

IOT

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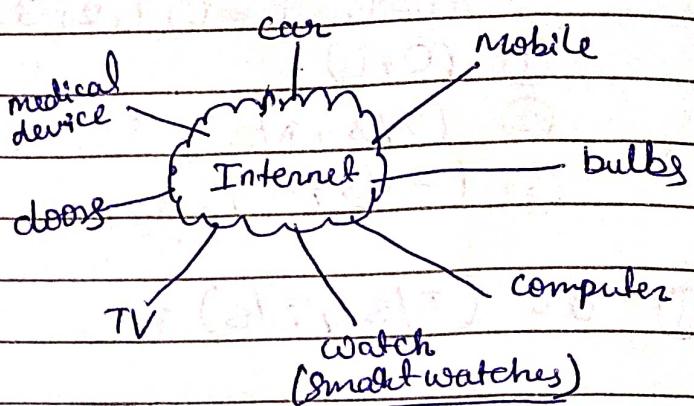
Internet of Things

Things / objects accessible or connected through the internet.

Things → Objects → Mobile

computer
washing machine
TV
Watch
Door
camera

Human $\xrightarrow{\text{connection}}$ Device
Device $\xrightarrow{\text{connect}}$ Humans
Human \longrightarrow Human



IOT is a simple concept of basically controlling different devices by establishing a connection & communicating from mobile app or web browser.

Taking everyday things, embedding them with electronics, software, sensors & then connecting them to internet & enabling them to collect and exchange data without human intervention is called IOT.

Disadvantage of IOT → ① Lack of security or privacy → IOT devices first share data over the internet, where the risk of losing privacy increases because of the hackers.

② Complexity → Designing, developing & maintaining IOT is complicated. Any failure or error in the software or hardware will have serious consequences.

Power failure or no Internet can cause a lot of trouble.

③ Increasing unemployment → As daily activities getting automated there will be fewer requirement of human resources.

④ Technology takes control of life → With IOT we are losing control of our life. We are dependent on technology. We always want to do small tasks by doing minimum efforts.

⑤ Compatibility → There is ~~no~~ ^{international} standard of compatibility for IOT, it is difficult for devices from different manufacturers to communicate with each other.

The Internet of things describes physical objects with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the internet or other communication networks.

use of IOT → • To connect physical devices and everyday objects to the internet, allowing them to send and receive data.

- IOT makes everything smart.

~~A New IOT~~

- Advantages → ① Minimize human efforts → As device interact & communicate with each other & do lot of task for us. It reduces the human effort.
- ② Save time → The IOT reduces the human efforts & hence it saves our time. Instead of repeating the same task everyday.

③ Save Money / Efficient resources utilization → If we know the functionality & the way that how each device work we can increase the optimum utilization of energy & resources. Hence, we can save money by using IOT.

Eg. When we forget to switch off the light and fan ~~when~~, then through the use of your phone device to check and off the light bulb and fan of your house.

④ Better monitoring of devices → The IOT allows us to automate & control the task that are done on a daily basis and we can monitor the devices connected to IOT & take necessary action in case of emergencies.

Ability to access information from anywhere at any time on any device.

Characteristics of IOT (Internet of things) →

- ① Connectivity → In IOT, anything, anywhere, anytime should be connected to the infrastructure without connection nothing makes sense.
- ② Intelligence → Extraction of knowledge from the generated data is important, sensor generate data & this data should be interpreted properly.
- ③ Scalability → The number of devices that need to be managed and communicate with each other will be much larger. Hence IOT setup shall be able to handle the massive expansion.
- ④ Heterogeneity → Devices in IOT are based on different hardware platforms & networks & can interact with other devices or service platforms through different network. IOT architecture should support direct network connectivity b/w heterogeneous network.
- ⑤ Unique Identity → Each IOT device must dynamically has an IP address. This is helpful in tracking the equipment & at times to query query its status.
- ⑥ Dynamic & Self-adapting → The IOT must dynamically adopts itself to the changing context (temperature, location, speed).
- ⑦ Safety → IOT devices are vulnerable to security threats. As our personal data is shared with the help of Internet it can be tampered.
- ⑧ Self-configuring → IOT have capability to configure themselves there is minimum user connection because IOT provide or configures everything according to user need.

Applications of IOT →

- ① Smart Home → With the use of IOT, the user can access the home appliance like lighting, heating, security and entertainment remotely.
Smart TV that are connected to Internet allow us to browse various application.
- Camera & home alarm system → provide safety to our home.
Detection of window and door opening → prevent intruders to enter to our home.

