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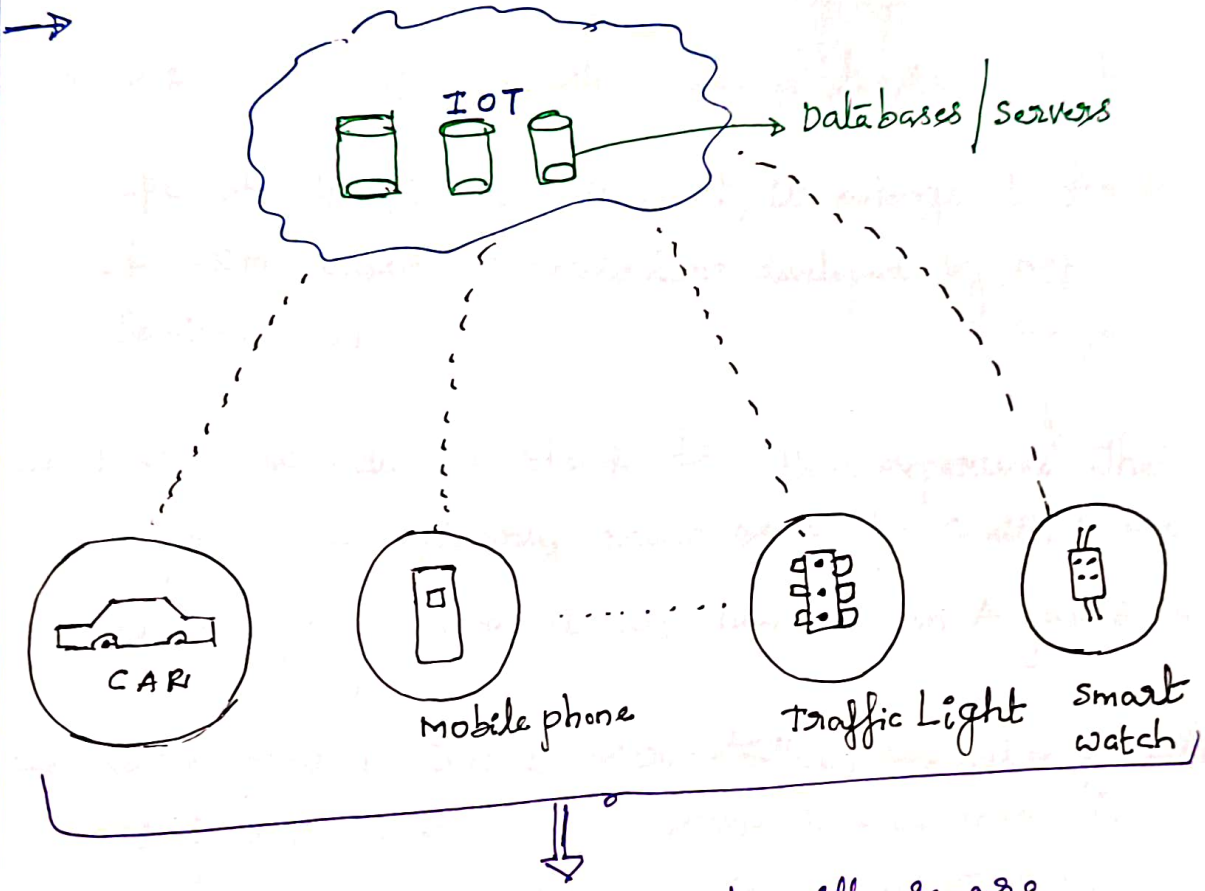
* IOT (Internet of Things) :

→ Connecting everyday things which are embedded with hard-ware and softwares to the internet enabling them to collect and exchange data.



Physical devices are equipped with sensors.

