Definition:- IoT refers to physical and virtual objects that have a UNIQUE identities that are connected to Internet.

* The scope of IoT is connecting things such as devices, Appliances, machines etc through the Internet and also IoT allows these things to Communicate and Exchange of data like control and Information.

Infering Information and knowledge from data

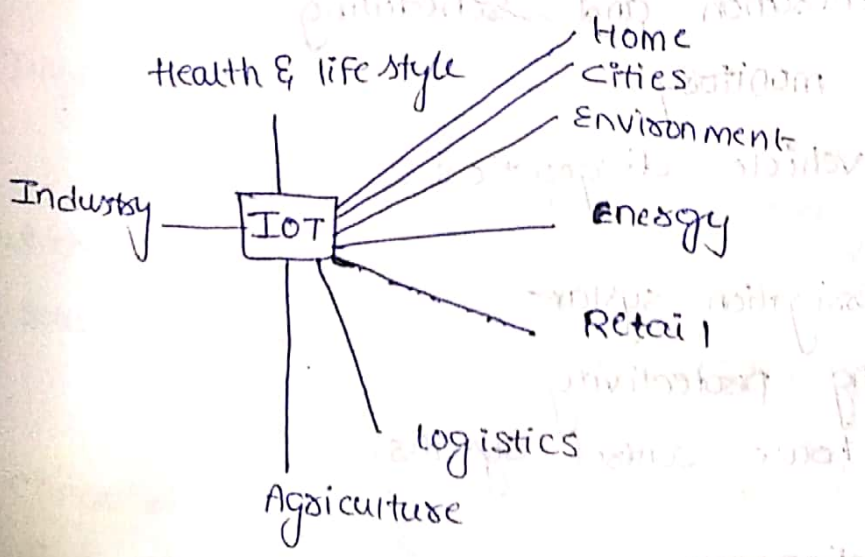
* Data raw and unprocess data obtained from IoT devices are systems.

* Data itself does not have a meaning until It is contextualised process into useful information.

Information:-

It is Inferred from Data by filtering, processing, categorizing, condencing and contextualising data.

Knowledge:- knowledge is inferred from information by organising and structuring information and is put into actions to acheive specific objectives.



Home:- 1. Smart lighting
2. Smart Appliances
3. Intrusion detection systems.
4. Smart smoke or gas detectors

Cities:-
1. Smart parking system
2. Smart lighting (or) lightening
3. Smart road

Environment:-
1. Wheather monitoring
2. Air and Noise pollution monitoring.
3. Forest fire detection.
4. River flood detection. System

Energy:-
1. Energy including: Smart grids. integration of renewable energy source.

Retail Domain :-
1. Inventory Management
2. Smart payments.
3. Smart Vending Machines.

Logistics :-
1. Route generation and scheduling
2. Ship melt monitory.
3. Remote vehicle diagnostics.

Agriculture field:-
1. Smart irrigation systems.
2. Enhancing protectivity
3. Green house control systems.

Industry:-
1. Machine diagnosis
2. Interior Quality System.

3. Determining the cause of fails.

Health and life style:-

1. Health and fitness monitory systems
2. wearable (wesable) electsonics.

Definition:- IoT

It Embeded with electsonics, internet connectivity and othes forms of hasdwase, these devices can communicate and intesact with othess oves the internet and they can be semotly contsol and monitos.

(os)

IoT is a system of interselated computing devices, Mechanical and digital machines, objects can peoples that ase povided with unique identifiess and the ability to tansfes data oves a netwosk

Chasactesistics of IoT:-

1. Dynamic and self adapting.
2. Self configusing.
3. Intes opesable communication psotocals.
4. unique identity.
5. Integsated into information Netwosk.
6. physical design of

Physical design of IoT:-

*The thing in IoT usually sefess to IoT devices which have unique identities and can pesfosm semote sensing, Actuating and monitosing capabilities

