Internet => The Internet came in the year 1960 with the creation of the first working model called ARPANET. (Advanced Research Projects Agency).
It allowed multiple computers to work on a single network that was their biggest achievement at that time.
ARPANET use Packet switching to communicate multiple computer systems under a single Network.
In October 1969, using ARPANET first message was transferred from one computer to another.
The Actual working of the internet takes place with the help of client and server.
* IP address stands for Internet Protocol address. Every PC/Laptop machine is having an IP address and that IP address is provided by IPS (Internet Service Providers).
There are the 4-Type of IP address.
(i) Static IP address =>
(ii) Dynamic IP address
(iii) Private IP address
(iv) Public IP address.

* Internet uses the standard TCP/IP.
* IP address is a unique set of number which define the computer location.

* A special computer DNS (Domain Name Server) is used to give name to the IP address so that user can locate a computer by a name.

* ARPANET (Advanced Research Project Agency Network)

* ARPANET was developed by United States Departments of defense.

* Internet is a group of computer systems ~~scattered~~ from all around the world.

<u>Working of Internet</u> ⇒ The Internet is a global computer network that connects various devices and finds a lot of information and media. It uses an Internet Protocol (IP) and TCP-Based Packet-routing network. TCP and IP work together to ensure that data transmission across the internet is consistent and dependable, regardless of the device or location. Data is delivered across the internet in the form of messages and packets. A message is a piece of data delivered over the internet, but before it is sent, it is broken down into smaller pieces known as packets.

"IP is a set of rules that control how data is transmitted from one computer to another via internet!! TCP is used with IP to ensure ~~and reliable manner~~ that data is transferred in a secure and reliable manner. This ensures that no packets are lost, that packets are reassembled in the correct order and that there is no delay that degrades data quality."

advantage => (i) It is the best source of a wide range of information.

(ii) There is no better place to conduct research than the internet.

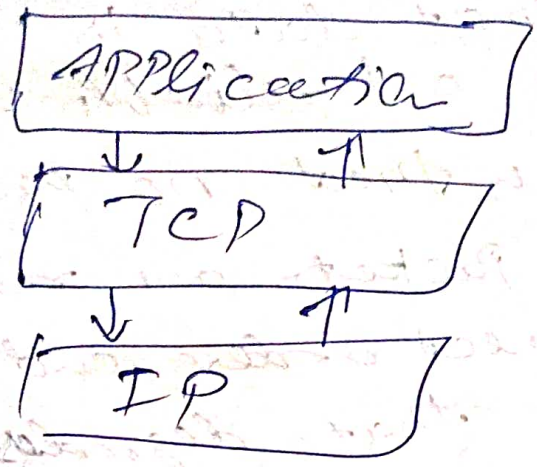
(iii) Online gaming, dating, browsing, music etc.

disadvantage => (i) spending too much time on the internet ~~is~~ ~~was~~ affect the new generation

(ii) children who use the internet develop an addiction, which is quite dangerous.

## Architecture of Internet ⇒

### a) Layers of Internet Architecture ⇒



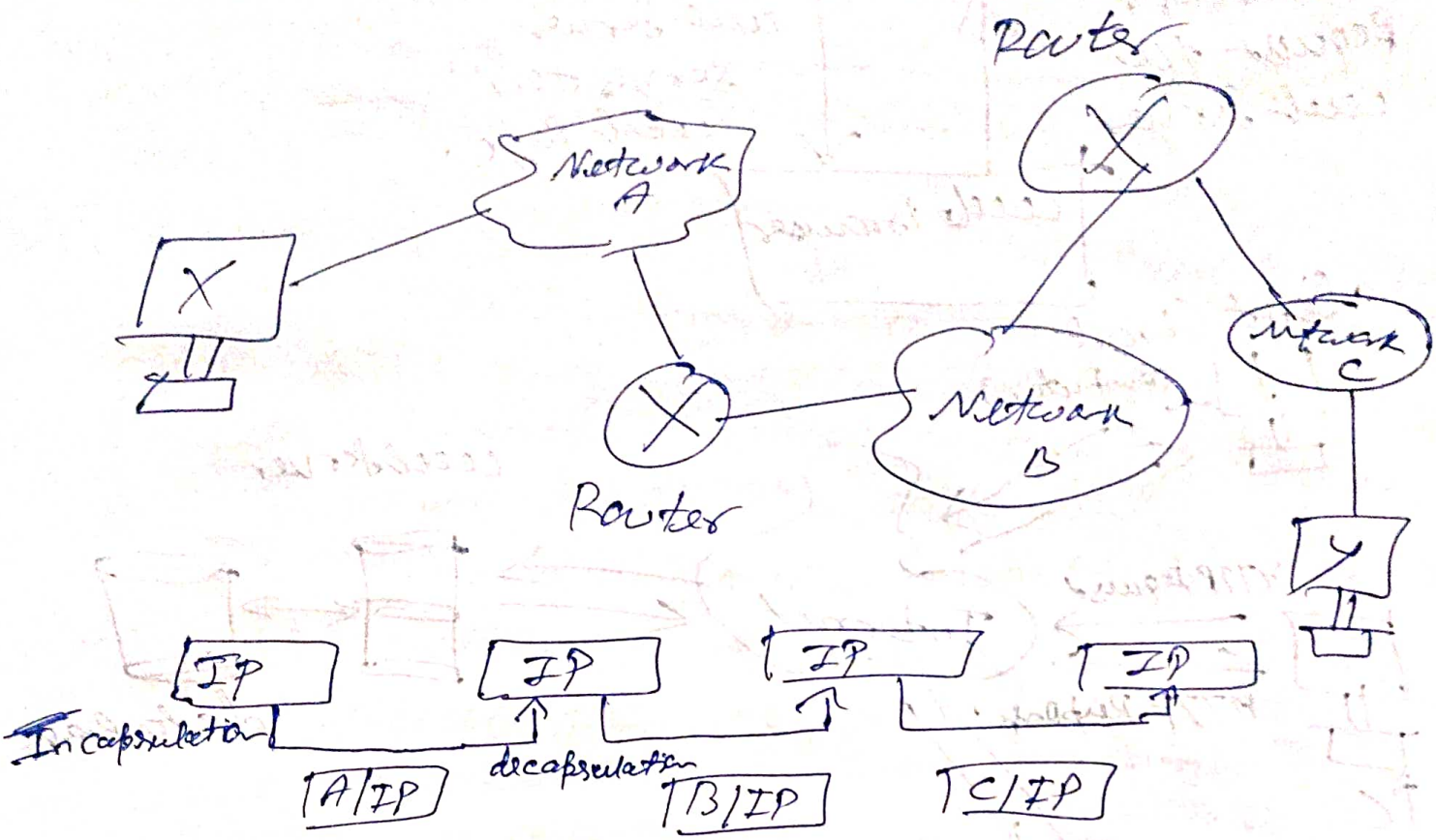

Internet Architecture consists of three layers.

**IP** ⇒ In order to communicate, we need our data to be encapsulated as IP packets. These IP-packets travels ~~across~~ across number of hosts in a network through routing to reach the destination. IP does not support error detection and error recovery.

**TCP** ⇒ It provides end to end transmission of data. It is a very complex protocol as it supports recovery of lost packets.

**Application Protocol** ⇒ This layer has different protocols on which the internet services are built. FTP, SMTP, TELNET etc

Internet architecture is based on a simple idea:




## Function of Internet ⇒

(I) Web access ⇒ It is the way that we view the content on the internet

(II) Web sites ⇒ web site form all the content that we view on the internet.

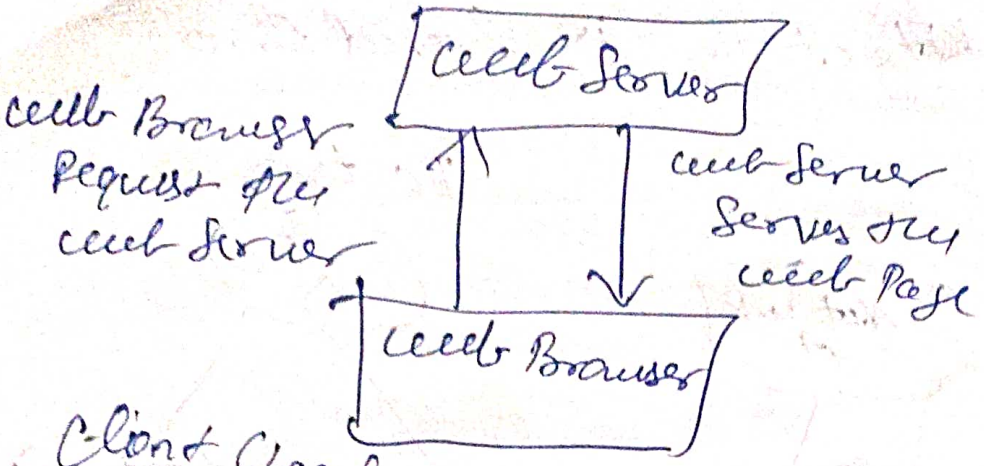
(III) E-commerce ⇒ It is simply selling product on the internet

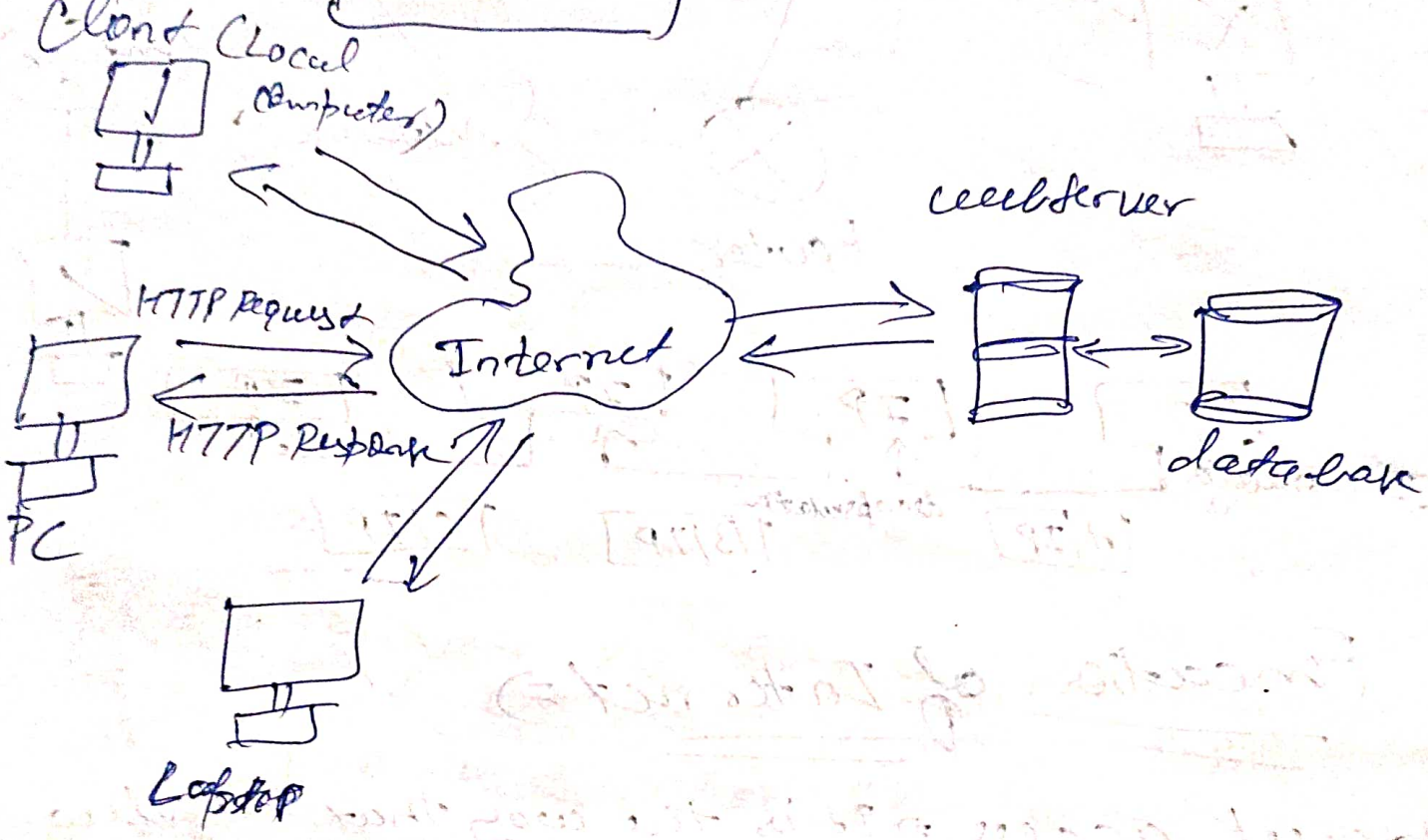
(IV) Education ⇒ It is use for education purpose.

(V) Research ⇒ also use for research

WWW ⇒ world wide web, which is also known as a web, is a collection of web sites or web pages stored in web server and connected to local computers through the Internet.

* WWW is a collection of web site connected to the internet so that people can search and share information.




<u>web Browser</u> => A web Browser, which is commonly known as a browser, is a program that displays text, data, pictures, videos, animation, and more. It provides a s/w interface that allows you to click hyperlinked resources on the world wide web.

It is a application s/w. to explore www. "It provides an interface b/w the server and the client" and request to the server for web documents and services. A web Browser is a s/w program that is used to explore, retrieve and display the information available on the www.

Web Server => Web Server is a Program which Processes the network requests of the users and serves them with files that create web Pages. This exchange takes Place using Hypertext Transfer Protocol (HTTP)

* Web Browser => A Browser is a client Program as it runs on a user computer or mobile device and contacts the web Server for the information requested by the user. The web Server sends the data back to the browser that displays the result on the internet supported devices.

Features of web Browser =>

(I) Refresh button => Reload the Page.

(II) stop Button => It is used to cancel the communication of the web browser with the Server and stop loading the Page content.

(III) Home Button => move to predefine home Page.

