Assignment -1

1. Define IOT. Also few Applications of IOT.

→ The Internet of things (IOT) is the network of physical object devices, vehicles, buildings and other items embedded with electronics, software, sensors and network connectivity that enables these objects to collect and exchange data.

- The Internet of Things also called The Internet of objects, refers to a wireless network between objects, usually the network will be wireless and self-configuring such as household appliances

- The IOT refers to the capability of everyday devices to connect to other devices and people through the existing Internet infrastructure.
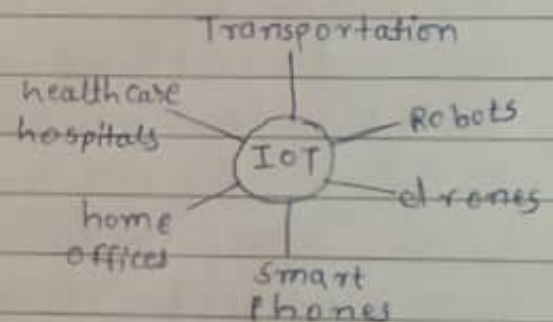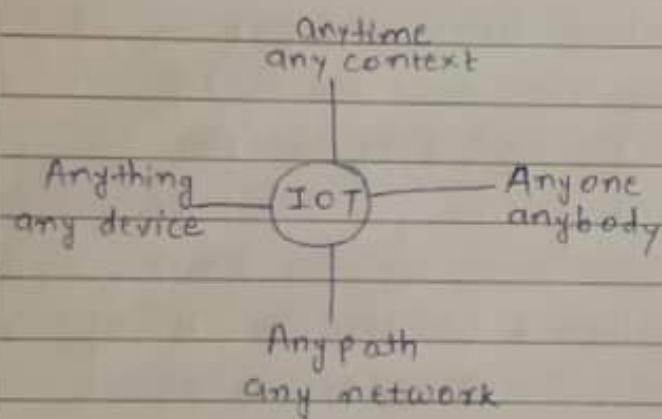
Applications:-

Home :- Building where people live. It controls home and security systems.

Offices :- Energy management and security in office building, improved productivity, including for mobile employees

Vehicles :- Vehicles including cars, trucks, ships, aircraft, and trains, condition based maintenance, usage-based design, pre-sales analytics.

Factories :- Places with repetitive work routines, including hospitals and farms, operating efficiencies, optimizing equipment use and inventory.

2. Write various characteristics of IOT.

→ Interconnectivity :- Everything can be connected to the global information and communication infrastructure.

Heterogeneity :- Devices within IOT have different hardware and use different networks but they can still interact with other devices through different networks.

Things-related services :- provides thing-related services within the constraints of things such as privacy and semantic consistency between physical and virtual thing.

Dynamic changes :- The state of a device can change dynamically, thus the number of devices can vary.

Integrated into information network :- IOT devices are integrated with information network for communication purpose. It will exchange data with other devices.

Self - adapting

Self - configuration primarily consists of the actions of neighbour and service discovery, network organization and resource provisioning.

3. Write about Request - Response and Exclusive pair Communication model of IOT.

→ In the Request/Response model, client requests information from the server and waits till the response is served from the server.

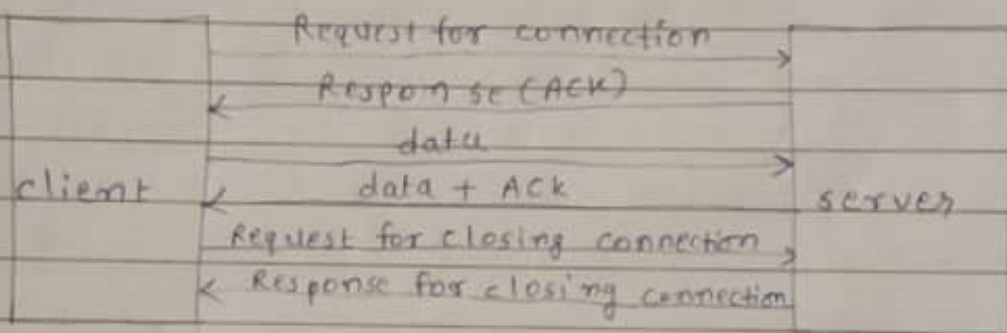| client | server |

HTTP GET →

← HTTP 200 ok (content)
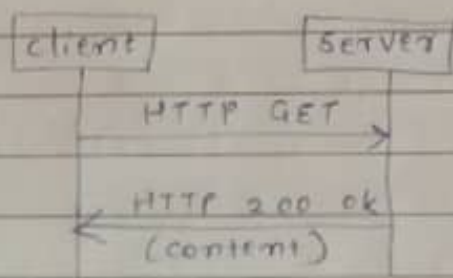
- HTTP protocol is used by this model. For example a browser client may request a web page from the server through a "Request" and the corresponding

webpage will be served by the server as a "Response".
- The client and the server can communicate one to one, or one to many with more requests. This model is stateless communication model.

