Cloud Computing

→ Cloud Computing :- It is the use of remote servers on the internet to store, manage and process data rather than local servers.

Why cloud Computing :-
- Reduces Cost
- More Storage
- having better work life balance

→ There are certain type of Services and models working behind the scene making the cloud computing feasible and accessible to end users.
- Deployment models
- ~~Ser~~ Service models.

- ~~Deploym~~ Deployment model :- Define the type of access to the cloud i.e how the cloud is located?

Cloud can have any of the four types of access :-
- Public
- Private
- Hybrid
- Community

- Service model :- are the reference models on which the cloud computing is based.
- IaaS (Infrastructure as a Service)
- PaaS (Platform as a Service)
- SaaS (~~Softw~~ Software as a Service)

→ IaaS :- Infrastructure as a Service
It provides access to fundamental resources such as physical machines, virtual machines, virtual storage

i) Operating System
ii) Virtual m/c & storage
iii) IP addresses
iv) Provides Infrastructure
v) Enhanced & Scalibility
vi) Flexible

→ PaaS :- Platform as a Service
It provides the runtime environment for application development & deployment tools etc.

i) UI
ii) Runtime Environment
iii) offers development & deployment tools
iv) Developers use it.
v) No need to purchase expensive H/w & S/w.

→ SaaS :- Software as a Service
This model allow us to use Software as a service to end users.

i) On demand
ii) End user/client
iii) No need to install on Pc
iv) Servers/Resources managed by Vendor
v) Platform independence.

→ XaaS :- Everything as a Service is a collective term that refers to the delivery of anything as a Service. It encompasses the many products, tools and technology that vendors deliver to users as a service over a network.

i) Everything / Anything
ii) Remote Access
iii) H/w, S/w, n/w, desktop, Infrastructure, Communication, OS
iv) Faster & Scalable
v) Cheap and Safe.

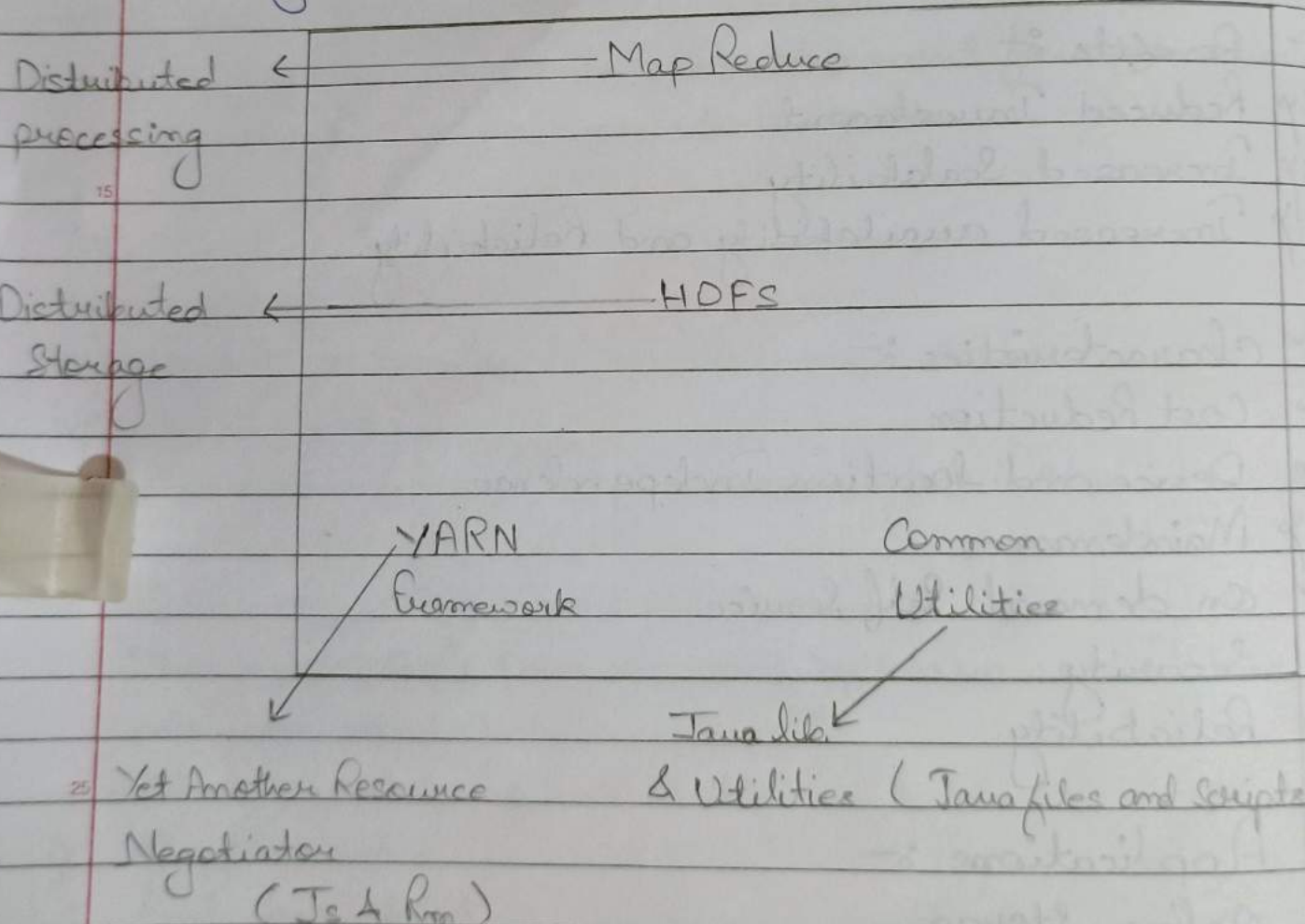
→ Benefits :-
i) Reduced Investment
ii) Increased Scalability
iii) Increased availability and Reliability.

→ Characteristics :-
i) Cost Reduction
ii) Device and location Independence
iii) Maintenance
iv) On demand Self Service
v) Security
vi) Reliability

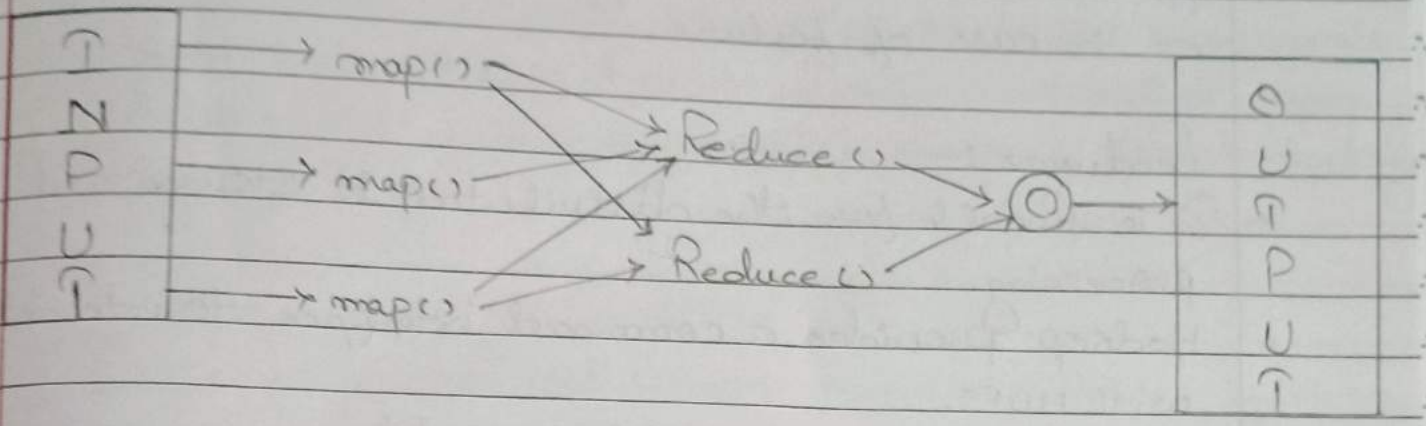
→ Applications :-
i) Online Storage
ii) Photo and Video editing S/w
iii) & Presentation S/w
iv) Finding way on map
v) Word processing Application

→ 7th What is Hadoop?

Ans:- Hadoop is an Apache open source framework written in java that allow distributed processing of large datasets across clusters of computers using simple programming models. The Hadoop framework application works in an environment that provides distributed storage and computation across clusters of computers. Hadoop is designed to scale up from single server to thousand of machines, each offering local computation and storage.



→ Map Reduce :-



One
- Master Job Tracker :-
  - i) Managing resources
  - ii) Scheduling tasks
  - iii) Monit Monitoring tasks

Many
- Slave task Tracker :-
  - i) Executes the task
  - ii) Provide task status

→ MapReduce is a processing technique and a program model for distributed computing based on java. It contains two important tasks, ~~or~~ namely map and Reduce. Map takes a set of ~~dat~~ data and converts it into another set of data, where individual elements are broken down into tuples. Secondly, reduce task, which takes the output from a map as an input and combines those data tuples into a smaller set of tuples.

The major advantage of MapReduce is that it is easy to scale data processing over multiple computing nodes.

→ HDFS :-

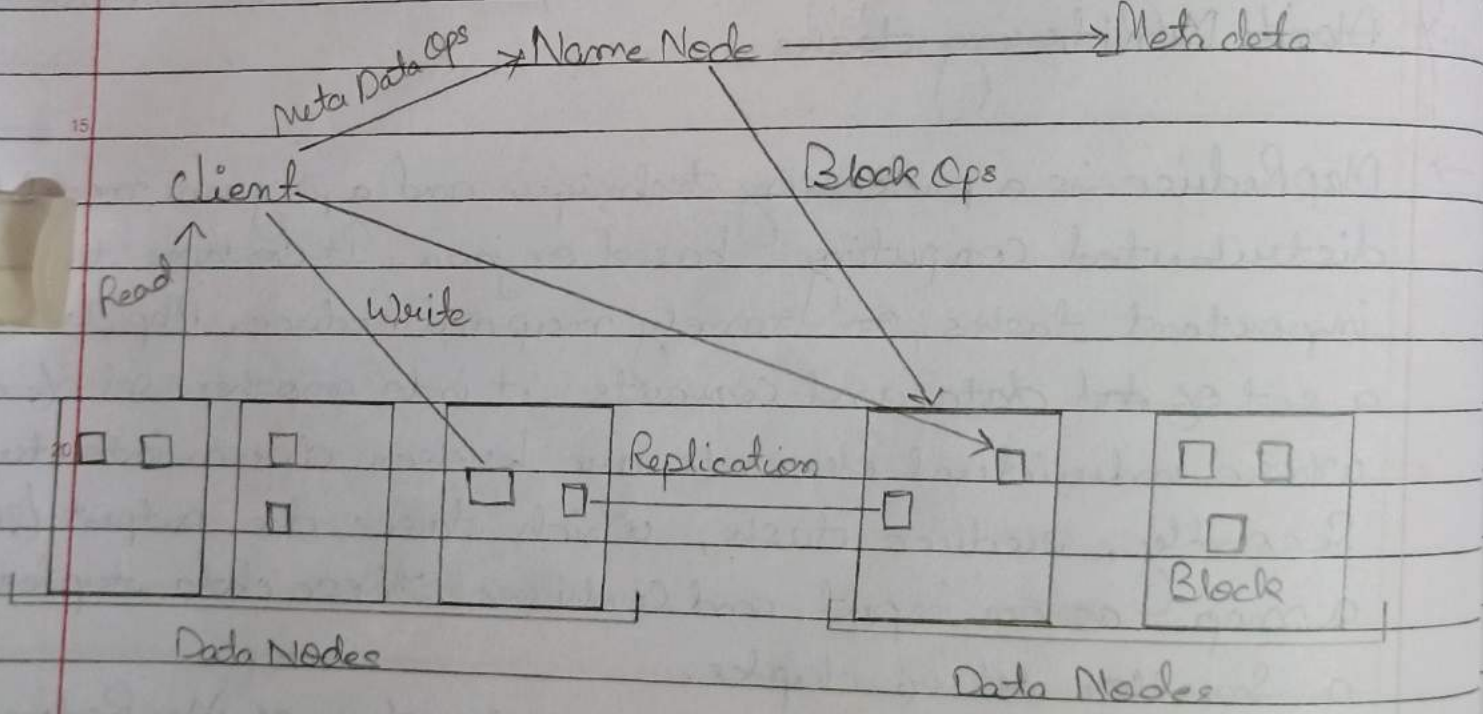
Hadoop file system was developed using distributed file system design. It is run on commodity hardware. It holds very large amount of data and provides easier access. These files are stored in redundant

fashion to rescue the system from possible data loss in case of failure.