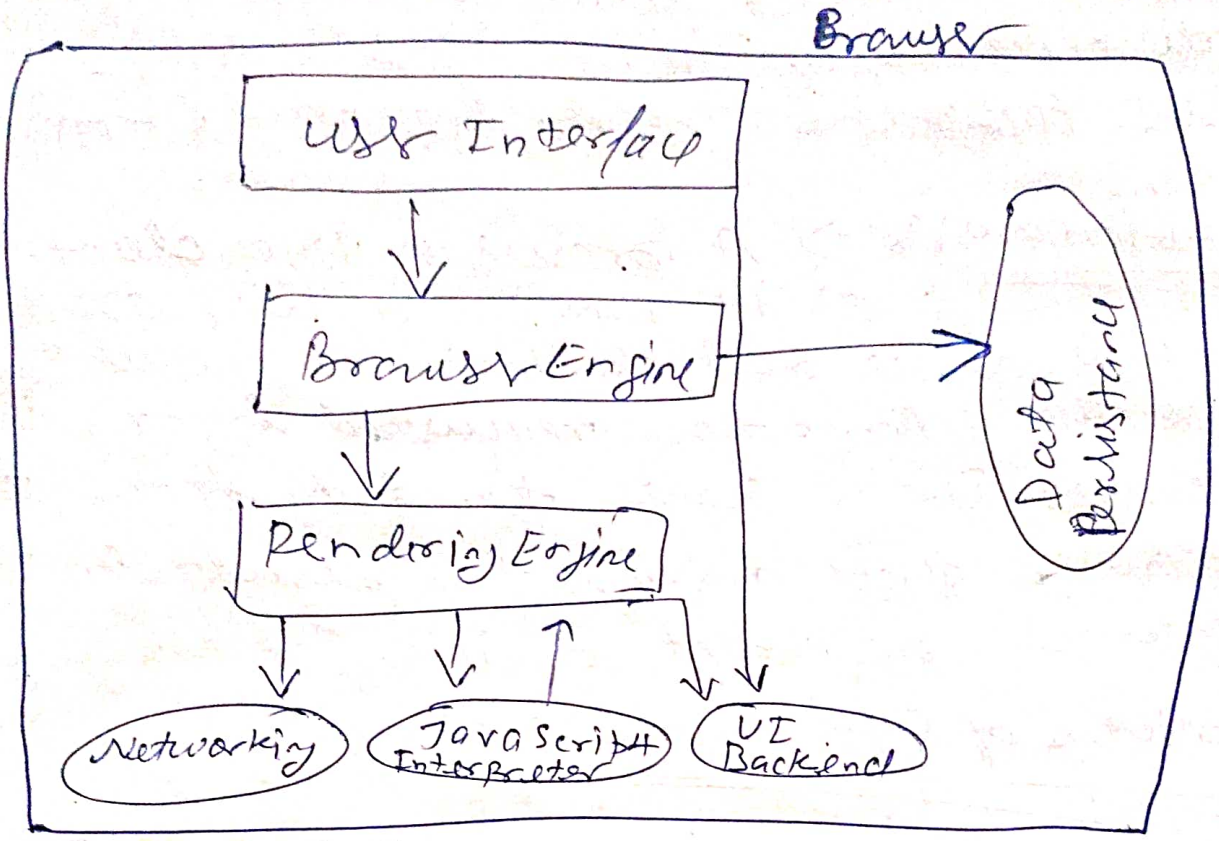
(IV) web address bar => It allow the users to enter a web address in the address bar and visit the web site.

(V) Tabbed browsing => It Provides the option to open multible web sites on a single window.

(VI) Bookmarks => It allow the users to select Particular web site to save it for the later retrieval of information, which is Predefined by the users. (locally store on the client system only)

# Component of web Browser ⇒

CSS - cascading style sheet

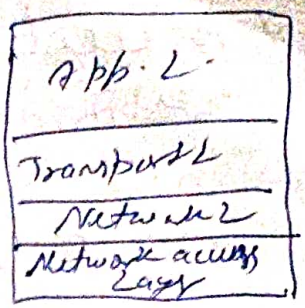



(i) User Interface ⇒ The user Interface is an area where the user can use several options like address bar, back and forward button, menu etc. to interact with the Browser.

(ii) Browser Engine ⇒ It connect the UI (user Interface) and the rendering engine as a bridge. It queries and manipulates the rendering engine based on input from several user Interfaces.

(iii) Rendering Engine ⇒ It is responsible for displaying the requested content on the Browser screen. It translates the HTML, XML files and images which are formatted by using the CSS. It generates the layout of the content and display it on the Browser screen.

- Internet Explorer uses Trident
- Chrome and Opera 15+ use Blink
- Chrome (iPhone) & Safari use WebKit.
- Firfox & other Mozilla use Gecko.



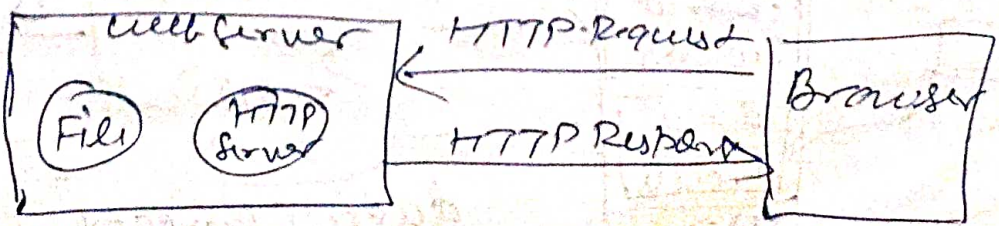

(IV) Networking ⇒ It retrieves the URLs by using Internet Protocol like HTTP or FTP. It is responsible for maintaining all aspects of Internet communication and security. It may be used to cache a retrieved documents to reduce network traffic. Handle HTTP calls and other network related tasks.

(V) JavaScript Interpreter ⇒ JavaScript Interpreter translates and executes the JavaScript code, which is include in a web site. The translated result are sent to the rendering Engine to display result on the device screen. * V8 (C++) Google Chrome * Spider Monkey (mozilla) * Nitro (JavaScript Core → Safari)

(VI) UI Backend ⇒ It is used to draw basic combo boxes and windows. It specifies a generic interface, which is not a platform specific. It is mainly used for drawing basic widgets like a select box, an input box, a check box etc.

(VII) Data Storage ⇒ The data storage is a Persistence layer that is used by the browser to store all sorts of information locally like cookies. It is a database stored on local drive of your computer where the browser is installed.

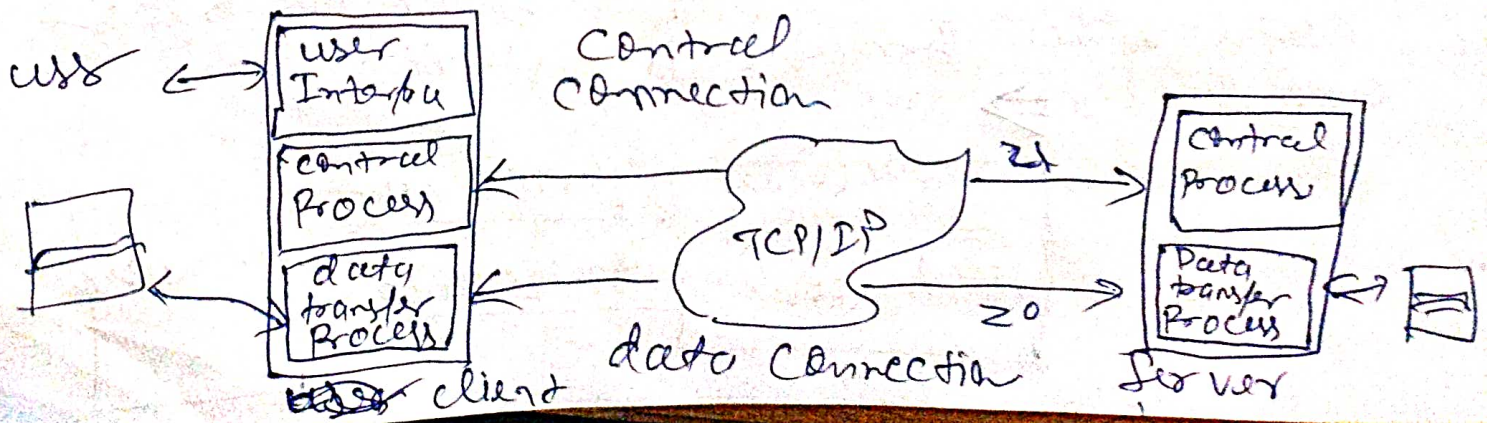
Web Server ⇒



* A web server is a dedicated computer responsible for running websites sitting out on those computer some where on the internet. The Primary objective of any web server is to collect, Process and Provide web pages to the users.

## FTP ⇒ (File transfer Protocol) ⇒

FTP is a standard internet Protocol Provided by TCP/IP used for transmitting the files from one host to another. It is mainly used for transferring the web page file from their creator to the computer that acts as a server for other computer on their internet. It is also used for downloading the file to computer from other servers. It also provide the sharing of files. It transfer the data more reliably and efficiently. "It is a client-server based protocol." Two system may have different directory structures. Two system may have different ways to represent text and data. FTP Protocol overcomes these Problem by establishing two connections b/w hosts. One connection use for data transfer and another connection is used for the control connection.



The FTP client has three components: The user interface, control process, and data transfer process. The server has two components: The server control process and server data transfer process.

* There are two types of connection in FTP.

a) Control connection ⇒ The control connection uses very simple rule for communication. Through control connection, we can transfer a "line of command" or "line of response" at a time. The control connection is made b/w the control processes. The control connection remains connected during the entire interactive FTP session.

b) Data connection ⇒ The data connection uses very complex rules as data types may vary. The data connection is made b/w data transfer processes. The data connection opens when a command comes for transferring the files and closes when the file is transferred.

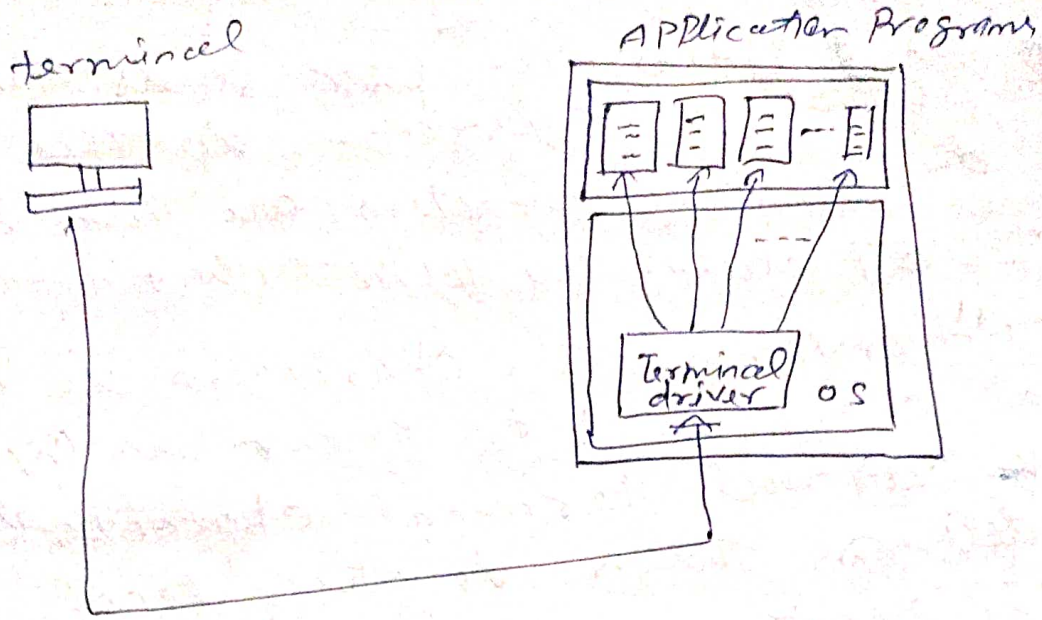
FTP client ⇒ FTP client is a program that implements a file transfer protocol which allows you to transfer file b/w two hosts on the internet. It allows a user to connect to a remote host and upload or download the file. It has a set of commands that we can use to connect to a host, transfer the file b/w you and your host and close the connection.

Data Transfer (Port = 20) / Control information (Port...

advantage ⇒ (i) Speed.
(ii) Efficient
(iii) Security (USERID and Password for accessing server)
(iv) Back and forth movement (suppose you are a manager of the company. you send some information to all other employees, and they all send information back on the same server.

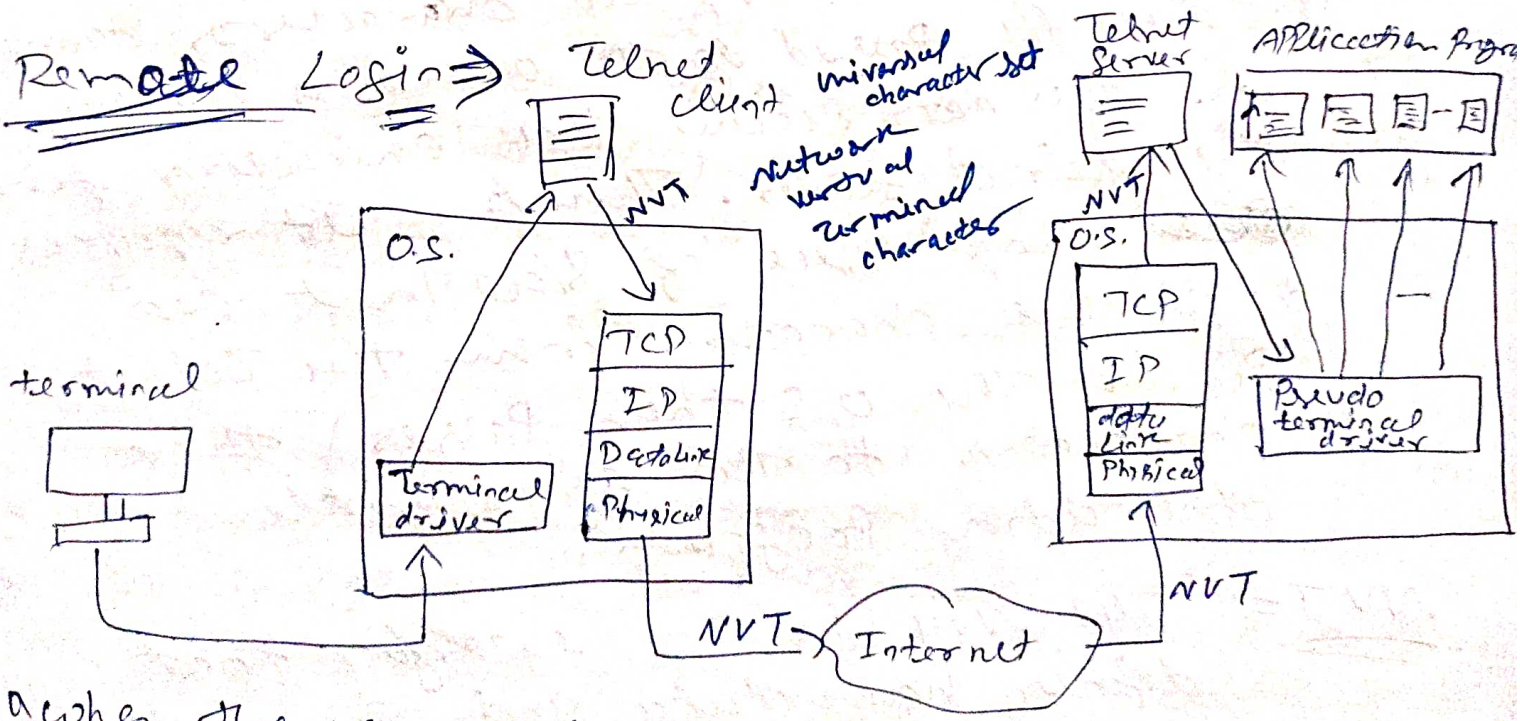
disadvantage ⇒ (i) It is not compatible with every system.
(ii) Security issue (Password and file content are sent in clear text that allow unwanted eavesdropping.
(iii) The standard requirement of the industry is that all the FTP transmission should be encrypted. However, not all the FTP Provider are equals and not all the Providers offer encryption.
(iv) FTP ~~Serves~~ two operations. to send and recieve large file on a network. However the size limit of the file is 2 GB that can be sent. It does not allow you to run simultaneous transfers to multiple receivers.

Telnet ⇒ The main task of the internet is to Provide services to users.
Telnet Provides a connection to the remote computer in such a way that a local terminal appears to be at the remote side.
There are two types of login: ⇒
Local Login: ⇒
(Telnet Type Network)




"When a user logs into a local computer, then it is known as "local login."
When the workstations running terminal emulator, the keystrokes entered by the user are accepted by the terminal driver. The terminal driver then passes these characters to the OS which in turn, invoke the desired application program. However, the OS has special meaning to special characters.

