is an internetworking device which is used to connect both LAN & WAN with an internet connection.

**Features:** - full-Duplex, No Broadcast, Highly Intelligence [Routing Table [Port Number (2/4/8) & Network ID {Use IP Address}], Works as a traffic Controller, choose congestion free path, connect two dis-similar networks, speed: - Fast 10mbps/100mbps/1gbps/100gbps, Layer-3

**Gateway:** - It is an interworking network device. used to connect two Dissimilar networks. (Enter Exit Point), Layer Application Layer (OSI Layer:4,5,6)

**Modem:** - It stands for Modulator/Demodulator. **Modulator:** - Convert Digital to Analog signal **Demodulator:** - Convert Analog to Digital signal

**“NETWORK  
DEVICE”**

**NIC**



**HUB**



**SWITCH**



**CABLE**



**ROUTER**



**BRIDGE**



**REPEATER**

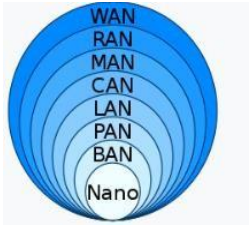


**GATEWAY**

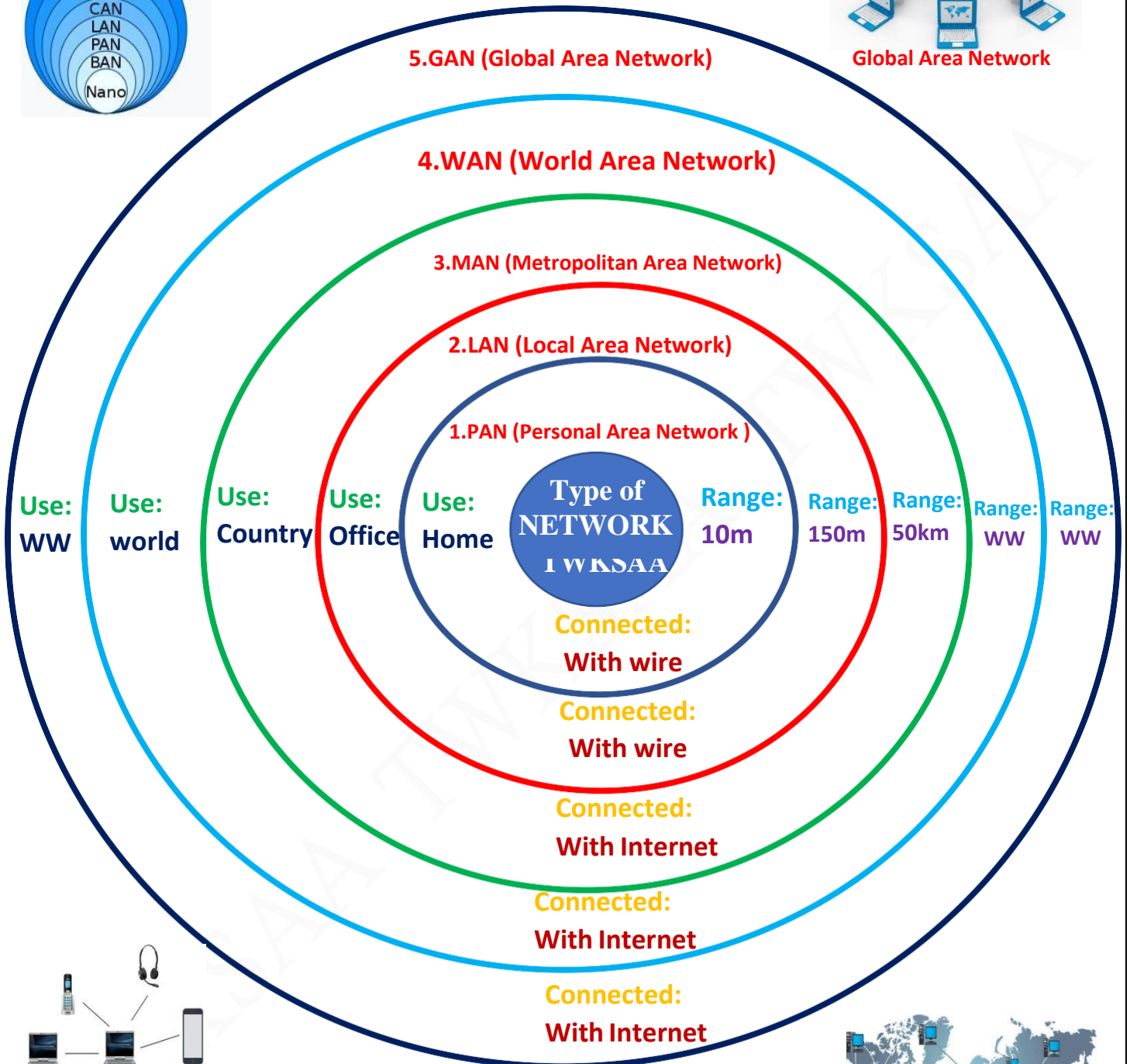


**Modem vs Router**





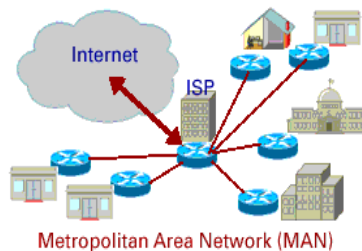
Global Area Network



Personal Area Network



Local Area Network



Metropolitan Area Network (MAN)



World Area Network



**Definition:** - it is layout of computer. it is show how device and cables are connected to each other.

**Types:** - 1. Bus      2. Ring      3. Star      4. Mesh      5. Hybrid      6. Tree

**1. Bus Topology:** - All Nodes/Computer are connected to a single cable.

**2. Ring Topology:** - Nodes are connected to two or more nodes & thus forming a single continues path for the data transmission.

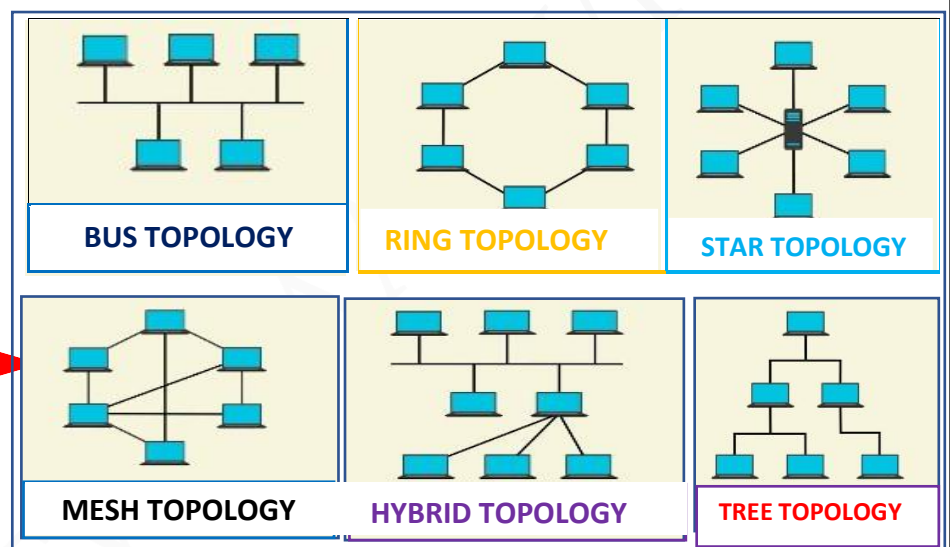
**3. Star Topology:** - ALL Nodes are connected to a single device known as a central device.

**4. Mesh Topology:** - ALL Nodes are individually connected to other nodes.

Types: - 1. fully connected      2. Partially connected

**5. Hybrid Topology:** - Combination of various different topology.

**6. Tree Topology:** - All the branch of tree are combination of Bus and star topology.



**“Network  
Topology”  
TWKSAA**

**Definition:** -it is a set of rules. use: - used for digital communication, formatting and processing the data

**Type:** -TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, ICMP, POP, IMAP, ARP, RIP, NFS, FMTP, SNMP etc...

**Application Layer Protocols:** - **HTTP**: -- Hypertext Transfer Protocol, **DNS**: - Domain Name System,  
**FTP**: - File Transfer Protocol, **Telnet**, **SMTP**: - Simple Mail Transfer Protocol, **SNMP**: - Simple Network Time p.

**Presentation Layer Protocols:** - SSL, HTTP/ HTML (agent), FTP AppleTalk Filing Protocol, Telnet

**Session Layer Protocols:** - **RPC**: - Remote Procedure Calls **PPTP**: - Point-to-Point Tunnelling P  
**SCP**: - Secure Copy Protocol, **SDP**: - Session Description Protocol etc..