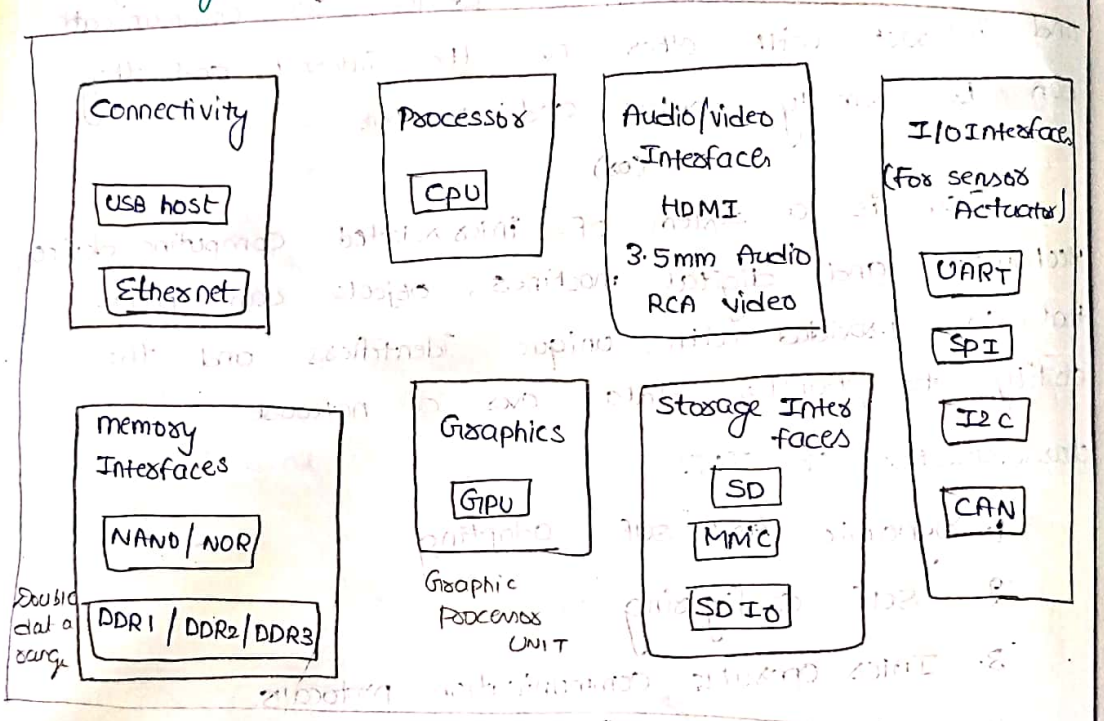
* IoT devices can Exchange data with othes connected devices and applications (os) collect data fsom othes devices and pscocess the data eithes locally (os) send the data to a centsalised seswes

(or) cloud based applications

Intesface :-

Def:- Intesface is a software (or) hardware interfaces b/w two pieces of equipment (or) protocal layers in computer Network.

Block Diagram of Iot devices:-




* Audio/video Interfaces
* IIO Interfaces
* Storage and memory Interfaces
* Interface/Connectivity

USB - universal Serial Bus.