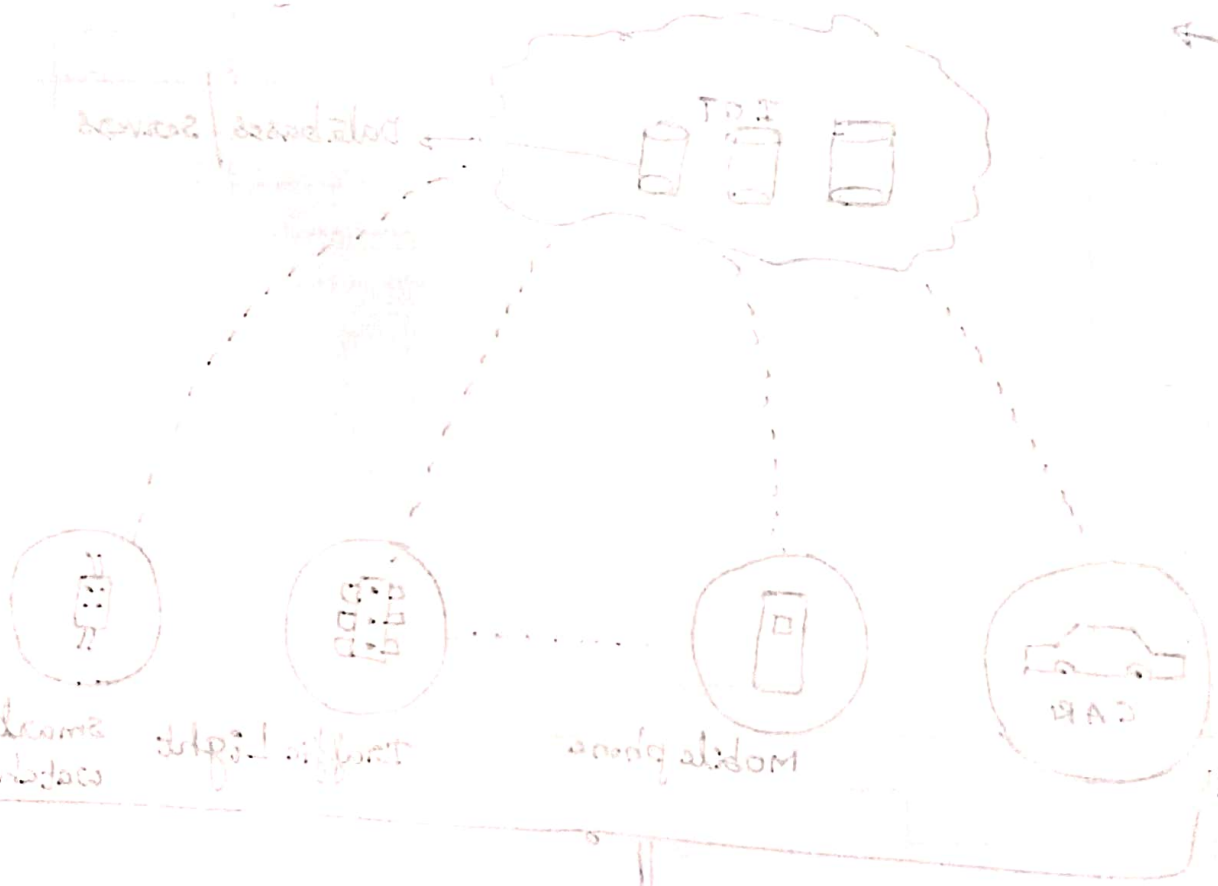
→ The data is emitted from various sensors of the physical devices and sent to IOT platform.

→ The IOT platform receives and Integrates the various data of devices.

→ The IOT platform performs computational analysis and analytics on the stored data. And, the valuable

information is extracted as per requirement.

→ Finally, the result is shared with other devices for better user experience and improving efficiencies.



Internet of things (IoT)

Prof. K. B. Ramesh

↳ IoT: Internet of things

↳ IoT = Internet + Things

↳ Internet: Is a vast global Network which is governed by standard protocols. It enables the communication of data/Information.

↳ Things: are physical objects Ex: servers, vehicles, sensors, human being etc...

↳ Definition of IoT:

"A dynamic global Network Infrastructure with self-configuring capabilities based on standard and Interoperable communication protocols where physical and virtual things have identities, physical attributes and virtual personalities and uses Intelligent Interfaces and integrated into the information network for data exchanges with users and their environments."

* Characteristics of IoT:

1. Dynamic & Self Adapting:

⇒ IoT devices and systems having the capability to dynamically adapt with changing contexts based on their operating conditions, user's context or sensed environment.

Ex: Surveillance System which consists of Surveillance cameras. The cameras can adapt their modes based on whether it is day or night. Cameras changes from lower to higher resolution modes.

2. Self-configuring:

→ The devices having the ability to configure themselves in association with the IoT infrastructure to setup the networking.

3. Interoperable communication protocols:

→ IoT devices supports a wide variety of interoperable communication protocols to communicate with other devices and also with the Infrastructure.

4. Unique Identity:

→ Each IoT device has a unique identity and a unique identifier (such as Ip address or a URL).

5. Integrated into Information Network:

→ IoT devices are integrated into the information network which allows them to communicate and exchange data with other devices and systems.

→ IoT devices can be dynamically discovered in the network by other devices and/or the network, and have the capability to describe themselves to other devices or user applications