→ Exclusive pair model :- This communication model is full duplex, bi-directional communication model. It uses persistent connection between client and server.
- client send request to server for opening the connection. This connection is open till the client send request for closing the connection.

Request for connection →
Response (ACK) ←
data
client   data + ACK →   server
Request for closing connection →
← Response for closing connection.

4. Write about IOT level-5 and IOT level-6.
→ IOT level-5 :- It contains multiple end sensor and one coordinator sensor.
- The end sensor perform sensing and/or activation. Coordinator sensor collect data from the end sensor and sends to the cloud.
- Data is stored and analysis in the cloud and application is also cloud based. Forest fire detection system uses level 5 IOT system.

End sensor
End sensor
coordinator
cloud
data storage and application.
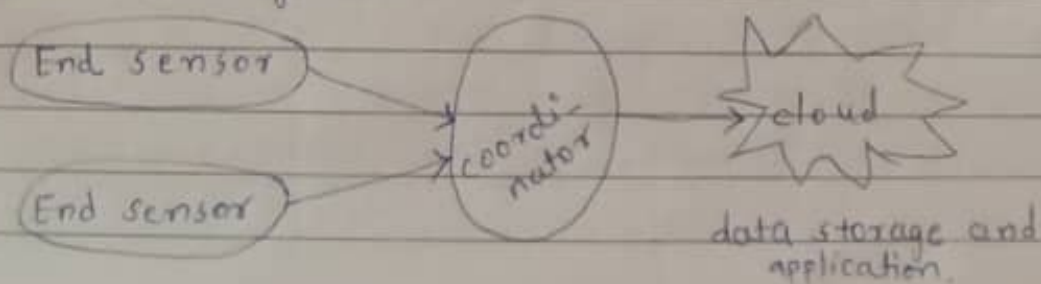
→ IoT level 6 : It contains multiple independent end nodes & it performs Sensing and/or actuation function. It sends data to the cloud.
  - Data is stored on the cloud and application is also cloud based. Result is displayed on the cloud.
  - Weather monitoring system uses level 2 IoT based system. cloud based application is used for display data.

5. What is M2M ? Describe it with few examples.
→ Machine to Machine (M2M) communication is the communication among the physical things which do not need human interaction.
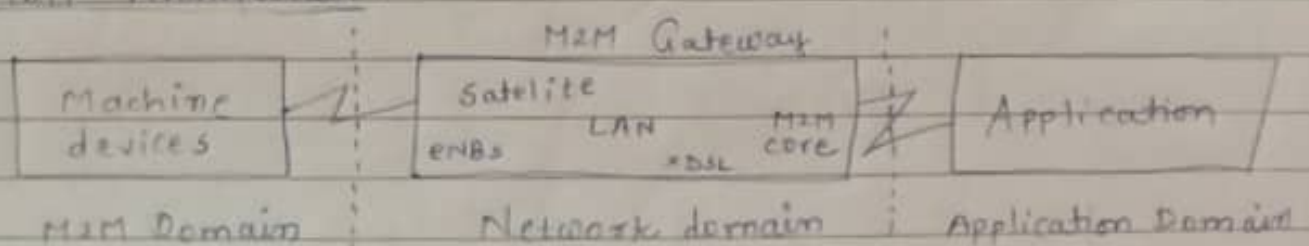 - M2M communication is a form of data communication that involves one or more entities that do not necessarily require human interaction or intervention in the process of communication. M2M is also named as Machine Type communication (MTC) in 3GPP.
  - M2M is only a subset of IoT. IoT is a more encompassing phenomenon because it also include H2M communication.
→ key features of M2M :-

    1. low Mobility   2. Time control
    3. Time Tolerant   4. Packet switched
    5. low power consumption   6. Location specific Trigger