## Remote Login ⇒




When the user want to access an application program on a remote computer, then the user must perform remote login

At the local site ⇒ The user sends the keystrokes to the terminal driver, the characters are then sent to the TELNET client. The TELNET client which in turn, "transforms the characters to a universal character set known as (NVT) network virtual terminal character" and delivers them to the local TCP/IP stack.

At the remote site ⇒

The command in NVT forms and transmitted to the TCP/IP at the remote machine. Here, the characters are delivered to the OS and then pass to the Telnet server. The Telnet server transforms the characters which can be understable by a remote computer. However, the characters cannot be directly passed to the OS as a remote O.S. does not recieve the characters from the telnet server. Therefore it requires some piece of S/W that can accept the characters from the Telnet server. The OS then passes these characters to the appropriate application program.

NVT ⇒ The NVT is an interface that defines how data and commands are sent across the network. The TELNET client translates the characters that come from the local

terminal into NVT form and then delivers them to the network. The Telnet server then translates the data from NVT form into a form which can be understandable by remote computer.

* Telnet stands for "Tele Type Network". It is a type of protocol that enables one computer to connect to local computer. It is used as a standard TCP/IP protocol for virtual terminal service which is given by ISO. "computer which starts connection known as the local computer, computer which is being connected or which accepts the connection known as remote computer."

**Telnet commands** ⇒ commands of telnet are identified by a "Prefix character", "Interpret As Command" (IAC) which is having code 255. IAC is followed by command and option code. Basic format of the command is as -

| IAC | Command code | Option code |
|---|---|---|

| Command | character | Decimal | Binary |
|---|---|---|---|
| | will | 251 | 1111011 |
| | WONT | 252 | 1111100 |
| | DO | 253 | 1111101 |
| | DONT | 254 | 1111110 |

Common option :-

| Code | Option |
|---|---|
| 0 | Binary |
| 1 | Echo |
| 3 | suppress go ahead |
| 5 | status |
| 6 | Timing mark |
| 8 | Line width |
| 9 | Page size |
| 24 | Terminal type |
| 32 | Terminal speed |
| 34 | Line mode |

## Telnet ⇒

### Mode of operation :⇒

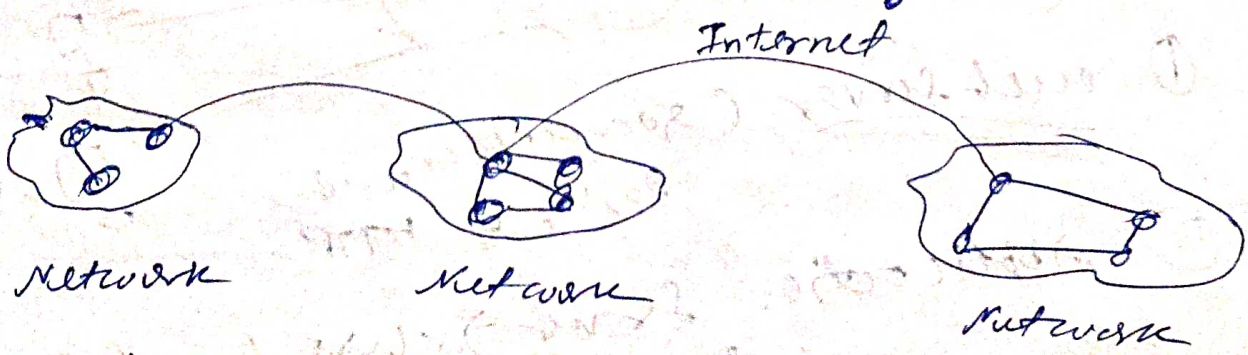
i) Default mode
ii) character mode
iii) Line mode.

- use Port 23.
- No Graphics / GUI
- Command Panel are used.
- access. (Server, router, switch)
- Required sharing Permission.
- Easily access by ~~[illegible]~~ unauthorized Person. because all code is written in ~~[illegible]~~ simple Text.
- One computer give Permission to other computer is called remote login.
- Command line - tool (text-oriented) to accesses remote system.
- Client-Server Protocol (Bidirectional).

**Gopher** ⇒ Gopher is an application-layer protocol that provides the ability to extract and view web documents stored on remote web server. Gopher was designed to access a web server or data base via the internet. It requires that files be stored in a menu style hierarchy on a Gopher server that is accessible through a Gopher-enabled client browser and/or directly. It initially supported only text-based file/documents access but later came to support some image formats such as GIF and GPEG. Gopher was succeeded by the HTTP protocol and now has very few implementations. Gopher-based databases, servers or web-sites can be accessed through two search engine. Veronica and Jughead.

**WWW** ⇒ It is an Information system where documents and other web resources are identified by URL. These resource may be interlinked by Hyper text, and are accessible over the Internet.

* WWW is not a Internet.
* Internet is a physical Network.

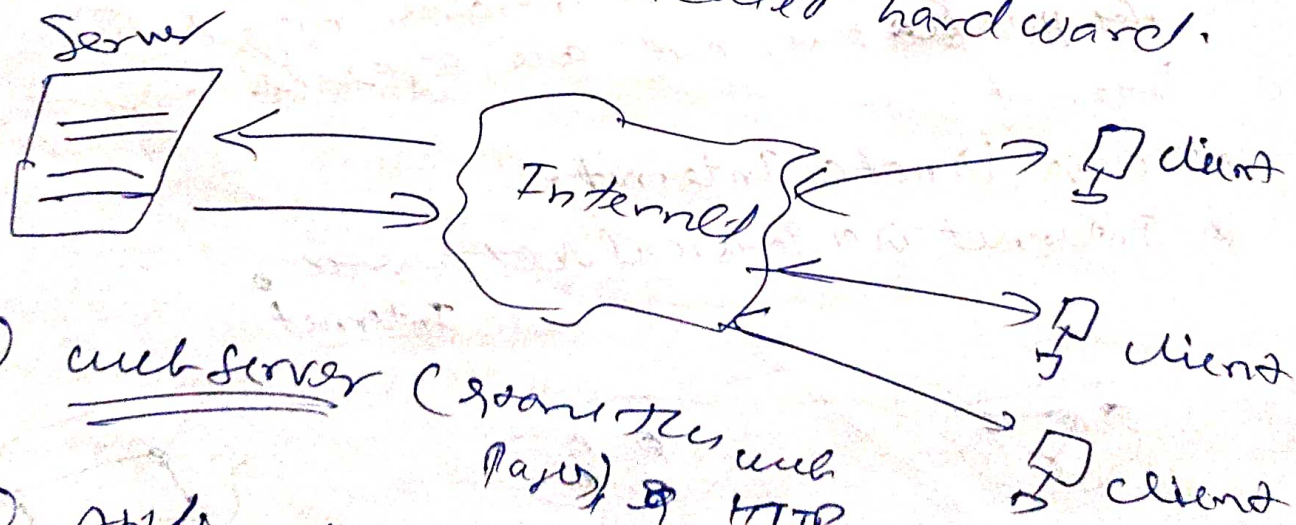



* WWW is a application service.

**Web Browser** ⇒ web browser is a client, program s/w or tool through which we sent HTTP request to web server. It know how to communicate with server. The main purpose of web browser is to locate the content on www and display the web page (image, audio or video form.

**Web Server** ⇒ A web server can be either a s/w or Hardware, which provides the web pages via HTTP. web server gets the request and find the resources then response to client. web server provides services only for web application. All communication b/w client and server takes place via HTTP.

**Type of Server** ⇒ Server is a s/w component or dedicated hardware.




(i) **Web Server** (stores the web pages) & HTTP.

(ii) Application Server ⇒ use for application a program ~~use~~ b/w user and ~~database~~ application database.

Database Server ⇒ work on data base
* use SQL for access the

Mail Server ⇒ * use to send or received the mail.
* use to store the user data (SMTP)

Domain Name Server ⇒ * Central Server of Internet
* Convert the domain name into IP address.

FTP Server ⇒ use to store File.

FTP ⇒ FTP is a language that computers use to transfer files over a TCP/IP network
* Send text data, not secure.
* SFTP ⇒ Secure FTP
* TFTP ⇒ trivial FTP.

FTP allow three types of data structure ⇒

(I) File structure ⇒ In file structure there is no internal structure. file is continuous sequence of data bytes.
(II) Record structure ⇒ In record structure, the file is made up of sequential records.
(III) Page structure ⇒ * store in a page form.
* Indexed Page.

Type of FTP connection ⇒

(I) Active FTP connection ⇒ Client established the command channel and the server establish the data channel.
(II) Passive FTP connection ⇒ [illegible] data and command

For better understanding of Active

## Transmission mode of FTP ⇒

ftp < ip address or domain
Ex ⇒ ftp < local host
↓
for connection

(i) Stream mode ⇒ continious stream of Byte, transmission in continious manner. "No Break".

(ii) Block mode ⇒ In Block form. In form of Block. (Data transfer in the form of Block) (3-byte header)

(iii) Compressed mode ⇒ Data is compressed then send. Generally used for sending large file.

## FTP commands ⇒

* 1-Byte contains type information about the block (description block)
* 2-Byte contain the size of the block

(i) Transfer file command ⇒ GET, from server
PUT, SEND ↳ send single file
Send or file upload single file
upload multiple input

(ii) Connect to Remote Host command ⇒ USER ← user identification
OPEN ⇒ open address
↳ to connect to the FTP server
PASS ⇒ user password to the server

(iii) Terminate Session command ⇒
CLOSE → disconnect to FTP, about does not terminate user. (Not connection Break)
quit ⇒ no connection / terminate FTP.

(i) disadvantage :- (i) Not send data in encrypted form. Send in Text form.
(ii) Not secure. → in Password no specification or old technology
& virus ⇒ not detect/scan for viruses
& Limited ⇒ very limited user Bandwidth and mobile device
& required more memory and programming effort.

* Secure FTP ⇒ (i) Same as FTP
(ii) Encrypted data transfer.
(iii) SSH / SSL / TLS
↓ Socket Secure layer
↳ Transport Layer Security
(iii) Slow as compare to FTP
(iv) Command same as FTP.
(v) TCP/IP Based.

Part 22

* TFTP ⇒ (i) use in Local area Network.
(ii) Same in a company not works to use internet. Then TFTP are used.
(iii) use UDP.
(iv) unreliable.
(v) use Port No - 69 (LAN)
(vi) Fast as compare to other.
(vii) Not use on internet.
(viii) use TFTP Server for storing File.

TELNET ⇒ (Tele Type Network) ⇒ It is a network protocol to use to connect one computer to another computer remotely (Server)

* SSH (Security Shell) use to remove the disadvantage of Telnet.
* "Telnet not Provide security"
* "Not use at a time". To send data from one to another. (Router) Server) access by Telnet
* Based on command
* Type all command.
* Before GUI.

Ex (Team viewer).

Gopher ⇒ * Minnesota — मिनिसोटा

* Communication Protocol.
* use to show text Based data on client.

* The Gopher Protocol is communication Protocol designed for distributing, searching and retrieving document in IP.
* Text / Binary file Arranged by Gopher.
* It is an application layer Protocol.
* Extract the data from remote web Server.
* It is very old Protocol, use to organize the text files in a Hierarchical manner or structure & view the file in a remote computer
* Initially support only text file. after that image / music.
* On a date HTTP are used.

Search Engine ⇒ A Search Engine is a online answering machine, which is use to search, understand, and organize result in it's data base on the search query (Keywords) inserted by the end user. To display search results, all search engines first find the valuable result from their data base, sort them to make an ordered list based on the search

algorithm, and display in front of end user.
"The Process of organizing content in the form of a list is commonly known as a "Search Engine Results Pages (SERP)" Google, Yahoo, Bing.

advantage ⇒ (i) Time Saving (Every Up. spend "Eliminate the need to find information manually.

(ii) variety of information

(iii) Precision ⇒ All search engines have the ability to provide more precise results.

(iv) Free access.

(v) advanced Search ⇒ Search Engine allow us to use advanced Search options to get relevant, valuable and Information result. Advanced Search result make our Searches more flexible as well as sophisticated.

Disadvantage ⇒ (i) Some time the Search Engine takes too much time to display relevant content.

(ii) Search Engine like Google frequently update their algorithm, and it is very difficult to find the algorithm in which Google runs.

(iii) It makes end-user effortless.

Component of Search Engine ⇒

(i) Web Crawler (क्रॉलर) ⇒ Web Crawler is also known as a Search engine bot, web robot, or web Spider.

It plays an essential role in search Engine optimization Strategy (SEO). It is mainly a b/w component that traverses on the web, then downloads and collects all the information over internet.

(II) Data Base ⇒ The search Engine database is a type of Non-relational database. It is placed where all the web information is stored. It has large No of web Resources.

(III) Search Interfaces ⇒ (1) important component of Search Engine. It is an Interface b/w the user and the database. It Basically helps users to search for queries using the database.

(IV) Ranking algorithm ⇒ The Ranking algorithm is used by Google to rank web pages according to the Google Search algorithm.

How Search Engine work ⇒

(I) Crawling ⇒ Crawling is the first stage in which a search engine uses web crawlers to find, visit and download the web pages on the www. Crawling is performed by b/w robots, known as 'spiders' or 'crawlers'. These robots are used to revisit the web site content.

Start with small steps

Port-143 ↓ non-encrypted Port 993 IMAP Security

* SMTP → is used to send message (Internet Message Access Protocol)

Post office Protocol ← POP → or IMAP → used to retrieve message from mail server
↓ PC, MAC ↓ PC, MAC, mobile, tablet etc

(ii) Indexing ⇒ Indexing is an online library of website, which is used to sort, store and organize the content that we found during the crawling. Once a page is indexed, it appears as a result of the most valuable and most relevant query.

(iii) Ranking and Retrieval ⇒ The Ranking is the last stage of the search engine. It is used to provide a piece of content that will be the best answer based on the user's query. It display the best content at the top rank of the website.

Email ⇒ (Electronic mail) Email is defined as the transmission of message on the internet. It is one of the most commonly used features over communication network that may contain text, files, images or other attachment. It is information that is stored on a computer sent through a network to a specified individual or group of individuals. Email messages are conveyed through email servers. It uses multiple protocol with in the TCP/IP suite.

Email messages include three components

a) message envelope ⇒ It depicts the email's electronic format.

b) message header ⇒ It contains email subject line and sender/recipient information.

c) message body ⇒ It comprises images, text, and other file attachments.

## Advantage of E-mail ⇒

(i) Cost-effective ⇒ Email is a very cost effective service to communicate with other as there are several email services available to individual and organization for free of cost.

(ii) Speed and Simplicity ⇒ Email can be composed very easily with the correct information and contracts.

(iii) Mass Sending ⇒ You can send a message easily to large numbers of people through email.

## Disadvantage ⇒

(i) Impersonal ⇒ As compared to other forms of communication, email are less personal.

(ii) Misunderstandings ⇒ As email includes only text, and there is no tone of voice or body language to provide context. Therefore, misunderstanding can occur easily with email.

(iii) Malicious use ⇒ As email can be sent by anyone if they have only email address.

(iv) Accident will happen ⇒ Send to wrong person.

(v) Spam ⇒ unwanted mail received.

(vi) Viruses.

(vii) In Secure

(viii) Pressure to Response.