6. Real-time Data: Data is collected and exchanged in real-time allowing for Immediate insights and actions.

7. Scalability:

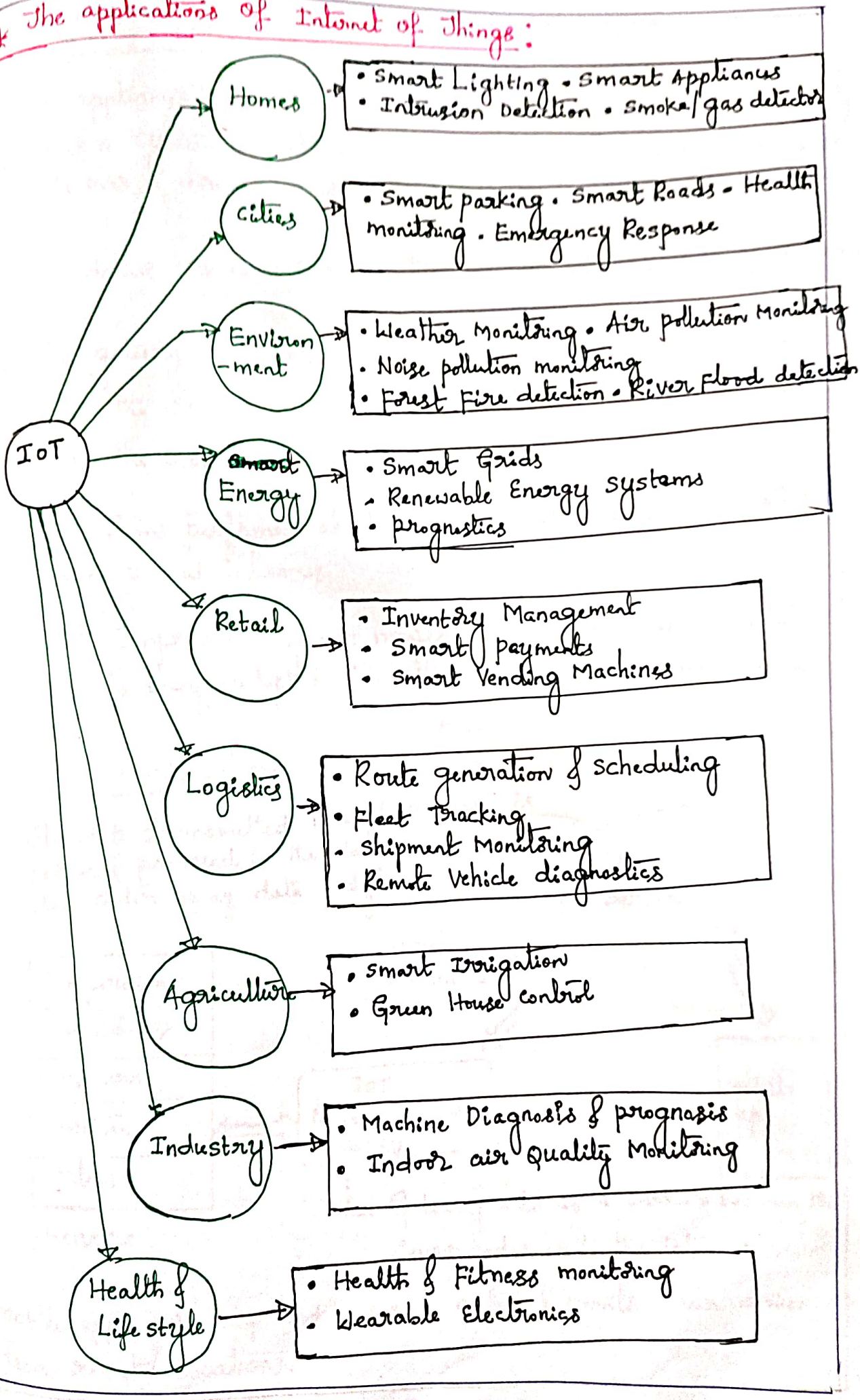
→ IoT Systems can scale to handle large number of devices network and data.

8. Automation:

→ IoT enables automated tasks and processes.

9. Remote control: Devices can be controlled Remotely.

* The applications of Internet of Things:

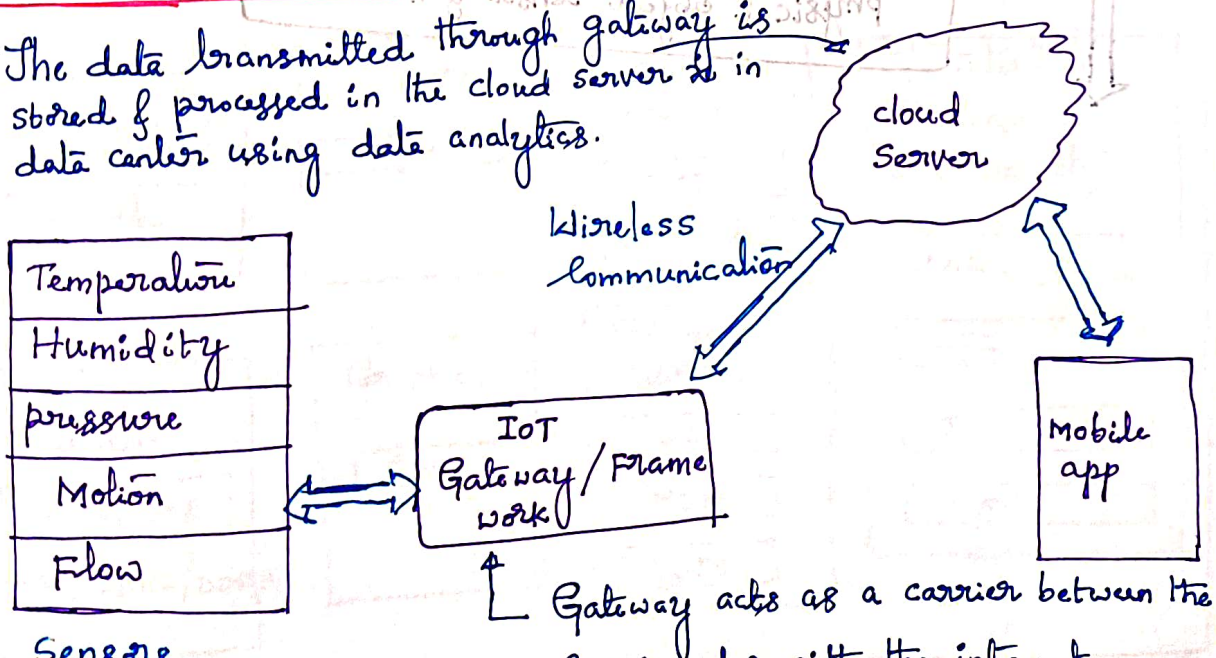


Example of IoT:

- All appliances can be connected to the internet and monitored remotely.
- It is a system of interconnected devices that transfer and exchange data over a wireless network without any human intervention.
- IoT devices are connected to the Network with the help of gateways
- The gateways/processing nodes process the information collected from the sensors and transfer it to the cloud which acts as both the storage and processing unit.
- All actions performed at the collected data are used for further learning and inferences.
- With Improved response monitoring and analytical capabilities IoT is being adopted in almost all industries and domains.