* Ethernet - Lan Connection

CPU - central processing UNit

GPU - Graphics processing unit

NAND/NOR used for SD Ram

Synchronize dynamic Random Access Memory - SDRAM

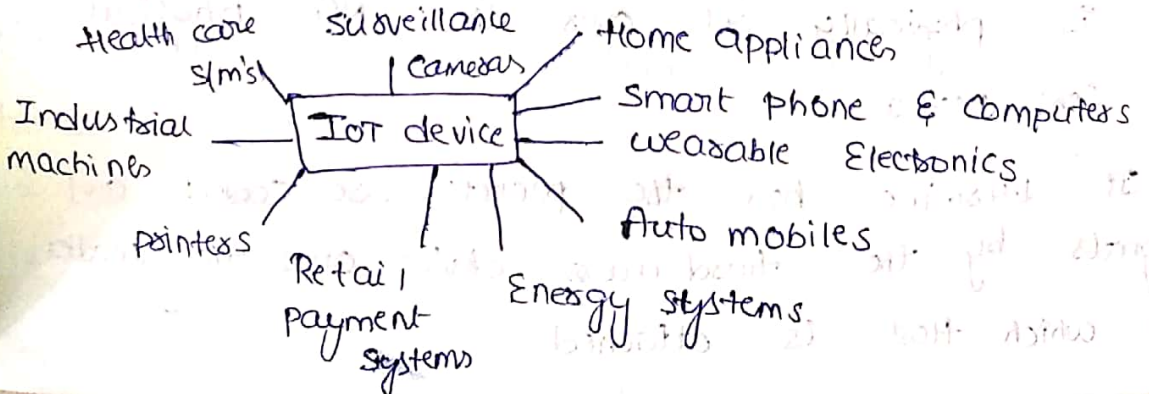
DDR → Double data Range

Intesface :-

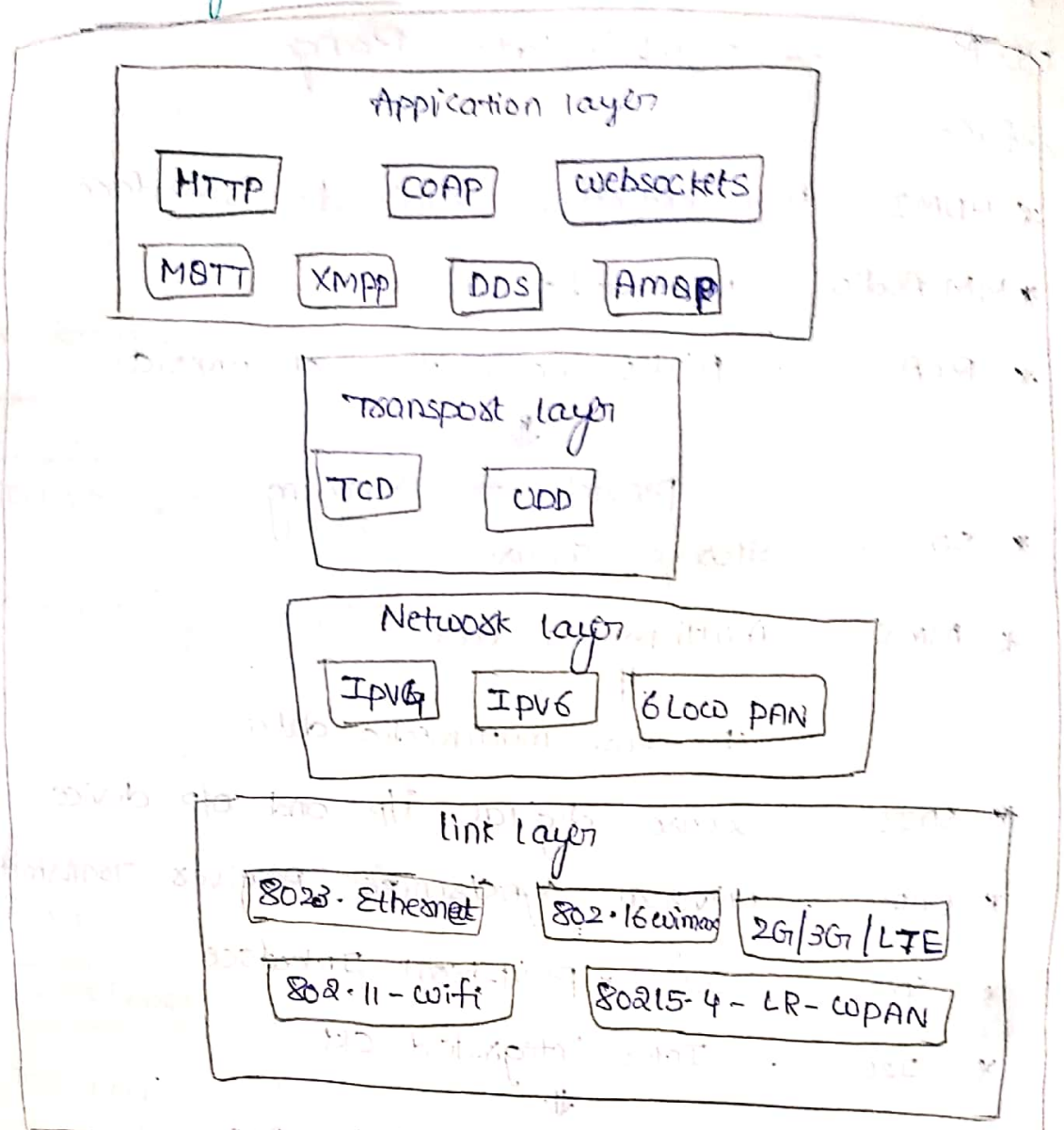
* HDMI - High definition Multimedia Interface
* MM Audio - Multi Media Audio
* RCA - Radio corporation of America
  ⇓
  Provider for Encoding
* SD - Storage secure
* MMC - Multi media card
  ⇓
  To store multimedia data
* SDIO - secure digital i/p and o/p devices
* UART - universal synchronize Receiver, Transmitter
* SPI - Serial peripheral Interface
* I2C - Inter integrated ckt
  ⇓
  Bidirectional Serial Bus
* CAN - Controller Area N/w.

Accuators:- It takes an electrical I/P and terms it into physical action.

* IOT devices can be connected to accuators that allow them to Interact with other physical entities in the vicinity of the device



Application layer:-




It has 4 layers :- LTE - Long term Evaluation

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

link layer:- link layer protocols determine how the data is physically set over the N/w physical layer (or) Media.

* It determine how the packets are coded and signals by the Hard ware device over the media to which Host is attached.

* The scope of the link layer is the LAN connection to which host is attached

* IEEE 802.3 Ethernet → It is a connection of wired Ethernet standards for the link layers. The shared medium in the Ethernet are coxial cable, fiber optics and Twisted pair.

* The shared media carries the communication for all the devices, all the N/w thus, the data send by one device can received by all the devices.

* Ethernet standards for 802.3 is the standard for 10 BASe 5 Ethernet use coxial cable for shared media.

* 802.3.i is the standard for 10 Base -T Ethernet copper twisted pair connection

* 802.3.j is the standard for 10 BASE-F Ethernet fiber optic connection.

* 802.3ae is the standard for 10 GB/sec Ethernet-fiber optics

* The Data range from 10MB/sec to 40 GB/sec.

* It is a collection OF wireless LAN, the standards 802.11a 5GHz, 802.11b, 802.11g → 2.4GHz band 802.11n, 802.11ac using 5GHz band. 802.11ad → 60GHz band.

* Data rates 1MB/sec to 6.75 Gb/s

* 802.16 is wimax

* It is a collection of wireless broad band standard data rate from 1.5MBps to 1GBps, 802.15.4 LR WPAN low rate wireless personal area n/w

* Data rate upto 2MBps to 250KBps.

* 2G/3G/4G → 2G represents second generation GSM [→ Global System for Mobile communications], CDMA [Code division Multiple Access].

* "3G" it is used for UMTS and CDMA.
UMTS = Universal mobile Telecommunication Services

* 4G Includes LTE. Data rate ranges 9.6 KBps for 2G, 100MBps for 4G.

Network layers:-

Network layers are responsible for sending of Ip datagrams from the source n/w to the destination N/w.

* This layers performs the host addressing packet routing. The standard IPV4 which is used to identify the devices a Hierarchal addressing scheme.