IOT (Internet of things) ⇒ "IOT is the networking of physical objects that contain electronic embedded with in their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment." IOT-based technology will offer advanced levels of services and practically change the way people lead their daily lives.

" IoT is network of interconnected computing devices which are embedded in everyday objects, enabling them to send and recieve data".

Main component use in IOT ⇒

a) Low-Power embedded system ⇒ Less Battery consumption, high performance and the inverse factors that play a significant role during the design of electronic systems.

b) Sensors ⇒ Sensors are the major part of any IOT application. It is a physical device that measures and detect certain physical quantity and convert it into signal which can be provide as an input to processing or control unit analysis purpose.

c) Control units ⇒ It is a unit of small computer on a single integrated circuit containing microprocessor or processing core, memory and programmable input/output

devices. It is responsible for major processing work of IoT devices and all logical operations are carried out here.

d) Cloud Computing ⇒ Data collected through IoT devices is massive and this data has to be stored on a reliable storage server. This is where cloud computing comes into play.

e) Availability of big data ⇒ we know that IoT relies heavily on sensors, especially in real-time. As these electronic devices spread throughout every field, their usage is going to trigger a massive flow of big data.

f) Networking Connection ⇒ In order to communicate, internet connectivity is a must where each physical object is represented by an IP address. However, there are only a limited number of addresses available according to the IP naming. Due to the growing number of devices, this naming system will not be feasible anymore.

Characteristics of IoT ⇒

(i) massively scalable and efficient

(ii) IP-based addressing will no longer be suitable in the upcoming future.

(iii) An abundance of physical objects is present that do not use IP, so IOT is made possible.

(iv) Devices typically consume less power when not in use, they should be automatically programmed to sleep.

(v) A device that is connected to another device right now may need be connected in another instant of time.

(vi) IOT devices aren't always connected.

Characteristics ⇒

(i) Unique Identity

(ii) Dynamic Nature

(iii) Self-adapting

(iv) Self configuring

(v) Heterogenity ⇒ different devices with different configurations are connected to each other.

(vi) Integrated to Information Network.

(i) Self configuring

(ii) Connectivity

(iii) Unique Identity

(iii) Scalability

(iv) Dynamic & Self adapting.

(v) Architecture ⇒

(vi) Safety.

Benefits of IOT ⇒ (i) Efficient Resource utilization

(ii) Saves time.

(iii) Human efforts and errors.

(iv) Security.

(v) User Friendly / Easy to use

Architecture ⇒ It cannot be Homogeneous in nature. It should be Hybrid, supporting different manufacturers

Self configuration ⇒ able to update their s/w with user interaction

"Taking everyday things, embedding them with electronics, s/w, sensors and then connecting them to internet and enabling them to collect and exchange data without human intervention is called as the IoT."

**Sensor** ⇒ A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by a computer.

**Smart city** ⇒ It provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of smart tech.
Smart Grid, Smart Governance, Smart education, Smart healthcare, Smart weather tech, etc

**Sensor type** ⇒ weather

(i) Analog → Temperature / continuous analog values.
(ii) Digital → Based on output
→ discrete digital output signal [yes/no]
(iii) Scalar
(iv) Vector } → Based on data type.
→ that focus on magnitude only but also direction / orientation
→ more than one factor

* Magnitude is matter (direction is not need) (Only that factor consider)

Analog ⇒ Accelerometer, Light sensor, Sound sensor, Pressure sensor, Temperature sensor

digital ⇒ Digital accelerometer

| vector sensor → | image sensor |
|---|---|
| acceleration sensor, | sound sensor |

* Scalar ⇒ color sensor, Strain sensor, Temperature sensor

**Web hosting :=>** Web hosting is the operation of Internet-facing hardware and S/W that provides web services to the end user. It is a place where your web site and services are stored, processed and served from.

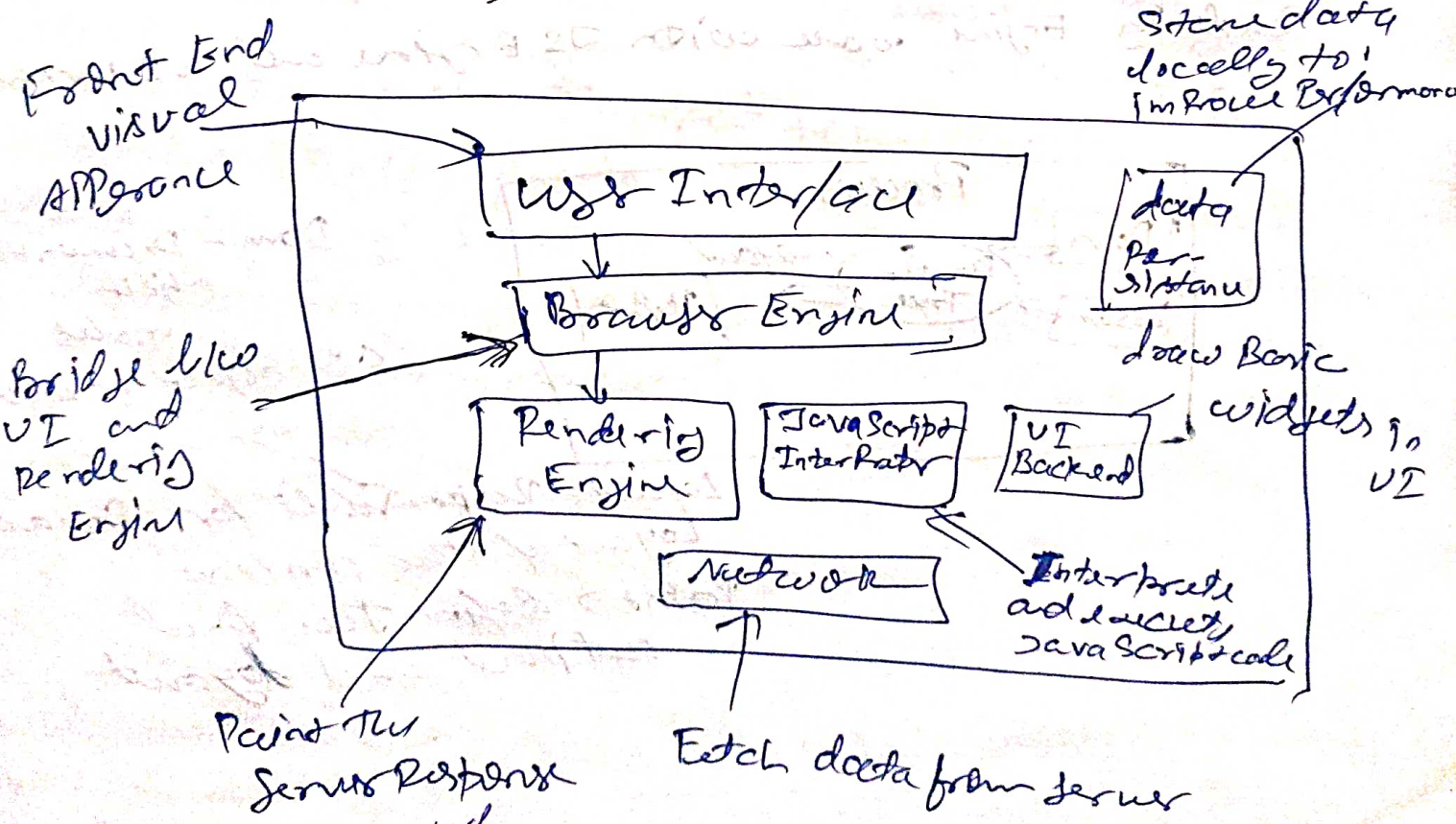
(I) Shared hosting
(II) Dedicated hosting
(III) cloud hosting
(IV) virtual Private Server

**DNS => (Domain Name Server)** => DNS is the phone book of the internet.

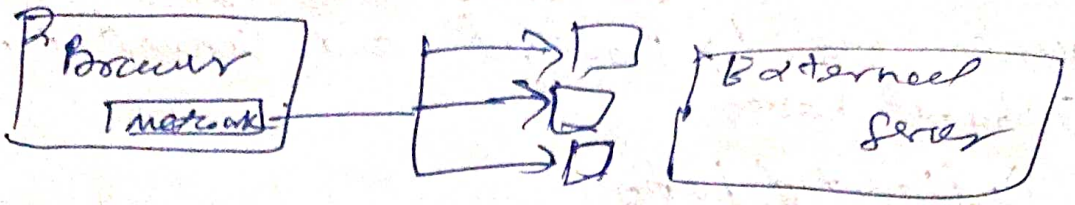
DNS is a directory service that provides a mapping b/w the name of a host on the network and its numerical address.

DNS is a service that translates the domain name into IP address.

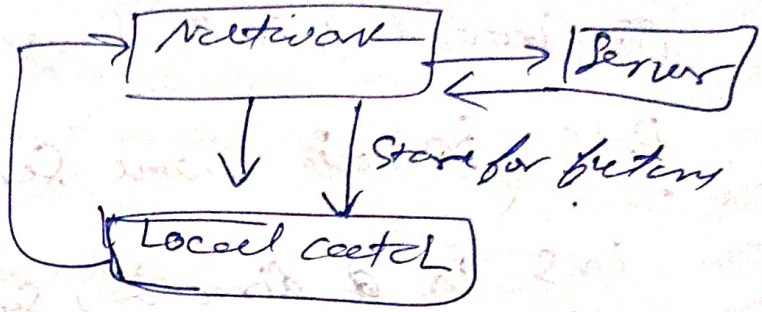
**Web Browser Component =>**



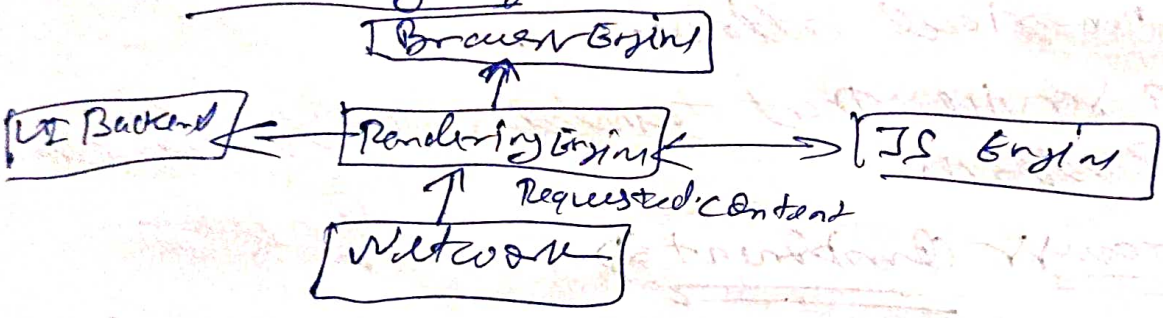
## (10) Network Layer ⇒



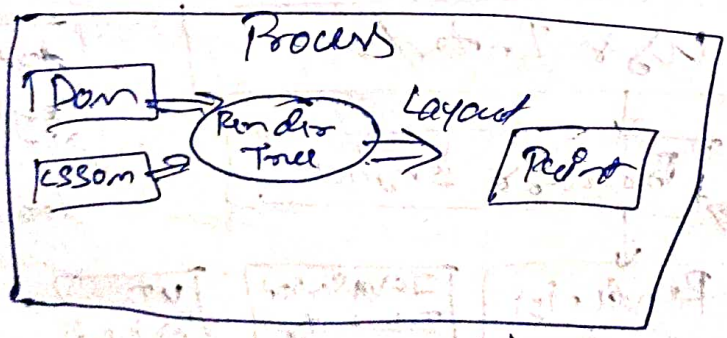

i) HTTP/FTP




## (11) Rendering Engine ⇒




Rendering Engine work with JS Engine and UI Backend




Dom – Document object model

CSS object model

Layout – Responsible for size and Layout of the content

Paint → defines the final output and layout

Smart City ⇒ A smart-city is a municipality that uses "Information and communication technology (ICT)" to increase operational efficiency, share information with the public and improve both the quality of government services and citizen welfare. The main goal of a smart city is to optimize city functions and promote economic growth while also improving the quality of life for citizens by using smart technology and data analysis.

Set of characteristics ⇒

(I) An Infrastructure based around Technology (इन्फ्रास्ट्रक्चर)

(II) Environmental friendly initiatives (पर्यावरणीय)

(III) Effective and highly functional Public transportation

(iv) Confident Progressive city plans.

(v) People able to live and work within the city, using its resources.

* A smart city uses a framework of "information and communication technology" to create, deploy and promote development practices to address urban challenges and create to technologically enabled and sustainable infrastructure.

Smart City Technology ⇒ Smart-city uses "Variety of S/W, User Interfaces and communication networks along-side the IOT" to deliver connected solns for the public. Of these, the IOT is the most important.

a) Application programming Interface (APIs)
b) Artificial intelligence (AI)
c) Cloud computing service
d) ~~Device~~ Dashboards.
e) Machine Learning.
f) Machine to machine communication.
g) mesh Network.

How Smart city work ⇒ Smart cities follow four steps to improve the quality of life and enable economic growth through a network of connected IOT devices and other technologies. These steps are as follows:

(i) Collection :⇒ Smart sensors gather real-time data.

(ii) Analysis ⇒ The data is analysed to gain insights into the operations of city services and operations.

(iii) Communication ⇒ The result of the data analysis are communicated to decision makers.

(iv) Action ⇒ Action is taken to improve operations, manages assets and improve the quality of city life for the residents.

Industrial Internet of Things ⇒ The industrial Internet of Things refers to the extension and use of IOT in industrial sector and applications, "with a strong focus on machine to machine communication, big data, and machine learning", the IIOT enables industries and interprise to have better efficiency and reliability in their operations.

Benefits of IIOTs ⇒ Industrial IOT systems are made powerful by connected devices and machines that can speak the same language, monitor and analyze industrial performance data, and allow real time visibility into what's going right, what's going wrong, and even predictions on when

something will go wrong.

Hackerrank, Leadcode, Coding Ninja, Code 360

(i) Maximize Revenue ⇒ Eliminate unplanned downtime and operational road blocks to keep revenue growing. Scale to new market, improve throughput and unlock new business models such as Products as a service with IIOTs.

(ii) Reduced Time to market ⇒ Get to market faster with rapid application development. An Industrial IOT platform allows you to wrap and extend legacy assets for new functionality.

(iii) Lower operational cost ⇒ Unlock industrial data from connected Products and systems to boost productivity and efficiency while keeping cost low.

(iv) improve quality ⇒ Secure and Scale your product, service, and factory operations improve service and quality, reliability and customer satisfaction.

*IIOT brings (→ लाना) machines, cloud computing, analytics and people together to improve the performance and productivity of Industrial Processes. With IIOT, industrial companies can digitize processes transform business model and improve performance and productivity, while decreasing waste.

## e-mail ⇒ (Electronic mail)

* Method of exchange message (mail) b/w people over the internet using electronic device.
* Internet & electronic device is compulsory.
*

**Component of email ⇒**
(I) Format of mail
(II) Header (Sender / Reciver)
(III) Body (Content / message)

**Process ⇒** * SMTP (Simple mail transfer protocol)
* SMTP used to transfer mail over the internet.
* Most of p/w use this protocol to send message.
* Set up communication rules b/w server.