* IoT Architecture:

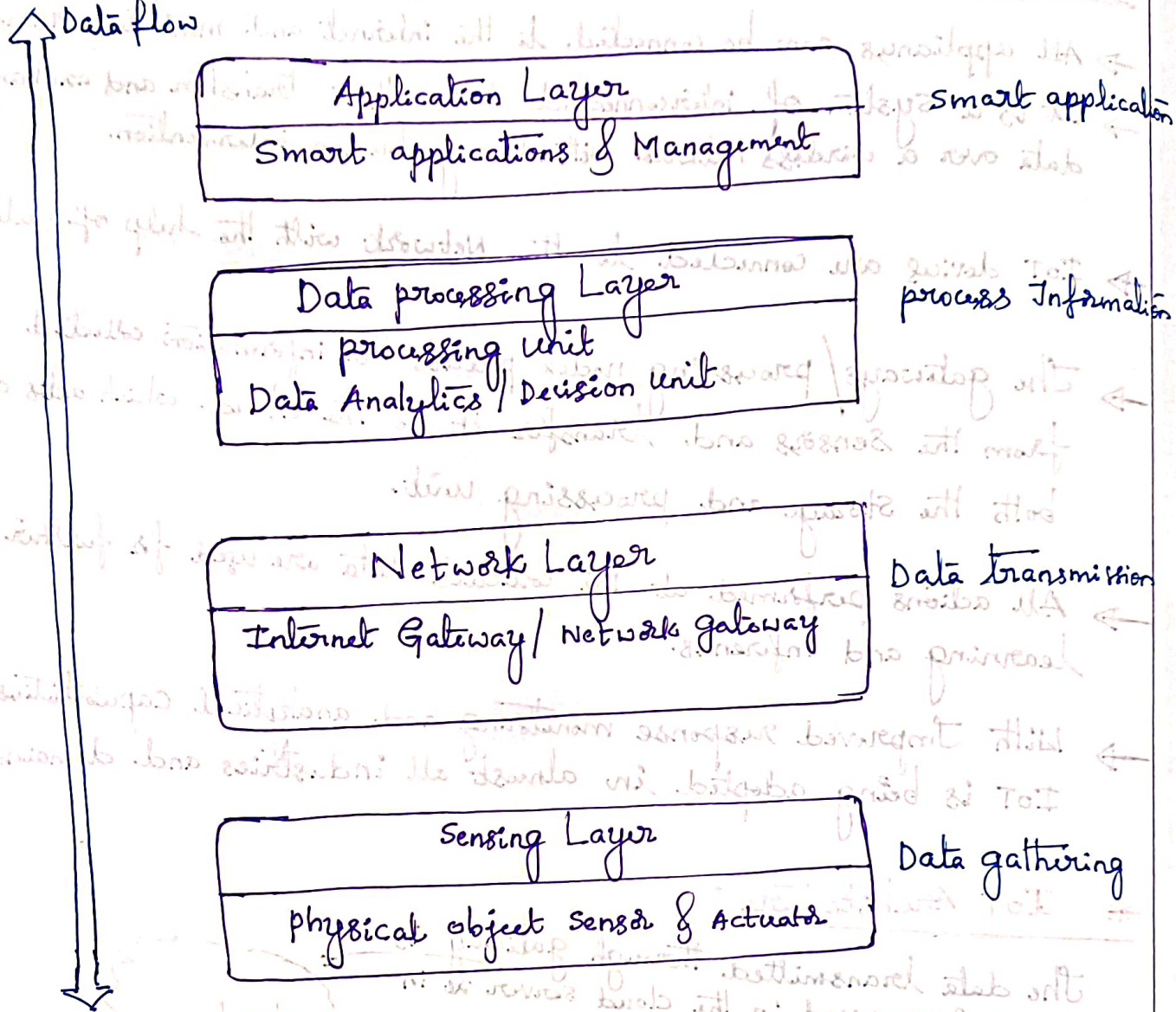
The data transmitted through gateway is stored & processed in the cloud server in data center using data analytics.



Gateway acts as a carrier between the Sensor nodes with the internet.

Mobile apps will help end users to control & monitor their devices from remote locations.