① **Wearables** → Virtual glasses, smart watches are examples of wearable tools.

IOT wearables work on sensors and store data of user daily etc.

IOT wearable tools can display calls, text messages, social media updates & track fitness & health.

IOT wearables are small & energy efficient devices.

IOT wearable devices are portable, ~~where~~ anywhere user should go with the early.

② **Connected Health** → the use of wearables or sensors connected to patients, allows doctors to monitor the patient's condition outside the hospital and in real time.

Integration of IOT technology into hospital beds, can collect and transfer health data like blood pressure, oxygen and blood sugar levels, weights and ECGRs. This ~~so~~ data is stored in the cloud & can be accessed by doctors when required.

③ **Smart Retail** → This IOT application saves times of shopping with the help of IOT apps, customers do not need to stand in long queue as the checkout system can easily read the tags from the products & deduct the total amount from the customers mobile payment app.

④ **Smart Farming** → As quality of soil is crucial to produce good crops. So, IOT offers farmers the possibility to access detailed knowledge & valuable information of their soil condition.

Information such as soil moisture, level of acidity, the presence of certain nutrients, temperature etc. helps farmers to control irrigation and make efficient use of water.

So with the help of IOT, farmers will be able to increase their productivity at low cost.

- (6) Industrial Automation → IoT technology can automate manufacturing processes remotely.
With help of IoT, we can manage the inventory & supply chain. We can monitor the emission of toxic gases to avoid damage to worker health & the environment.
With the help of IoT machine require repair and maintenance. Alert goes to the owner or manager.
- (7) Connected Car → Car connected with IoT system will report to the user the condition of the car such as the fuel efficiency, advanced navigation, maintenance etc. It generates an alert of heavy traffic & other security alerts.
- (8) Smart Grid → Smart Grid is used to monitor & manage everything remotely such as lighting, traffic light, traffic jams, parking light, road warnings etc. It also detects earthquakes & extreme situations weather.
It can effectively avoid or reduce the damage of natural disasters & reduce the economic loss.

Physical design of IOT

Physical design of IOT refers to

① IOT devices

② IOT Protocols

IOT devices

- Things in IOT are IOT Devices.
- They have unique identifier
- They perform monitoring, actuating or remote sensing.

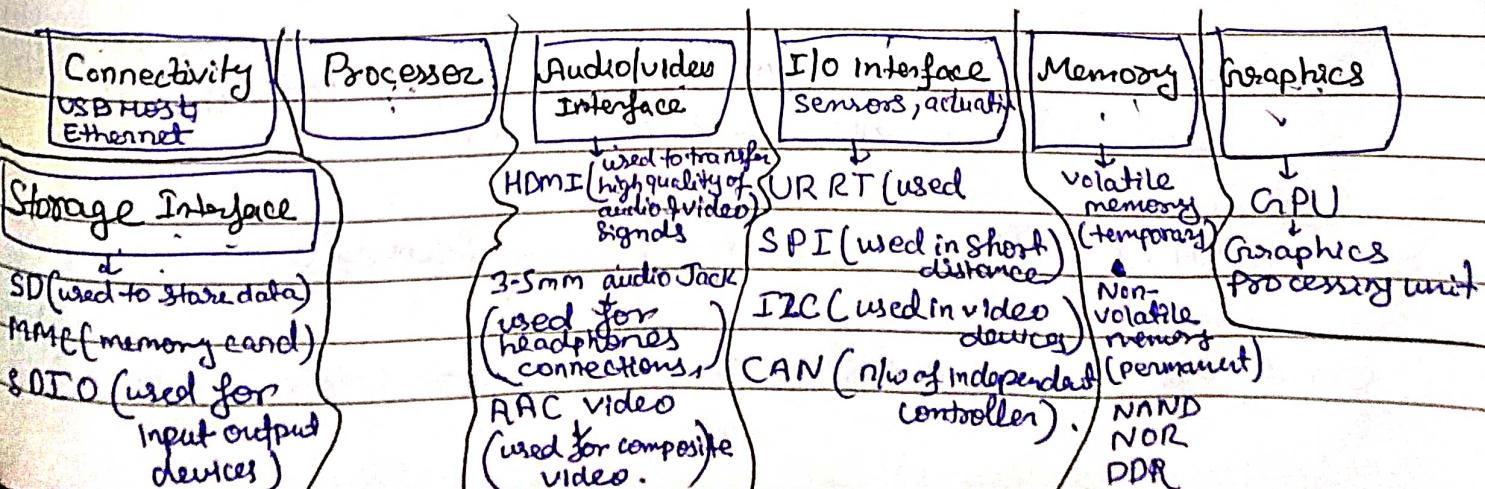
Types of IOT Devices

- Sensing devices, Smart watches, smart Electronic appliances, wearable sensors, Automobiles, Etc.