* It uses a 32 bit addressing scheme and allows a total numbers of $2^{32}$ addresses.

* IPV6 → It is the newest version of internet protocal. It uses 128 address scheme that allows a total of $2^{128}$ address.

* 6LOWPAN - Ip version 6 over low power wireless personal area N/w brings Ip protocal to the low power devices which has limited processing capability.

Data rate is 250KBps.

Transport layer:-

It provides End to End message transfer capability

TCP - Transmission control protocol.

UDP protocal.

Application layer:- Application layer protocal defines how the application interface with the lower layer protocal to send the data over the N/w.

* port numbers are used for application addressing.

Ex:- Code Numbers port NO 80 for http
" " 22 for SSH (secure shell)

Http = Hyper text transfer protocal.

It is a request response model. Clients sends request response model to servor using Http comments ie [ Get and host].

CoAp - constrained application protocal

* It is used for Machine to Machine communications.
* It is a web transfer protocal. based on request response model.

It is based on UDP [user data protocal]

web Socket :- It is a full duplex Communication.

MQTT - Message queue telementary transport.

* It is based on Claint Sevor architecture.
* bublish Subscribe model.

* The Claint is an IOT device connect to the Sevor ie brokes, bublishes messages to topics on the sevos. The brokes forwarded to the messages to the Claint Subscribed to topics.

XMPP:- Extensiable Messaging and presence pleasant protocal

* It is real time communication.
* It allows Sending small amount of XML data from one Networ Entity to another N/w Entity in real time.
* It allows realtime communications b/w IOT devices.
* It is used for the following applications
  1. Gaming
  2. multiparty Chat
  3. Voice and Videocalls.

DDS:- Data Distribution Service

1. It is used for device to device (or) machine to Machine communication.
2. Publishes is responsible for data description.
3. Suscriber is responsible for Receiving publisher
4. It is based on Publish Subscribe model.

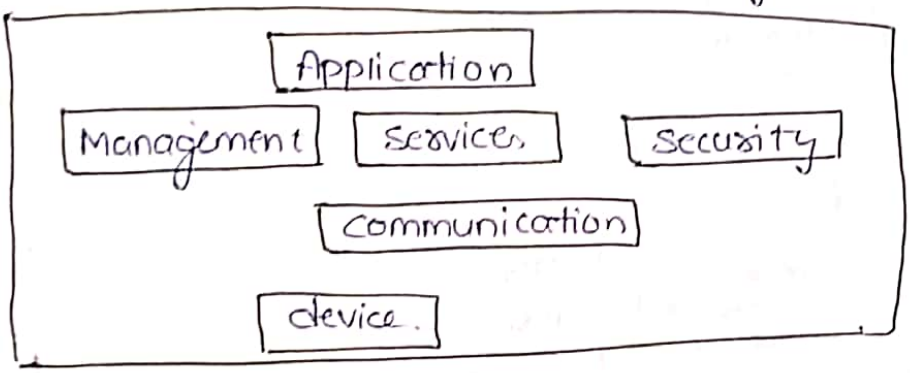
AMQP:- Advanced message Queuing protocal.

## Logical design of IoT:-

logical design of IoT refers to abstraction representation of entities and processors without going to the low level implementation

## IoT functional blocks:-

* It provides the s/m capability of identification sensing, actuation, communication and management.




Device monitory

* Data publishing services and services for device discovery

It provide sensing actuation monitoring and control function.

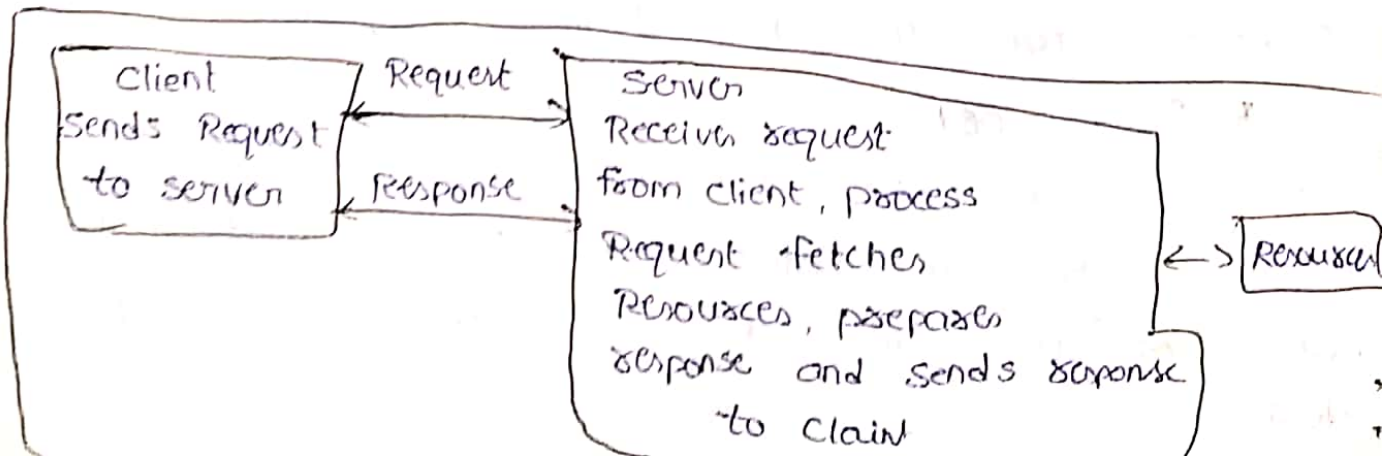
Communication for IoT system.

security → protection of data

* To secure the IoT s/m such as message, authentication and content Integrity and security. data application. It allows users to given system states and viewer analysed.