**Transport Layer Protocols:** - **TCP**: - Transmission Control Protocol **UDP**: - User Datagram Protocol

**Network Layer Protocols:** - **IP**: -Internet protocol, **ICMP**: -Internet Control Message Protocol  
**ARP**: -Address Resolution Protocol

**Data Link Layer Protocols:** - **SDLC**: - Synchronous Data Link Protocol, **PPP**: - Point to Point Protocol  
**LCP**: - Link Control Protocol **LAP**: - Link Access Procedure **SLIP**: - Serial Line Interface Protocol

**Physical Layer Protocols:** - Physical layer provides an electrical, mechanical, and procedural interface to the transmission medium.



**“NETWORK  
PROTOCOL”**

**Application Layer Protocols:** - **HTTP** :- Hypertext Transfer Protocol, **HTTPS**:- Hypertext Transfer Protocol  
secure **DNS**:- Domain Name System, **FTP**:- File Transfer Protocol , **Telnet**, **SMTP**:- Simple Mail Transfer Protocol ,  
**SNMP**:- Simple Network Time protocol **DHCP**:- Dynamic host configuration Protocol **LDAP**:-Lightweight Directory  
Access Protocol **MGCP**:- Media Gateway control protocol **MQTT**:- Lightweight protocol **OSPF**:- open shortest path  
first **IMAP**:- internet message access protocol **BGP**:-BORDER Gateway Protocol **IRC**:- Internet relay chat pop:- post  
office protocol **PTP**:- Precision Time protocol **NTP**:- Network time protocol; **RTP**:- Real time transport **RIP**:- routing  
information protocol **SIP** :- Session initiation protocol **SSH**:- Secure shell Protocol **SSL**:- Secure Socket Layer **RTSP**:-  
real time streaming protocol **ONC/RPC**:- open network computing  
**RPC**: - remote procedure call.

**Transport Layer Protocols:** - **TCP**: - Transmission Control Protocol **UDP**: - User Datagram Protocol  
**DCCP**: - Datagram congestion control Protocol **SCTP**: -Stream Control Transmission Protocol

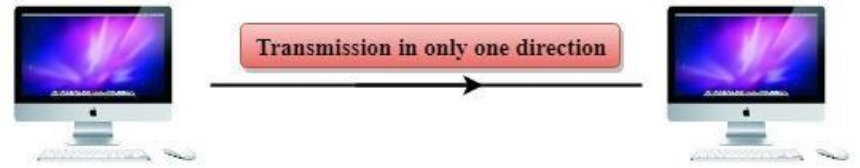
**Network/ Internet Layer Protocols or:** - **IP**: -Internet protocol, **ICMP**: -Internet Control Message  
Protocol **ARP**: -Address Resolution Protocol **IGMP**: - Internet group management Protocol **ECN**: - Explicit  
Congestion Notification **NDP**: - Neighbour Discovery Protocol



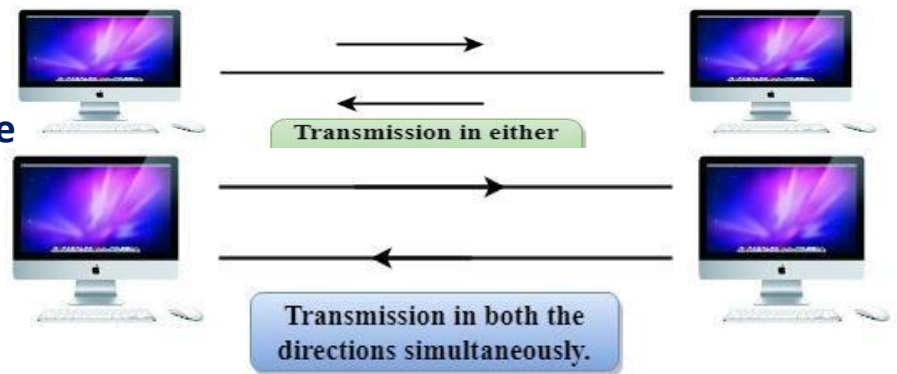
**Definition:** -The way in which data is transmitted from one device to another device is known as transmission mode. It is also known as Communication Mode

**Type:** - 1. Simplex mode 2. Half-duplex mode 3. Full-duplex mode

**Simplex mode:** -



**Half-Duplex Mode:** - Messages flow in both the directions, but not at the same time.



**Full-Duplex Mode**

Transmission in both the directions simultaneously.

Transmission modes  
TWKSAA

**“Digital Transmission”**

**Definition:** - Conversion of Data from Analog to Digital is known as Digital Transmission.

**Transmission Media:** - communication channel that carries information from sender to receiver.

**Why Need:** - Because Computer store data in Digital Form.

- carry the information in the form of bits. It's support Physical Layer, OSI Model
- Data is transmitted through the electromagnetic
- It is a physical path between transmitter and receiver.

❖ Guided Media is physical medium through which the signals are transmitted.

- Coaxial cable is TV wire it contains two conductors parallel.

1. Baseband: - process of transmitting a single signal at high speed.

2. Broadband: - Transmitting multiple signals simultaneously.

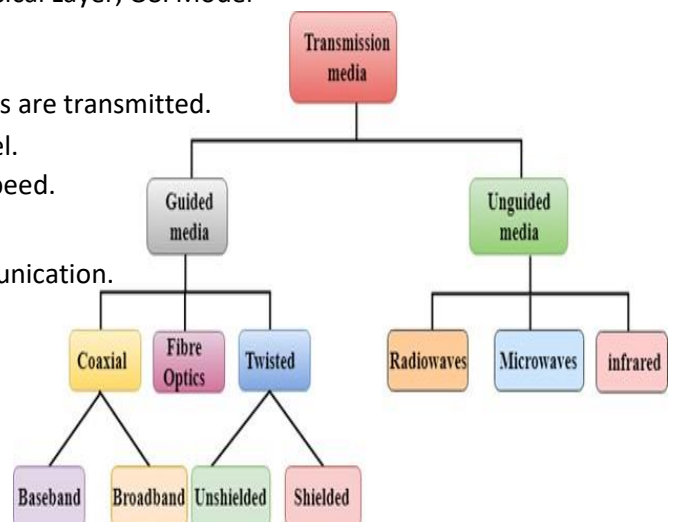
- Fibre optic is a cable that uses electrical signals for communication.

- Twisted pair is physical media made up of a pair of cables

1. unshielded is widely used in telecommunication.

2. shielded is a cable that contains mesh surrounding wire that allows higher transmission rate.

❖ unguided Media transmits electromagnetic waves without using any physical medium. (wireless)



- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.

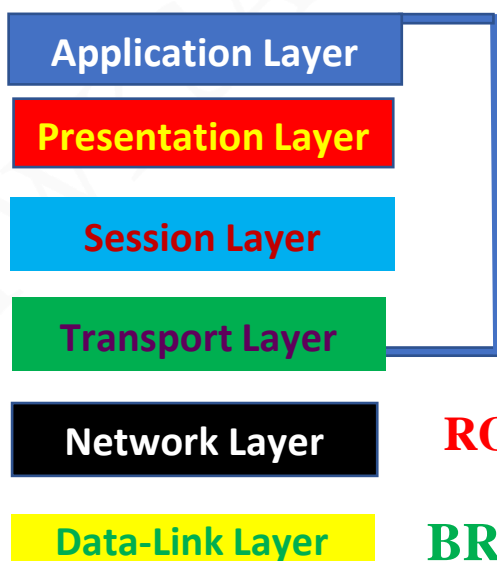
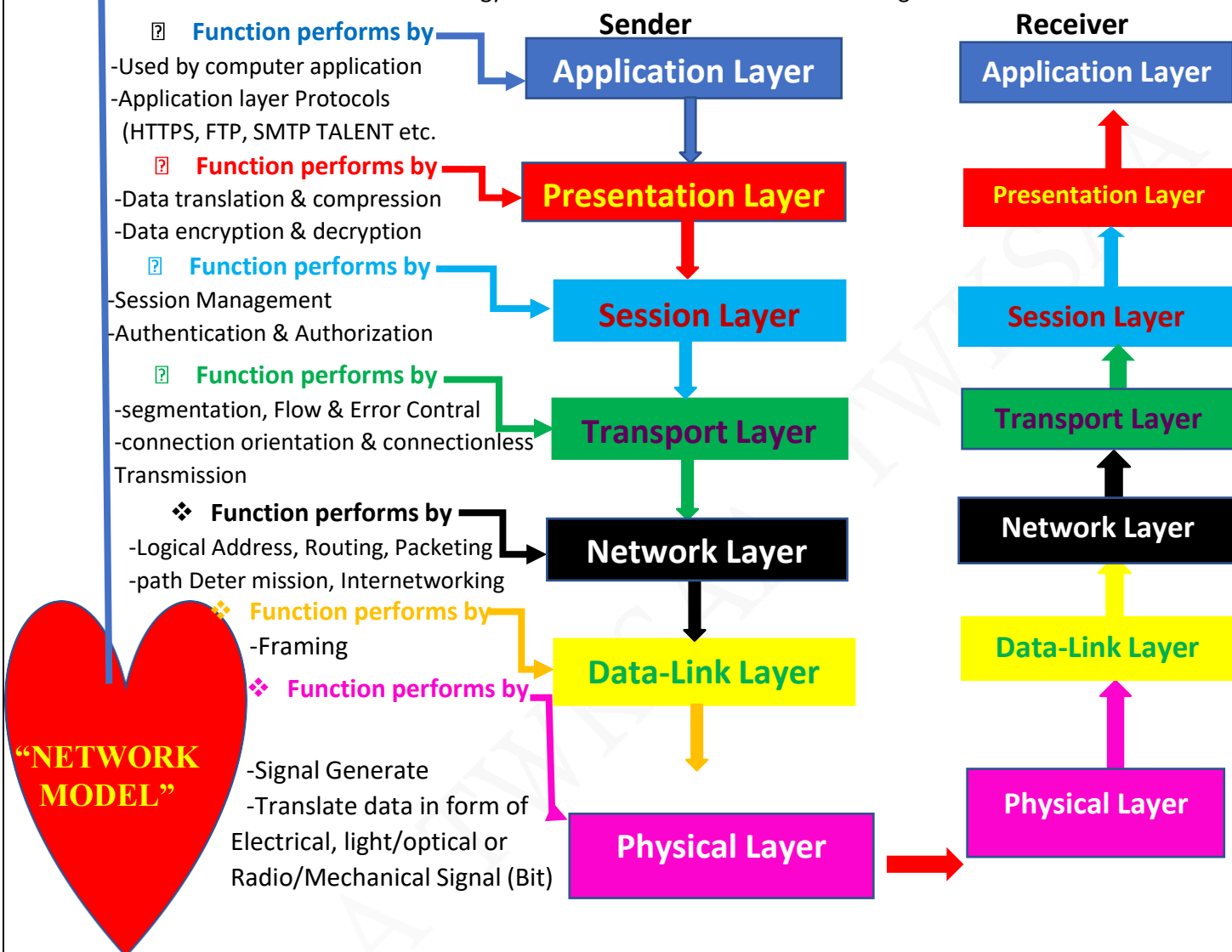
- Microwaves are of two types:

1. Terrestrial Microwave transmission is a technology that transmits the focused beam of a radio signal from one ground-based microwave transmission antenna to another.

2. satellite is a physical object that revolves around the earth at a known height

## OSI Model: - Open System Interconnection Model. OSI model was developed by the International

- infrared transmission is a wireless technology used for communication over short ranges.



HUB

Physical Layer

R

## TCP/IP Model

### Transmission Control Internet Protocol

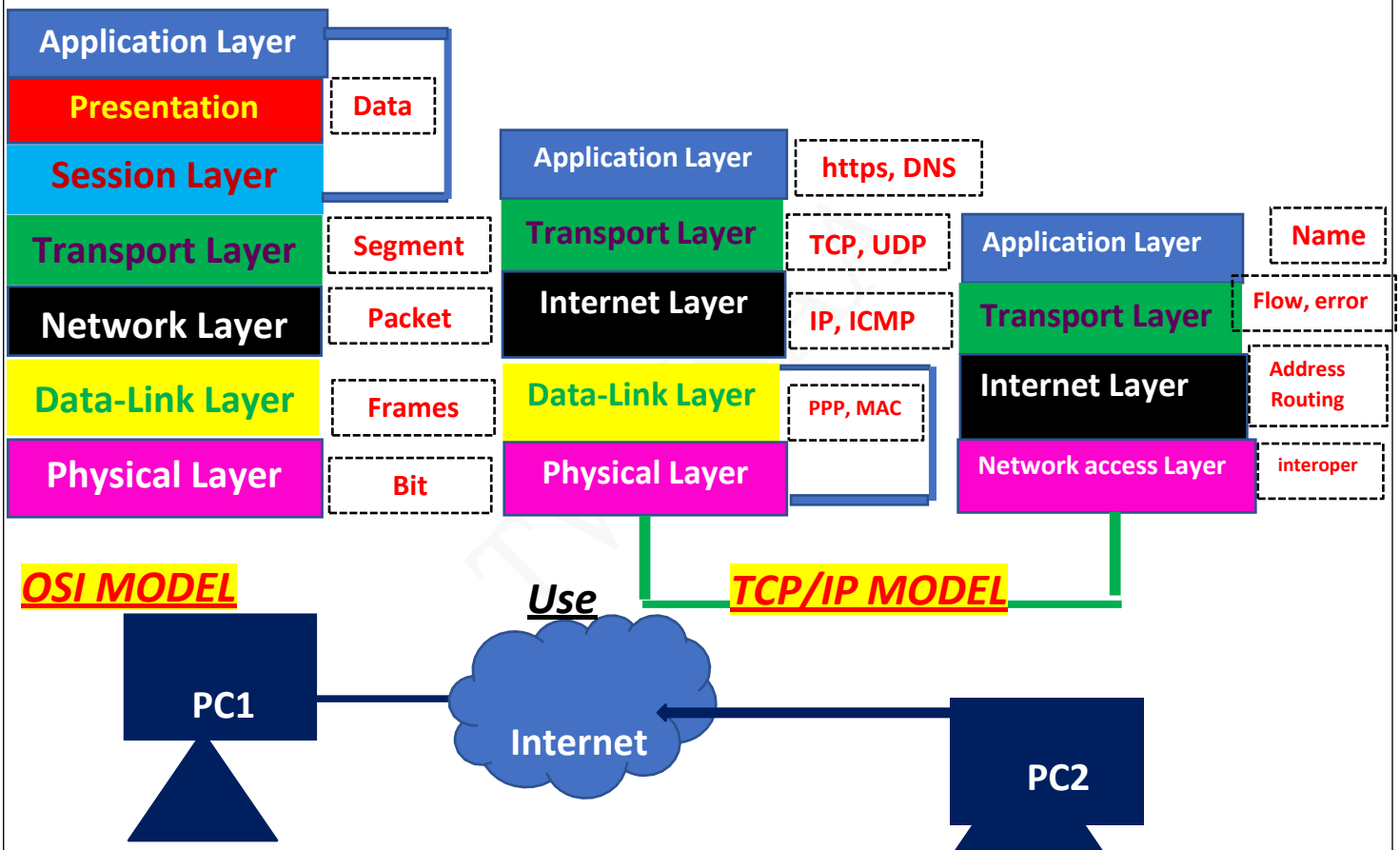
- TCP/IP model developed by American DOD (Defence of Department) in flag day 1-jan-1983. It is practical Model.

#### ❖ what was Problem?

1. How data transmitted across a network. &
2. How data should be formatted so other network system can understand.

#### ❖ TCP/IP Model Features: - 1. End Node Verification & 2. Dynamic Routing

### TCP/IP Model Layers



### Protocols

**1. Application Layer (Protocols):** - **HTTP/HTTPS:** - Hypertext Transfer Protocol, **DNS:** - Domain Name System, **FTP:** - File Transfer Protocol, **HTTPS, DNS, FTP, DHCP, ICMP, IRC, NTP, POP, RTP, SSL, SSH, SMTP** etc.

**2. Transport Layer (Protocols):** - **TCP:** - Transmission Control Protocol, **UDP:** - User Datagram Protocol  
- TCP, UDP, DCCP, SCTP, RSVP, QUIC etc.

**3. Internet Layer (Protocols):** - **IP:** - Internet protocol, **ICMP:** - Internet Control Message Protocol, **ARP:** - Address Resolution Protocol, **IP, ICMP, NDP, ECN, IGMP, IPSEC** etc.

**4. Data Link Layer (Protocols):** - **SDLC:** - Synchronous Data Link Protocol, **PPP:** - Point to Point Protocol, **LCP, LAP SLIP, NCP, MAC** etc.

**Definition:** - it is a unique physical or logical address that identifies a network node or device over a computer or telecommunications

**Type:** - 1. IP Address or Logical Address 2. MAC Address or Physical Address.

**IP Address:** Internet Protocol is a unique address that is used to identify computers on the internet.

**IP ADDRESS = NETWORK ID(1) + HOST ID(0)**

**IP ADDRESS**

**IPv4 Type:** -1. Private IP & 2. Public IP

**IPv6 Type:** -1. Unicast 2. Multicast 3. Anycast

**IPv4**

**IPv6**

**Length**

**32 Bites**

**128 Bites**

**Octet**

**4 Octet**

**8 Octet**

**Range**

**0-255**

**0-FFFF (65535)**

**Count**

**4B ( $2^{32}$ )**

**340 Trillion ( $2^{128}$ )**

**Example**

**192.123.02.25**

**3F4:1653:AB:35:02C:3A:00:53A**

**Class**

**A, B, C, D, & E**

**No class concept**

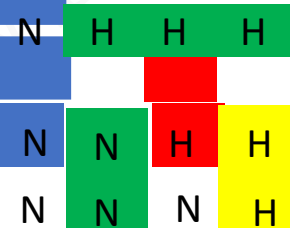
**Class-A (0-126)**

**Class-B (128-191)**

**Class-C (192-223)**

**Class-D (224-239)**

**Class-E (240-255)**



Use for multicasting  
Used for Research

**127.0.0.0 Range Ip used for local server**

**IPv6 Features**

- End To End connectivity
- Auto Configuration, Mobility
- Fast Routing, IP security Enable
- No Broadcast, Anycast Support
- Large Address Space
- Smooth Transition

**"NETWORK ADDRESS"**

## MAC Address

### Media Access Control address

**Definition:** - it is a Globally unique physical and Permanent address that identifies device over a Network.

- MAC address also known as Physical address or Hardware Address or BIA(Burnt-in) address.