Data generated by IOT devices processed by data analytics systems leads to useful information to guide further action locally or remotely.

IOT devices can exchange data with other connected devices & applications directly or indirectly to collect data from other devices.

Generic Block Diagram of IOT Devices



Physical design of IOT

② IOT Protocols

IOT protocols helps to establish communication b/w I/O devices & cloud based server over the internet.

It also helps to send commands to IOT device & receive data from an IOT device over the Internet.

IOT protocols used at different layers →

① Application layer

HTTP XMPP WebSockets

② Transport layer

TCP UDP

③ Link layer

802.3 - Ethernet 802.16 WiMax
802.11 - WiFi

④ Network layer

IPv4 IPv6

Application layer →

HTTP → Hypertext Transfer Protocols.

It is a protocols for transmitting hypermedia documents such as HTML

It is a method for encoding & transporting information b/w web browser and web servers.

HTTP follows Client-Server Model.

Generally, use TCP connections to communicate with servers.

Web Sockets → It is a low-level web friendly communications mechanism (FB, messenger)

It is a full duplex communication over a single socket connection for sending message b/w client & servers.

XMPP

XMPP → Extensible Messaging & Presence Protocol

It is a communication protocols for message oriented middleware based on XML.

It is suitable for voice/video chat, calls, messaging, gaming etc.

(ii) Transport Layer →

TCP → It is a connection Oriented protocol.

(iii) Network layer → This layer is responsible for sending of IP datagram from the source network to the destination network.

This layer performs the host addressing & packet routing.

IPv4

It defines an IP address as a 32-bit no.

IPv6

It defines an IP address as a 128-bit no.

It is a numeric address separated by a dot

It is an alphanumeric address separated by a colon (:)

e.g. 12.244.133.155

300:lab6:0000:0001

(iv) Link Layer → Link Layer Protocols determine how data is physically sent over the network layer or medium.

802.3 Ethernet → Ethernet is a set of technologies & protocols that are used primarily in LANs.

~~Data Sublayer~~

802.11 - WiFi → It defines an interface b/w two wireless clients. It is used to provide secure end to end communication for WLANs.

802.16 WiMax → The standard for WiMax technology is a standard for wireless Metropolitan Area Networks.

Specialized in point to ~~one~~ multipoint broadband wireless access.

Logical design of IOT

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② Logical design of IOT systems refers term used for logical design are

- ① IOT functional blocks
- ② IOT Communication Models
- ③ IOT Communication APIs.

① IOT functional blocks

IOT System consists of many functional blocks that provide the system

- Capability for identification
- Communications
- Sensing
- Management
- Actuation

Functional Blocks of IOT → Application

① Device → IOT system devices provides sensing, actuation, monitoring & control function.



② Communication → Handles communication for IOT System.

③ Services → Provide services for device monitoring, device control service, data publishing services & service for device discovery.

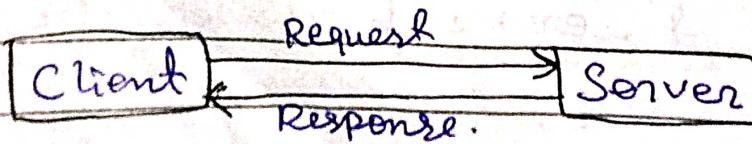
- (W) Management → It provides various functions to govern the IOT System.
eg. Data organization, Proper way to store data.
- (S) Security → This blocks secures the IOT System by providing function such as authentication, authorization, message & content integrity & data security.
- (V) Application → This is an interface that the user can use to control & monitor various IOT System.
It also allow users to view the system status & view or analyze the processed data.

