IOT Internal-2

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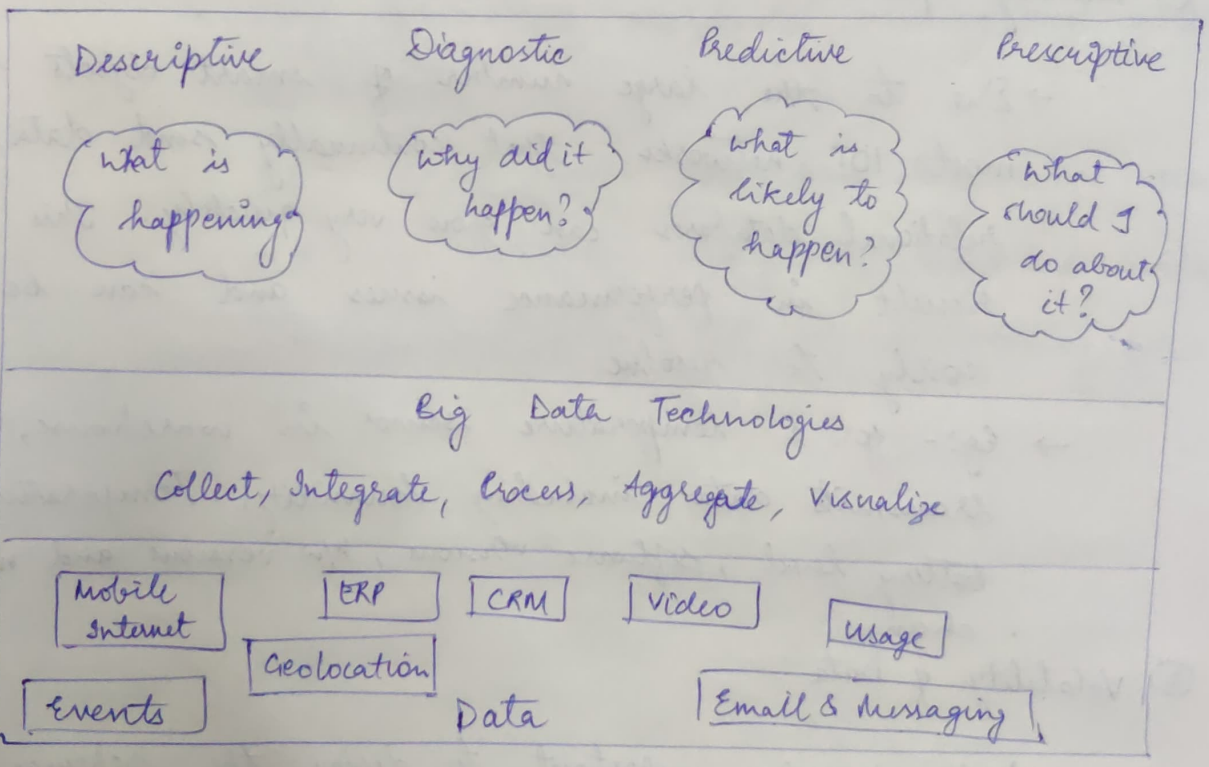
Q1) Data Analytics for IOT? Explain the challenges giving examples.

→ Data analysis is used to derive insights from the data. It also helps in improving the business intelligence for an organization.

In IOT, data from smart objects can be analyzed using the data analytics. There are 4 types of data analysis results.



* Descriptive data analysis tells what is happening, either in the present or the past. For eg:- a thermometer in a truck engine reports the temperature values every second.

* Diagnostic tells us "Why" questions. For eg:- Why the truck engine failed to operate.

* Predictive helps to foretell problems or issues before they occur. For eg:- Based on the temperature values, it can tell if any component will be affected.

* Prescriptive analysis goes beyond predictive and recommends solutions for the problems. For eg:- A fault in the working of truck engine could tell us to replace the coolants in the engine.

• IOT Data Analytics challenges

① Scaling problems:

→ Due to the large number of smart objects in most IOT networks that continually send data, relational databases can grow very quickly. This can result in performance issues and can be costly to resolve.

→ Eg:- for a temperature sensor in warehouse, it transmits data including humidity, temperature, battery level, software versions, h/w versions and motion changes.

② Volatility of Data:

→ It is very important to design the schemas for the databases beforehand. changing it later can slow or stop the database from working.

→ For eg:- If proper schema is not designed, software bug or a hardware failure could cause wrong readings.

Q5, (a) What is SANET?