Features :-

- It is suitable for the distributed storage and processing.
- Hadoop provides a command interface to interact with HDFS.
- Streaming access to file system data.
- HDFS provides file permissions and authentication.

Architecture :-



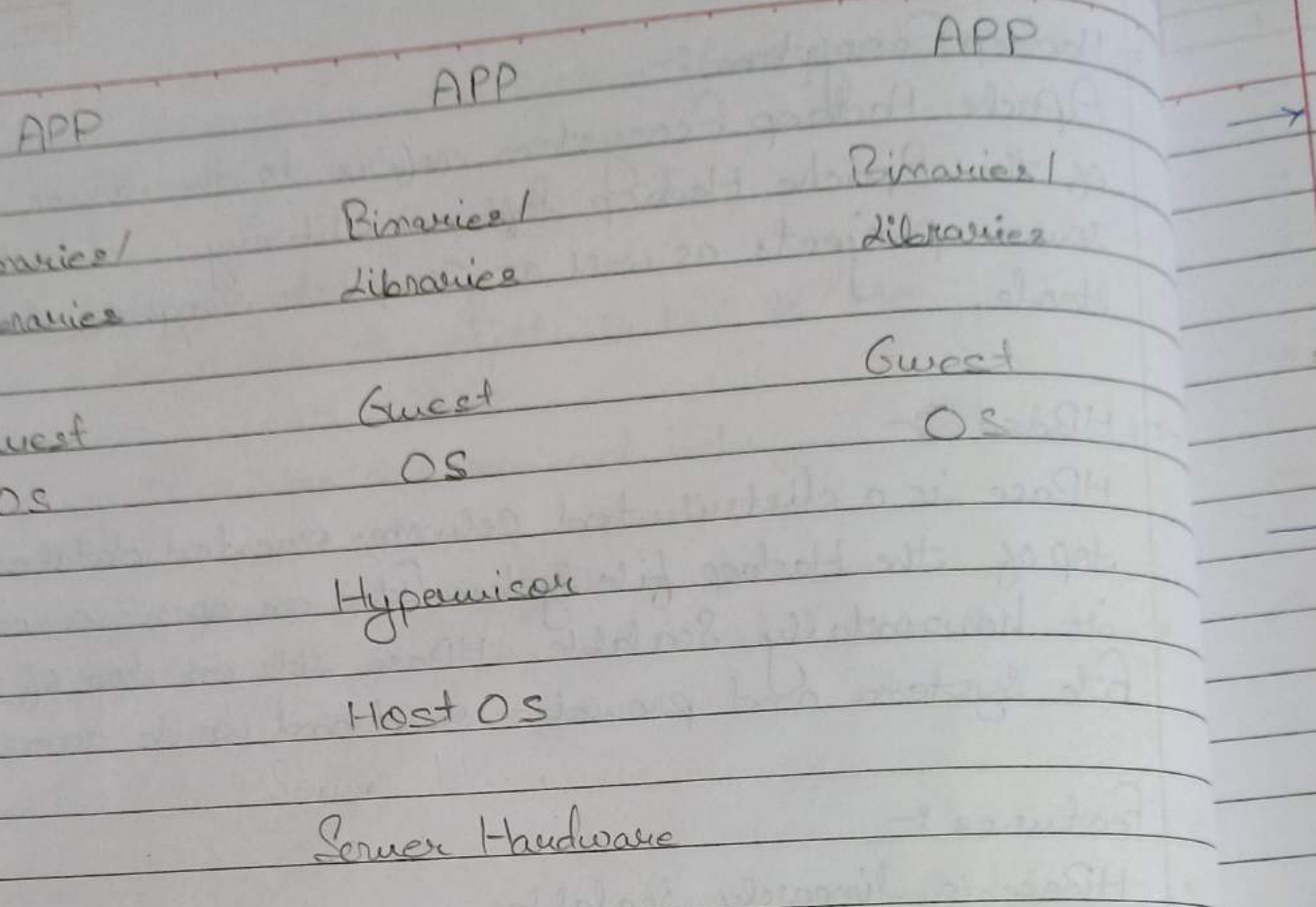
- Name Node - Node that manages the Hadoop DFS.
- Data Node - Node where data is presented in advance before any processing take place.
- Block - The user data is stored in the files of HDFS.

→ Hadoop Ecosystem :-
Apache Hadoop Ecosystem refers to the various components of the Apache Hadoop software library; it includes open source projects as well as complete range of complementary tools.

→ HBase :-
HBase is a distributed column-oriented database built on top of the Hadoop file system. It is an open-source project and is horizontally scalable. HBase sits on top of the Hadoop file system and provides read and write access.

Features :-
- HBase is linearly scalable.
- It has automatic failure support
- It provides consistent read and writes.
- It integrates Hadoop, both as a source and a destination.
- It has easy java API for client.
- It provides data replication across clusters.

→ Virtualization :- It is technique how to separate a service from the underlying physical delivery of that service. It is the process of creating a virtual version of something like computer hardware. It allows sharing of a single physical instance of a resource or an application among multiple customers or org. at one time.



Host Machine :- The machine on which the virtual machine is going to be built is known as Host machine.

Guest Machine :- The Virtual Machine is referred to as a Guest Machine.

→ Benefits :-

- More flexible and efficient allocation of resources
- Enhance development productivity.
- Remote access and rapid Scalability.
- Cost effective
- Security

→ AWS :- Amazon Web Services

It is a comprehensive, evolving cloud Computing platform provided by Amazon that includes a mixture of infrastructure as a Service, PaaS, SaaS.

→ AWS Global Infrastructure :-
It consist of multiple geographical locations which are called Regions. AWS regions are divided into Availability Zones which consists of one or more physically separated data centres.
It has 102 AZs within 32 geographical regions.

→ EC2 :- Elastic Compute Cloud
Provide servers and resizeable compute ~~Cap~~ Capacity in cloud. (developer ease)

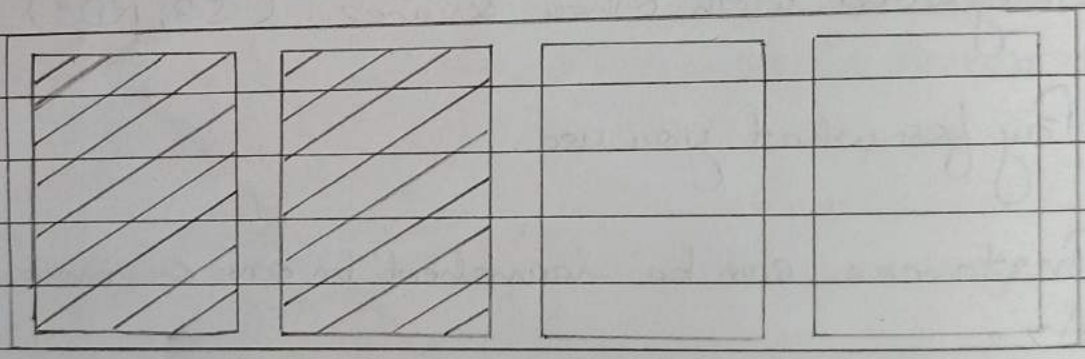
Benefits :-
1) Scaling. (Instances scaled up or down)
2) Integrated with other services. (S3, RDS)
3) Pay for what you use.
4) Instances can be launched in one or more Regions and AZs
5) Support for different OS.
6) Works with Amazon VPC to provide secure network to resources.

→ S3 :- ~~Simple~~ Simple Storage Service
Provides object storage which is ~~built~~ built for storing and recovering any amount of data from anywhere over the internet.

Benefits :-

i) Durability :
ii) Availability :
iii) Cost effective
iv) Scalability
v) Security
vi) Object consist of Data + Metadata.
vii) Bucket stores objects
viii) Data Encryption : To protect data when its being transmitted and also when at rest.

→ Auto Scaling :-
Auto Scaling monitors your applications and automatically adjusts capacity to maintain steady, predictable performance at the lowest possible cost.



Types :-
i) Manual Scaling
ii) Scheduled Scaling
iii) Dynamic Scaling

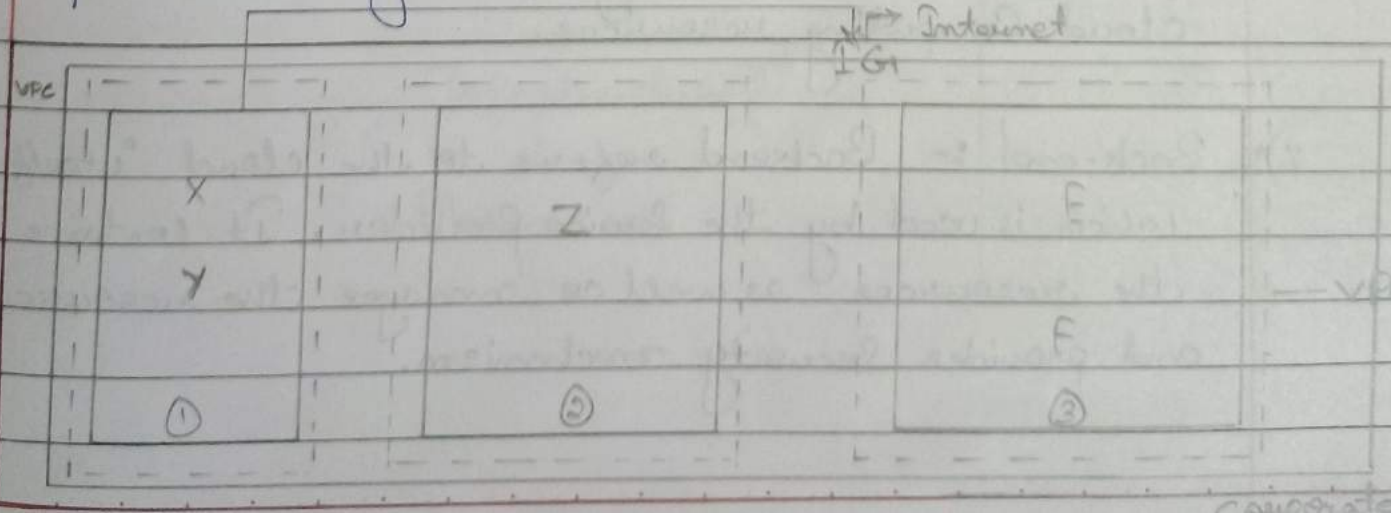
Benefits :-
i) Fault tolerance
ii) Availability
iii) Cost Management

→ Elastic Load Balancing :-
- Distribute Incoming traffic across multiple targets.
- Single or multiple AZs.