→ M2M Architecture :-

M2M Gateway

Machine devices	Satelite eNBs LAN *DSL	M2M core	Application
M2M Domain	Network domain		Application Domain
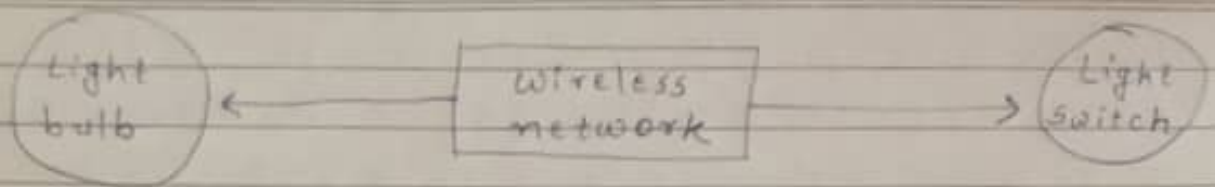
```
   ┌─────────┐        ┌──────────┐        ┌─────────┐
   │  Light  │ ←──────│ Wireless │──────→ │  Light  │
   │  bulb   │        │ network  │        │ Switch  │
   └─────────┘        └──────────┘        └─────────┘
   Manufacture A    Bluetooth, Z-wave, Zigbee   Manufacture B
```

- A number of subsets of users of M2M services can be identified : consumers in the home, business users and facility managers, city governments, logistics businesses, energy providers and more.

6. Difference between M2M and IOT.

M2M	IOT
– Support single application with single device.	– It support multiple application with multiple device.
– It is communication and device centric.	– It is information and service centric.
– It support closed business operations.	– It support open market place.
– Used in B2B	– Used in B2B & B2C
– Uses vertical system solution approach.	– Uses horizontal enabler approach.

Assignment - 2

1. Write functionality of XMPP.

→ Extensible Messaging and presence protocol (XMPP) is an open XML technology for real-time communication. It is based on instant messaging and presence.

- It allows the exchange of data between two or more systems and supports presence and contact list maintenance.
- It also uses publish/subscribe mechanism for data sharing like MQTT Protocol.
- XMPP allocates an XMPP address to every client on the XMPP network. This address works just like a standard email address with an IP address/domain name, an optional node, and a username for the resident server.

| XMPP client | | XMPP server | | XMPP client |
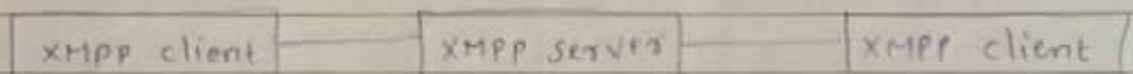
- In a simple XMPP architecture consisting of a server and two clients, a client with a unique name communicates through an associated XMPP server with another client using a unique name.
- XMPP uses the Transmission control protocol as its original and native transport protocol for web applications and firewalls.
- Applications: Message delivery, conferencing, voice and video calls, online gaming, News websites, Instant messaging apps
- Advantages: - Supports HTTP transport protocol
  - It offers persistent connection
  - It allows servers with different architecture to communicate
- Disadvantages: - It does not have QoS mechanism as used by MQTT protocol.

2. Explain various protocols that are used at Network layer of IOT.

→ The network layer is responsible for the delivery of packets from the source to destination.

- network layer uses IP address to choose one host among millions of host. In network layer, datagram needs a destination IP address for delivery and a source IP address for a destination reply

→ IPv4 :- An IP address is made up of 32 bits of information. These bits are divided into four parts containing 8 bit each.
   - IPv4 addresses are unique. Two devices on the internet can never have the same address at same time. A datagram is a variable length. Packets in the IPv4 layer are called datagram.

→ IPv6 :- IPv6 address are 128 bits in length. Addresses are assigned to individual interface on nodes, not to the node themselves.
   - A single interface may have multiple unique unicast address. The first field of any IPv6 address is the variable length format prefix, which identifies various categories of addresses.

→ 6LoWPAN :- IPv6 over low power Wireless personal Area network enables IPv6 in low-power and lossy wireless networks such as WSNs.
   - 6LoWPAN defines header compression mechanisms.

3. Explain various protocols that are used at link layer of IOT.

→ link layer protocols decide how data is sent on physical

medium. link layer works within the local area network Protocol of link layer is explained below:

→ **802.3 Ethernet :-** This protocol is used for wired medium. most basic version runs at to mbit/s Ethernet has traditionally been used to network enterprise workstation and to transfer non-real-time data.
- The Ethernet standard allows for several different implementations such as twisted pair and coaxial cable. The maximum length of an Ethernet is determined by the nodes ability to detect collisions.

→ **802.11 Wifi :-** Commonly referred to as wi-fi as the 802.11 standard's define a through-the-air interface between a wireless client and a base station access point or between two or more wireless client

802.11 a :- This standard uses the 5 GHz spectrum and has a maximum theoretical 54 Mbps data rate.