(b) Explain advantages . . . . . solution offers

→ (a) SANET:

- SANET refers to a sensor/actuator network, is a network of sensors that sense and measure their environment and/or actuators that act on the environment.

- They are capable of communicating and cooperating in a productive manner.

- They offer highly coordinated sensing and actuation capabilities

- Eg:- Smart Homes can have temperature sensors that are ~~strageeia~~ strategically networked with heating, ventilation and air conditioning (HVAC) actuators.

(b) ADVANTAGES:

1) Greater deployment flexibility
2) Simpler scaling to a large number of nodes.
3) Lower implementation costs.
4) Easier long term maintenance.
5) Effortless introduction of new sensors/actuators nodes.
6) Better equipped to handle dynamic/rapid topology changes.

* DISADVANTAGES

1) Potentially less secure.
2) Typically, lower transmission speed than wired network.
3) Greater impact / influence by environment.
4) It is more difficult to setup and is less stable.

Q7) Explain the trends in Smart Objects impacting IOT.

→ The broad generalizations and trends impacting IOT:

1) Size is decreasing: In reference to MEMS, there is a clear trend of ever-decreasing size. Some smart objects are so small they are not visible to the naked eye.
This reduced size makes smart objects easier to embed in everyday objects.

2) Power consumption is decreasing: The different hardware components of a smart object continually consume less power. This is especially true for sensors, many of which are passive.
Some battery-powered sensors last 10 or more years without battery replacement.

3) Processing power is increasing: Processors are continually getting more powerful and smaller. This is a key advancement in Smart Objects, as they are becoming more complex and connected.

4) Communication capabilities are improving: There is a strong push on increasing the wireless speeds, but they are also increasing in range.

IOT is driving the development of more and more specialized communication protocols. In addition, they are covering a greater diversity of use cases and environments.

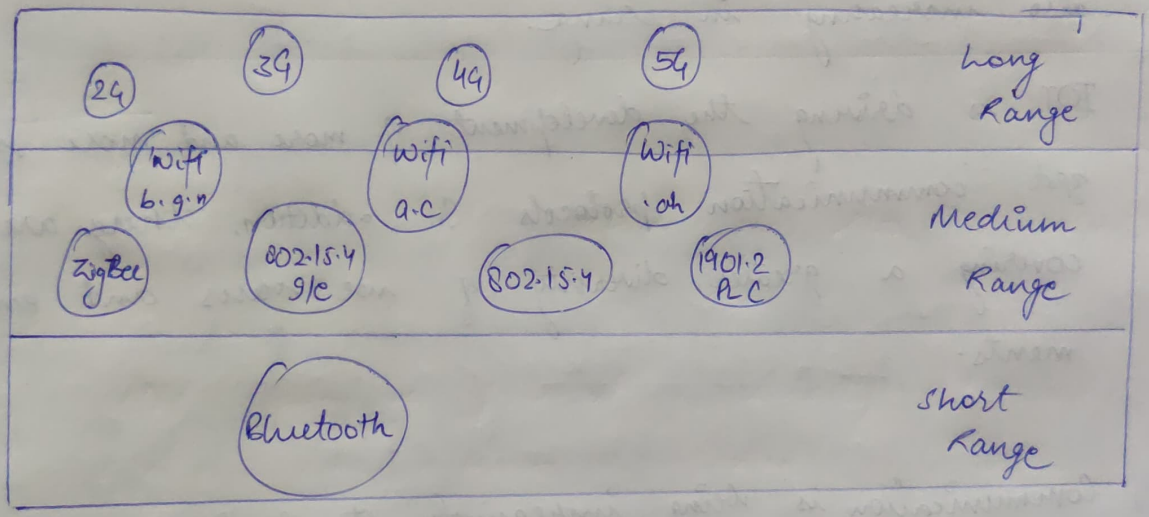
5) Communication is being increasingly standardized: There is a strong push in the industry to develop open standards for IOT communication protocols.

In addition, there are more and more open source efforts to advance IOT.

Q6) Explain ... real time applications.

→ The characteristics and attributes considered when selecting and dealing with connecting smart objects are:-

① Range: It defines how far does the signal need to be propagated. That is, what will be the area of coverage for a selected wireless technology.



- Short Range
  - Wireless short-range tech are often considered as an alternative to a serial cable, supporting tens of meters of maximum distance between two devices.
  - Examples:- IEEE 802.15.1 Bluetooth and IEEE 802.15.7.V2

- Medium Range
  - In the range of tens to hundreds of meters, many specifications and implementations are availble. The maximum dist is < 1 mile b/w two devices
  - Ex:- IEEE 802.11 wifi, IEEE 802.15.4 and 802.15.4G WPAN

- Long Range
  - They support distances greater than 1 mile b/w two devices, require long-range technologies. These technologies are therefore ideal for battery powered IOT sensors
  - EX:- Cellular (2G, 3G, 4G), IEEE 802.11 Wifi and LPWA technologies.