* Application LB : HTTP and HTTPs traffic
* Network LB : TCP and TLS traffic
* Classic LB : for application that were built with EC2 classic network.
{ Basic Load Balancing }

Benefits :-
i) High Availability
ii) Elastic : changes in traffic pattern
iii) Secure : works with VPC

→ VPC :- Virtual Private cloud.
- It is a virtual network dedicated to your AWS account.
- One can launch EC2 instances into their VPC
  i) Public Subnets - Connected to internet.
  ii) Private Subnets - not Connected to internet and etc.
  iii) VPN-only Subnets - Connected to VPG.



→ Cloud Ecosystem :-

i) CSN (Cloud Service Partner) → hardware, Software, Application Developer

ii) CSP (Cloud Service Provider) → SaaS, PaaS, IaaS

iii) CSU (Cloud Service User) → Consumer, Organisation.

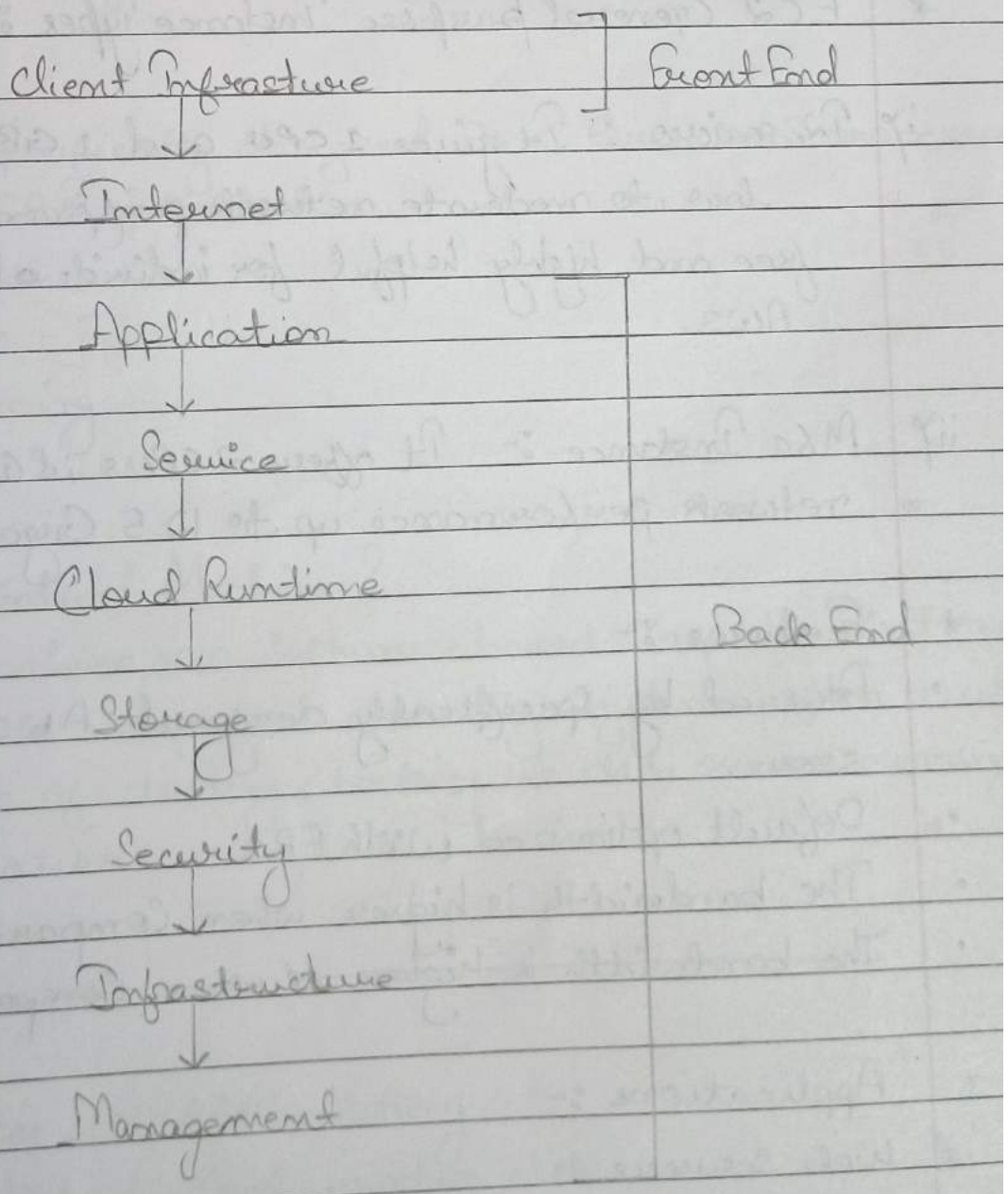
→ Cloud Computing Architecture :-
It is one of the demanding technology of the current time and which is giving a new shape to every organization by providing on demand virtualized resources. Transparency, Scalability, Security etc are some of the most important Constraints.

→ Two parts :-
i) Frontend
ii) Back end

i) Front-end :- Frontend of the cloud architecture refers to the client side of cloud computing System. Means it contains all the user interfaces and applications which are used by the client to access the cloud Computing resources.

ii) Back-end :- Backend refers to the cloud itself which is used by the service provider. It contains the resources as well as manages the resources and provides Security mechanism.

a) Appl' Application
b) Service
c) Runtime cloud
d) Storage
e) Infrastructure
f) Management
g) Security
h) Internet
i) Database
j) Networking
k) Analytics



→ Amazon EC2 instances Types :-

1. General Purpose Instances :- The Computation, memory and networking resources in general-purpose instances are balanced. General purpose Instances, are serving Servers, small databases etc. Assume you have an application with a kind of equal computing, memory and networking resource requirements. Because the program does not require optimization in any particular resource area, you can use General purpose instance to execute it.

* EC2 General purpose Instance Types :-

i) T2. micro :- It gives 1 CPU and 1 GB of memory with low to moderate network performance. It is also free and highly helpful for individuals first starting AWS.

ii) M6a Instance :- It offers 2 CPUs, 8 GiB memory and network performance up to 12.5 Gigabit.

* Features :-

- Powered by specifically designed AWS Graviton 3 processors.
- Default optimized with EBS.
- The bandwidth is higher when Compared to other types.
- The bandwidth is higher when Compared to other

* Applications :-

i) Web Servers
ii) Development and Test Environment
iii) Content Delivery.

2. Compute - Optimized Instances :- Compute optimized instances are appropriate for applications that require a lot of computation and help from high-performance CPUs. You may employ Compute-optimized instances for workloads including web, application, and gaming servers just like general-purpose instances.

* Ec2 Compute - Optimized Instances :-

i) C5d.24 large :- It has 96 CPUs, 192 GiB of RAM, 3600 GB of SSD ~~long~~ storage and 12 Gigabit of network performance.

* Features :-
- Powered by specifically designed AWS Graviton3 processors
- By default EBS optimization.

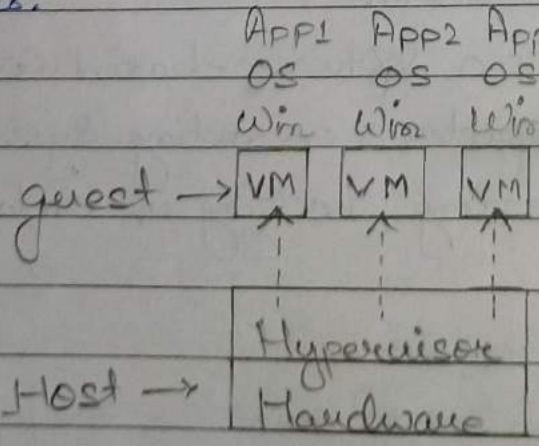
* Application :-
i) Machine learning
ii) Gaming

→ What is a Virtual Machine ?
A virtual machine is a Software-based computer that exist within another Computer's operating System, often used for the purposes of testing, backing up data on ~~the~~ running SaaS applications.
- guest machine
- host machine
- VMM
- Key files : log, NVRAM, Setting Virtual, Configuration disk
- Process VM
- System VM

→ Hypervisor :- A hypervisor
A hypervisor is a form of virtualization Software used in Cloud ~~Computing~~ hosting to divide and allocate the resources on various pieces of hardware. The program which provides partitioning, isolation or abstraction is called a virtualization hypervisor. The hypervisor is a hardware virtualization technique that allows multiple guest operating System to run on a single host System at same time. A hypervisor is sometimes called a virtual machine manager.

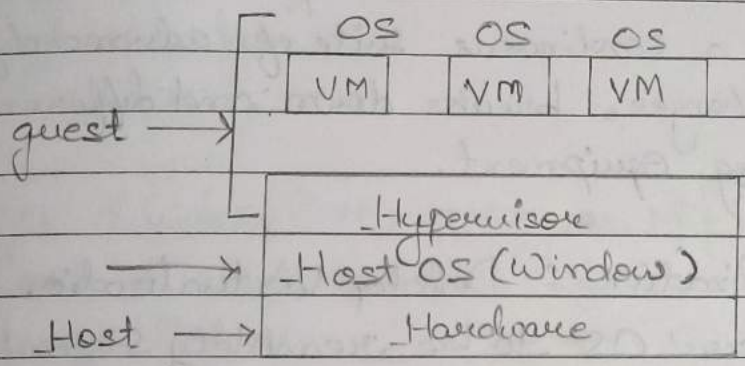
* Types of Hypervisor :-
i) Type - 1
ii) Type - 2

i) ~~The~~ Type - 1 :- ~~The hyperv~~ The hypervisor ~~runs~~ runs directly on the underlying host System. It is also known as a "Native Hypervisor" or "Bare Metal hypervisor". It does not require any base server operating System. It has direct access to hardware resources.

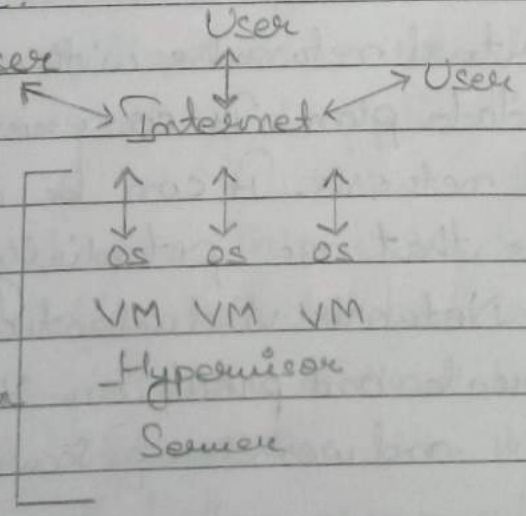


ii)

ii) Type-2 :- A host operating System runs on the underlying host system. It is also known as 'Hosted Hypervisor". Such kind of hypervisors doesn't run directly over the underlying hardware rather they run as an application in a Host System. Basically, the Software is ~~installed~~ installed on an operating System. Hypervisor asks the the Operating System to make hardware Calls.