**Length=48 Bits**

**48bits = 24bits + 24bits**

**MAC address= Organization + Device**

**MAC address= OUI + Vendor Specific**

- OUI provided by IANA (Internet Assigned Number Authority) Organization.

**MAC Address Representation: it is represented as hexadecimal format**

- 12 Hexadecimal (0-9, A, B, C, D, E, F)

### Format

**mm: mm: mm: ss: ss: ss**

**mm-mm-mm-ss-ss-ss**

**mmm. mmm. sss. sss**

- MM=Organisation (OUI {organization unique identifier})
- Ss=device Model

Ex: - Dell=AE: 40: FF: 00: 00: 01

aB-df-2b-33-39-3a

a4c.def.34a.bc6



### IPv4 Header

32-	Version	32-	Identifier	32-	TOS	32-	Total length	32-	
32-		32-	Flags	32-		32-	Fragment	32-	
32-	TTL	32-	Protocol	32-		32-	checksum	32-	
32-	Source Address								
32-	Destination Address								
32-	Optional (0-40 bytes)								

-IPv4 header is 20 bytes long  
 Version: - represent version of IP  
 IHL: - Internet Header Length  
 TOS: -Types of Service  
 Total Length: - Length of entire packet  
 TTL:- Time to live

### IPv6 Header

32-	Version	32-	Traffic class	32-	Flow Label	32-	
128-	Payload length	128-	Next Header	128-	Hop limit	128-	
128-	Source Address						
128-	Destination Address						

IPv6 header is 40 bytes long  
 Version: - represent version of IP  
 Traffic Class: - classified the Priority  
 Flow Label: - set of Packets in same Payload Length: - used to tell Routers  
 Next Header: - Protocol used by packet  
 Hop Limit: - Avoid the looping

**Subnet:-** it is a technique to use for save IP address.

**Subnetting:-** network within network or logically division of IP address

**Why need Subnetting:-** for save Ip address and dividing a network into two or more network.

**Class-A IPv4 (0-126) CIDR=8 Network=NNNH Subnet Mask= 225.225.255.255(H)**

Example: - 12.0.0.0  
 Subnet Mask= 255.0.0.0  
 Subnet id=12.0.0.0/12

**Class-B IPv4 (128-191) CIDR=16 Network=NNHH Subnet Mask= 225.225.255(H).255(H)**

Example: - 190.201.0.0  
 Subnet Mask= 255.255.0.0  
 Subnet id=190.201.0.0/16

**Class-c IPv4 (192-223) CIDR=24 Network=NHHH Subnet Mask= 225(N).225.255.255**

Example: - 197.10.10.0  
 Subnet Mask= 255.255.255.0  
 Subnet id=197.10.10.0/24

### Subnet

**CDR:-** Classless inter domain Routing it is a method for allocating IP address and for IP Routing

**History:-** IETF (International Engineering task force) introduce in 1993

**Purpose:-** For replace the previous classful network address sting architecture on the internet CIDR is Based on Variable length subnet masking (VLSM)

**CIDR Notation:** - it is a compact representation of an Ip address and its associated network mask  
This notation was invented by “pill kam” in 1980

**Example:** - 198.36.100.0/24 Subnet mask=255.255.255.0



# CIDR

address of website; it is a string & Unique name in the world.  
 identify services provided the internet such as website, email. Networking Contexts, application  
 addressing purpose identify domain or Ip resources.

**Types:** -1. Top-level Domain (TLD) 2. Second & low-level Domain (SLD)  
**TLD:** - It is two types 1. Generic TLD (GTLD) 2. Country Code TLD (CCTLD)

**GTLD:** - .com, .net, .org, .edu, .mil, .int, .biz, & .gov,

**CCTLD:** - .IN, .US, .CN, .PK, etc.

**SLD:** - ex:- [www.twksaa.ra.org](http://www.twksaa.ra.org) where .ra is SLD

**Fully Qualified Domain Name:** - [www.twksaa.org.in](http://www.twksaa.org.in).

**Partially Qualified Domain Name:** - [www.twksaa.org.in](http://www.twksaa.org.in)

**1<sup>st</sup> Domain Name:** - Symolics.com in 15.03.1985

**1<sup>st</sup> Edu Domain Name:** - Berkeley.edu in 24.04.1985

**DNS:** - Domain Name System is a host name (Domain name) Ip address translation service.

**Use:** - it is used to Translate Domain name to Ip address vice-versa. DNS was introduced on  
 ARPANET in 1983 and Published by Internet Engineering Task Force (IETF). Managed BY ICANN  
 (Internet Corporation for Assigned Names and Numbers)

**Name Space:** - 1). Flat Name Space 2). Hierarchy Name Space

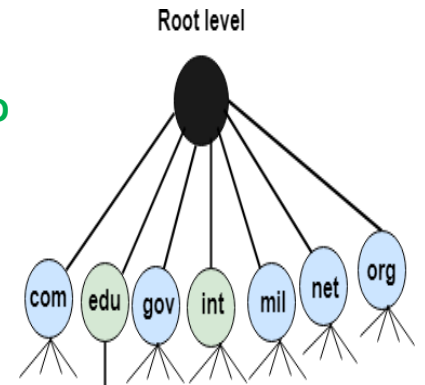
**Flat DNS Name Space:** - Name is assigned Sequence of character without any Structure.

**Hierarchy DNS Name Space:** - Name Space can be decentralised Hierarchy of Name  
 Servers a).Root name server b).Top-level Server c).Authoritative Name Server.

**DNS Resolver Method:** - 1) Iterative Method 2). Recursive Method

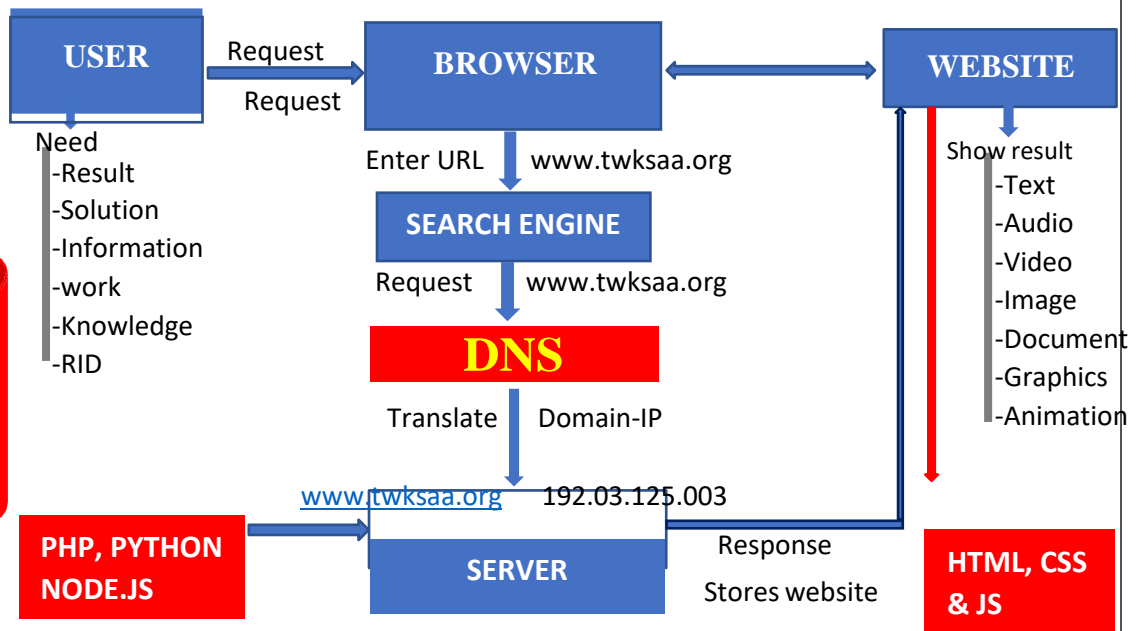
**Iterative Method:** -Root name server involved at a single time.