**ESMTP ⇒** (Extended SMTP) ⇒ Transmission of multimedia in Email.

**IOT ⇒** *

**Characteristics of IOT ⇒**

(I) Unique Identity
(II) Dynamic Nature ⇒ key Feature ⇒ Sleeping (Wake up) active / No of IOT device
(III) Self - adapting
(IV) Self - configuring → configuration from self / Basic setup / latest s/w updation network
(V) Heterogenity
(VI) Interacted to Information Network

* when environment is change change itself.
* Change from one mode to another change architecture
different/different device with different configuration and different in network are connected to each other

## Benefits of IOT ⇒

(I) Efficient Resource utilization ⇒ All Resource are utilize more / also decrease the Resource misuse.

(II) Save time ⇒

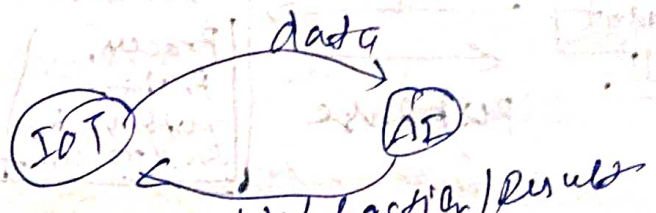
(III) Human efforts & errors ⇒ Reduced Human efforts, and also Human errors is also Reduced.

(IV) Security ⇒ Improved Security features.

(V) user friendly / Easy to use.

## Future of IOT ⇒

(I) AI & IOT

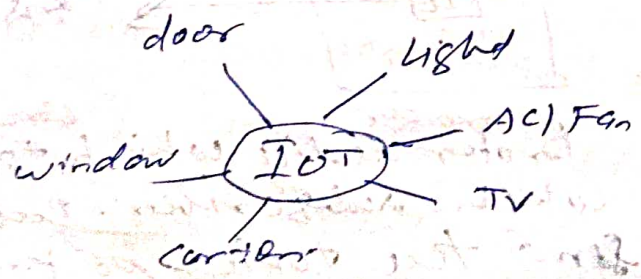



(II) VUI – (voice user interface)

(III) Power

(IV) Big data & IOT

## IOT Communication model ⇒




"The Internet of Things describe the network of ~~Physical~~ Physical objects - "things" - that are embedded with sensors, s/w and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet."

(i) Request & response communication model

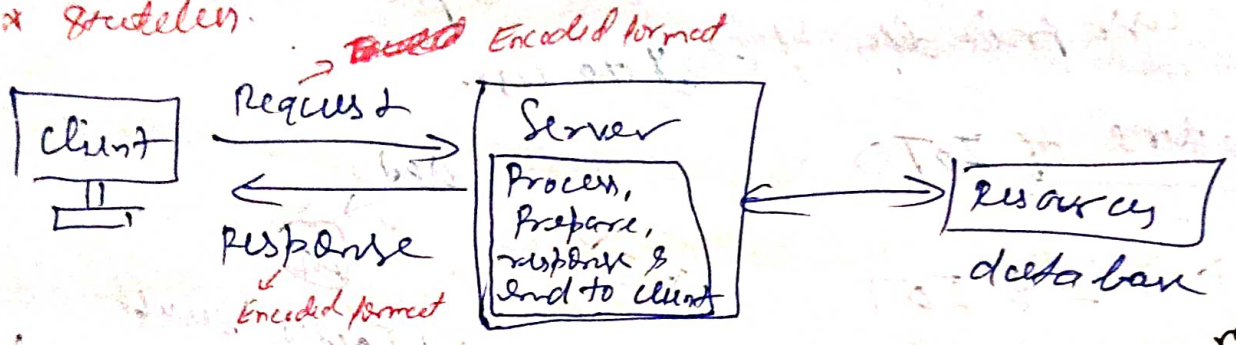
(ii) Publisher Subscriber communication model

(iii) Push - Pull communication model

(iv) Exclusive Pair communication model

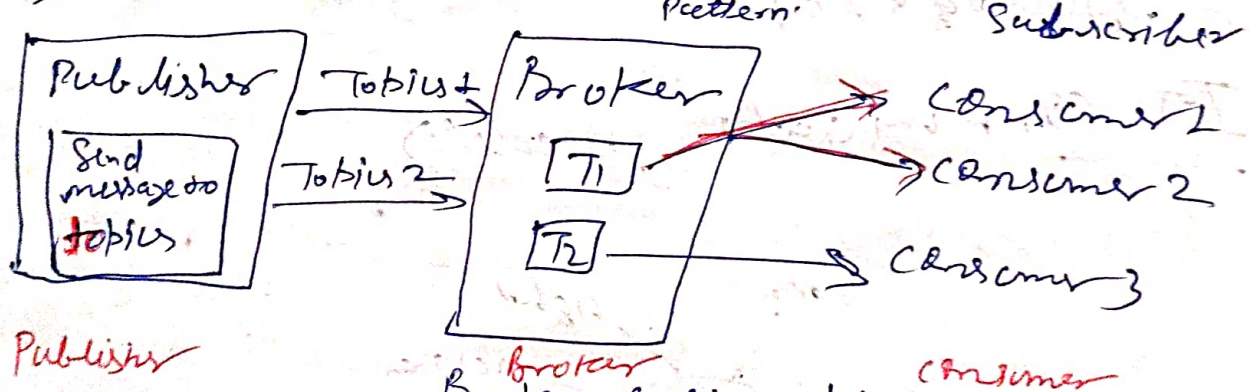
## (i) Request & Response Comm. model ⇒

* Follow client server architecture.
* Stateless.



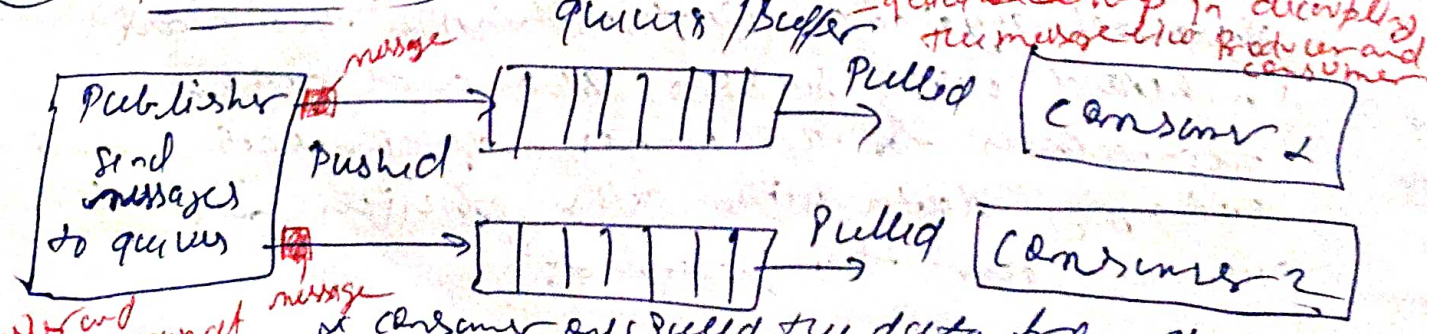

## (ii) Publisher subscriber Comm. model ⇒

* Sender does not know about Receiver
* Stateless
* Broadcast



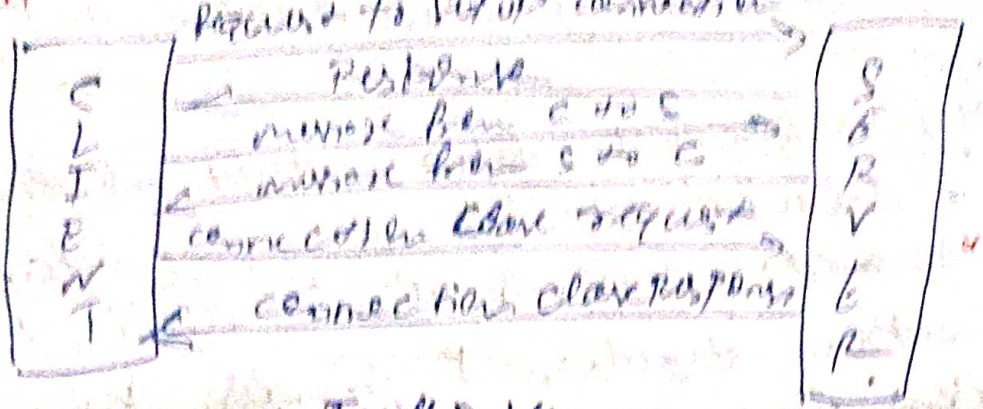

Broker decide which topic send to which subscriber. Publisher only send the topic. No knowledge about consumer.

## (iii) Push - Pull ⇒




Publisher and consumer are not aware to each other & consumer only pulled the data from queue. queues are used to control the flow of message.

(17) Exchange Pairs  Bidirectional




Stateful: FTP, TCP and Telnet are stateful. Request state need remained response & tracking keeping track of the connection information

Full Duplex & Bidirectional.

Stateless: HTTP, UDP, DNS (does not require the server to retain session information or status about each communicating partner for multiple requests.

**Blockchain** ⇒ 1990 — 2009 —

A Blockchain is a distributed, peer-to-peer database that hosts a continously growing number of transaction. Each transaction, referred to as a "Block", is secured through cryptography, timestamped, and validated by every authorized member of the database using consensus algorithm (A set of rule). A transaction that is not validated by all members of the database is not added to the database. Every transaction is attached to the previous transaction in sequential order, creating a chain of transaction (or blocks). A transaction cannot be deleted or edited, thereby creating an immutable (unchangeable) audit trial. "A transaction can only be changed by adding another transaction to the chain."

* A Blockchain is a distributed database or ledger (DLT) that is shared among the nodes of a computer network. As a database, a "blockchain stores information electronically in digital format."

Blockchains are best known for their crucial role in cryptocurrency system such as "Bitcoin".

* One key difference b/w a typical database and a blockchain is how the data is structured. A Blockchain collects information together in groups, known as Blocks, that hold sets of information. "Blocks have certain storage capacities and when filled are closed and linked to the previously filled Block, forming a chain of data known as the Blockchain." All new information that follows that freshly added block is compiled into a newly formed block that will then also be added to the chain once filled.

* Blockchain could be a data structure that could be a growing list of information blocks. The knowledge blocks are a coupled along, such recent blocks can't be removed or altered. Blockchain is the backbone technology of digital cryptocurrency.

**Benefits of Blockchain ⇒ / Need of Blockchain ⇒**

① Time-saving ⇒ No central authority verification needed for settlements making the process faster and cheaper.

(ii) Cost saving ⇒ A Blockchain network reduces expenses in several ways. No Need for third-party verification. Participants can share assets directly.

(iii) Tighter Security ⇒ No one can tamper with Blockchain Data as it shared among millions of participant. The system is safe against cybercrimes and Fraud.

(iv) Collaboration ⇒ It permits every party to interact directly with one another while not requiring third party negotiation.

(v) Reliability ⇒ Blockchain certifies and verifies identities of every interested party. This removes double record, reducing rackets and accelerate transactions.

* A Blockchain can be used for the secure transfer of money, property, contracts, etc. without requiring a third party intermediary like bank, or government.

* A Blockchain is a P2P Protocol, but it could not be run without the Internet.

---

Blockchain ⇒ definition based on these point

(i) Open
(ii) Distributed
(iii) Ledger ⇒ database / Public ledger / Local copy.
(iv) Efficiency ⇒ Scalability.
(v) Verify ⇒ verify transaction if is Possible or not.
(vi) Permanent ⇒ Not tampered.

Blockchain ⇒ Blockchain is the latest sensation in the field of technology, offering an advanced database mechanism with transparent data-sharing option with in a particular network.

⇒ "A Blockchain is a collection of publicly accessible records referred to as blocks encrypted using cryptography.

Blockchain is not a single advent, its a combination of three technologies. they includes:-

a) cryptographic key.
b) A peer-to peer network.
c) A digital ledger.

These three technology work seperatly to deliver the combined result.

a) Cryptographic key ⇒ It is a combination of private key and public key. That means they are two types - one is a private key, while the other is a public key. Both keys are used to create a digital signature. The digital signature is a digital identity, making every transaction unique and secure.

b) peer to peer network ⇒. It refer to a large group of individuals acting as authorities who reach a consensus on transaction. While cryptographic keys create a digital signature, the peer to peer network authorizes the transaction

using mathematical verification in peer to peer network.

⇒ Digital Ledger ⇒ It is a structure that houses all of there transactions. In bitcoin English, the digital ledger is like a spreadsheet that contains every node in a network and records every purchase that node have ever made. we dont altered the data only view the data.

Features of Block chain ⇒

① Public Distributed Ledger or Decentralization. ⇒

A public distributed ledger is a digital data set replicated, synchronized and shared globally across numerous locations, nations and organization. Lets now consider a Blockchain that anyone on the network can access from anywhere in the world. Everyone with in the network will have a copy of the ledger, so if someone tries to change data in one of the blocks, everyone in the network will be able to see the change. Data tempering is avoided in this way. The main Benefit of Blockchain technology is the absence of a traditional centralized organizations.

(10) Hash Encryption ⇒ Blockchain uses cryptograph to keep all the data in the blocks secure from unauthorized and unaltered access. Blockchain encrypts data using SHA-256. One of the most robust hashing algorithm is SHA-256. This cryptographic hash fn. creates a 256-bit signature for a nearly unique text. "Blockchain also uses digital signatures to verify users". There are public and private key for each user. The user is uniquely identified by their public key, which also serves as their access token to the entirety of their account. The finder message is hashed as part of the process, and the output is then sent through a signature algorithm using the users private key to produced the user's digital signature. The user message, digital signature, public key are all sent during the transaction.

(11) Proof of work / Transparency ⇒ Proof of work is a crucial feature and system that Bitcoin uses. It is a piece of information that is very difficult to produce. That means you need to invest a lot of memory and effort to produce the information. However, it can be readily verified by others and satisfied specific criteria.

(11) receiver side ⇒ Ledger - लेजर - बही खाता।

message is passed through a cryptographic f^n to get a hash value → That hash value is compared with the hash output obtained by passing the digital signature and public key through a verification value.

## Blockchain ⇒

- Decentralized ⇒ multiple user have access so No change easily.
- Difficult to change ] → Database
- Block ⇒ Relevant data + Hash
- "Genesis Block ⇒ First Block"
- Track the history easily and secure.
- Each Block have relevant information like data, hash and previous Block hash.
- Each block have unique hash.
- Proof of work ⇒ Consensus sub → voting/choice majority for change in a Block
- Each node have a copy of each Block.
- Notary / Real state / Hospital / Project / startup etc business.

1990 – 2009 | Bitcoin

## Feature of Blockchain ⇒

- Immutable Ledger ⇒ (Not changable)
- Smart contract ⇒ If and Then

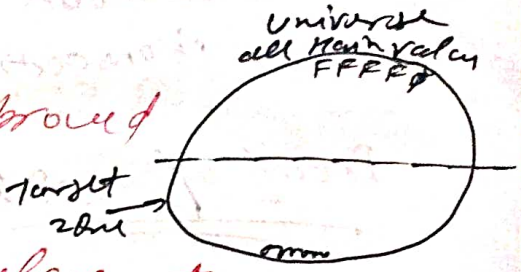
Real contract → Smart Contract ← [ If (condition) then (Action) ] if condition true/satisfied then Action occurs

- No need of third Party.

mining ⇒ miners ⇒ * Trial (Try & order)
* Error

* Find Rewards of respective hash value.
* High electricity Bill
* High computation support.
* Power consumption more
* Miners are find the particular Hash values.
* multiple miner in a single Network
*

* Proof of work ⇒ * Algorithm
* worldwidely approved
*




⇒ * if one miner find a hash value then all other verify it they are correct or need so called proof of work

* Block store primary information about transaction, such as date, time, and purchase amount of gas last transaction in a chronological manner.
* Each Block stores a unique code called a "hash". that allows it to be different from every other block. Hash code also ensures that block in a blockchain are sync with each other.