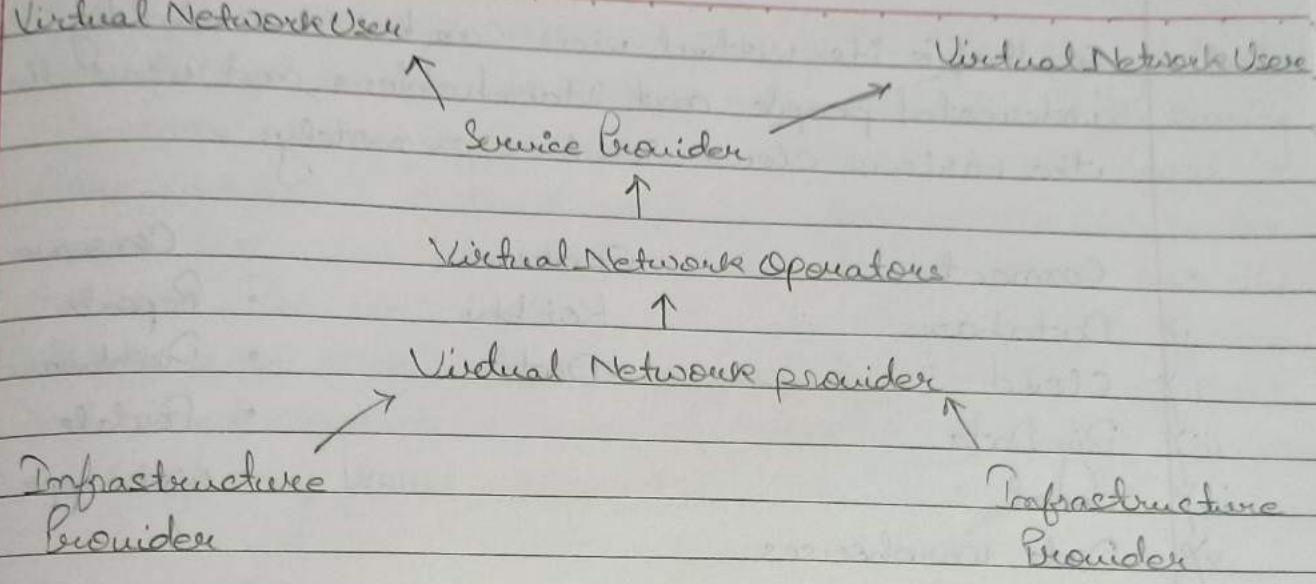
→ Server Virtualization :- Now migrate this concept to data Centers ~~where~~ where lot of Servers are available. Enterprise owning data centre provide resources requested by Customers as per their need. Data centres have all resources and on user request, particular amount of CPU, RAM, NIC and Storage with preferred OS is provided to users. This concept of ~~the~~ Virtualization in which Servers are requested and provided over Internet is Called Server Virtualization.



→ Storage Virtualization :- Storage Virtualization is an array of servers that are managed by a virtual Storage System. The Servers aren't aware of exactly where their data is stored and instead function more like worker bees in a hive. It makes managing storage from multiple sources be managed and utilized as a single repository. Storage Virtualization Software maintains smooth operations, consistent performance and a continuous suite of advanced functions despite changes, breaks down and differences in the underlying equipment.

→ Desktop Virtualization :- Desktop Virtualization allows the Users' OS to be remotely stored on a Server in the data center. It allows the user to access their desktop virtually, from any location by a different machine. Users who want specific operating systems other than Windows Server will need to have a virtual desktop. The main benefits of desktop Virtualization are user mobility, portability and easy management of Software installation updates and patches.

→ Network Virtualization :- The ability to run multiple virtual networks with each having a separate Control and data plan. It co-exists together on top of one physical network. It can be managed by individual parties that are potentially confidential to each other. Network virtualization provides a facility to create and provision VN, logical switches routers, VPN and workload security within days or even weeks.



- NV divides PNR among multiple VNs.
- Combine all components of n/ws & to administer them using Sirf s/w.
- ENV (Combine one or more n/w into Virtual Units)
- INV (no external n/w, Single n/w Server)

→ Application Virtualization :- Application Virtualization helps a user to have remote access to an application from a server. The server stores all personal information and other characteristics of the application but can still run on a local workstation through a internet. An example of this would be a user who needs to run two different versions of the same software. Technologies that use application virtualization are hosted applications and packaged applications.

→ Data Virtualization :- This is the kind of Virtualization in which the data is collected from various sources and managed at a single place without knowing more about the technical information like how data is collected, stored and formatted then arranged that data logically

So that is its virtual view can be accessed by its interested people and stakeholders, and users through the various cloud services remotely.

	Combine	Consume
i. Connect	Koi bhi	• Reports
ii. Databases	Data	• Dashboard
iii. Cloud		• Portals
iv. Big Data		• Web apps
v. Excel		
vi. Data warehouses		

* Data format
* Real-Time
* Data Physical Location
* Single Representation of data from Multiple, different kind of sources
* No Copy or Replication of data
Middleware [integrate virtually]

→ DAS :- Directly Attached Storage :- The storage device which is permanently attached to a desktop computer. DAS is for a single User. DAS is well suited for a small-to-medium sized business where sufficient amounts of storage can be configured at a low startup cost. The DAS enclosure will be a separate adjacent cabinet that contains the additional disk drives.

Components are :-

i. Storage Devices
ii. Cables
iii. Disk array
iv. Protocol
v. Storage protocol : ATA, SAS, FC

→ NAS :- Network Attached Storage :- This Storage Device is attached on the Local Area Network and used for sharing of data among different users attached to the local Area Network. Instead accessing data at the ~~sec~~ sector level, user can access information on file level over the network. This NAS System is having its own file system which is set once set with proper configuration of NAS and is not dependent upon the ~~operatin~~ operating System of Computers from which it is connected.

Components are :-

i) CPU, Memory
ii) Network Interface Card
iii) ~~Optimiz~~ Optimized operating System
iv) Protocols
v) ~~Storage p~~ Storage protocol : ATA, SCSI

→ SAN :- Storage Area Network :- is used for transferring the data between the servers and storage devices fiber channels and switches. In SAN data is identified by disk ~~floor~~ block.

Components are :-

i) Node ports
ii) Cables
iii) Storage Arrays
iv) SAN management ~~Services~~ Software.

→ Load Balancer :- Load Balancing is an essential technique used in cloud computing to optimize resource utilization and ensure that no single resource is overburdened with traffic. It is a process of distributing workloads across multiple computing resources, such as servers, virtual machines or containers. Load Balancing helps to improve the overall performance and reliability of cloud based applications by ensuring that resources are used efficiently and that there is no single point of failure. It also helps to scale applications on demand and provides high availability and fault tolerance to handle spikes in traffic or server failures.

→ Round Robin Algorithm :- A round robin is an arrangement of choosing all elements in a group equally in some rational order, usually from the top to the bottom of a list and then starting again at the top of the list and so on. A simple way to think of round robin is that it is about "taking turns".

Weighted Round Robin Algorithm :- is one of the most widely used load balancing algorithm. It considers the priority of every task before assigning the task to different virtual machines.

→ Least Connections :- The least connections load balancing technique takes into account the current number of active connections on each server. The Least Balancer checks which servers have the fewest active connections and sends traffic to those servers

→ Weighted Least Connection :- The load master makes load balancing decisions based on active connections and the assigned server weights. If there are two servers with the lowest number of connections, the server with the highest weight is chosen.

→ Least Response time :- The least response time load balancing strategy collects response times to calls made with service instances and picks an instance based on this information.

→ Cloud Computing :- Cloud Computing comes under the evolution of cloud Computing which includes all the nodes that are located in different locations. It has heterogeneous nodes that that are located in a different Company. Some nodes are set ideal and these nodes can be combined to perform any one task. It is highly preferable to perform Complex activities as these are many computers or nodes involved in the same network.

* Nodes :-

i) User node :- The user node or the Computer requests for need of resources and them gets them from other nodes of the Computer. It Simply uses the resource available in the network.

ii) Provider Node :- It is a node that shares it its resources with the user nodes based on the request. when the request is received from the User node, some service of task is performed by the nodes like forecasting the stocks needed in the feature.

iii) Control node :- It is a computer with a server or group of servers that serve as an administrator and manages both the user and provider node.

* For controlling the network and its resources a software / networking protocol is used generally known as Middleware. This is responsible ~~to~~ for administrating the network and control nodes are ~~mer~~ merely its executors.

→ Difference CC and GC :-

1. CC :- a) It is a Client Server architecture
b) It is a centralized executive
c) more flexible than grid Computing
d) the users pay for the use
e) It is a high accessible service
f) It can be accessed through standard web protocols.

GC :- a) It is a decentralized executive
b) It is a Distributed Computing architecture
c) less flexible than cloud Computing
d) the users do not pay for use.
e) It is low accessible service
f) It is accessible ~~than~~ through grid middleware.

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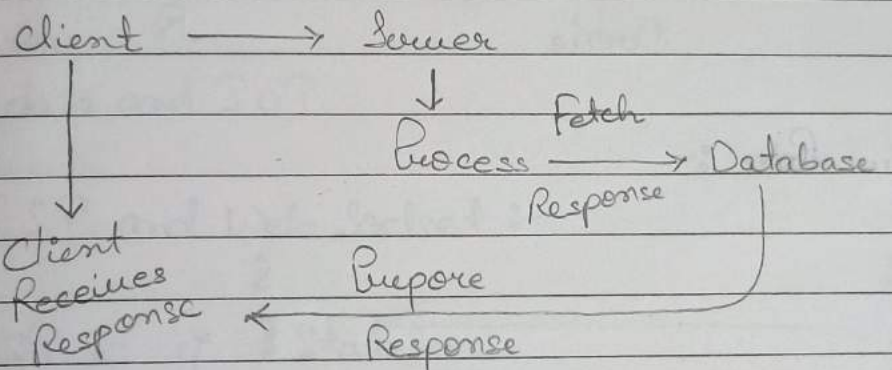
Internet of Things :-

→ What is IOT?

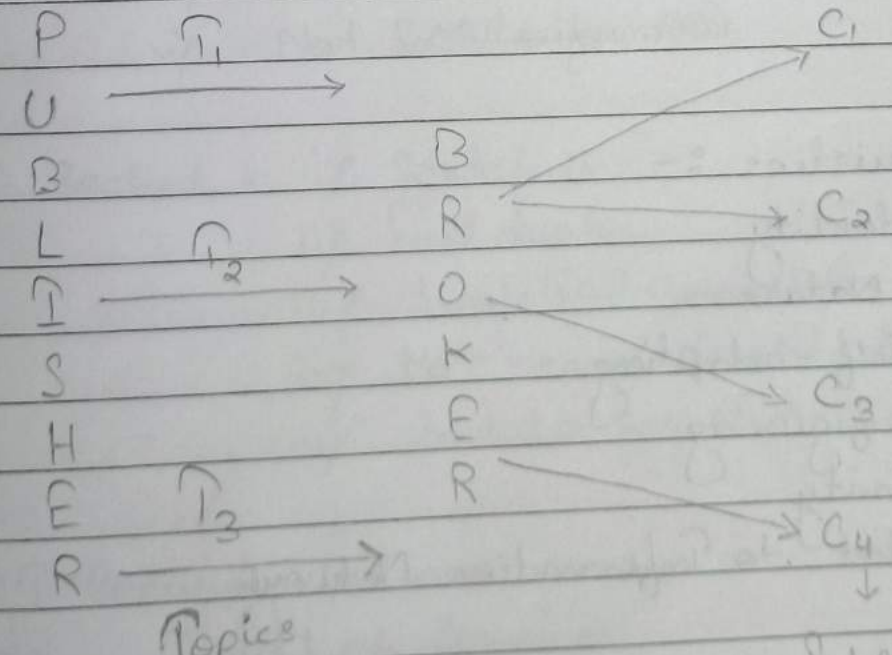
It refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.