* Four stages of IoT Architecture



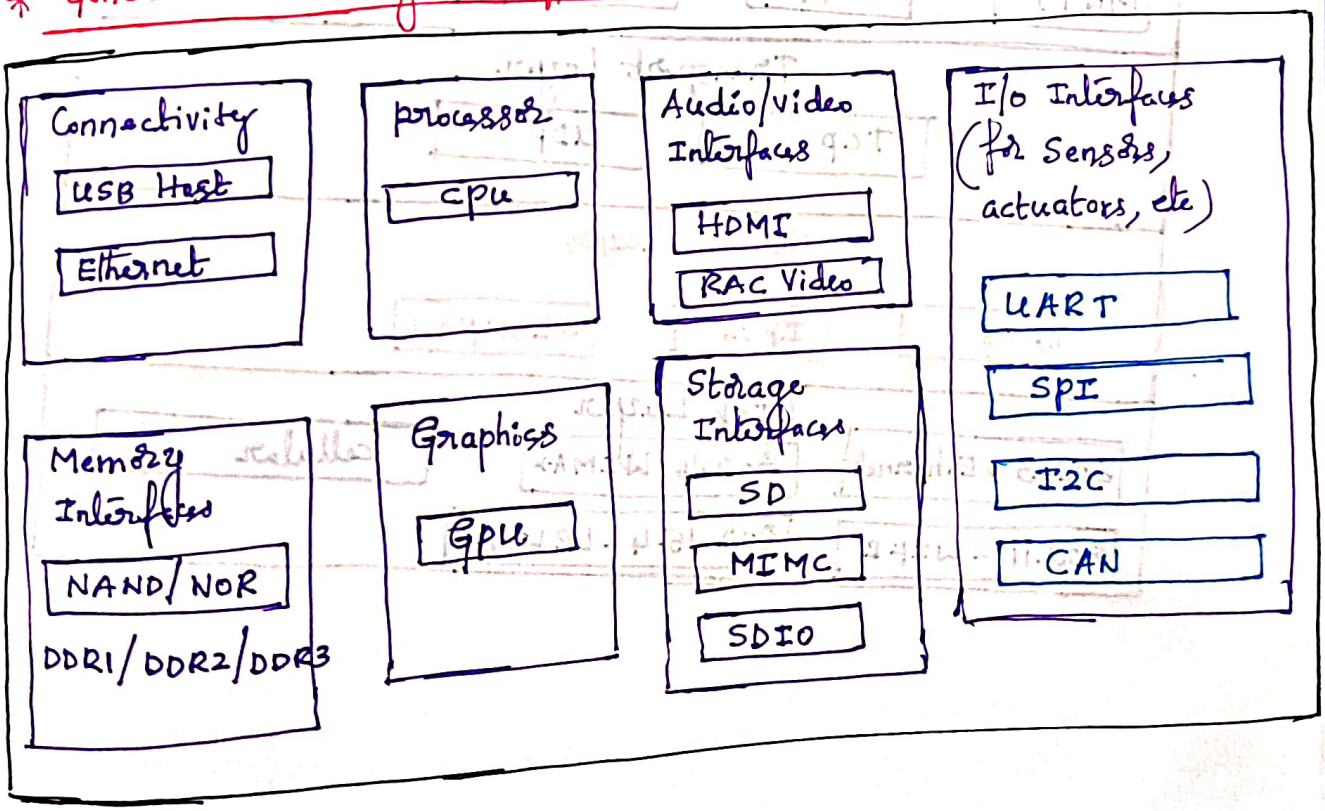
* The functionalities of Gateways:

- The gateway receives data from devices/sensors within the network.
- After receiving data the gateway intercept and analyze data packets
- Based on the analysis of the data packets, the gateway routes the data packets to their destination address.
- Gateway helps in connecting two different Networks.
- provides the security from external attacks.

* physical design of IoT:

- It Includes Things/devices and protocols.
- Things: Sensors, actuators, smart devices.

* Generic block diagram of an IoT Device:



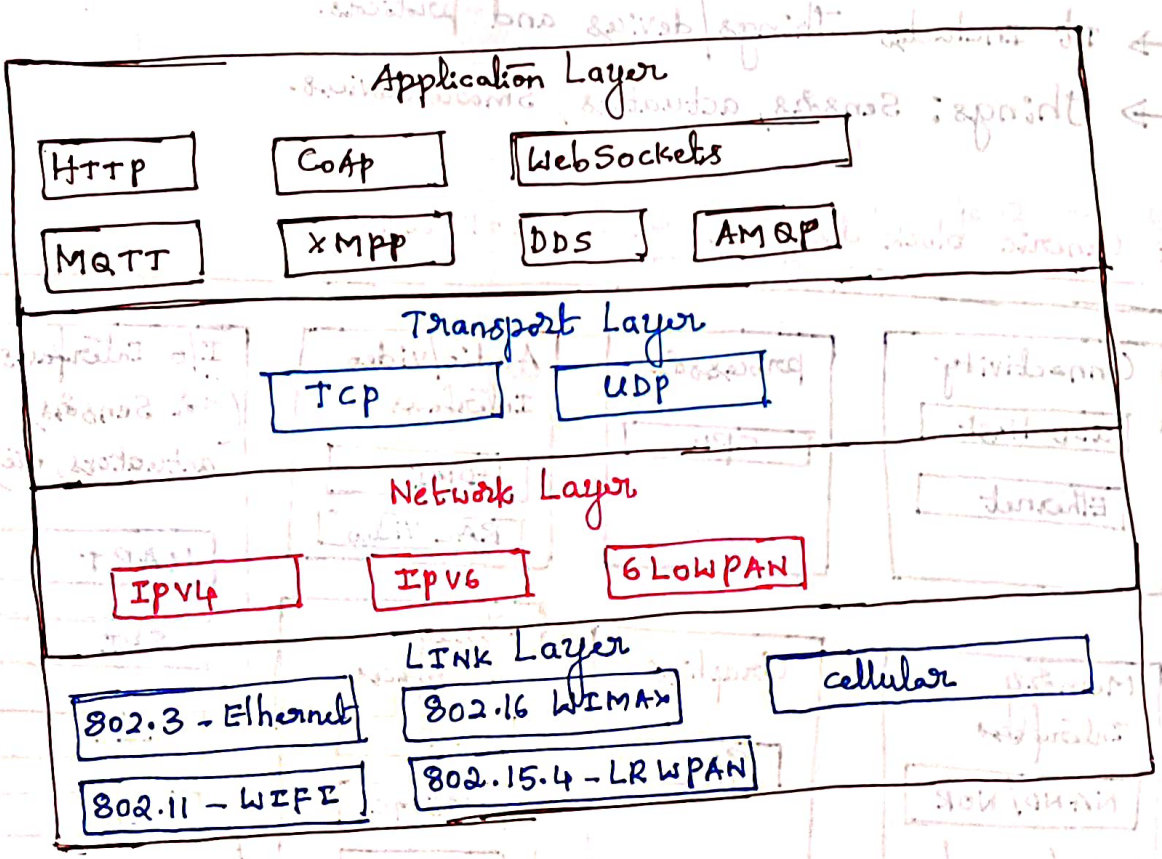
* Summary:

Physical Design of IoT = Things + protocols

→ physical design is more than the creating a products.