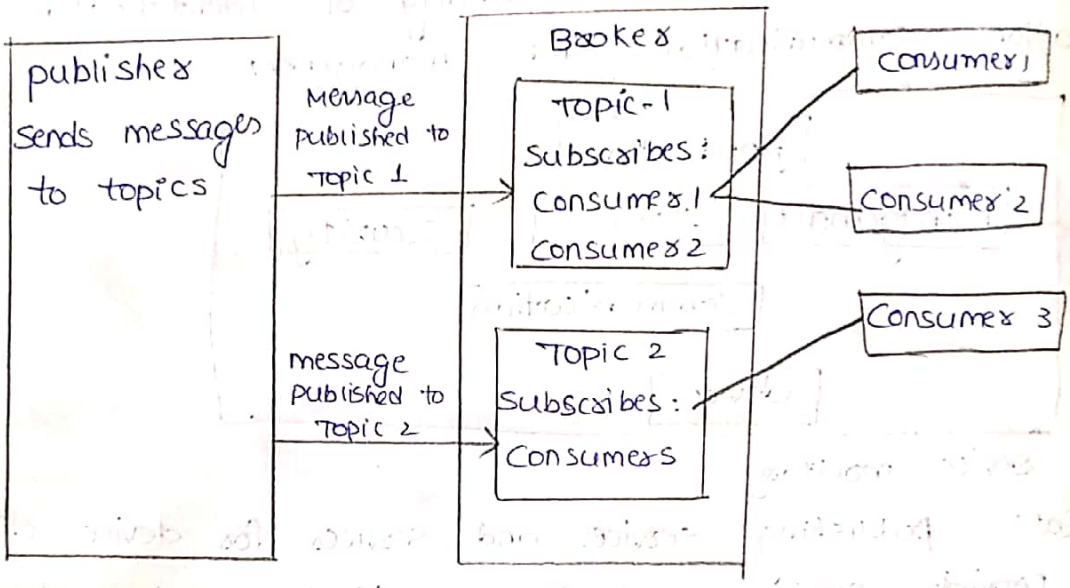
## IoT communication model:-

① Request response model:-



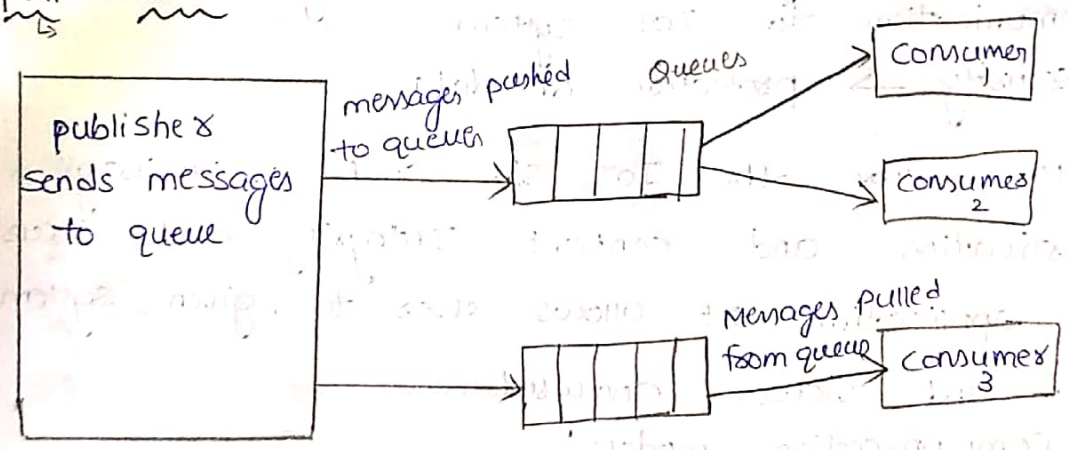
## Publish Subscribe model:-

* This model involves publishers, brokers and also the consumer. publishers are the source of data.
* These datas are managed by brokers.
* Consumers subscribe to the topics which are managed by the brokers