→ Communication model :-

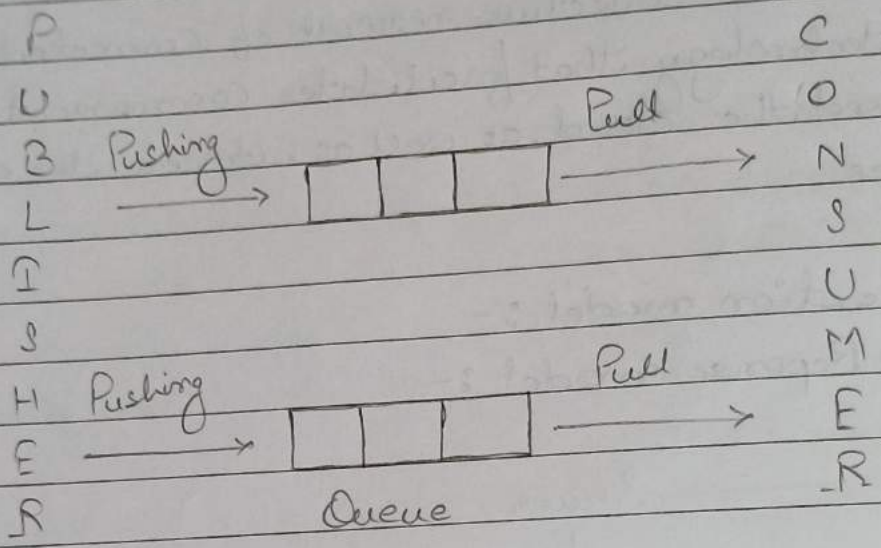
I Request & Reponse model :-



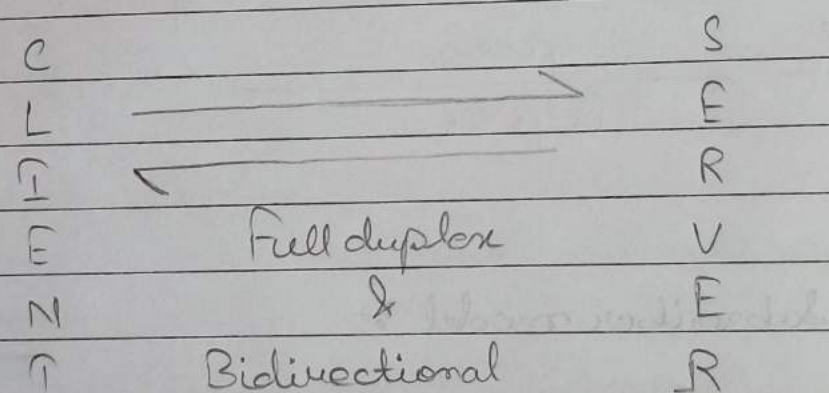
II Publisher Subscriber model :-



iii) Push-pull model :-



iv) Exclusive Pair :-



→ Characteristics :-

i) Unique Identity
ii) Dynamic Nature
iii) ~~Self Self~~ Self-adapting
iv) Self-Configuring
v) Heterogenity
vi) Integrated to Information Networks.

→ ~~Benfit~~ Benefits of IOT :-

i) ~~Effici~~ Efficient Resource utilization
ii) Save times
iii) Human efforts & errors
iv) User friendly / easy to use

→ Future of IOT :-

i) AI and IOT
ii) VUI - Voice User Interface
iii) ~~Minit~~ Miniaturization of things
iv) Power
v) Big data and IOT

→ REST and Web Socket :-

REST :- i) Stateless
ii) Request Response Communication model
iii) Each request includes setting up a new TCP Connection
iv) Header Overhead
v) Not Suitable for RTA

Web Socket :- i) Statefull
ii) Full duplex
iii) Single TCP Connection
iv) No Header Overhead
v) Suitable for RTA

→ IOT Security problems :-

i) DOS - Denial of Service
ii) DDOS - Distributed Denial of Service
iii) Information Manipulation

iv) Unauthorized Access
v) Information Disclosure

→ Key Elements of IOT :-
i) Authentication
ii) Access Control
iii) Data Security
iv) Non-Repudiation
v) Availability

→ Application of IOT :-
i) Smart City
ii) Health Care
iii) Education
iv) Agriculture
v) Smart Home
vi) Vehicle Industry.

→ Sensing :-
Sensors are used for sensing things and devices etc. A device that provides a usable output in response to a specified measurement.

* Transducer :-
A transducer converts a signal from one physical structure to another.
- It converts one type of energy into another type.
- It might be used as actuator in various System.

* Sensors characteristics :-
1. Static
2. Dynamic

1. Static Characteristics :- It is about how the output of a sensor changes in response to an input change after steady state condition.
   - Accuracy
   - Range
   - Resolution
   - Precision
   - Sensitivity
   - Linearity
   - Drift
   - Repeatability

2. Dynamic characteristics :- Properties of system
   - Zero-Order System - The output shows a response to the input signal with no delay.
   - First-Order System - When the output approaches its final value gradually.
   - Second-Order System - Complex output response.

* Sensor classification :

1. Passive Sensor : Can not independently sense the input. Ex- Soil moisture, water level.

2. Active Sensor : Independently Sense the input. Ex- Radar, Sounder.

3. Analog Sensor : The response or output of the Sensor is some continuous function of its input parameter. Ex- Temperature Sensor

4. Digital Sensor : Response in binary nature. Design to overcome the disadvantage of analog sensor. Along with the analog ~~sensor~~ sensors, it also comprises extra electronic for bit conversion. Ex- Passive Infra red

5. Scalar Sensor : Detects the input parameter only based on its magnitude. The answer for the sensor is a function of magnitude of some input parameter. Not affected by the direction of input parameters.
Ex :- temperature

6. Vector Sensor : The response of the sensor depends on the magnitude of the direction and orientation of the input parameter. Ex- ~~Accelor~~ Accelerometer.

→ Actuation :-
An IOT device is made up of a Physical object ~~thing~~ "thing" + "Controller "brain" + Sensors + Actuators + Networks. An actuator is a machine component or system that moves or controls the mechanism of the system.

Sensors ——→ Controller ——→ Actuator
measure the temperature — decision maker — Cooling fan

Camlin Page
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* Types of Actuators :-

1. Hydraulic Actuators :- A hydraulic actuator uses hydraulic power to perform a mechanical operation. They are actuated by a cylindrical or fluid motor. The mechanical motion converted to rotary according to need of IOT devices.

2. Pneumatic Actuators :- A Pneumatic actuators uses energy formed by vacuum or compressed air at high pressure to convert into either linear or rotary motion.

3. Electrical Actuators :- An electric actuator ~~goes~~ uses electrical energy, is usually actuated by a motor that converts electrical energy into mechanical torque.

4. Thermal or Magnetic Actuators :- These are ~~actuators~~ actuated by Thermal or mechanical energy. Shape Memory Alloys or Magnetic Shape Memory Alloys are used by these actuators.

6. Mechanical Actuators :- A mechanical actuators executes movement by converting rotary motion into linear motion. It includes chain, gears ~~at~~ etc.

→ MQTT :- Message Queue Telemetry Transport

~~It It~~ ~~is a simple lightweight~~

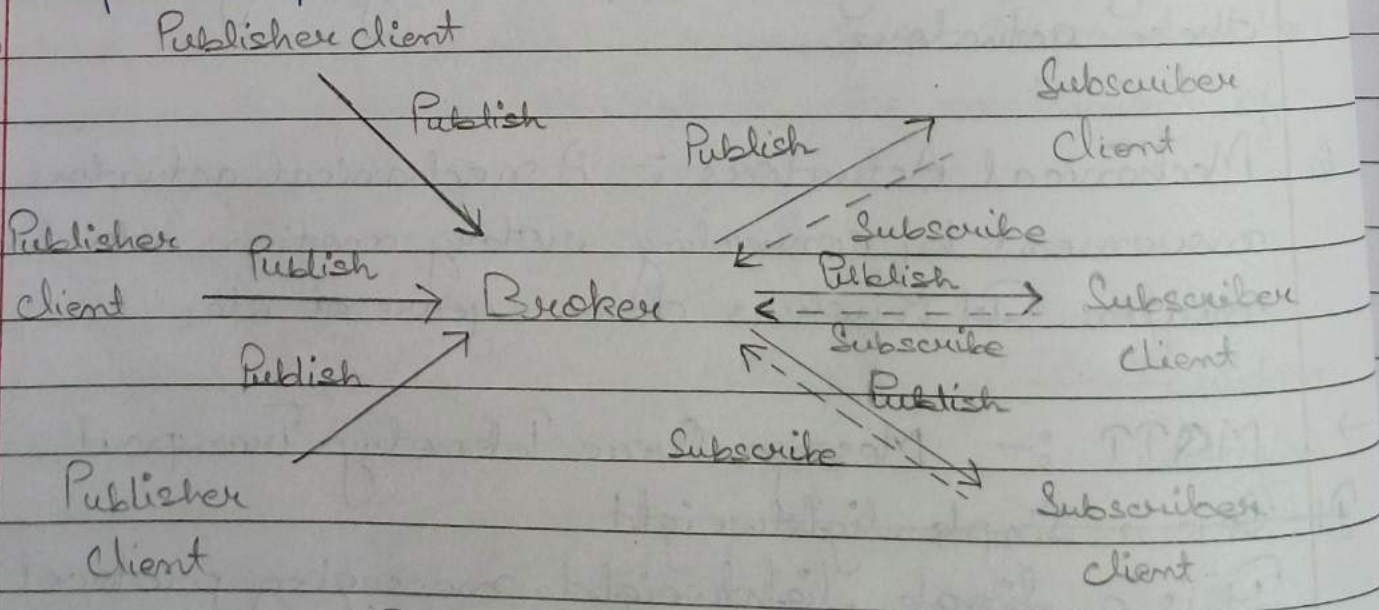
It is a simple lightweight messaging protocol used to establish communication between multiple device. It is TCP- based protocol relying on the public publish - subscribe model. This communication protocol

is suitable for transmitting data between resource constrained devices having low bandwidth and low power requirements.

* Publish - Subscribe model :- This model involves multiple interacting with each other, without having any direct connection established between them. All clients communicate with other clients only via via third party known as Broker

* Client and Broker :- clients publish messages on different topic of broker. The broker is the central server that receives these messages and filters them based on their topics. It then sends messages to respective clients that have Subscribe to those different topics.

Hence client that has Subscribed to a Specific topic receives all messages published on that ~~topics~~ topic.



Publish - Subscribe model

* Topics :-
topic is UTF-8 string that the broker uses to filter messages for each individual connected client. Each topic consists of one or more different topic levels. Each topic level is separated by forward slash also called topic level separator.

eg: home / kitchen / table { different level of topics }

∴ Wildcard is an additional feature in MQTT to make topics and their levels more flexible and user-friendly.

