Om Dhangar E223
BTech CS AI

DAIOT
Assignment -2

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Unit 4:- IOT Protocol and Architecture

2] Explain the role of each layer in IOT architecture how do these layer interact to enable seamless IOT functionality

→ IOT architecture consist of 5 layers that work together to ensure seamless functionality.

Perception layer:- This is a physical layer that consist of sensors actuators and RFID tags. It is responsible for collecting data from environmental and sending it to network layer.

Network layer :- It transmits the collected data to another layer through wired or wireless communication technologies such as Wifi, Bluetooth, Zigbee and 5G.

Middleware layer:- Also known as the processing layer it consists of cloud servers and local Database where data is stored, analyzed and managed. It acts as bridge between lower and upper layer.

Application layer:- thin layer provides user interface where processed data in displayed through applications such as smart home apps, industrial monitoring systems and health monitoring tools.

Business layer :- Thin layer defines the business model, policies and revenue strategies by analyzing process-sed data and providing decision making insights for enterprises.

Interaction between layers ~~effects~~

The perception layer collects data, which is tran-smitted via the network layer. The middleware layer processes and analyze the data. The application layer presents insights to user and the business layer utilizes the information for decision making and business optimization.

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Q2) Compare and contrast MQTT protocol and web socket in term of their architecture, working principle and use cases

→

Features	MQTT	Websocket
Architecture	Publish / subscribe	Full duplex communication
Working Principle	Uses brokers for Delivery of message to user	Direct bidirectional comm-unication betn client and server
Use Cases	IOT application, low power devices	Web based real time apps, chat applications
Transport Protocol	TCP/IP	TCP
Message overhead	Minimal starting From 2 bytes	Minimum 2 bytes, 6 bytes for market frame
Data efficiency	High due to minimal message overhead	low due to framing overhead

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Q3] Describe MAC layer in IOT networks How does it impacts routing and performance consideration

→ 1] MAC (Medium Access Control) layer manages how devices acces and share the communication medium

2] It unlikely identifies lach devices on a given network ie two devices cannot have same MAC address.

3] It is represented in a hexadecimal format on each device such as 00:0a:95:9d:67:16
There are 3 types of MAC address
- Unicant MAC addres
- Multicast MAC address
- Broadcas MAC address

Impact of MAC layer on routing and perf-ormance consideration :-

- Routing Efficiency :- It minimizes collision, reducing the need of retransmission making rauting efficient.
- latency reduction :- Reduces transmission delay ensu-ring timely delivery of IOT data, which is essentia for real time application.

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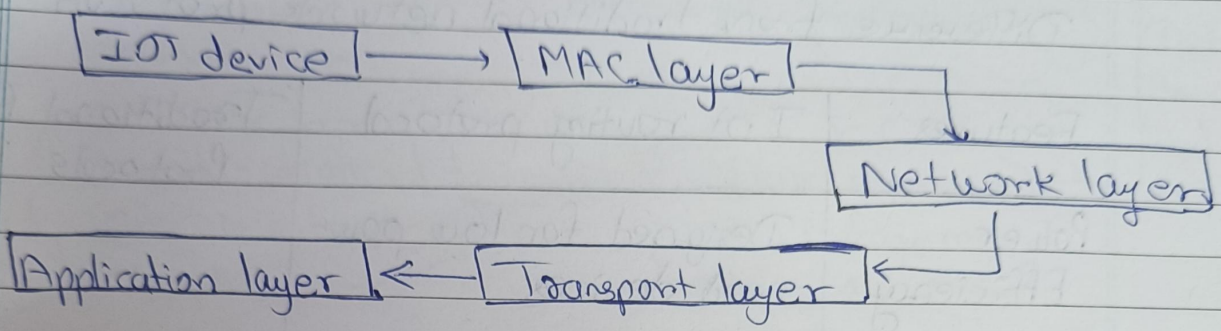
- Scalability :- By optimizing channel access and scheduling transmission, the MAC layer supports a large number of IOT devices in a network.



Q4] Discuss the importance of routing protocols in IOT networks ? How do they differ from traditional networking protocols

→ Routing is the process of determining the best path of data packets to travel from a source to destination within a network. Routers use routing protocols to dynamically update and share routing information allowing them to automatically adjust to network changes

Importance of routing protocols are :-

- Energy efficiecy :- helps in minimizing energy consumption by selecting optimal path.

- Reliability :- It enhances data delhivery success by managing node failure and finding alternative paths.

Load balancing:- Prevents network congestion by distributing data traffic efficiency across multiple paths.

Difference from traditional network protocols.