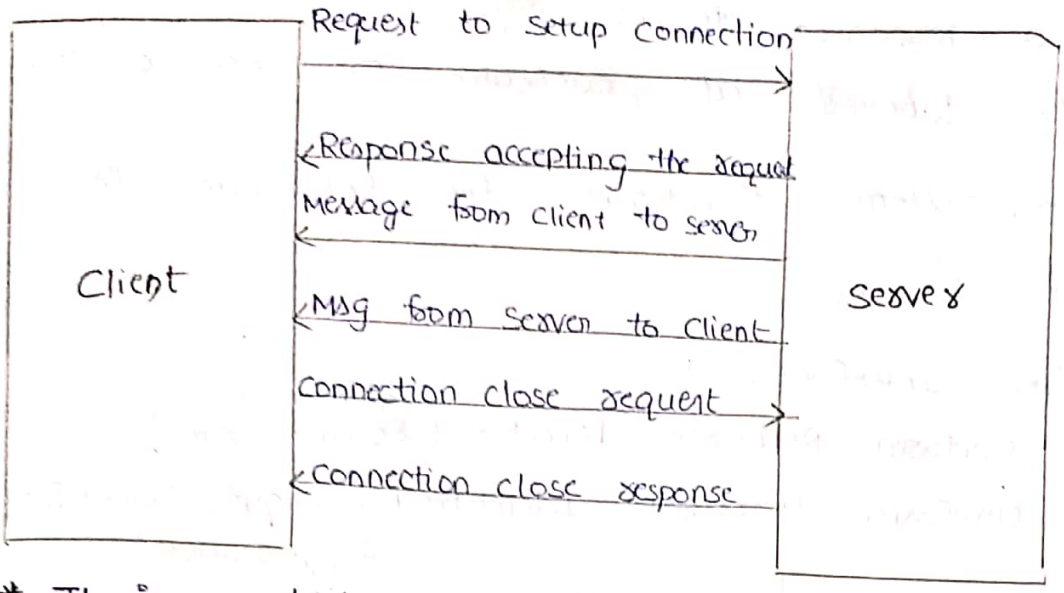

Insert the data

## Push - pull model:-




* The producers push the data to queues and the Consumers pull the data from the queues.
* Queues acts like a buffers so it can be controlling the data rate also. when there is a mismatch b/w the rate at which the producer push data and the rate at which the consumers pull data.

Exclusive pair :-




* It is a bidirectional full duplex communication model. once the connection is setup, it remains open until the client send a request to close the connection.

*

## IoT Communication APIs:-

API - Application programming interface.

1. REST based Communication API
2. WEBSOCKET based communication API.

REST - Representational state Transfer.

It is helpful to design web services and web API's that focus on system resources and how resources state or data and transfer.

- Claint server :-

Constraint is the seperation of claint and server

2. State less :- Each request from claint to server first contain all the information necessary to understand the request and cannot take the advantage of any stored context on the server.

3. Cacheable :- These constraints requires that the data within a response to a request be implicity or Explicity labelled at cacheable or non-cacheable.

4. Layered system:- Constraints the behaviour of Components

5. uniform Interface :-

URL - uniform Resource Locator (represented by Domain name)

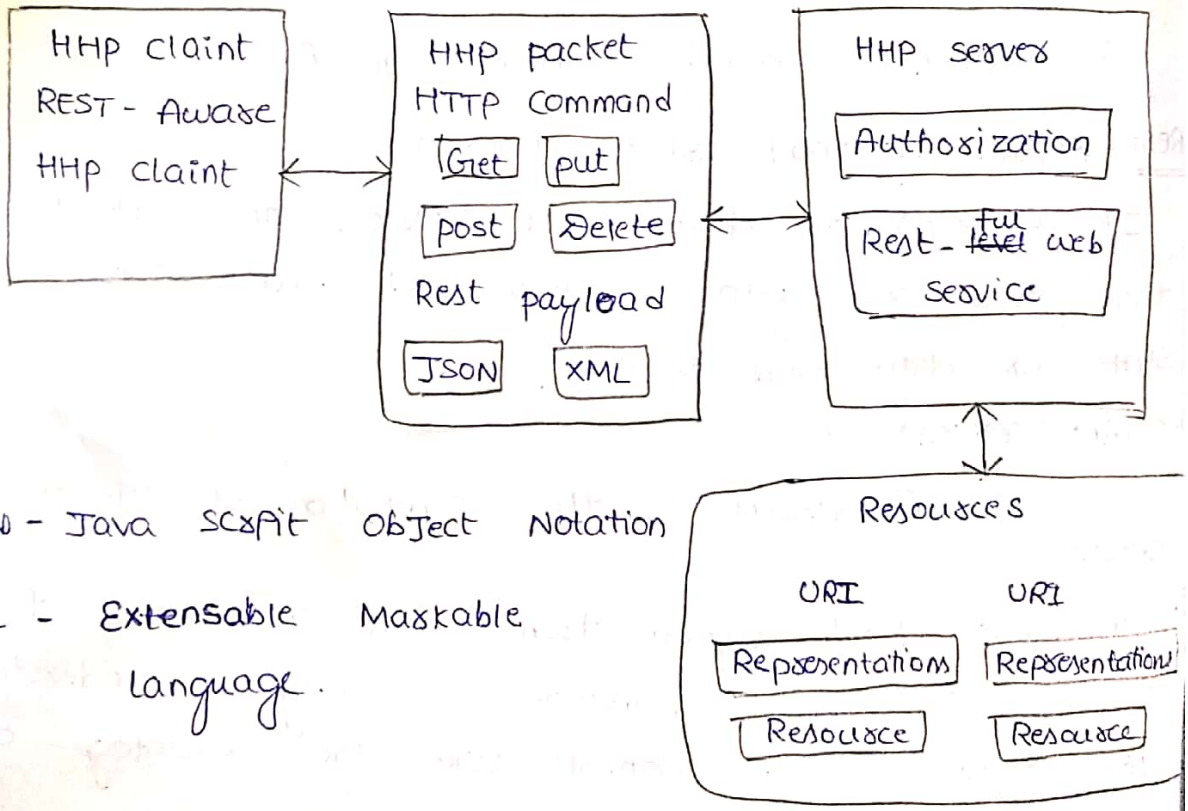
URI - uniform Resource Identifier. (unique identifier for request).