1. Single level "+" :-
Single level wildcard represented by "+" symbol can replace single level in topic

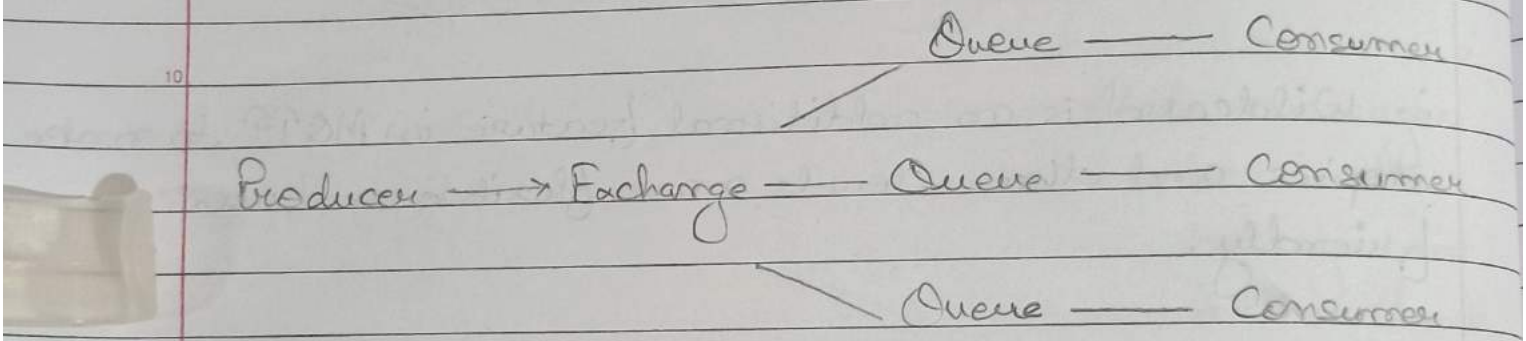
eg: home / + / table

2. Multi level "#" :-
Multi-level wildcard represented by "#" symbol can replace multiple level in topic.

eg: home / ground / #

→ AMQP :- Advanced message Queuing Protocol

→ AMQP :- Advanced Message Queuing Protocol is an open protocols for asynchronous message queuing which has been developed and matured over several years. AMQP is an open standard, binary application layer protocol designed for message oriented middleware i.e, AMQP protocol standardizes messaging using Producers, Brokers and Consumers and messaging loose coupling and scalability.

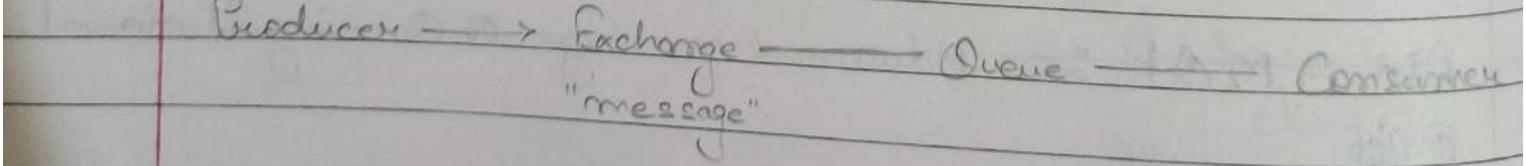


* How it works ?

It deals with publishers and consumers. The publishers produce the messages, the consumers pick them up and process them. It's the job of the message broker to ensure that the messages from a publisher go to the right consumer.

Two components are :-

- Exchanges
- Queues



:- Publishing

Producer → Exchange —— Queue —— Consumer
"message"
:- Consuming

* How messages routed from the Exchange to The Queue?
→ First, the queue has to be attached to the given exchange. Typically, a consumer creates a queue and attaches it to an exchange at the same time. Second, messages received by the exchange have to be matched to the queue - a process called "binding."

1. The exchange is where publishers distribute messages. The messages contain routing keys that the "exchange" module uses to route them. There are several exchange mechanism, including default, direct, fanout, topic and header exchange.
2. Queues are where messages are held until they are delivered to or received by subscribers.
3. Default trade : Message routing to the Queue.
routing Queue = Queue name

4. Direct Exchange : Message routing to a queue based on routing key.
routing key = Bind key

5. Fanout Exchange : Routing message to several queues without using a routing key.

6. Subject Exchange : Messages are routed to a a queue based on a routing key, such as a topic.
routing key match a pattern

7. Header Exchange : Message routing to queue based on header fields.

* A frame is the fundamental data unit in AMQP. They are used to start, regulate and terminate message transfer between peers.

i) be open (the connection)
ii) begin (the session)
iii) affix (the link)
iv) transfer
v) flow
vi) temperament
vii) Separate (the link)
viii) final (the session)
ix) final (the connection)

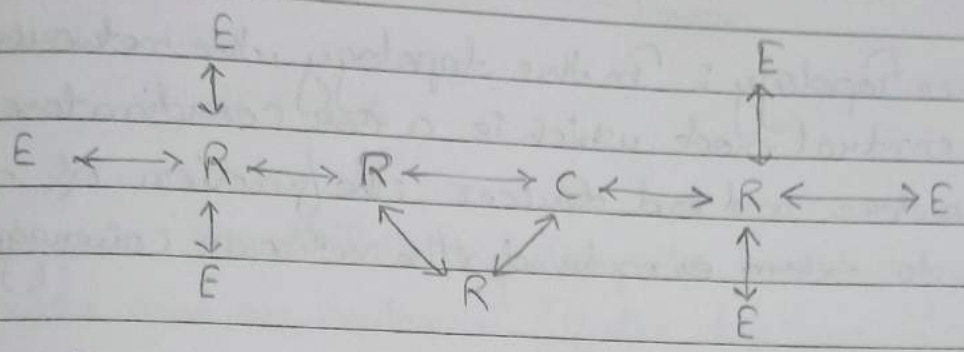
→ Zigbee :- It is a Personal Area Network task group with low rate task group 4. It is a technological logy of home networking. ZigBee is a technological standard created for controlling and sensing the network. As we know that ZigBee is the Personal Area Network of task group 4 so it is based on IEEE 802.15.4 and is created by ZigBee Alliance

* Types of ZigBee Devices :-

i) Zigbee Coordinator Device : It communicates with routers. This Device is used for connecting the device

ii) Zigbee Router : It is used for passing the data between Devices.

iii) Zigbee End Device : It is the device that is going to be controlled



* Features :-
1. Stochastic addressing :-
2. Link Management :-
3. Frequency Agility :-
4. Asymmetric link :-
5. Power Management :-

* Advantages :-
1. Designed for low power consumption
2. Use in smart home
3. Easy implementation
4. Adequate Security features
5. Low Cost
6. Mesh networking
7. Reliability

* Zigbee Network Topologies :-

- Star topology : Consist of a coordinator and several end devices, end devices communicate only with the coordinator.

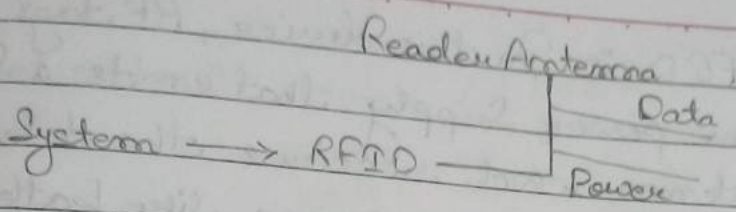
- Mesh Topology : Mesh topology consists of one coordinator, several routers and end devices.

- Tree Topology : In this topology, the network consists of a central node which is a coordinator, several routers and end devices, the function of the router is to extend the network coverage.

* Architecture of ZigBee :-

1. Application layer
2. Application Interface layer
3. Security layer
   Network layer
   Medium Access Control layer
6. Physical layer.

→ RFID :- Radio Frequency Identification
Is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person. It is a method that is used to track or identify an object by radio transmission uses over the web. Data digitally encoded in an RFID tag which might be read by the reader. This device work as a tag or label during which read data read from the tags that are stored stored in the database through the reader as compared to traditional barcodes and QR codes.



* Components of RFID :-

1. RFID tag :- The RFID tag comprises an integrated circuit, a substrate and an antenna. If the tag has an active power source and thus can support a sensor, it is called an active RFID tag. If the tag doesn't have an active power source, it is called a passive RFID tag.

2. RFID reader :- It is a device that reads RFID tags and gathers data about the connected object. It can can be both wired and wireless. It can use many technologies to communicate with the software, including USBs and Bluetooth connections.

3. RFID Software :- The software monitors and tracks the object connected to the RFI RFID tags. It can be called data exchange and management software.

* Types of RFID :-

1. Passive RFID :- Passive RFID tags does not have their own power source. It uses power from the reader. In this device, Rf tags are not attached by a power supply and passive RF RF tag stored their power when it is emitted emitted from active antenna and the RF tag are used specific for frequency like 125-134 KHz as low frequency.

2. Active RFID :- In this device, RF tags are attached by a ~~power~~ power supply that emits a signal and there is an antenna which receives the data means, active tag uses a power source like battery. It has its own power source, does not require power from source / ~~reader~~ reader.

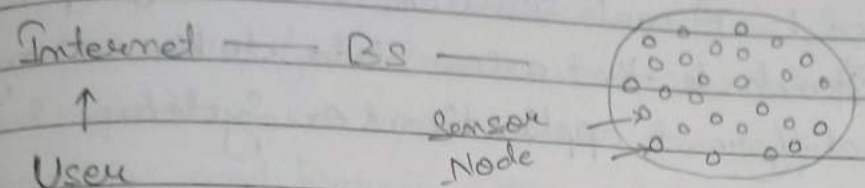
* Working :- Generally, RFID uses radio waves to perform AIDC function. AIDC stands for Automatic Identification and Data Capture ~~technology~~ technology which which performs object identification and collection and mapping of the data.

An antenna is an device which converts power into radio waves which are used for communication between reader and tag.

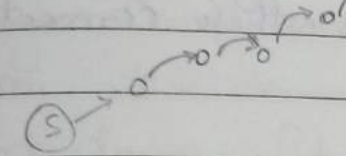
→ Wireless Sensor Networks :- Is an infrastructure-less wireless network that is deployed in a large number of wireless sensors in an ad-hoc manner that is used to monitor the system, physical or environmental conditions.

Sensor nodes are used in WSN with ~~the~~ the onboard processor that manages and monitores the environment in a particular area. They are connected to the Base station ~~which~~ which acts as a processing unit in the WSN System.

Base station in a WSN System is connected through the Internet to share data.



* Multihop Path :- Sink / Gateways → Internet → User



* Types :- a) SWSN :- Stationary WSN. They stick to one place and do whatever the things they have to do.

b) MWSN :- Mobile WSN. They jump over the network and do whatever the job they have to do.

→ Keywords :-

- Device :- are a pieces of hardware, such as sensors, actuators, gadgets, appliances or machines that are programmed for certain application and can transmit data over the internet.

- Resources :-

- Controller Services :- It sends data from the device to the web service and receives commands from the application for controlling the device.