802.11 b :- This standard provides a maximum theoretical 11 Mbps data rate in the 2.4 GHz Industrial, scientific and Medical (ISM) band.

802.11 g :- It provides 20 Mbps and more in the 2.4 GHz.

→ **802.16 WiMax :-** It refers to broadband wireless networks that are based on the IEEE 802.16 standard, which ensures compatibility and interoperability between broadband wireless access equipment.

→ **802.15.4 Zigbee :-** ZigBee communications can be reach up to 500 m, with a data rate of up to 250kbs, for a typical power consumption of 125 to 400 MW.
- As ZigBee is based on IEEE 802.15.4, there is no wake-up signal, but also slots for sleep or activity or in asynchronous mode.

→ Mobile communication (2G/3G/4G):- GSM frequencies originally designed on 900 MHz range, now also available on 800 MHz, 1800 MHz and 1900 MHz ranges.
- 4G is also called as long term evolution. It's promises data transfer rates for 100 Mbps.

4. Briefly Write about CARP protocol.
→ Channel-Aware Routing protocol (CARP) is a distributed routing protocol. It is designed for underwater communication. It has lightweight packets so that it can be used for IOT.
- CARP is network layer routing protocol. CARP is a location free and greedy hop-by-hop routing protocol
- It performs two functions : Network initialization and data forwarding. CARP protocol does not support previously collected data. Hence, it is not beneficial for those IOT or other application where data is changed frequently.

5. Discuss zigbee.
→ Zigbee is built on top of the IEEE 802.15.4 standard. Zigbee provides routing and multi-hop functions to the packet based radio protocol. ZigBee is a registered trademark of the Zigbee Alliance. 802.15.4 TH is a trademark of the Institute of Electrical and Electronics Engineers (IEEE). 802.15.4 defines the physical and MAC layers and zigbee defines the network and application layers.
- The 802.15.4 specification was created and is maintained by IEEE. This specification defines the physical and MAC layers of a personal area, low power, wireless network.
- The Zigbee specifications enhance the IEEE 802.15.4 standard by adding network and security layer and an application work

- ZigBee targets the application domain of low power, low duty cycle and low data rate requirement devices.
- Features:- Stochastic addressing, link Management, frequency agility, Asymmetric link, power management.

6. Discuss MQTT protocol in detail.

→ Message Queue Telemetry Transport (MQTT) is open connectivity for mobile, MEM and IoT.

- MQTT is designed for high latency, low band width or unreliable networks. The design principle minimize the network bandwidth and device resource requirements.

- Characteristics:- lightweight message queueing and transport protocol. Asynchronous communication model with messages (events). publish/subscribe (Pubsub) model. Runs on connection-oriented transport (TCP).
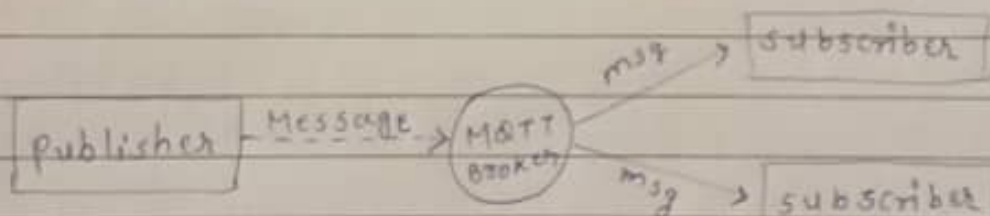
- A MQTT topology has a MQTT server and a MQTT client. MQTT control packet headers are kept as small as possible.

- The MQTT messages are delivered asynchronously (push) through publish subscribe architecture.

- The MQTT protocol works by exchanging a series of MQTT control packets in a defined way.

- A variable header contains the packet identifier if used by the control packet. A payload up to 256 MB could be attached in the packets.

- MQTT Quality of service:

① QoS 0 :- AT most once
- Guarantees that a particular message is only ever received by the subscriber a maximum of one time.
- The sender and the receiver will attempt to deliver the msg but if something fails and the msg does not reach its destination the msg may be lost.

② QoS 1 :- AT least Once
- Guarantees that a message will reach its intended recipient one or more time. The sender will continue to send the msg until it receives an acknowledgment from the recipient, confirming it has received the msg.

③ QoS 2 :- Exactly once
- The most costly of the QoS, this QoS will ensure that the msg is received by a recipient exactly one time.

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