IOT Communication Models

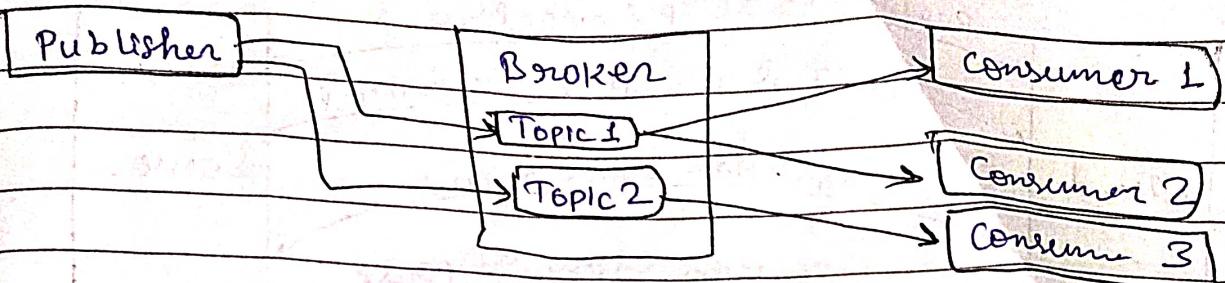
- (1) Request - Response Model → Request - Response Model is communication model in which Client sends requests to the Server & Server responds to the requests.

Server may be remote or local & can handle requests of multiple clients.

When Server receives a request it decides how to respond, fetches the data, retrieves resource and prepare the response and sends the response.



② Publish - Subscribe Model →

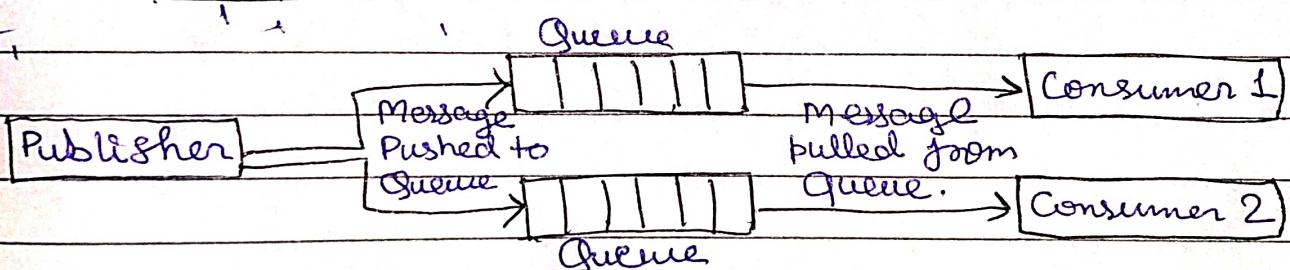


Publish Subscribe is a communication Model that involves publisher, brokers & consumers.

* Consumer → Consumer subscribe to the topics which are managed by the broker.

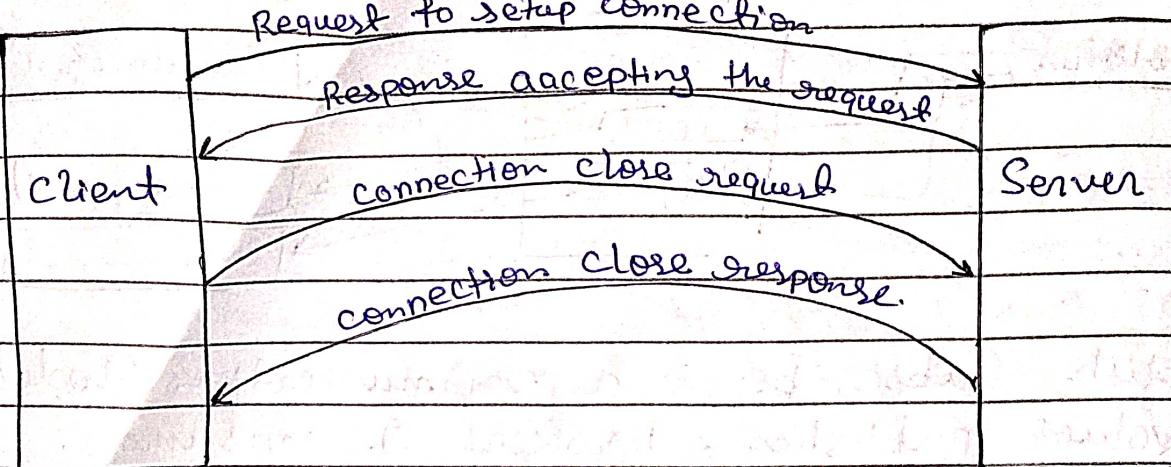
Broker → when the broker receive data for a topic from the publisher, it sends the data to all the subscribed consumers.

③ Push - pull model →



Push - Pull is a communication model in which the data producer "push" the data to queue and the consumer "pull" the data from the queue.

④ Exclusive pair Communication Model.



Exclusive pair is a bi-directional, full duplex communication model that uses a persistent connection b/w client \rightarrow Server.