## Blockchain Technology is NOT ⇒

⇒ Blockchain technology is not entirely all about bitcoins

⇒ It is not a Product.

⇒ Blockchain is not needed in the absence of a Business network.

⇒ Blockchain is not the replacement of a transaction Processing system.

**Proof of work ⇒** In Blockchain, each block consists of 4- main header

a) **Privious Hash ⇒** This hash address locates the Privious block.

b) **Transaction details ⇒** Details of all the transaction that need to occur.

c) **Nonce ⇒** An arbitary number given in cryptography to differentiate the block's hash address.

d) **Hash address of the Block ⇒** All of the above are transmitted through a hashing algorithm. This gives an output containing a 256-bit, 64-character length value, which is called the unique "hash address".

**Limitation of Blockchain ⇒**

① **Lake of Awareness ⇒** People do not know the true value of Blockchain and how they could implemented it in different situation.

(ii) Limited availability of technical talent.

(iii) Immutable ⇒ we cannot make any modification to any of the records.

(iv) Scalability ⇒ It limits the number of transactions a blockchain network can process.

(v) Key management ⇒ we have two key public and private key so management of these key are very important.

Block-chain Hash function ⇒ A hash function takes an input string (number, alphabets, media file) of any length and transform it into a fixed length. The fixed length output is called a hash.

Cloud computing ⇒ Cloud computing is a virtualization-based technology that allows us to create, configure, and customize applications via an internet connection. The cloud technology includes a development platform, hard disk, s/w application and database.

"It is a technology that uses remote servers on the internet to store, manage, and access data online rather than local drivers. The data can be any thing such as file, images, documents, audio, video and more.

## Operation in cloud computing ⇒

(i) Developing new application and services.
(ii) Storage, backup and recovery data.
(iii) Hosting blogs and website.
(iv) Delivery of S/w on demand
(v) Analysis of data
(vi) Streaming videos and audios.

## Characteristics of cloud computing ⇒

(I) **High availability and reliability** ⇒ The availability of servers is high and more reliable because the chances of infrastructure failure are minimum.

(II) **High Scalability** ⇒ Cloud offers "On demand" provisioning of resources on a large scale, without having engineers for peak loads.

(III) **Multi-sharing** ⇒ multiple user and application can work more efficiently with cost reductions by sharing common infrastructure.

(IV) Device and Location Independent

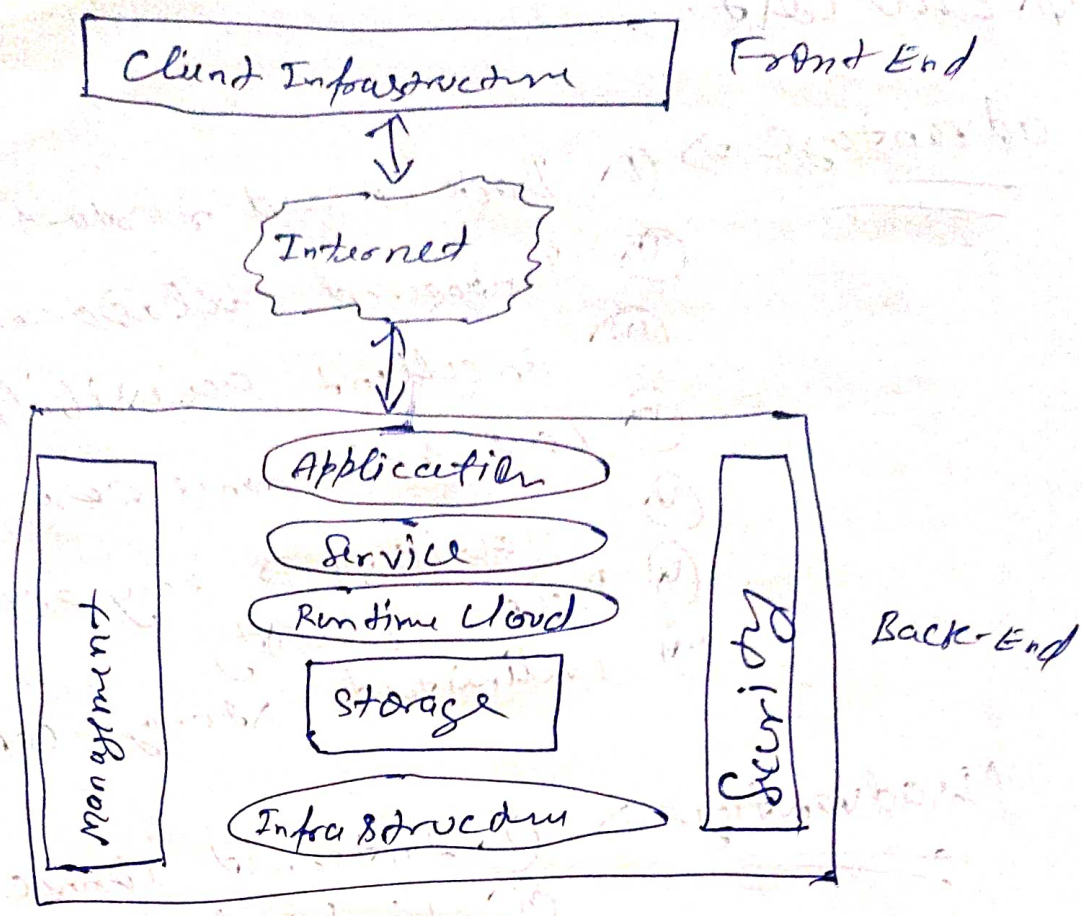
(V) **Maintenance** ⇒ No need to download of client system so maintenance is easy.

(VI) Low cost.

advantage ⇒ (I) Back up and restore data
(II) Improved collaboration
(III) Excellent accessibility
(IV) Low maintenance cost
(V) mobility → easy access by mobile.
(VI) Data security
(VII) unlimited storage capacity.

Disadvantage ⇒ (I) Internet connectivity
(II) Limited control
(III) Security
(IV)

Cloud computing Architecture ⇒ Cloud computing architecture is a combination of Service-oriented Architecture and event-driven architecture.
Cloud computing architecture is divided into the following two Parts
a) Front End
b) Back end.




The Front-End is used by the client. It contains client-side Interfaces and applications that are required to access the cloud computing platform. The front end includes web servers thin & fat clients, tables and mobile devices.

The Back-end is used by the service provider. It manages all the resources that are required to provide cloud computing services. It includes a huge amount of data storage, security mechanism, virtual machines, deploying models, servers, traffic control mechanism.

## Component of cloud Computing ⇒

(i) **Client Infrastructure** ⇒ Client Infrastructure is a Front-end Component. It Provides GUI to interact with the cloud.

(ii) **Application** ⇒ The application may be any flow or Platform that a client want to access.

(iii) **Service** ⇒ A cloud services manages that which type of service you access according to the client requirment. Three type of services:-

a) **Flow as a Service (SaaS)** ⇒ It is also know as cloud application services. mostly SaaS application run directly through the web browser means we do not require to download and install these applications.

b) **Platform as a Service (PaaS)** ⇒ It is also know as cloud platform services. It is quite similar to SaaS, but the difference is that PaaS provides a platform for flow creation, but using SaaS, we can access flow over the internet without the need of any platform.

c) **Infrastructure as a Service** ⇒ It also know as cloud Infrastructure service. It is responsible for managing application data, middleware, and running environment.

(IV) Runtime cloud ⇒ Runtime cloud Provides the execution and runtime environment to the virtual machines.

(V) Storage ⇒ Storage is one of the most important components of cloud computing. It Provides a huge amount of storage capacity in the cloud to store and manage data.

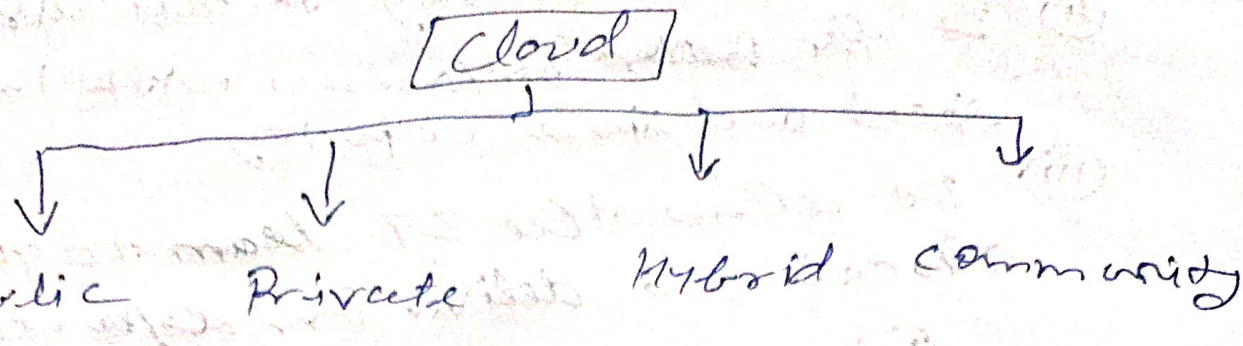
(VI) Infrastructure ⇒ It Provides services on the host level, application level, and network level. cloud Infrastructure includes hardware and S/W component such as servers, storage, network device, and other storage resource that are needed to support the cloud computing model.

(VII) Management ⇒ Management is used to manage component such as application, service, runtime cloud, storage, Infrastructure, and other security issues in the backend and to establish coordination b/w them.

(VIII) Security ⇒ Security is an in built back end component of cloud computing.

(IX) Internet ⇒ The Internet is a median through which front end and back end can interact and communicate with each other.

## Type of cloud ⇒




(I) **Public cloud** ⇒ Public cloud is open to all to store and access information via Internet using the "pay-per usage" method. In Public cloud, computing resources are managed and operated by the cloud-service-Provider.

advantage ⇒
(I) Low cost
(II) maintain by cloud service-Provider so no need to worry about maintenance.
(III) location Independent.
(IV) highly Scable

disadvantage ⇒
(I) Less Secure (share Publically)
(II) Performance depends upon the high speed Internet

(II) **Private cloud** ⇒ Private cloud is also known as an Internal cloud or corporate cloud. It is used by organization to build and manage their own data centers internally or by the third party. Based on the location and management, National Institute of standards and Technology (NIST) divide Private cloud into the following two Parts:-
a) On Premise Private cloud.
b) outsourced Private cloud.

advantage ⇒ (I) It is a high-level of Security and Privacy to the users.

(II) It offer Better performance with Improved speed and space capacity.

(III) It allow the IT team to quickly allocate and deliver on-demand IT resources.

(IV) The organization has full control over the cloud.

disadvantage ⇒ (I) Skilled people are required to manage and operate cloud services.

(II) Private cloud is accessible with in the organization, so the area of operations is limited.

(III) private cloud is not suitable for organization that have a high use base, and organization that do not have the prebuilt infrastructure, sufficient manpower to maintain and manage the cloud.

(VI) Hybrid cloud ⇒ Hybrid cloud is a combination of the public cloud and private cloud. Hybrid cloud is partially secure because the services which are running on the public cloud can be accessed by anyone, while services which are running on a private cloud can be accessed only by the organization's users.

advantage => (i) It is suitable for organizations that require more security than the public cloud.

(ii) It help you to deliver new product and services more quickly.

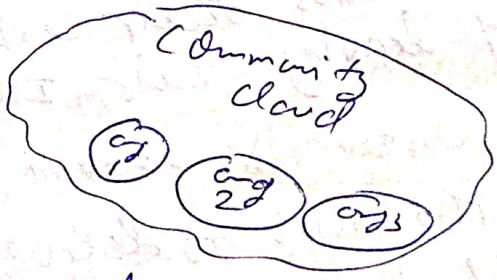
(iii) It provides an excellent way to reduce the risk.

(iv) It offer flexible resources.

disadvantage => (i) Security feature is not as good as private cloud.

(ii) managing a hybrid cloud is complex.

(iv) Community cloud => community cloud allows systems and services to be accessible by a group of several organization to share the information b/w the organization and a specific community. It is owned, managed and operated by one or more organizations in the community, a third party, or a combination of them.




advantage => (i) It is cost effective (share by various organizations)

(ii) It is suitable for organization that want to have a collaborative cloud with more security features than the public.

(iii) It provide better security to public

(iv) It provides collaborative and distributive environment.

(iv) Community cloud allow us to share cloud resources, Infrastructure etc

Disadvantage ⇒ (I) It is not not a good choice for every organization

(II) Security is not good as compare to Private.

(III) It is not suitable if there is no collaboration

(IV) The fixed amount of data storage and bandwidth is shared among all community member.

AWS ⇒ (Amazon web Services) ⇒ The AWS Services is Provided by the Amazon that uses distributed IT resources available on demand. It Provides different Services such as infrastructure as a Service (IaaS), PaaS, and SaaS. Amazon launched AWS, a cloud computing platform to allow the different organizations to take advantage of reliable IT Infrastructure.

Use of AWS ⇒ (I) A Small manufacturing organization uses their expertise to expand their business by leaving their IT management to the AWS.

(II) A Large enterprise spread across the globe can utilize the AWS to deliver the training to the distributed workforce.

Advantage ⇒ (I) Flexibility

(II) Cost-effectiveness

(III) Scalability / Elasticity

(IV) Security

Feature of AWS ⇒ (I) Flexibility
(II) Cost-effective
(III) Scalable and elastic
(IV) Secure
(V) Experienced

Bitcoin
Ethereum
Litecoin, Ripple

→ cryptographic wallets.

or user can also buy the currencies from brokers. Then spend and spend them using

Cryptocurrency ⇒ Cryptocurrency (also know as crypto) is a digital currency designed to work as a "medium of exchange". It uses cryptography to secure and verify transaction, as well as to control the creation of new units of a particular digital currency. Many cryptocurrencies are built on blockchain technology, which is a distributed ledger enforced by a distributed network of computer. "Bitcoin is first cryptocurrency"

It is any form of currency that exists digitally or virtually and uses cryptography to secure transaction. Cryptocurrencies don't have a central issuing or regulating authority, instead using a decentralized system to record transaction and issue new units.

* Not required to bank to verify transaction.

"A cryptocurrency is a virtual or digital currency that can be used to buy goods and services; which implies there's no physical coin or bill used and all the transaction take place online.

"It is a purely virtual line of currency that runs on the system of cryptography"

It is a digital currency, which is an alternative form of payment created using encryption algorithm.
It is sorted in a digital algorithm.

uses ⇒

(I) cryptocurrencies open up access to financial services for users around the world.

(II) Ethereum was the catalyst for the growth of the crypto space into an industry through the ERC20 standard.

(III) IOTA aims to develop use cases for the Internet of things in real life.

(IV) Asset-backed tokens grant ownership to assets such as real estate and precious metals.

(V) Stablecoins are increasing in popularity because they trade at parity with fiat currencies.

How to buy ⇒

(I) Step 1: choosing a platform
decide which platform is use
a) Traditional Brokers
b) cryptocurrency exchanges

(II) Funding your account
Provide fund to purchase crypto

(III) Placing an order

(IV)

Use of cryptocurrency ⇒

(I) Payment mode

(II) Investment

Benefits of cryptocurrency ⇒

(I) In contrast to, say, the price for moving money from a digital wallet to a bank account, the transaction cost with cryptocurrencies is minimal to non-existent.