* IoT protocols:

1. Link Layer
2. Network Layer
3. Transport Layer
4. Application Layer



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- Link Layer: Deals with how the data is physically sent over the Networks physical layer or medium.
  The mediums are copper wire, electrical cable or radio wave.
- N/w or Internet Layer: Deals with sending datagrams from source to destination. performs Host addressing & packet Routing.
- Transport Layer: provides end to end message Transfer capability & its Independent of network.
- Application Layer:

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Logical Design of IoT

→ Logical design represents the conceptual representation of various components and entities within an IoT system.

→ It focuses on the functional aspects of IoT System.

→ It represents the abstract of components and entities

→ Logical design is the actual design of how its components should be arranged to particular function.

→ Logical Design
- IoT functional Blocks
- IoT communication models
- IoT communication APIs.

→ Logical design of IoT doesn't go into the depth of describing how each component is built with low-level programming specifics.

* Differences between physical design and logical Design of IoT

→ Physical design: Deals with hardware components of IoT.
Ex: Sensors, actuators and communication devices that collect and transmit data.

→ Logical design: This focuses on the software, data management and architecture that define how IoT systems operate and Interact.

Sensors & Actuators

Sensors: Detect physical paramaters/properties into electrical signals.
Ex: Temperature Sensor

Actuator: converts input signals into actions or movements

Example: Motor.

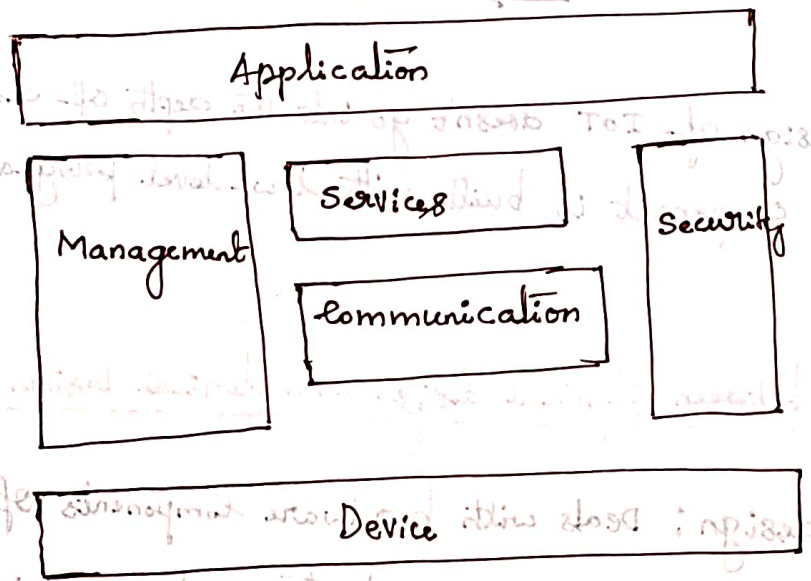
Motor receives the signal from a controller and rotates, potentially moving a conveyor belt or robotic arm.

* IoT Functional Blocks:

↳ The IoT functional blocks performs the following.

- → Sensing
- → Verification
- → Actuation
- → Management
- → Communication

↳ The IoT functional blocks consisting of the following.



* IoT Communication Models:

- Request - Response model
- publish - Subscribe model
- push - pull model
- Exclusive pair model

→ Describe how devices in an IoT Network interact and exchange data.

* IoT Communication APIs:

- Rest - based communication APIs
- Websocket - based communication APIs

* IoT Enabling Technologies:

↳ IoT is a collection/group of many technologies/devices.

↳ Enabling Technologies are:

- Technologies for acquiring data/Sensing data
- Technologies for analysing data/processing data
- Technologies for taking control action.
- Technologies for providing the security/privacy.

1. **Sensors:**
   Examples: camera, temperature/humidity/moisture sensors
2. **cloud computing:**
   Examples: Amazon, Azure, Adafruit etc.
3. **Big data (Data Analytics):** It is characterised by three factors. 1) Volume 2) Variety 3) Velocity of data.
4. Embedded Boards/Systems:
5. Communication protocols:
6. User Interfaces.