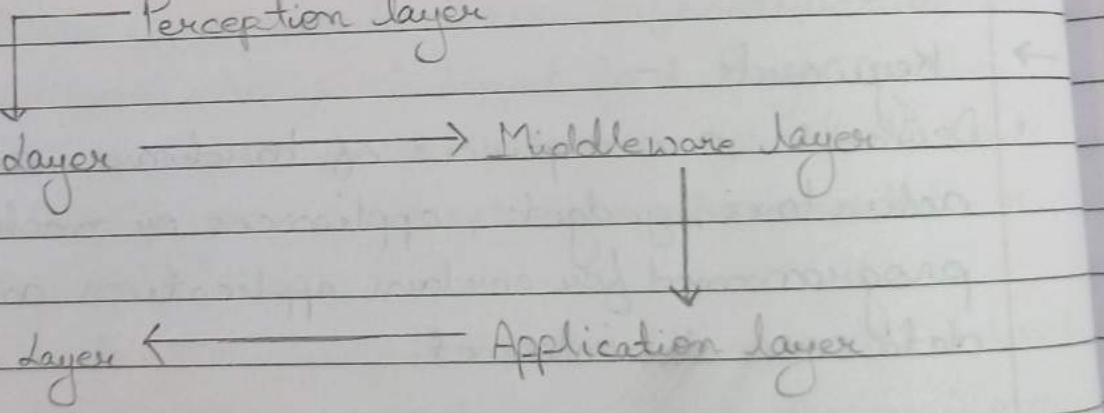
- Database :- Is a queryable and updateable dataset Comprised of data points collected from various sources.

- Web Service :- A web service is a set of open protocols and standards that allow data to be exchanged between different applications or systems.

- Analysis Components :- It allows these devices to be controlled and monitored remotely. It automatically collects and share data with other connected device and systems.

- Application :- It runs on IoT devices and can be created to be specific to almost every industry. IoT application are using AI and machine learning to add intelligence to devices.

→ 5 layer of IOT Architecture :-



i) Perception layer :- The main function of this layer is to get information from surroundings and to pass data to another layer so that some actions can be done based on that information.

ii) Network layer :- It is the connecting layer between perception and middleware layer. It gets data from perception layer and passes data to middleware layer using networking technologies like 3G etc.

It is also known as communication layer because it is responsible for communication between perce perception and middleware layer. All the transfer of data done securely and keeping the obtained data confidential.

iii) Middleware layer :- It has some advanced feature like storage, computation etc. It stores all data-set and based on the device address and gives appropriate data to that device. It can also take decisions based on calculation done on data-set obtained from sensors

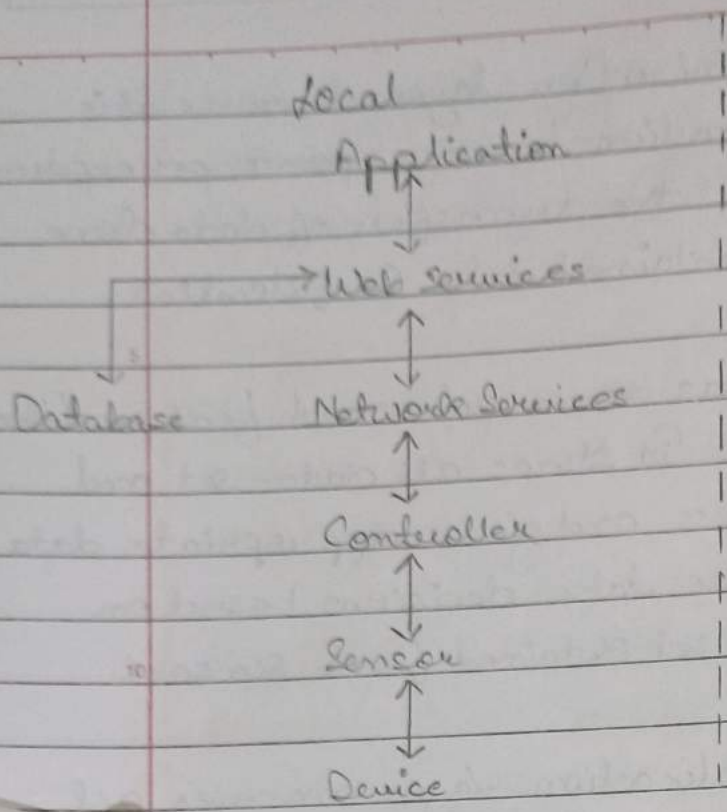
iv) Application layer :- The application layer manages all application process based on information obtained from middleware layer. ~~This involves~~ This involves sending emails, etc.

v) Business layer :- The success of any device does not depend only on technologies used in it but also how it is is being delivered to consumers. Business layer does these tasks for the ~~device~~ device. It involves making flowcharts, graphs etc.

→ IoT levels :-

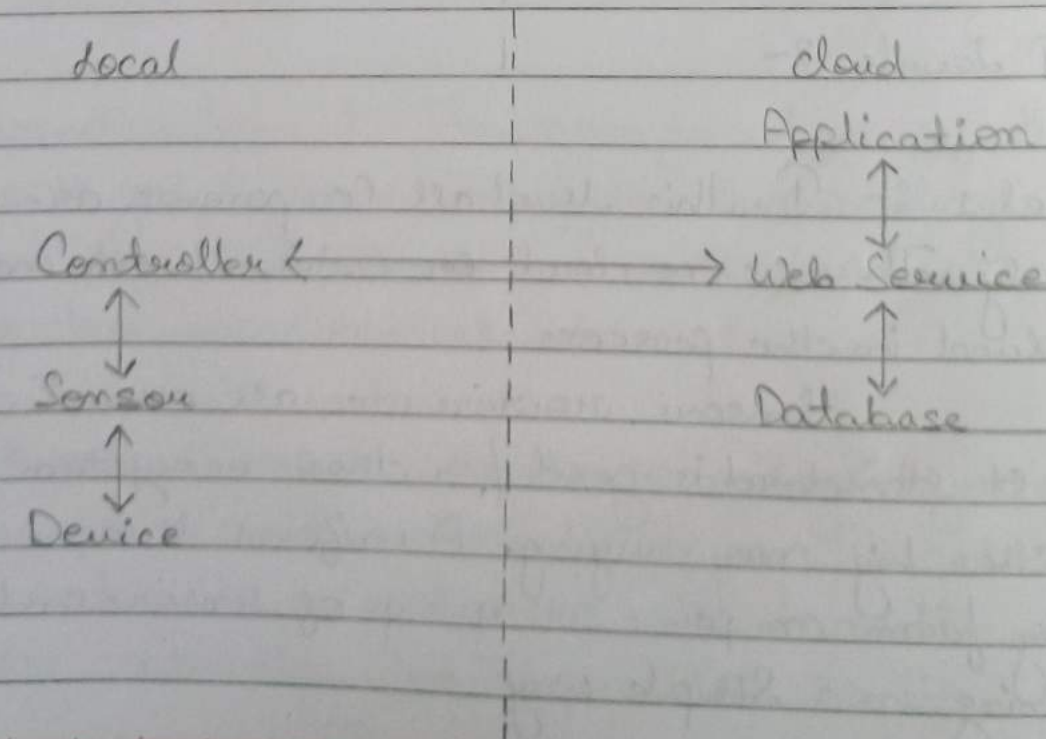
i) Level 1 :- In this level all components are deployed locally. There is no cloud or external ~~net~~ networks involved in the process.

Sensors, routers etc all are at the user's end. This ~~of~~ standard is good for those ecosystem where data is neither big nor varying. A uniform stream of data is coming from ~~one~~ pre-set group of sensors and that is all happening in a simple way.



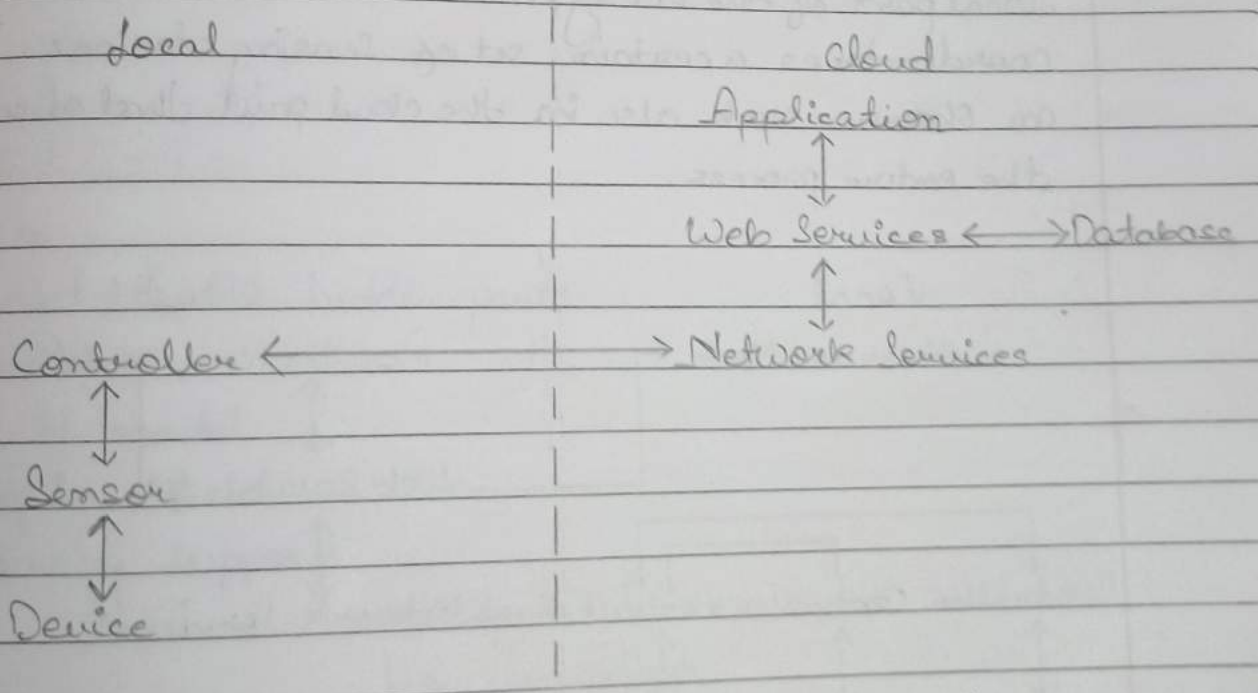
Level 2 :- In this level all the components are deployed locally except the servers. There is a cloud or an external network involved in the process.

At the user end there are only sensors, routers and application. The cloud part is having the servers configured for the purpose of storage and analysis. This standard is good for those ecosystems where data is big.