**Recursive Method:** - Root name server involved from starting to end (Request-Response)



**"DOMAIN NAME"**

**"DOMAIN NAME SYSTEM"**



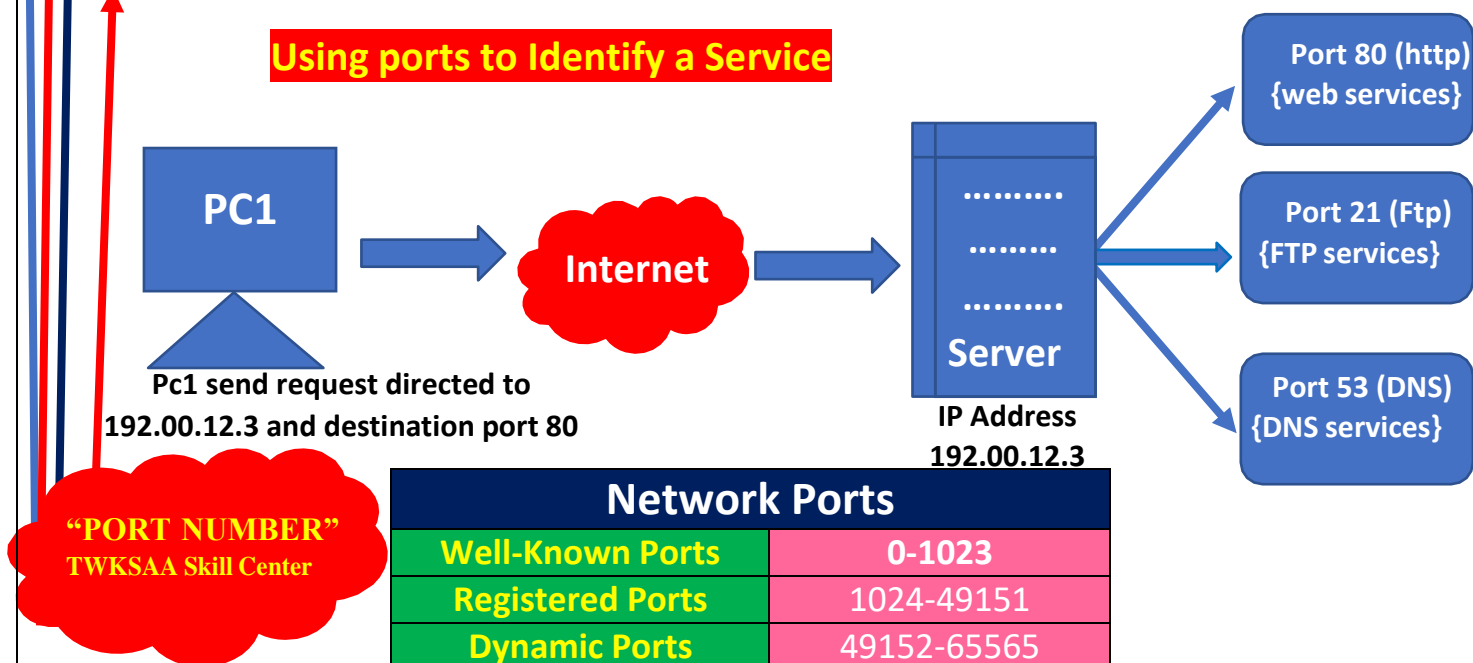
**Definition:** - Port Number is assigned to uniquely identify a connection endpoint and to direct data Specific Service. it is logical Number that identifies a specific process or a type of network service. Manged by (IANA)  
 Port Number is a 16-Bits, Port is connection on computer to peripheral Devices.

**Range:** - (0-65535) 1). Well-Know Ports (System Port) {0-1023} 2). Registered Ports {1024-49151} 3). Dynamic or Private Ports (49152-65535)

Service	DNS	HTTP	HTTPS	FTP	SSH	TALNET	SMTP	DHCP	POP3
Port Number	53	80	443	20 & 21	22	23	25	67 & 68	110

**Types:** - 1). Serial Port: - Interface to connect using serial port 2). Parallel Port: - Used Parallel Port

### Using ports to Identify a Service



**Definition:** - it is network of network. Or the global System of interconnected computer networks

**use:** - it is used to communicate between network & device by using the suite of network Protocols.

**Discover:** - US DOD, ARPA (advance Research projects agency) in 1969 1<sup>st</sup> Internet ARPANE

**How it's Work:** - 1. Packets & 2. Protocols

**ICANN:** - Internet Corporation for Assigned Names and Numbers "Organisation" responsibl (Domain names, IP addresses, application port numbers & other parameters.

**ISP:** Internet service Provider, it's provide internet **1). Tier-1** {Globally} **2).Tier-2** {Countries wise} **3).Tier-3** {Local}

**IPS:** - Internet Protocols Suite **1). TCP/IP** Model **2). OSI** (opent System Interconection) Model

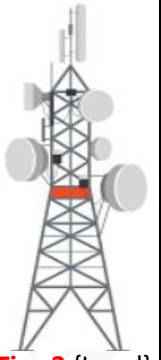
**RIR:** - Regional Internet registries established five regions of the world for assign IP address & other Internet parameters. **1. AfriNIC:-**African Network Information Center **for Africa**, **2.ARIN:-**American Registry Internet Numbers **for North America** **3.APNIC:-**Asia-Pacific NIC **for Asia** **4. LACNIC:**for Latin America &**5. RIPE NCC:-**Réseaux IP Européens – Network Coordination Centre **for Europe**

**Parameter's:** 1). Network 2).IP Address 3). Protocols 4).Domain Name 5).Port Number & 6).ISP

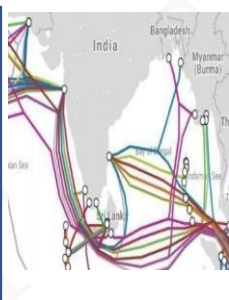
**Access:** 1).Cellular telephone (3G,4G, 5G, ...) 2).Wi-fi 3).Satellite 4).Fibber Optics 5).Coaxial cable 6).Copper wire 7).DSL(Digital Subscriber Line) 8). BPL (Broadband over powerless 9).DLL

**Application:** - www, Social Media, Mobile Application, mail, File Transfer, Online work etc...

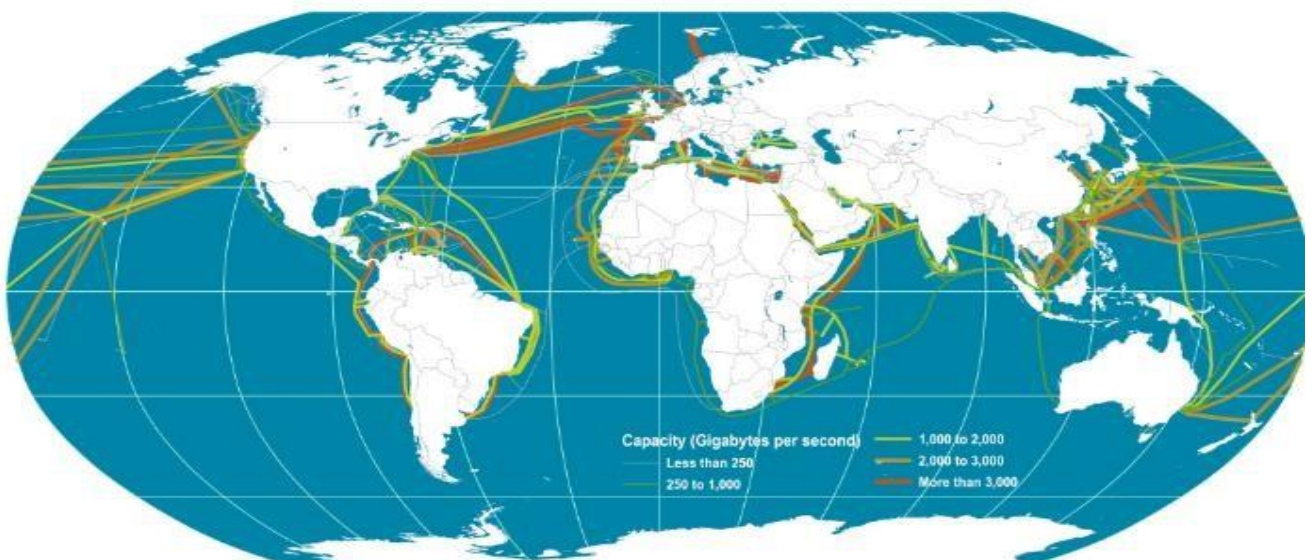
**Internetworking Device:** - Router, Switch. Internet Gateway etc..



**"INTERNET"**



## Global Submarine Cable Network





**Definition:** - www is a global collection of documents and other resources linked by hyperlink and URLs. it is known as web, it is an information system technology enabling.

**History:** - computer scientist "Tim Berners Lee" at CERN {(European Organization for nuclear Research) it is a Intergovernmental org. established in 1954}} invented in 1989. 1<sup>st</sup> proposal was written & working system implemented by end of 1990 including www Browser & http server.