Features	Iot routing protocol	Traditional Routing Protocols
Power Efficiency.	Designed for low powered devices	
Network Topology	Dynamic mesh based	mostly static, hierarchial
Scalability	High, supports loots of devices	limited to few devices
Data Transmission	Event driven, periodic updates	Continuous data flow

Q5] Explain data processing in IOT. What are the key challenges and strategies used at thin layer

→ In IOT data processing, raw data from devices is transformed into actionable insights. It involves collecting, analyzing and deriving insights from data generated by IOT devices

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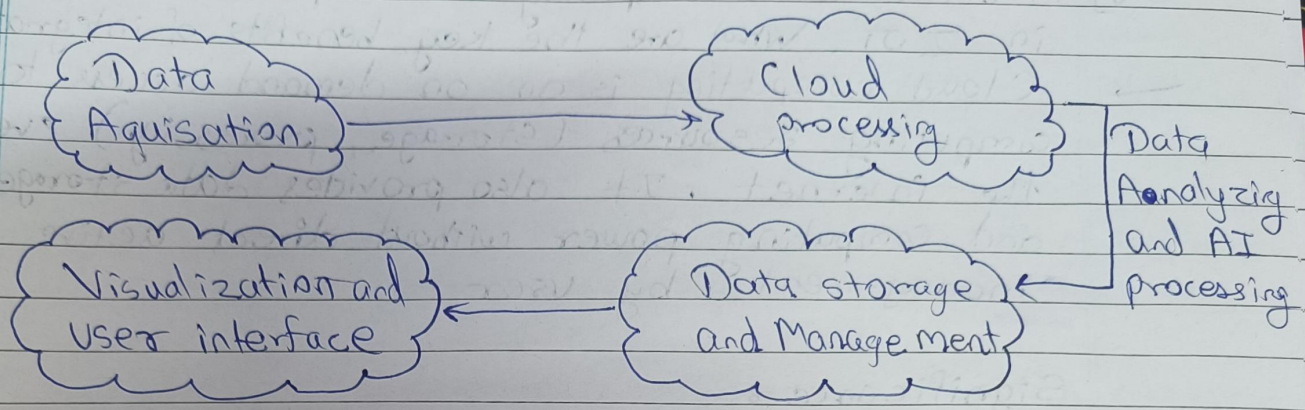
Stages of IOT processing



Key challenges and strategies

latency Issues :- implement edge computing to process data closes to the source

Data security :- Use encryption, authentication and secure cold storage

Scalability :- Deploy cloud computing and distributed processing techniques

Data Redundancy :- Use data filtering aggregation and compression methods.

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Units - Cloud Platform for IOT

Q6] Define cloud computing and explain its significance in IOT. What are the key benefits of integrating

→ Cloud computing is an on demand access to shared computing resources (storage, processing) event the internet. It also provides data storage and computing power without direct active management by user

Significance :-

→ IOT devices produce vast volume of data. The cloud effects ~~set~~ scalable storage solutions to accomodate this data

→ The cloud provides powerful computing resources for processing and analyzing IOT data, enabling the extraction of valuable insights.

→ The cloud simplifies the development and deployment of IOT application by providing platform services and tools

key benefits :-

- scalability & flexibility :- Cloud resources can be scaled up or down as needed, accomodating fluctuating data volume and device count.

- Cost effectiveness :- Cloud services eliminate the need for significant support investment in hardware

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- Increased reliability & Availability:- This ensures that IOT systems remains operated.

Q7] Differentiate between Saas, Paas, Iaas in the context of IOT, Provide real world example for each

Saas (Software as a service)	PAAS (Platform as a service)	Iaas (Infrastructure as a service)
i] Ready to use applications delivered over the internet	i] Provide a platform for developing and managing application	i] Provides access to fundamental computing resources like servers
ii] End user application for IOT data visualization and control	ii] Tools and services for building custom IOT application, data processing & analysis	ii] Provides the underlying infrastructure for storing and processing large volume of IOT data.
iii] Very low level of responsibility	iii] moderate level of responsibility	iii] high level of responsibility
iv] Smarthome energy monitoring	iv] Platform for building a connected vehicle fleet management application	iv] Virtual server for storing sensor data from and industrial IOT deployment

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28] Explain the thing Speak API. How does it helps in IOT data processing and visualization ?

→ Thing Speak is an open source IOT analytics platform that allows you to collect, store, visualize and analyze live data streams in the cloud. In API enable devices and applications to easily send and retrieve data.