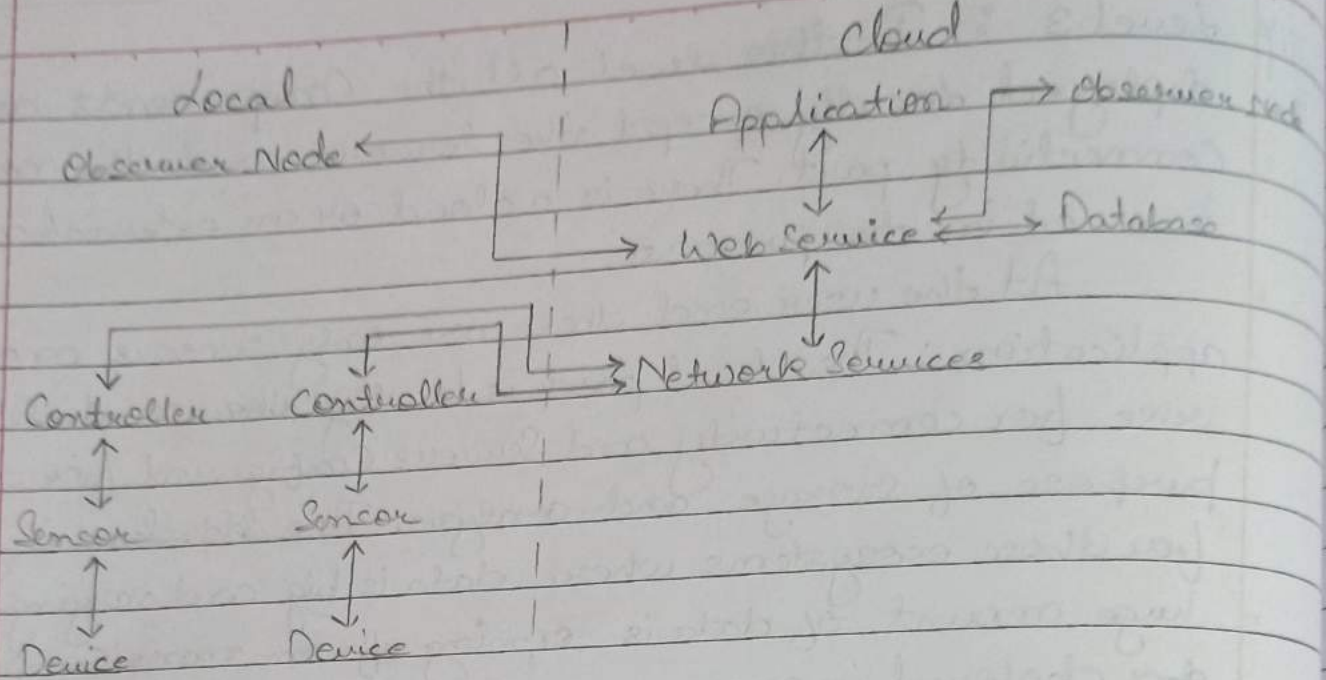
iii) Level 3 :- In this level all the components are deployed locally except the servers and the network connectivity part. There is a cloud or an external network involved in the process.

At the user end there are only sensors and application. The cloud part is having the essential networks for connectivity and servers configured for the purpose of storage and analysis. This standard is good for those ecosystems where data is big and varying. A huge amount of data is coming from many components deployed in many ecosystem and that too on a rapid speed.

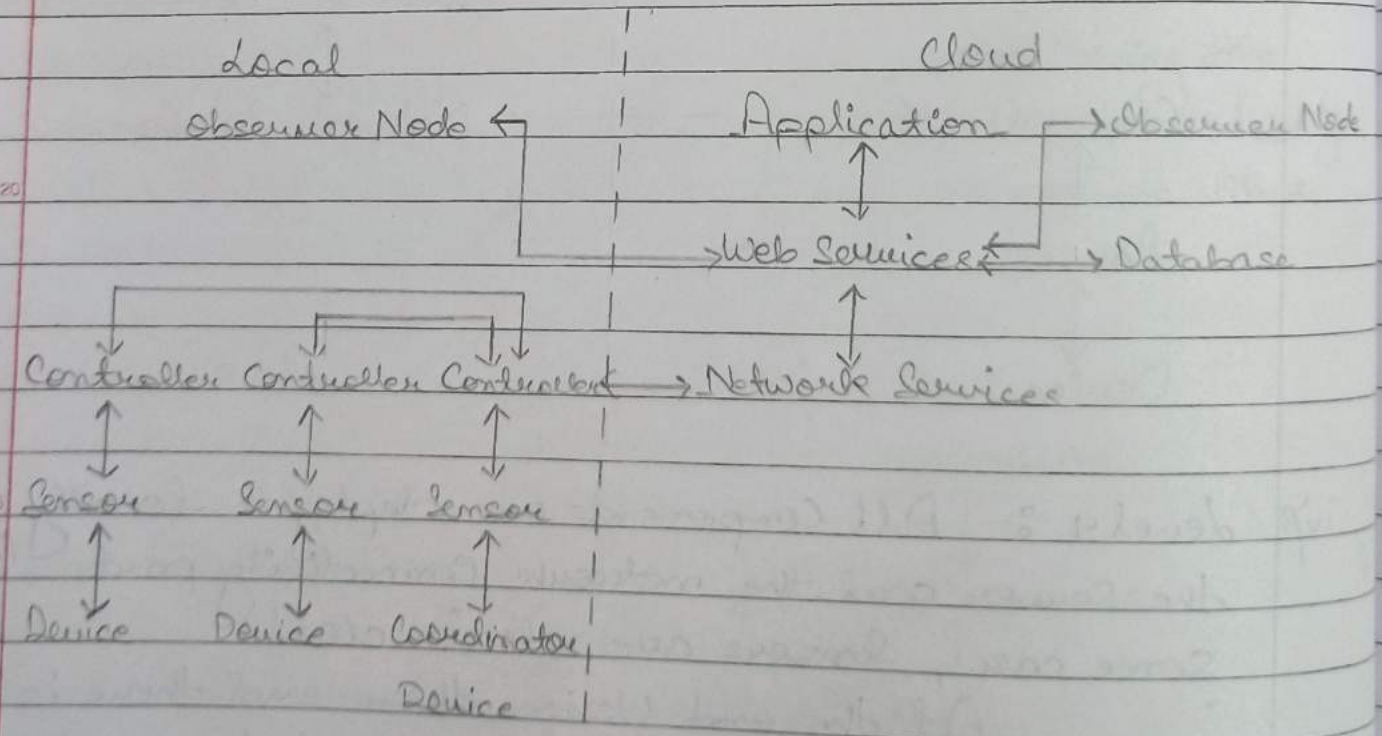


iv) Level 4 :- All components are deployed locally except the servers and the network connectivity part. In some case, sensors are also in cloud.

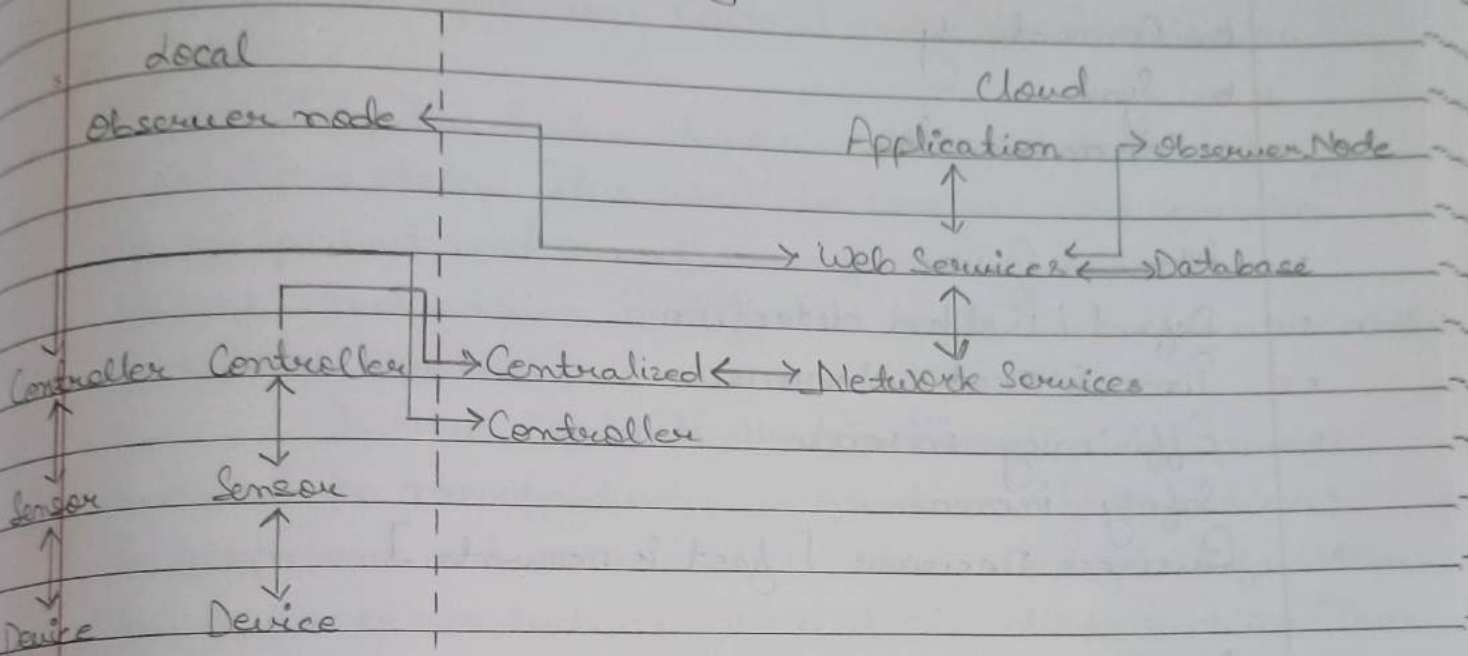
At the end User there end there is only application. The cloud part part is having the essential networks for connectivity and servers configured for the purpose of storage and analysis. This standard is good for those ecosystem where data is big.



Level 5 :- Coordinator devices are also there in the local part of the ecosystem. A coordinator device coordinates a certain set of sensing devices. There is an Observer Node also in the cloud part that observes the entire process.



Level 6 :- Coordinator devices are replaced by a single component Centralized Controller and that is there in the cloud part of the ecosystem.



→ ML & IOT :-

- Data
- Predict / Explore hidden parts
- Transform
- Build model
- Deploy model
- Library support
  - ↳ Scikit learn
  - ↳ Tensorflow
  - ↳ Keras

- Agriculture, Healthcare, Automobile, Defence.

→ IIOT :- Industrial Internet of Things

→ M2M
a. Connectivity
b. Sync
c. Communication

- Manual Error
- Defect / Problem detection
- Time & Cost decrease
- Efficiency increase
- Safety increase
- Business Decisions [fast & accurate]

→ M2M :- This is commonly known as Machine to Machine Communication. It is a concept where two or ~~more~~ more than two machines communicate with each other without human interaction using a ~~weird~~ wired or wireless mechanism. M2M is an technology that helps the devices to connect between devices without using internet.

- Remote Monitoring
- Control
- Transfer
- Protocols
  - ↳ Zigbee
  - ↳ Bluetooth
  - ↳ Modbus
  - ↳ 6LOWPAN
- M2M nodes (ENM)
- Communication n/w (Wired & Wireless)

- Human Involvement decrease.
- Efficiency & optimization increase.

→ SCADA :- Supervisory Control and Data Acquisition.

It is a Computer System designed to gather and analyse real time data. It is used to control and monitor the equipment and manufacturing processes in various industries in different fields such as water and waste control.

SCADA controls the functioning of equipment involved in manufacturing, production, fabrication, development and more. It is also used for infrastructural processes such as gas and oil distribution. Thus, it has reduced human intervention to a great extent.

→ NFC :- Near Field Communication

It enables short range communication between compatible devices. At least one transmitting device and another receiving device is needed to transmit the signal. Many device can use NFC standard and are considered either passive or active.

Passive NFC device :- These includes tags and other small transmitters which can send information to other NFC devices without the need for a power source of their own. These device don't really process any information sent from other sources and can not connect to other passive components.

2. Active NFC devices :- These devices are able to both the things i.e send & receive data. They can communicate with each other as well as with passive devices Touch payment terminals are good ~~exa~~ eg.

- Works on RFID.
- Security high
- Electromagnetic Radio field.
- Power less Consumption
- ~~Shor~~ Short Range ~~upt~~ upto 10 cm.
- Fast connectivity.

* Autonomous Vehicle :-

L_0 →

L_1 → ADAS

L_2 → ADAS → S, A, B

L_3 → ADS

L_4 → ADS

L_5 → ADS → Autonomous Vehicle