**Function:** - 1). HTML 2). Linking 3). www prefix 4). Scheme specifiers 5). Web Page 6). Website 7). Browser 8). Search Engine 9). Server 10). Cookie 11). Deep web 12). Caching 13). Security 14). Privacy 15). Standards

**HTML:** - Hypertext Markup Language it used for Creating Web page & Web Application.

**Linking:** - it is interconnecting the web page via Hyperlinks.

**www prefix:** - it is like .com, .org, .net etc. **Scheme specifiers:** - http:// or https://

**Browser:** - it is a software responsible for open the website

**Web Page:** - A webpage is an HTML document on the WWW. **Website:** - it is a collection of web page.

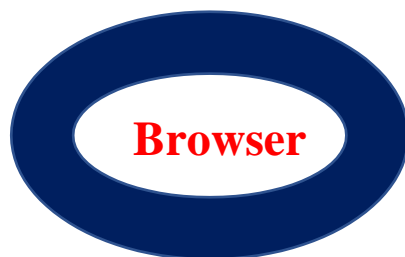
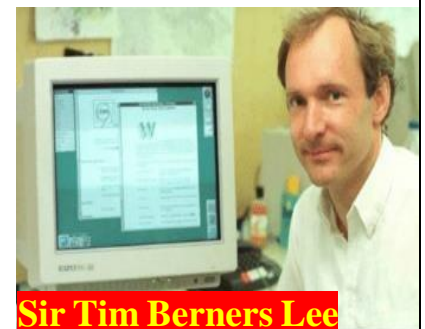
**Search Engine:** - it is a software program/system Software Design to carry out the web search.

**Server:** - it is a software or hardware device that accept & respond to request made over a network.

**Cookie:** - it is a small piece of data sent from the website and stored on the user's computer by the web browser while user is browsing. It is stateful

**Deep web:** - it is an invisible web or hidden web are parts of www whose contents are not indexed by standard web search engine. Computer scientist "Michael K. Bergman" is credited with deep web in 2001

**Caching:** - A web cache is a server computer located on the public internet. It stores recently accessed web page to improve response time for user's



**Definition:** - Browser is an application software or a software Program.

**Use:** - Browser is used for accessing websites fetch content from the www or from local storage and display on the user's Device

**History:** - www was the 1<sup>st</sup> Browser created in 1990 by sir Tim Berner Lee Mosaic-1993

Netscape-1994 Internet Explorer-1995 Opera-1995 Mozilla Firefox-2004 Safari-2003 Chrome-20008 Edge-

**Features:** - Automatically log user's Browsing history, set Book Marks, Customize Browser with Extensions, User password, Sync Service, Web Accessibility, open Multiple Pages, Back & forward Bottoms, Refresh, Reload



**Definition:** - A search engine is a software system designed to carry out web searches. Or it is set of Program.

**use:** - it is used to search www in a systematic way for particular information specified in a textual web search query.

**History:** - 10 sept 1990 is D.O.B of 1<sup>st</sup> Search Engine "Archie" by Alan Emtage (note: - note index Concept)  
1<sup>st</sup> Popular Search Engine was Yahoo! (Founded by Yang and David Filo in 1994) Google Search Engine  
(Founded by Lary Page & Sergey Brin in 1998) used Page Rank Algorithm, Indexing & Hyperlinks

**Example:** - Google, Bing, Yahoo, Baidu, DuckDuckGo, Yandex, Ask.com, AOL Search, Ecosia, Qwant etc.

**Types:** - 1. Conventional 2. Text-Based 3. Voice-Based 4. Multimedia Search 5. Q/A 6. Clustering  
7. Research System

**Conventional (Library CatLog):** - Search by keyword title, Author etc.

**Text-based & Voice-based:** - Google, Bing & Yahoo! Search by keyword

**Multimedia Search:** - (QBIC, Web seek, safe) Search by visual Appearance (Shapes, colours)

**Q/A:** - Stack Exchange, NSIR search in (Restricted) Natural Language.

**Clustering:** - Vivisimq, clustery **Research System:** - Lemur, Nutch

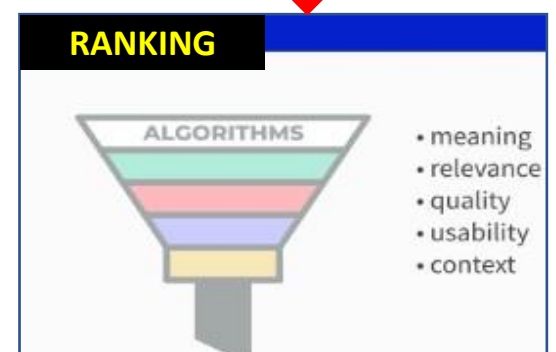
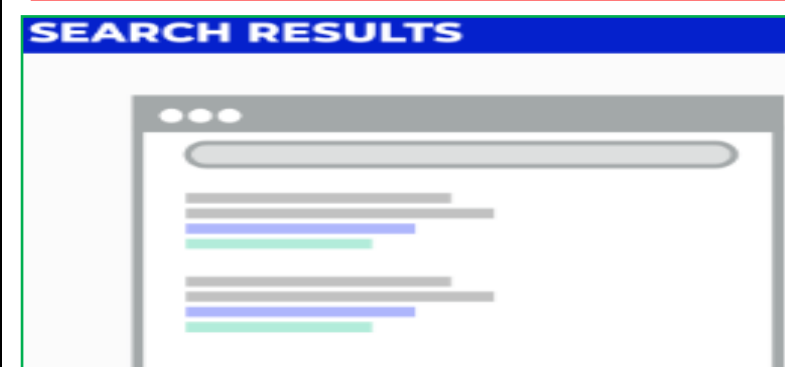
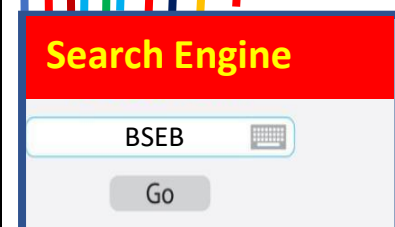
**How Search Engine work**

**Crawling:** - also known as Spider or Spider Bot it is internet bot that systematically browses the www and that is typically operated by search engine for the purpose of web indexing.

**Indexing:** - Collecting, Parsing and Storing of Data

**Ranking:** - position a website or webpage holds within a specific search engine results page.

**Search Results:** - it is a query that a user enters into a "web search engine" to satisfy the information needs



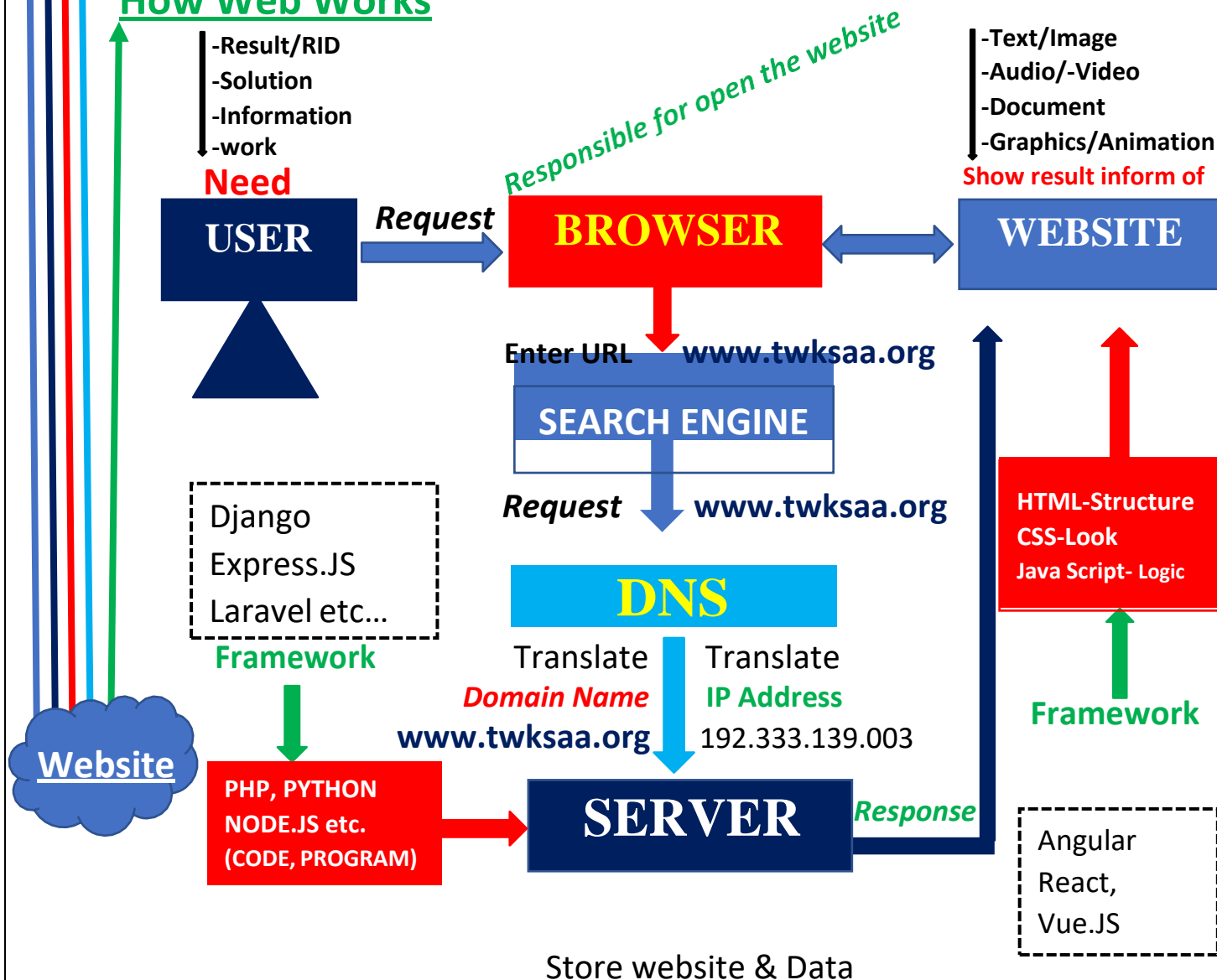
**Definition:** - website is collection of web page and related content that is identified by a common "Domain name"