(ii) There are no time restrictions on transaction, so you can conduct them whenever you choose during the day or night: no paperwork for opening an account and etc.

(iii) More quickly than wire transfer, international bitcoin transaction are also possible.

**Emerging Technology** => It is a term generally used to describe a new technology, but it may also refer to the continuing development of an existing technology; it can have slightly different meaning when used in different area, such as media, business, science or education.

**Augmented Reality (AR)** => AR is the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects". It is this "real world" element that differentiates AR from virtual reality. AR allows virtual objects to be overlaid in real-world environments in real-time. "Augmented Reality is defined as the technology and methods that allows overlaying of real-world object and environments with 3D virtual object using an AR device, and allow the virtual to interact with the real-world objects to create intended meanings.

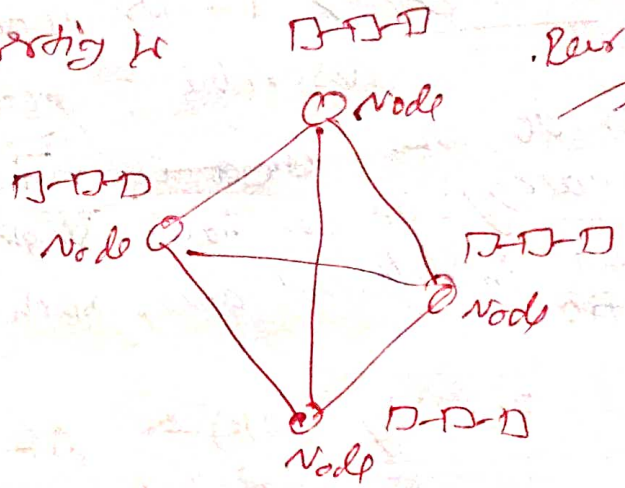
# Blockchain =>

## Features =>

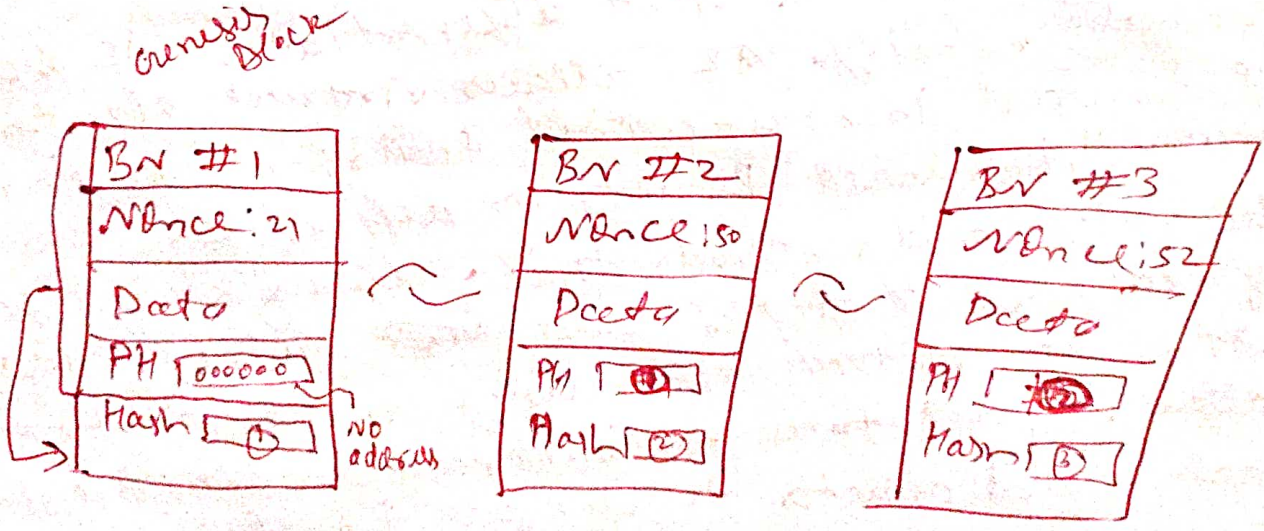
(i) Peer-to-Peer Network
(ii) Decentralized
(iii) immutable (Read only not modifying)
(iv) No hacking
(v) Security (Hash formate)
(vi) Data Availability

* Only reading and inserting is possible.

Peer to Peer Network




## Blocks => Blocks in Blockchain =>




BN - Block No.

Nonce (नाउनस) (Only Number use only once)

PH - Privious hash

Hash value :=> "unique identity" : each Block have a unique Id. (64-character (Hexadecimal value)

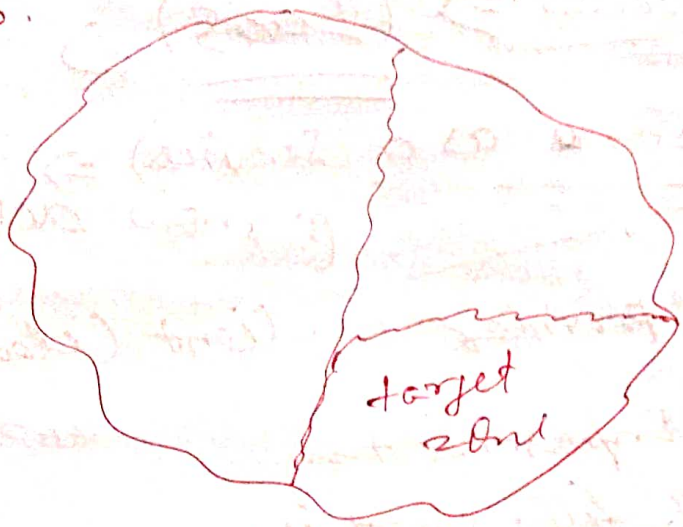
[0 – 9 A – F] = 16 ~~characters~~ bit

* Input of hash f^n (BN + Nonce + Data + PH) (any length as input)
↓ transform to fixed length
[Hash value] output of hash f^n. 64-character

Nonce (নাম্বার) ⇒ (Brute - Force method) try / Error

* complex
* an arbitrary no. given in cryptography to different the blocks hash address.

Hash value universe




Mining ⇒
⇓
miners are generate a Hash value.

| |
|---|
| BN |
| Nonce |
| Data |
| PH |
| Hash |

16-bit

64 bit character (Hexadecimal)

miners (try and error)
* Rewards (if successful)
* Power supply more (Power consumption)
* High computation system.

Cloud Computing => "On demand services" Provides via Internet"

* ~~Clouds~~ cloud Provider.
* "Pay as you go"
* Security
* Maintenance

"It is the use of remote servers on the internet to store, manage and process data rather than local servers."

Service model => (I) (IaaS) =>

(Infrastructure as a Service) =>

(I) more access

Cloud Provider — Client (cloud client)

* empty Infrastructure
* How to fill, what is use, How to use all depend on client.
* utilized, security all managed by client.

Benefit of IaaS =>

(I) O.S (depend on client)

(II) Virtual m/c & storage

(III) IP address (Provided by cloud Provider)

(IV) Provide Infrastructure

(V) Enchanced Scalability

(VI) Flexibility.

AWS Login
↓
Compute
↓
EC2

How to use as a web server, data server etc.

(II) PaaS => (Platform as a Service) =>

(I) OS (not choice to OS by client)
(II) UI (Only use Interface Service is Provided by Provider).
(III) Running Environment & deployment tools.
(IV) Developers use it
(V) No need to purchase expensive H/w & S/w.
(VI) Provide Programming language.
(VII) Simply develop a S/w using the tools via Internet.

* No need to Purchase S/w & H/w.
(1) less access as compare to IaaS

(III) SaaS (S/w as a Service) =>

Benefit of SaaS => (I) On demand
(II) End users/ clients (Not technical knowledge)
(III) No need to install on PC
(IV) Servers/ Resources managed by vendor
(V) Platform Independent.

* Only use the S/w as a Service and Provide money to the vendor. not need to know How to implement that S/w. & Very less assets.
* only access via Internet
* O.S. type is not compulsory.
* not Provide and Control to client.

## Characteristics of cloud Computing ⇒

(i) Cost Reductions
(ii) Device & location Independence
(iii) maintenance
(iv) On-demand Self Service (How much, what, which on.
(v) Security
(vi) Reliability

## Benefits of Cloud computing ⇒

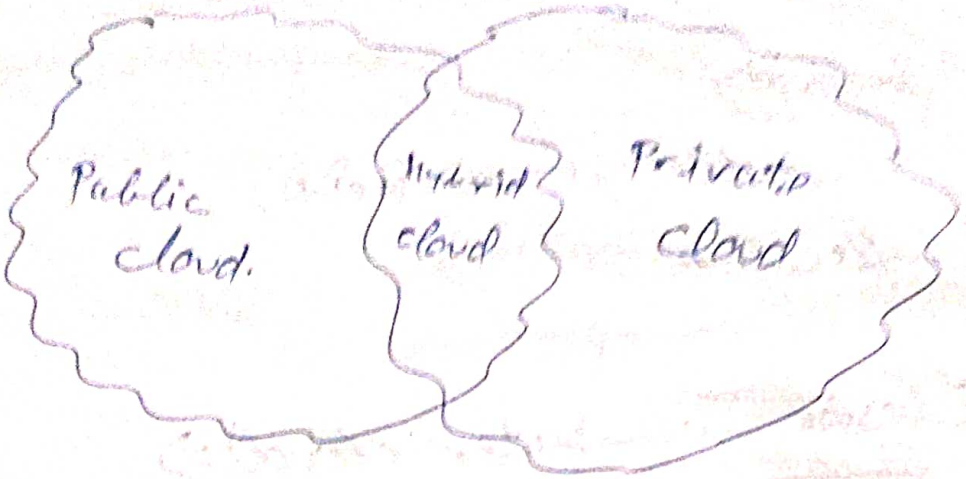
(i) Reduced Investment. — use cloud Provider for Reduced Investment.
(ii) Increased Scalability. इकेलो निर्भरता
(iii) Increased availability and Reliability.

Resources is scale up and scale down is Provided by Provider. when load is less then scale down and when load is more then scale up. On the basis of Resources and utilization as for the demand.

* Server and Services always available.
* Resources always available.

Cloud computing uses a client-server architecture to deliver computing resources such as servers, storage, database, and s/w over the cloud with pay-as-you-go pricing.

# Cloud computing models => (Deployment models)




**Public** =>
- open for all.
- deployed Globally
- Security / Privacy less
- cost less
- Customization less

**Private** => (i) only particular organization / institute,
- deployed locally.
- Security / Privacy more
- cost High
- Customization High

**Hybrid** => (i) cost efficient
(ii) Security / Privacy more as compare to Public.
(iii)

**AWS (Amazon web Services)** => "a Globale cloud Platform".
- "Pay as you go" model use by AWS.
- Secure cloud service platform.

## Benefits of AWS ⇒

(i) Flexibility
(ii) Security
(iii) Scalability (स्केलेबिलीटी)
(iv) cost effective

## EC2 (Elastic computer cloud) ⇒

AWS have different domain
- → computing
- → Storage
- → Security
- → database
- → Analytic
- → etc

In all domain AWS Provide security (Services) to each domain.

* EC2 is a service billing to compute domain in AWS.
* It is a service
* Provide secure and 'resizable' computer capacity in cloud (developer case)

Feature ⇒
* Scaling (Instances scale up and down.)
* Integrated with other services.
* Pay for what you use.
* Instances can be launched in one or more Regions and AZs (availability zone)
* Support for different O.S.

Grid Computing => Grid computing is also called as "distributed computing". It links multiple computing resources CPC, workstation, servers, and storage elements together and provides a mechanism to access them. The main advantage of grid computing are that it increases user productivity by providing transparent access to resources and work can be completed more quickly.

| Cloud | Grid |
|---|---|
| (I) use client-server Architecture (I) Interoperability | (I) distributed computing Architecture (II) network |
| (II) Scalability high | (II) Low / Normal |
| (III) more flexible then Grid | (III) less flexible then Cloud |
| (IV) Centralized management/processing | (IV) Decentralized management/processing |
| (V) It is service-oriented | (V) Application oriented |
| (VI) Cloud servers are owned by infrastructure provider | (VI) Grids are owned and managed by the organization. |

Grid Computing is a computing Infrastructure that combines computer resources spread over different geographical location to achieve a common goal. All unused resources on multiple computer are pooled together and made available for a single task. Organization use grid computing to perform large task or solve complex problem that are difficult to do on a single computer.

## Benefit of Grid Computing ⇒

(I) **Efficiency** ⇒ you can break down an enormous, complex task into multiple subtask. Multiple computers can work on the subtask concurrently, making grid computing an efficient computational soln.

(II) **Cost** ⇒ Grid Computing work with existing hardware, which means you can reuse existing computer. you can also cost-effectively access resources from the cloud.

(III) **Flexibility** ⇒ Grid computing is not constrained to a specific building or location. you can set up a grid computing network that spans several regions.

Uses of Grid Computing ⇒

(i) Financial Services
(ii) Gaming
(iii) Entertainment
(iv) Engineering

Grid Computing can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine. All machines on that network work under the same protocol to act as a virtual supercomputer. Grid computing is a subset of distributed computing.

Working ⇒ A Grid Computing network mainly consists of these three type of machines.

a) Control Node ⇒ A computer, usually a server or a group of servers which administrates the whole network and keeps the account of the resources in the network pool. (control node manage everything in network) Resources (Single computer or group of computers)

b) Provider ⇒ The computer contributes its resources to the network resource pool. (Provide resources for use)

c) User ⇒ The computer that uses the resources on the network. (use the resources)

⇒ No switch b/w provider & user is possible.

or (unity in separate Power)

* Each unit of system have its own capability and Resources.
* They are work together to complete a specific task. (achieve a specific goal).
* Complex task / high computation task
* Each computer in a network is called a Node.

Middleware ⇒ It run on central node to administrate / ~~[illegible]~~ overload / security. all their operation is handle by middleware. task distribution is perform by middleware.

every process is passed via verify process, so check the process is correct or not. if not correct then not executed.

* all system configuration same then called Homogenious Network. if system have different configuration then called Hetrogenious Network.

| CC | GC |
|---|---|
| (I) Client - Server model | (I) Distributed model |
| (II) CMS (centralized management | (II) DMS (Distributed management system) |
| (III) Resources are used in unutilized manner | (III) Resources are used in collaborative manner. |
| (IV) High Accessibility | (IV) low Accessibility |
| (V) 'Pay as you go' | (V) No need of money |
| (VI) IaaS, PaaS, SaaS | (VI) D.C / D.I (Distributed computing / Distributed Interface) |

| AWS (Amazon web Service) | Microsoft Azure (रेजपोर) | Google Cloud Platform |
|---|---|---|
| (I) 2006 official launched. (2002 in market) | (I) 2010 officially 2008 declear | (I) 2011 officially (2008 declear) |
| (II) market share 33% / 47% current | (II) 18% / 10% current | (II) 8% / 4% current |
| (III) Availability zone 76 Regions: 24 & 235 countries | (III) Availability zone :- 52 Region :- 60+ & 140+ countries | (III) Availability zone :- 61 Region :- 22 |
| (IV) customer :⇒ mcDonald's, MI, Netflix, ESPI, BMW, Samsung. etc. unilever. | (IV) Customer :⇒ Fortune base 80% company, Ebay, Apple, HP, PIXAR Honeywell. etc | (IV) HSBC, HTC, Phillips, Snapchat Mortuly, Gmail. |
| (V) Services :- 212+ Services & for computation & database large & use different engine to switch b/w two database engine & multiple option. | (V) 100+ Services & | (V) 60+ Services & faster computation & |
| (VI) Price ⇒ & Basic ⇒ High for short term & less for long term | (VI) Price ⇒ High for short term & more high for long term | (VI) Price ⇒ less for short term & High for long term |

Green Computing => Green => Environment
Computing => Processing.