These constraints requires that method of communication b/w claint and server must be uniform.

6. Code on demand:-

Server can provide executable code (or) sp scripts for claint to execute in their context.

Communication with REST APIS :-

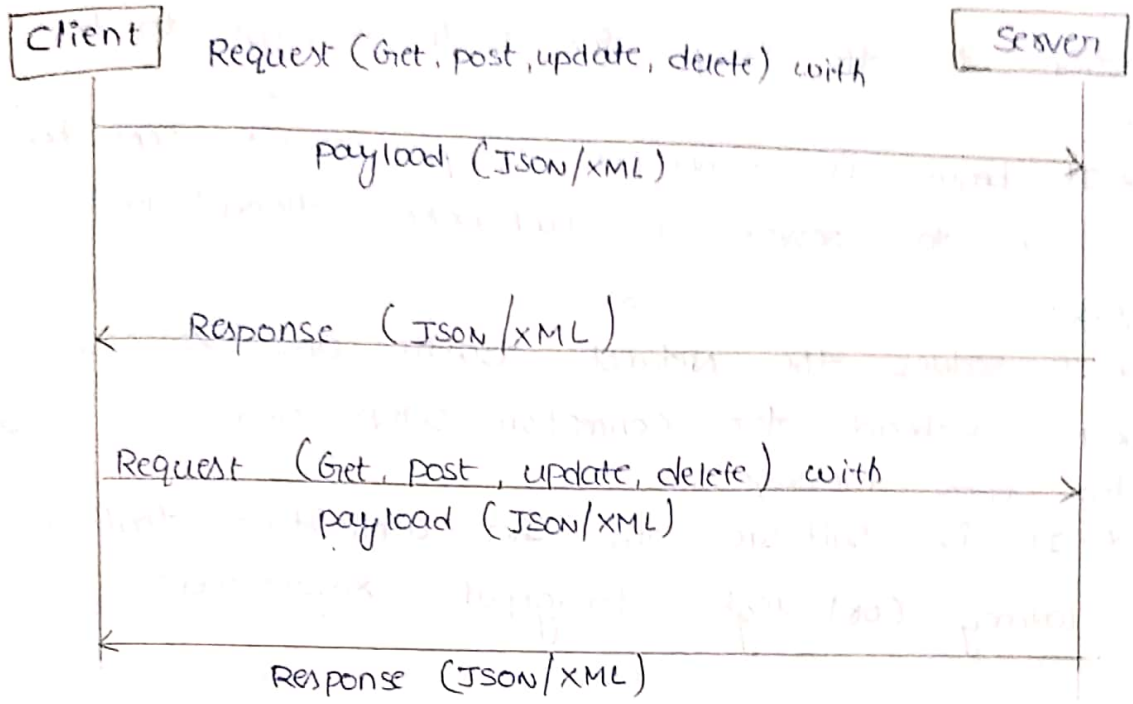



JSON - Java Script Object Notation

XML - Extensable Maskable language.

* Rest-ful web services is a web API implemented using Http and Rest principles

* The interaction in the request response model used by rest as follows




Rest ful web service is a collection of resources which are represented by the client sent request to these URI using the methods defined by the http protocol.

| Http method | Resource type | Action |
|---|---|---|
| four methods. | | |
| 1. Get method | Collection URI | List all the resources in a collection. |
| 2. Get method | Element URI | Get information about a resource |
| 2. POST method | Collection URI | create a new resource. |
| 4. POST method | Element URI | Generally not used. |
| 3. Put method | Collection URI | Replace the Entire collection with another collection |
| | Element URI | update a resource |
| 4. Delete method | collection URI | Delete the Entire Collection. |
| | Element URI | Delete a resource |