**Types:** - 1). Static Website 2). Dynamic Website

**Static Website:** - consists of a series of HTML files, each one representing a physical page of a website.

**Dynamic Website:** - change or customizes itself frequently and automatically.

## How Web Works



**Web:** The web is a global system of interconnected computer networks that use the Internet protocol suite to access and share information. It allows users to access and share information over the Internet. Or Web is virtual directory on web server. Or Web [ Portion of Internet]

### Site:

- Site [ Location] A site refers to a location or a collection of web pages hosted on a web server and accessible through a specific domain or URL.
- A site refers to a specific location on the internet identified by a unique domain name and accessible via a web browser.

### Page:

- A page refers to a single, individual document or resource on the web.
- It is a single document or resource that is part of a website and can be accessed through a specific URL?

### Web Page:

- A web page is a single hypertext document available on World Wide Web (WWW).

- Hyper Text document that contains information beyond what is displaying.

**Definition:-** it is the software or hardware device that accepts and responds to requests made over a network.

**use:-** it is used for store, send, & receive data. Responsible for Client/user, Http/Https Request & Response.

**Types:-** web server, application server, mail server, FTP server, real-time communication server, & virtual server.

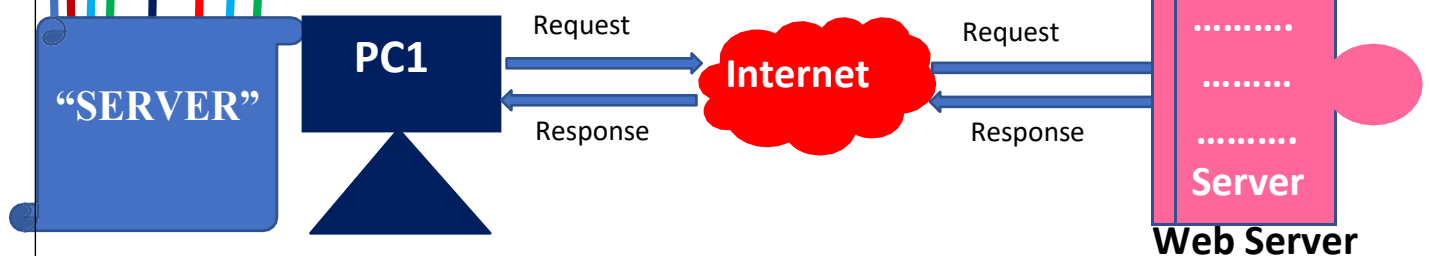
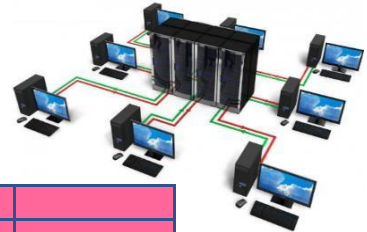
World 1<sup>st</sup> web server CERN httpd (later renamed to W3C httpd) was invented in 1989 by Tim Berners-Lee.

**Parameter's:-** Network, Internet, Data Centre, Host, Port, Protocol, Hardware, O.S, &Power.

**Hardware:-** RAID (Redundant array of independent) Disk, ECC (Error Correction Code) Memory,

**OS:-** Like Linux, Unix, Window Server (2016), MacOS Server etc...

**Features:-** Availability, Reliability, Durability, Fault Tolerant, Low Failure Rates, Uptime, Uninterruptible, H/w Redundancy, Clutter's or Server Form, Dual Power Supply, & Energy consumption



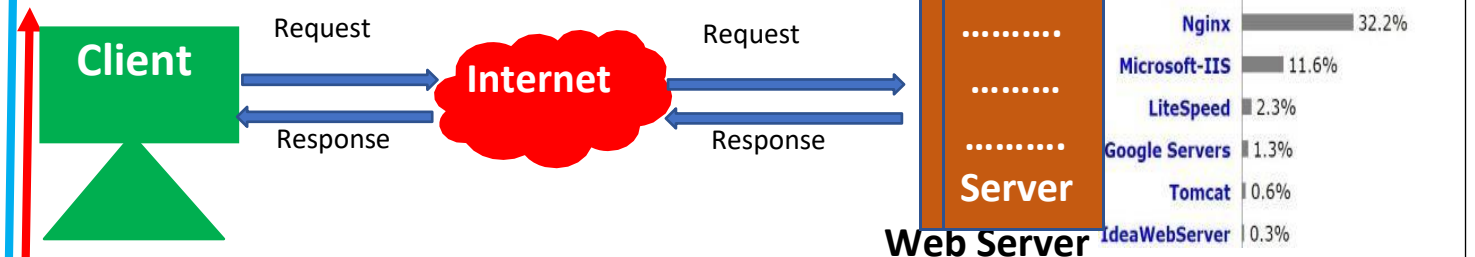
## WEB SERVER

**Definition:-** web server is computer software and hardware that accepts requests via HTTPS (IP created to distribute web content). A web server is a dedicated computer responsible for running websites

**use:-** it is used to process and manage HTTP/HTTPS requests and responses from the client system. A web server Store and protect website data.

**Example:-** Apache (Http server project), Microsoft IIS, Nginx, Apache Tomcat etc.

**How it's Work:-**



**Work:-** 1. Receive Client Request/Response (Read & Verify, URL-Normalization, URL Mapping, URL Path Redirections) 2. Executes or refuse HTTP Request Method (URL Authorization, URL Redirection, Directory Index File Regular Files) 3. Response/Replies (HTTP Response, Logs)

**Features:-** 1. Static Content serving 2. HTTP/HTTPS 3. Logging 4. Dynamic Content Serving 5. Virtual Hosting 6. Authorization 7. Content Cache 8. Large file Support 9. Bandwidth throttling 10. Rewrite Engine 11. Custom Error Page 12. Security

**"WEB SERVER"**

# HTTP/HTTPS

## Hypertext Transfer Protocol Secure

**HTTPS:** - HTTP is a client-server Protocol. it is State less but not session less.

**Use:** - information of particular website is exchanged between web server & web Browser.

**Components:** -



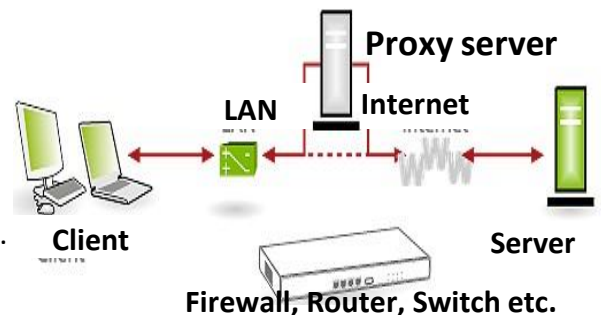
**Client:** - user agent is any tool that acts a behalf of the user Browser is always entity initiating request.

**Proxy:** - Between web Browser and the server numbers computers and machines relay the HTTP Message those operating at the application are called Proxies.

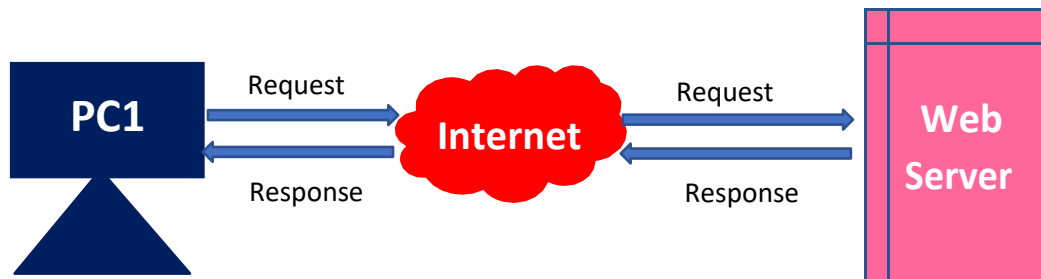
**Example:** -Firewall, Gateway, Router, Switch etc.