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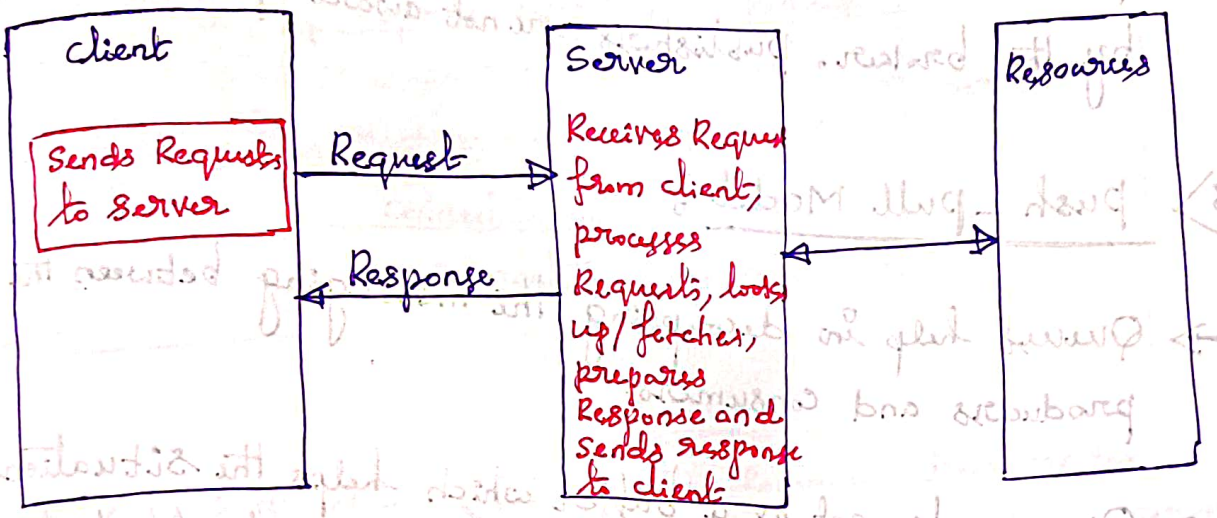
* IoT Communication Models :-

1) Request - Response model :-

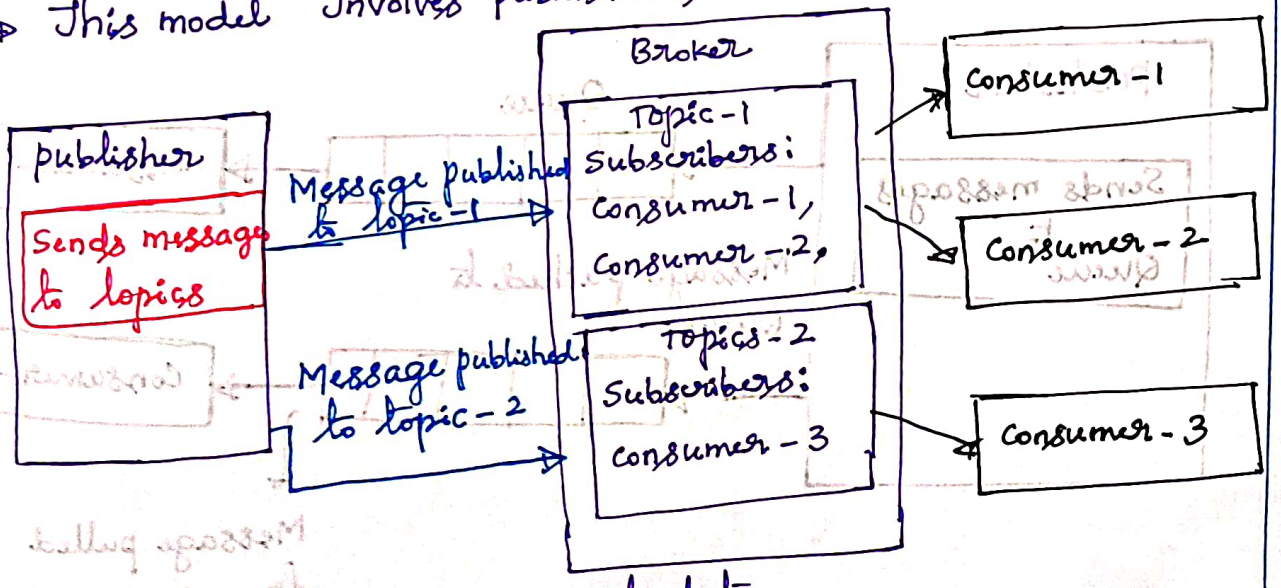


→ When the server receives a request, it decides how to respond, fetches the data, retrives resource representations, prepares the response and then sends the response to the client.

→ Stateless communication model.

2) Publish - Subscribe model :-

→ This model Involves publishers, brokers and consumers.



→ publishers are the source of data

→ publishers send the data to the topics which are managed by

→ publishers are not aware of the consumers.

→ The broker will analyse the data

→ publishers send the data to the topics which are managed by the broker. publishers are not aware of the consumers.