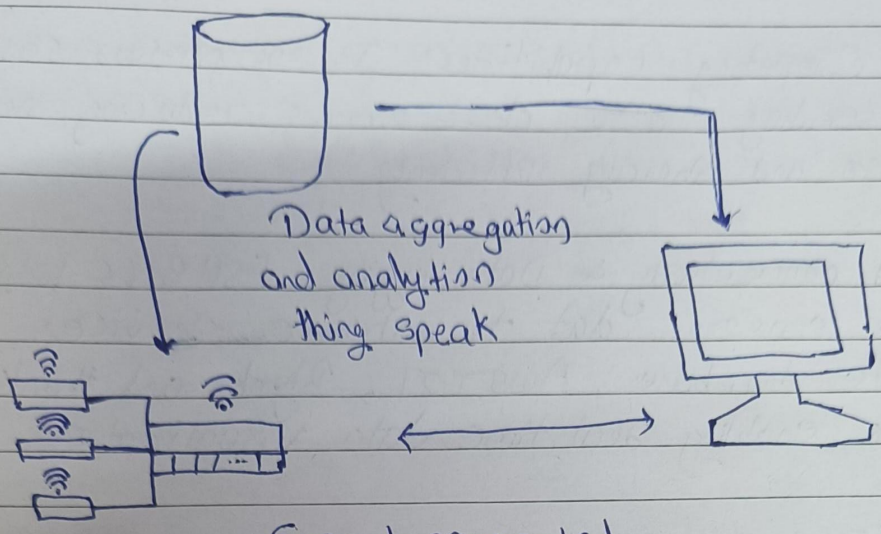
- Thing Speak provides simple ready to use chart and graph for visualizing data stream directly within platform.
- Thing speaks realtime data streaming capabilities ensure that visualization and always upto date, providing immediate insights into sensor data.
- The API allows developers to retrive data from thing speak channels and use it to create custom visualization in external applications or dashboards, offering ~~flexibility~~, and control.

In Data Processing

- MATLAB integration :-

Thinkspeak offers seamless integration with MATLAB, enabling user to perform advanced data analysis and processing directly within platform

- API allows for data retrieval, which enables the data to be processed on external devices or servers
- Thingspeak enables users to setup trigger and actions this allows for simple processing of the date.



Q9] Discuss the role of ESP 8266 in IOT application. How is it interfaces with server for IOT solution ?

→ The ESP8266 is a wifi enabled microcontroller that has revolution 2nd IOT application by providing low cost, low power and easy to program wireless connecting, widely used in smart home automation industrial monitoring, health tracking devices and environmental serving due to the ability to connect devices to the intent enfficiently

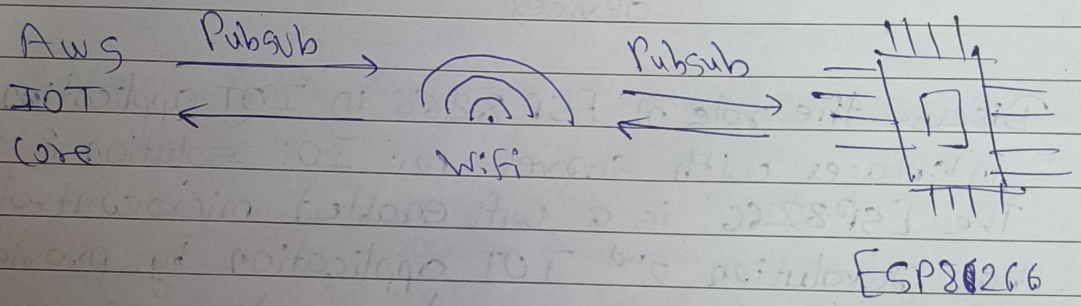
Key roles :-

- wireless communication :- ESP8266 allows IOT devices to send and received data over wifi, enabling cloud based control and remote monitoring

2] Edge computing capabilities :- It can process sensor data before sending it to cloud servers reducing network congestion and enhancing efficiency

3] Cloud connectivity & Data logging :- ESP8266 helps in logging sensors' dat to enhance services such as Google firebase, AWS IOT, Blynk and think speak, enabling real time data visualization.

Diagram :-



Interface with web services :-

1] HTTP Request :- The ESP8266 can use HTTP to send data to and receive data from web services, allowing interface with cloud platforms like AWS

2] MQTT : Often used for lightweight, efficient messaging between the ESP8266 and web servers on cloud systems in realtime IOT application

3] API's :- The ESP8266 can call restful API's request by webservices, enabling the devices to intract with online system

10] Compare Rasberry pi and Arduino as IoT supported hardware platform which one is more suitable for large scale IoT applications and why?

→ Rasberry pi and arduino are both popular platform for IoT projects, but they differ in there capabilities and use cases.

i] Rasberry Pi :-

1] Capabilities :- A full fledge mini Computer with an OS. capable of running complex applications, supporting networking and high level tasks

2] IoT support :- Ideal for more advanced IoT application that require higher processing power, networking and integration with databases or web services

3] Scaling :- Better suited for large scale IoT applications due to its processing power, storage and networking capabilities

ii] Arduino :-

1] Capabilities :- A microcontroller based platform with limited processing power, so built in IoT and usually used for simpler low level tasks like sensor data aquisition and control

2] IOT Support: More suited for smaller, localized projects where minimal processing and power consumpting are key.

The rasberry PI is more suitable for large scale IOT applications due to its higher processing power, networking capabilities and support for complex tasks making it ideal for handling large dataflows and interactions with cloud services.