Web Socket based communication API :-

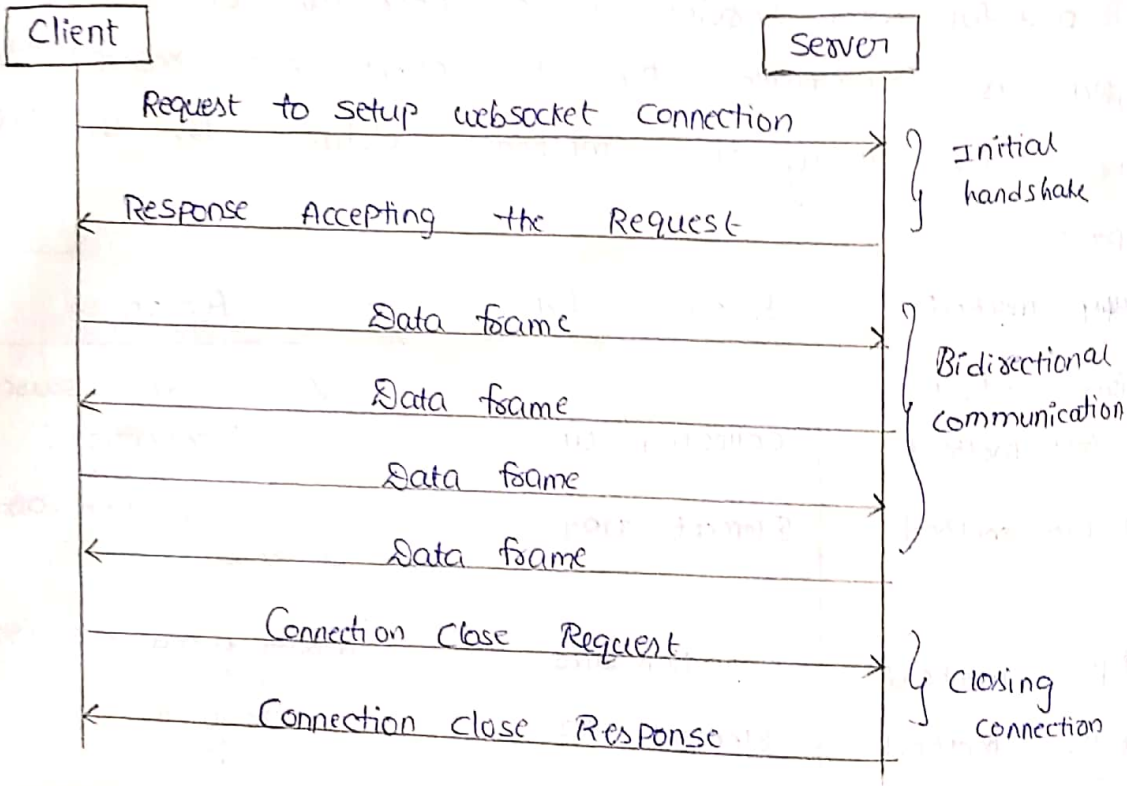
Put method Collection

* It allows bidirectional full duplex communication b/w client and server. It does not require a new connection to the setup for each message to be sent.

* It begins a connection setup request sent by the client to server is web socket Handshake.

Advantage :-

* It reduce the Network traffic and Latency
* No overhead for connection setup and termination for each message.
* It is suitable for IoT application that have low latency (or) High throughput requirement.




Iot enabling technologies :- Iot is enabled by diffesent technologies

1. Wireless sensor N/w. [WSN]
2. Cloud Computing.

3. Big data analytics
4. Embeded systems.
5. Security protocols and Architecture
6. Communication protocols
7. web services
8. Mobile Internet
9. Semantic Search Engines

1. WSN :-

* WSN Compsises of distributed devices with sensors which are used to monitor they environmental and physical conditions.
* It consist of a numbes of Nodes, routers and co-ordinators
* End nodes have several sensors attached to them and also act as a routes
* Routers are responsible for routing the data packets from end nodes to the co-ordinators.
* Co-ordinater collects the data from all the nodes.
* Co-ordinators acts as a gate way that connects the WSN to the internet.

Eg:- 1. wheather monitoring system.
2. Indoor air quality monitoring system.
3. Soil moisture monitoring system.
4. Surveillance systems
5. Smart grids
6. Structural health monitoring system.

* WSN's are enabled by wirless communication protocol such as IEEE 802.15.4

* Zigbee is the wireless technology used by WSN

* It has 2.4 GHz frequency data rate 250 KBps and ranges from 10 to 100 mts.

* Ability to deploy large numbers of low cost and low power sensing needs for continuous monitoring of Environmental and physical condition.

Cloud Computing (storage purposes) :- It is a transformetic computing paradigm it involves delivering application and services over the internet.

* It involves profering of computing, Networking and storage resources on demand.

* Cloud computing resources can be accessed over the N/w using standard Access mechanisms that provide Platform independent access through the use OF Hetrogenous client Platforms such as workstations, Laptops, tablets and smart phones.

Cloud computing services:-

1. Infra structure as a service (Iaas)

* It provides the users a ability to poss provision computing and storage resources. These resources are provided to the users as virtual machine instances and virtual storage. User

* users can start, stop, configure and manage the virtual machine instances and virtual storage.

* users can deploy os and application of the virtual resources provisioned in the cloud.

2. platform as a service (PaaS):.

* It provides the users a ability to develop and deploy application in the could cloud using the development tools, API, software libraries and services provided by the cloud service providers.

* Cloud service provided manages the cloud infrastructure including servers, Network, operating s/m (os) and storage.

* The users are responsible for developing, deploying, configuring and managing application on the cloud Infrastructure.

3. Software as a Service (SaaS)

* SaaS provides the users a complete softex application or the user interface to the application itself.

* They cloud service provided manages the cloud infrastructure including servers, Network, os, storage and application software then the user is unaware of the underlying main aschitecture of the cloud.

* SaaS applications are platform independent. and can be accessed from various client devices such as workstation, laptop, Tablets and Smart phone.

Big data analytics :