"Environment Friendly Computing"

How they Provide benefit =>

(I) Cloud Computing => single Resources can used by multiple users at a time.

(II) e-waste dispose Properly (During the designing use the material type is not much more harm to the Environment.

(III) Recycle easily.

(IV) Reduced paper consumption. (by saving each document electronically)

(V) LCD/LED use.

(VI) old machine replace by new machine.

* Green Computing is the Environmentally responsible and eco friendly use of computers and their resources.

* Green designing
* Green manufacturing
* Green disposal
* Green usage.

* UPgrade data centers
* Power management
* Computer Selection
* Alternative energy
* Power down.
* Refurbish existing device
* Refill Printer cartridge. etc.

* A way of designing, Producing using and discarding IT Products that is sensitive to the environment.

Virtual Reality ⇒ "Virtual Reality is a computer generated simulation of an alternate world or reality." It is used in 3D movies and video games. "It helps to create simulations similar to the real world and "immerse" the viewing computers and sensory devices like headsets and gloves.

| AR | VR |
|---|---|
| (i) The system augments the real-world scene. | (i) Completely immersive virtual environment. |
| (ii) In AR user always have a sense of presence in the real world. | (ii) In VR visual senses are under control of the system. |
| (iii) AR is 25% virtual and 75% real | (iii) VR is 75% virtual and 25% real. |
| (iv) This technology partially immerses the user into the action. | (iv) This technology fully immerses the user into the action. |
| (v) AR required upwards of 100 Mbps bandwidth. | (v) VR required at least a 50 Mbps connection. |
| (vi) No AR headset is needed. | (vi) Some VR headset device is needed. |
| (vii) With AR, end users are still in touch with the real world while interacting with virtual object nearer to them | (vii) By using VR technology, VR user is isolated from real world and immerses himself in a completely fictional |
| (viii) It is used to enhance both real and virtual world. | (viii) It is used to enhanced fictional reality for the gaming world. |

(1)

| On Premise | IaaS | PaaS | SaaS |
|---|---|---|---|
| Application | client | client | other / Service Provider |
| Data | client | client | Service Provider |
| Runtime | client | Service Provider | Service Provider |
| middleware | client | Service Provider | Service Provider |
| O/S | client | " | Service Provider |
| Virtualization | Service Provider | " | Service Provider |
| Servers | " | " | Service Provider |
| Storage | " | " | Service Provider |
| Networking | Service Provider | Service Provider | Service Provider |
| Staff/y | Infrastructure | Infrastructure or Paas | Software as a Service |

middleware ⇒ user and hardware connection created by middleware.

| | | | |
|---|---|---|---|
| OS | used by network administrator | used by developer | used by user |

runtime: Compiler / Interpreter.

virtualization ⇒ use vertical environment:

SaaS - Any App.

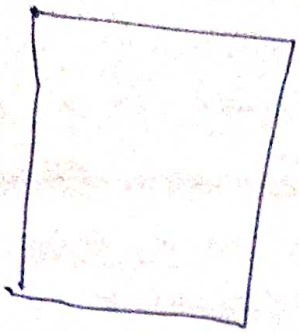
PaaS - use by developer.

AWS ⇒ Two Region: (I) AZ (Availability zone) — Physical.
↓
set of data center

In India. Only one

(II) Region:
↓
Physical geographical location

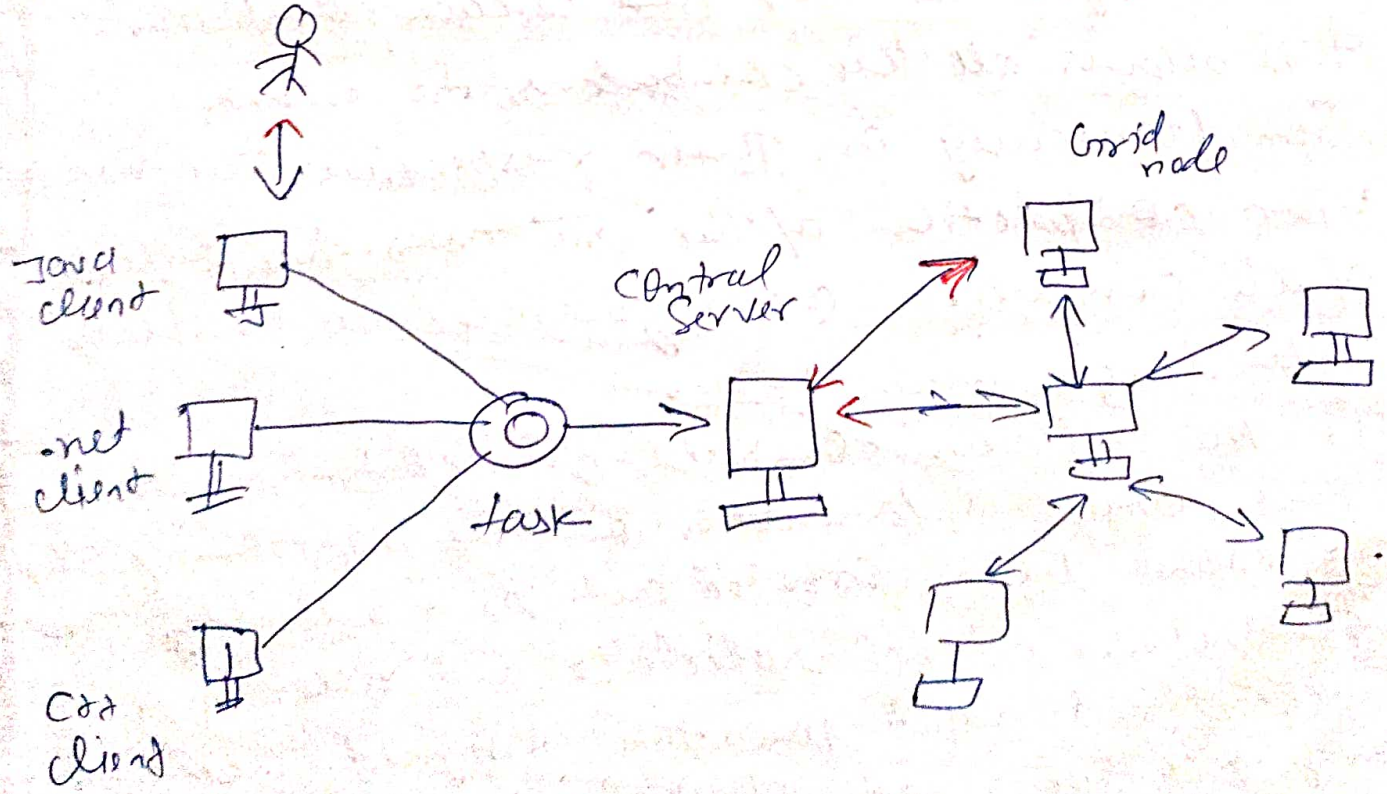
Each Region have availability zone and AZ have a set of data center.



Region
↓
AZ
↓
datacenter

**Grid Computing** => Grid computing is a distributed architecture of multiple ~~computers~~ computers connected by a network to accomplish a joint task. These task are computer intensive and difficult for a single machine to handle. Several machine on a network collaborate under a common protocol and work as a single virtual supercomputer to get complex task done.

**How Grid computing working** =>



A typical grid computing network consists of three machine type:-

a) Central node / Server => A central node is a server or a group of servers that administers the "entire network and maintains the record for resources in a network pool."

b) Provider / grid node => A Provider or grid node is a computer that contributes its resources to the network resources pool.

Nw or networking protocol middleware

c) User => A user refers to the computer that uses the resources on the network to complete the task.

Grid computing operates by running specialized s/w on every computer involved in grid network. The s/w coordinates and manages all the tasks of the grid. Fundamentally the s/w segregates the main task into subtask and assigns the subtasks to each computer. This allows all the computers to work simultaneously on their respective subtasks. Upon completion of the subtasks, the outputs of all computers are aggregated to complete the larger main task.

The s/w allows computers to communicate and share information on the portion of the subtask being carried out. As a result, the computers can consolidate and deliver a combined output for the assigned main task.

In grid computing, each computing task is broken into small fragments and distributed across

computing nodes for efficient execution. Each fragments is processed in parallel, and, as a result, a complex task is accomplished in less time.

## Key component of Grid computing ⇒

(i) User Interface
(ii) Security
(iii) Scheduler
(iv) Data management
(v) workload & resource management.

(i) **User Interface** ⇒ The interface has a portal style to help users query and execute various functions on the grid effectively.

(ii) **Security** ⇒ Security mechanism can include authentication, authorization, data encryption and other.

(iii) **Scheduler** ⇒ A Scheduler may not be needed if standalone tasks are to be executed that do not showcase interdependencies.

(iv) **Data management** ⇒ Data management is crucial for grid environments. It offers a data management component called grid access to secondary storage. It include GridFTP built on standard FTP protocol and utilize GSI for user authentication and authorization.

(v) **workload & resource management** ⇒ It interacts with the workload manager to determine the resource availability and update the status accordingly.

## Quantum Computing ⇒

bit
0 or 1

* qubit
  0 and 1
* Entanglement (जुड़ा होना) (virtual relation b/w two if one if effected then other is also effected.
* quantum Interference
  ↓
  ↑ Increase some property
  ↓ decrease some property

Have you ever heard of a computer that can do things regular computer can't? These special computers are called quantum computers. In normal computer we use 0 or 1 bit for on or off. but a qubit can be both zero or one at the same time. It means quantum computers can do many things at

Once and work much faster than regular computer.

quantum computers use a unit called a qubit to process information. A qubit is similar to bit, but it has unique quantum properties such as "superposition" and "entanglement." This means that a qubit can exist in both the one and zero state at same time. This allows quantum computers to perform certain calculation much faster than classical computer. In a real quantum computer, qubit can be represented by various physical system, such as electrons with spin, photons with polarization, trapped ions, and semiconducting circuits. With the ability to perform complex operation exponentially faster, quantum computer have the potential to revolutionize many industries and solve problems that were previously thought impossible.

① quantum superposition => qubits can do something really cool, they can be in two states at the same time. It's like having two helpers working on a task instead of just one. This means quantum computer can do many things at once and work much faster than regular computers. This special ability is called quantum superposition and its what make quantum comp

(ii) Quantum Entanglement ⇒ we know that qubit can be in two states at the same time? well, sometimes those qubit can become special friends and work together even when they are far apart! This is called quantum ~~entanglement~~ entanglement. Its like a secret connection b/w qubits. This is really important for quantum computers because it allows them to perform certain calculations much faster than regular computers and to communicate faster too.

disadvantage ⇒ (i) Noise ⇒ quantum systems are extremely sensitive to their environment and any noise or disturbance can cause error in the computation.

(ii) Scalability ⇒ Building a large-scale quantum computer with a large number of qubits is ~~other~~ extremely difficult, as it required the ~~[illegible]~~ precise control of a large number of quantum system.

(iii) Error correction ⇒ In quantum computing, the errors are much difficult to detect and correct, due to the nature of quantum systems.

(iv) High cost

(v) Power consumption.

Brain Computing ⇒

(BDA)

Big data Analytics ⇒ data may be structured unstructured, semi structured, different sources, different format different size, Process these data in faster and better decision making.

* Resources ⇒ Utilize Resources properly and manage ways. in BDA.
* Hidden Pattern is discover by Big data Analytics.
* unknown co-relation ⇒ It is also discover by Big data Analytics.
* Customer preferences & behaviour is also disclosed by BDA.
* Market / future trends is also discover by BDA.

| Classical Computing | quantum Computing |
|---|---|
| (I) It is large scale Integrated multi-purpose computer | (I) It is high speed parallel computer based on quantum machanics. |
| (II) Information store in bit. | (II) Information store in bit based on direction of an electron spin (qubit) |
| (III) Information Processing is carried out by logic gates. (AND, NOR, XOR etc) | (III) Information Processing is carried out by quantum logic gates. |
| (IV) circuit behavior is governed by classical Physics. | (IV) circuit behavior is governed explicitly by quantum mechanics. |
| (V) bit 0 or 1 Represent information | (V) quantum computer use qubit (0, 1 and both of them simultaneously to run machines faster |
| (VI) No Restriction exist on copying or measuring signals | (VI) Severe restriction exists on copying and measuring signals. |
| (VII) Circuits are easily implemented in fast. | (VII) circuits must use microscopic technology that are slow and not yet scalable. |
| (VIII) Classical computing is best suitable for the daily processing | (VIII) It is best appropriate for data analysis. |
| (IX) It has less error rate. | (IX) It has high error |
| (X) It operates at room temperature | (X) It operates at zero temperature |
| (XI) ~~much secure~~ less secure work with | (XI) much secure work with |
| (XII) | |

quantum computing => It is a new generation of technology that involves type of computer 158 million times faster than the most sophisticated super computer.

It is a device so powerful that it could do in four min what it would take a traditional super computer 10,000 year to accomplish.

* quantum theory is deal with atoms and the subatomics particles inside them.

* quantum particles can exist in multiple states at the same time. This is known as superposition.

* quantum computer use something called quantum bits, "qubits" for short.

* A qubit can be a one, a zero or it can be both at the same time.

This means that a quantum computer does not have to wait for one process to end before it can begin another, it can do them at the same time.

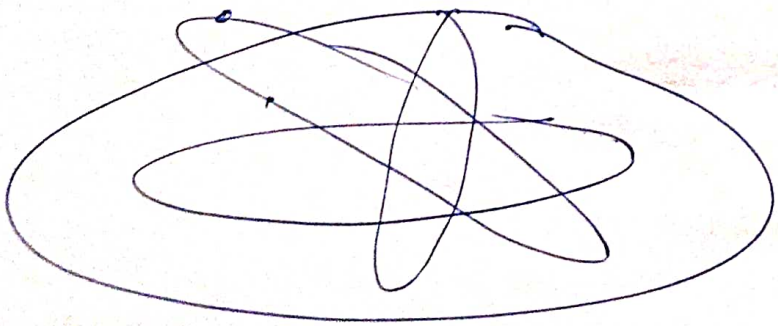
* when two quantum particles are entangled, they form a connection to each other no matter how far apart they are. when you alter one, the another responds the same way. even if they are thousands of miles apart

atoms
↓
subatom
↓
electrons or photons

**Superposition** => qubits can represent numerous possible combination of 1 and 0 at the same time. This ability to simultaneously be in multiple state is called superposition.

The final result of a calculation emerges only once the qubits are measured, which immediately causes their quantum state to "collapse" to either 1 or 0.

**Entanglement** => It means the two member of a pair exists in a single quantum state. changing the state of one of the qubits will instantaneously change the state of the other one in the predictable way. This happens even if they are separated by very long distance.



**Brain Computing** => (BC Interface) => (BCI)

BCI is a type of interface with connection Human Brain with the computer.

"neurons"