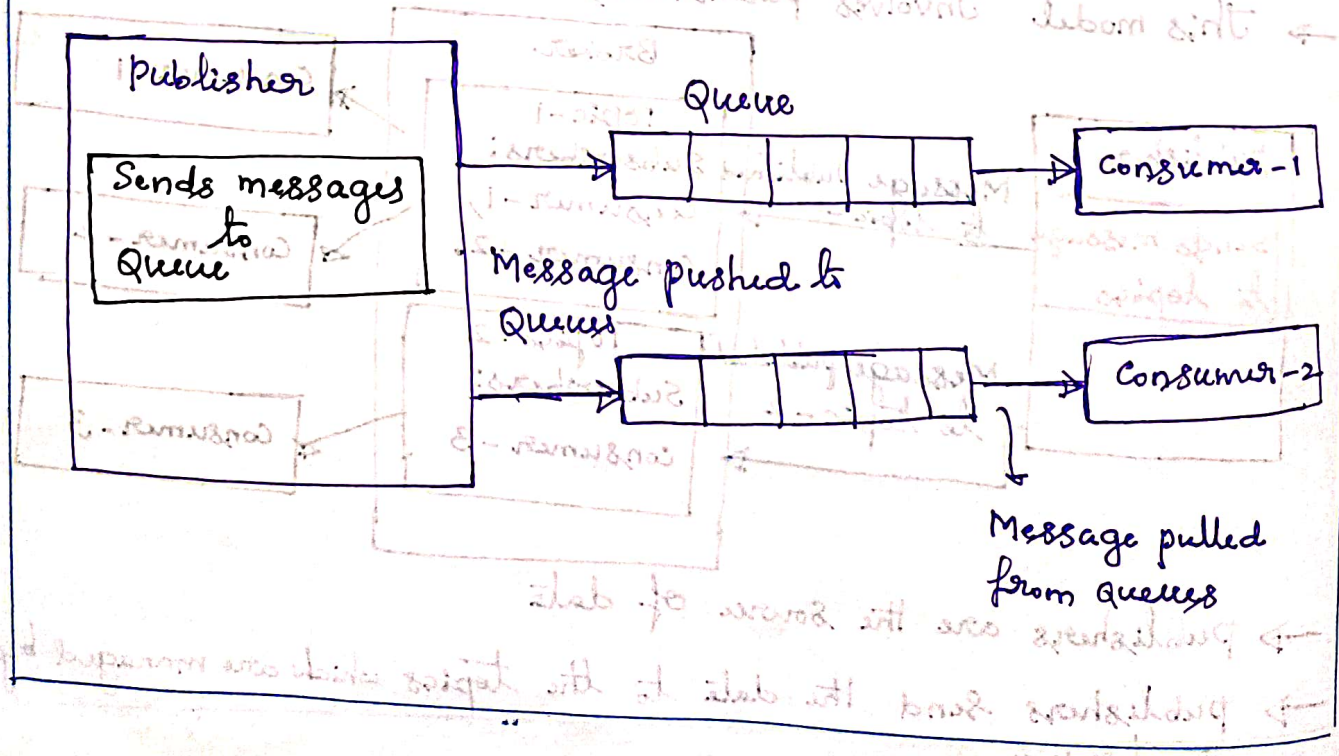
3) push-pull Model :

→ Queues help in decoupling the messaging between the producers and consumers.

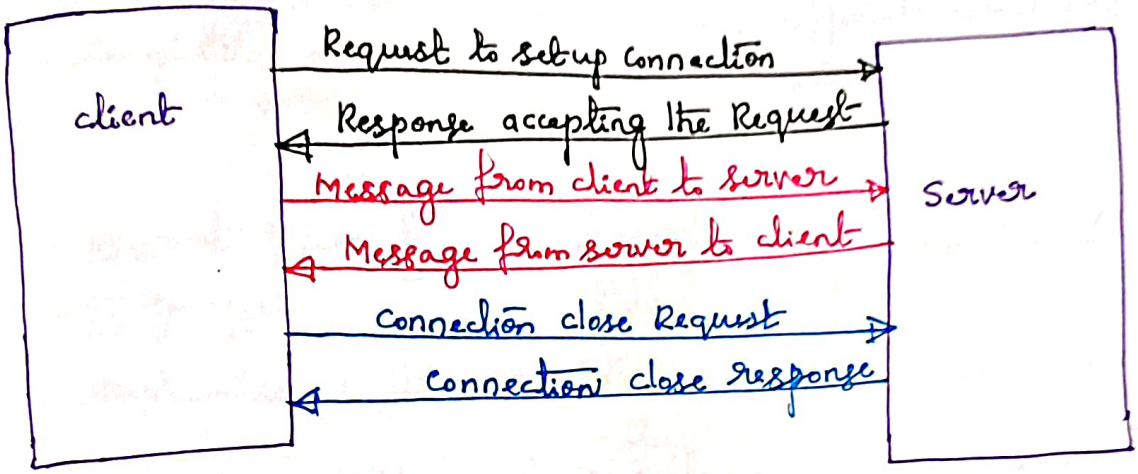
→ Queues also act as a buffer which helps the situations when there is a mismatch between the rate at which the producers push data and the rate at which the consumers pull data.

→ The data producers push the data to queues and the consumers pull the data from the queues.

→ producers do not need to be aware of the consumers.



4) Exclusive pair :



→ It is a bidirectional, fully duplex communication model which uses a persistent connection between the client and server.

→ once the connection is setup it remains open until the client sends a request to close the connection.

→ client and server can send messages to each other after connection setup.

* Levels of IoT Deployments:

→ IoT deployments can be categorized into different levels based on complexity and functionality of the system.

NOTE:
IoT Deployment refers to the process of setting up and implementing an IoT ecosystem

→ IoT Deployment is the complete Installation and implementations of IoT. It involves installing, configuring and managing IoT devices and connecting devices within a network to enable communication and data exchange

→ There are six levels of IoT Deployment. It means that there are six ways by which IoT System can be deployed.

* IoT components:

1. Device:
2. Resource: Software Component
3. Controller Service:
4. Database
5. Web Service
6. Analysis Component
7. Application Component

* IoT Levels:

↳ IoT Level-1: Simple IoT system having single node/device that performs sensing and/or actuation, stores data, performs analysis and hosts the application.

↳ IoT Level-2: Simple IoT System with cloud Service. Here the data is stored in cloud. computational complexity is less.

↳ IoT Level-3: Simple IoT System with Single node. High degree of computational Analysis is Involved.

↳ IoT Level-4: IoT System with multiple nodes. No coordinator.

↳ IoT Level-5: IoT System with multiple nodes connected with Gateway. Co-ordinator. REST and websocket communications are incorporated. Wireless Sensor networks are introduced.

↳ IoT Level-6: Highest IoT System with multiple nodes connected with multiple coordinators.