② Frequency Bands:

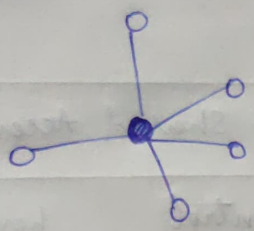
- Radio spectrum regulated by countries/organizations, such as ITU, FCC.
- These groups define the regulations and transmission requirements for various frequency bands.
- For IOT access, these are the most well-known ISM bands:
  - → 2.4 GHz band as used by IEEE 802.11 b/g/n Wifi.
  - → IEEE 802.15.1 Bluetooth
  - → IEEE 802.15.4 WPAN
- Some communications within the ISM bands operate in the sub-GHz range.

③ Power Consumption

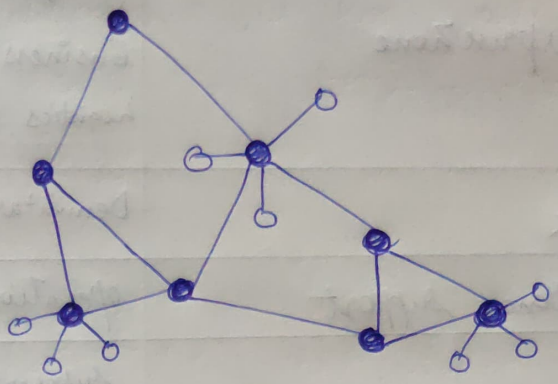
- Battery powered nodes bring much more flexibility to IOT devices. These nodes are often classified by the required lifetimes of their batteries.
- IOT wireless access technologies must address the needs of low power consumption and connectivity for battery powered nodes.

④ Topology

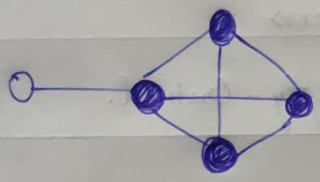
- Three main topology schemes are: Star, Mesh and P-2-P.
- Star topology is prevelant in utilizing a single central base station or controller to allow communication with end points.
- P-2-P topology allows any device to communication with any other device as long as they are in range of each other.
- Mesh topology requires the implementations of a layer 2 forwarding protocol known as mesh under or a layer 3 forwarding protocol refurred to as mesh-over on each immediate node.



STAR



MESH



Peer-to-Peer

● Full function Device

○ Reduced function device

Q2) Explain how IT and .... real time.

→ ○ IT information is typically used to make business decisions, such as those in process optimization, whereas OT information is instead characteristically leveraged to make physical decisions such as, closing a valve, increasing pressure..

○ The Purdue Model for control hierarchy identifies levels of operations and defines each level.

Enterprise Zone	Enterprise N/W	Level 5
	Business Planning and logistics N/W	level 4
DMZ	Demilitarized Zone - Shared Access.	
Operations support	Operations and Control	level 3
Process/Control SCADA Zone	Supervisory control	Level 2
	Basic Control	Level 1
	Process	Level 0.
safety	safety - Critical.	

- Enterprise Zone
  - LEVEL 5: Enterprise N/w: Corporate-level application such as ERP, CRM and document management and service such as internet access and VPN entry from the outside world exist at this level.
  - LEVEL 4: Business Planning & Logistics N/w: The IT service exist at this level and includes sheen scheduling systems, material flow applications and optimization & planning systems, and local IT services such as phone, email, printing and security monitoring.

- Industrial Demilitarized Zone
  - DMZ: Provides a buffer zone where services and data can be shared b/w the operational and enterprise zones.
    It also allows for easy segmentation and organizational control.

- Operational Zone
  - LEVEL 3: Operations and Control: This level includes the functions involved in managing the work flows to produce the desired end-products and for monitoring, controlling the entire operational system.
  - LEVEL 2: Supervisory Control: This level includes zone control rooms, controller status, control system application / administration and other control relation applications.
  - LEVEL 1: Basic control: At this level, controllers and IEDs, dedicated HMI and other applications may talk to each other to run part or all of the functions.
  - LEVEL 0: Process: This is where devices communicate with controllers or IEDs

- Safety Zone.
  - Safety-critical: This level includes devices, sensors and other equipment used to manage the safety fn. of the control system.