**-Proxies perform following functions: -**

- 1.caching: - like the history and Browser cache
- 2.Filtering: - like an antivirus scan
3. Load Balance: - to allow multiple servers to sever Load.
- 4.Authentication: - to control access to different resource.
- 5.Logging: - allowing the storage of historical information



**Server:** - it is a software or h/w device that accepts and responds to requests made over a network.



### Difference Between HTTP AND HTTPS :-

**Http: -**

- http URL begins with http://
- http Works at application level
- http is not encrypted (because send in plain text)
- http not required any certification
- Http use port no 80

**Https: -**

- https URL begins with https://
- https Works at Transport level
- https is encrypted
- https required SSL certification
- Http use port no 443

**HTTP & HTTPS**

# URL

## Uniform Resource Locator

**Definition:** - URL is a web address or location that pointing to a specific website.

**Use:** it is used to describe the identify of resource on internet. URL is a type of URI (Uniform Resource Identifier. It is used only for locating web pages.)

**History:** - URL introduced by time Berners lee in 1985 **Example:** - <https://www.twksaa.org>

**Component's:** - path, domain, hash, string query & protocols

**URL Contains:** - 1. Port Number 2. Protocols 3. address 4. Location of service  
5. Fragment 6. Directory Structure of server

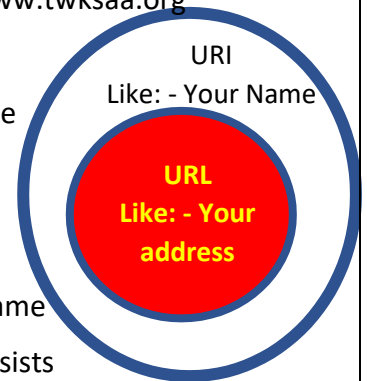
**URL Located:** - Address bar or search bar at the top of the Browser

**Format:** - Combines the pre-existing system of domain name with  
file path. syntax `//`: - Slashes are used to separate directory and filename  
HTTP URL conforms to syntax of a generic URI. URI generic syntax consists

of five components organized hierarchically in order of decreasing significance from left to right

**URI = scheme ":" ["//" authority] path ["?" query] ["#" fragment]**

authority component consists of subcomponents: authority = [userinfo "@" ] host [":" port]



<https://www.twksaa.org>



## DHCP

# Dynamic Host Configuration Protocol

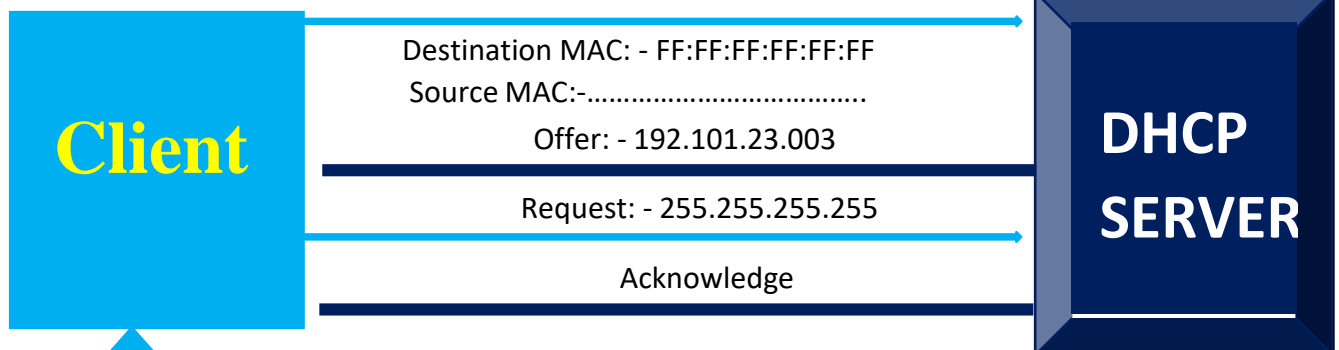
**Definition:** - DHCP is an automatically assign IP address to client. It is client server-based model. It's works on application layer, IP address assigned is known as dynamic IP address. DHCP IP address range is called scope.

**BOOTP:** - It is another method to allocate dynamic Ip address but MAC address must be entered manual.  
DHCP is advance version of BOOTP.

**DHCP Provide:** - 1. IP address 2. Subnet mask 3. Domain Name 4. Default Gateway 5. DNS Server address 6. Wins server Address.

**DORA Process:** - DHCP automatically assign IP address dynamically by DORA Process.

Discover: - Broadcast IP=255.255.255.255



**-Discover(port-68):** - UDP Broadcast from DHCP client to locate available server Layer2 Broadcast FF: FF: FF: FF: FF: FF Layer3 Broadcast: - 255.255.255.255

**-Offer(port-67):** - DHCP server to client in Response to DHCP discover with offer of configuration parameter (DHCP server offer IP, MAC add of client, subnet mask, Lease Length)

**-Request(port-68):** - then client Broadcast to DHCP server request for offered IP Address.

**-Acknowledge(port-67):** - server to client with configuration parameters including network address.

DHCP

**Definition:** - SMTP (simple mail transfer Protocol) is an application layer protocol. it is Push based Protocol.

**Use:** - it used for send mail and it is used by the client send mail to the server it's used TCP port-25 because TCP is connection oriented. SMTP requires each message in 7-bit ASCII Format.

**SMTP Commands:** - 1. HELO & EHLO:- initiate a new protocol session between client & server.  
2. MAIL FROM:- to initiate sending an email message or to identify sender.  
3. DATA:- indicating the start of transmission of email message . last message is "."  
4. RSET:- Reset connection if it encounter or error.  
5. QUIT:- Terminates the protocol session

"SMTP"

## “Difference Between POP3 and IMAP” it is pull based Protocol.

**POP3**(Post-office protocol version 3) and **IMAP** (Internet mail access Protocol) are used for Receive mail.

### **POP3: -**

- only allows downloading message
- it is used port 110 and with SSL port 995
- access from a single device at a time
- Read the mail after downloading
- does not allow user to organize mails & folder
- user can not search message before downloading
- no backup messages

### **IMAP: -**

- Allow see in the folder without download
- it is used port 43 & with SSL port 993
- access from multiple devices
- can be read partially before download
- can organize email directly in sever
- user can create, delete & rename email on the mail server
- Backup is possible.

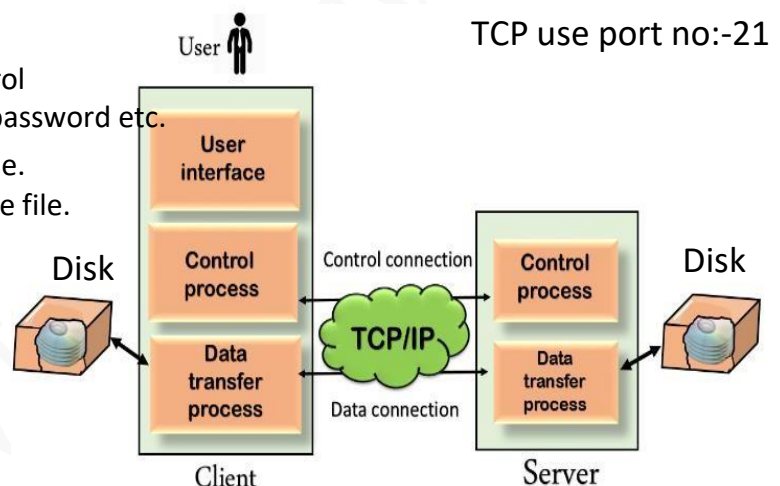
**Definition: -** FTP (file transfer Protocol) it is an application layer protocol.

**Use: -** To transfer a file 2 TCP connection are used by FTP in parallel control connection & data connection.

### **TCP Work Flow**

**-Control connection: -** for sending control information like user identification password etc.

**-Data connection: -** for sending actual file.  
It is also used for downloading the file.



### **FTP Data Structure: -**

- 1. File Structure: -** in file structure there is no internal structure and the file is considered to be continuous sequence of data a byte.
- 2. Record Structure: -** in record structure file is made up of sequential records.
- 3. Page Structure: -** in page structure the file is made up of independent indexed pages

### **Transmission mode of FTP: -**

- 1. Stream Mode: -** Data transmission in continuous stream of bytes
- 2. Block Mode: -** Data transmission in Blocks.
- 3. Compressed Mode: -** Data is compressed then send generally used for sending large files.

**FTP is not secure, it is plan text files transfer, data is not encrypted.**

### **SFTP: - Secure Transfer Protocol**

Data is encrypted SFTP use SSH|SSL|TLS For security. It is use port no-22 SFTP was designed by IETF as an extended version of SSH2.0, Allowing file transfer over SSH and use with transport layer.

### **TFTP: - Trivial file transfer protocol**

-it is used for transforming files within a local area network, it uses UDP therefore unreliable it is used port no-69 it is not used to transfer files over the internet, Fast

