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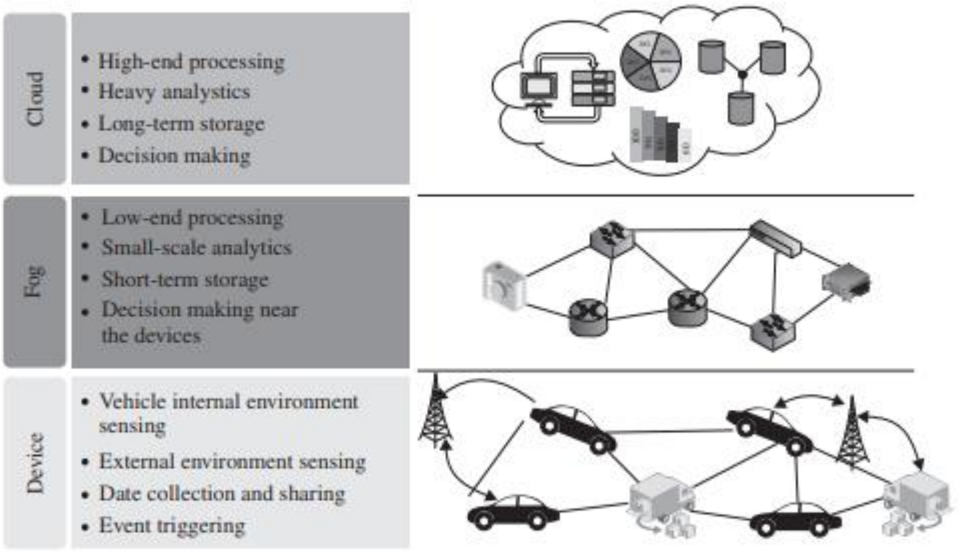
Internal Assesment Test-II

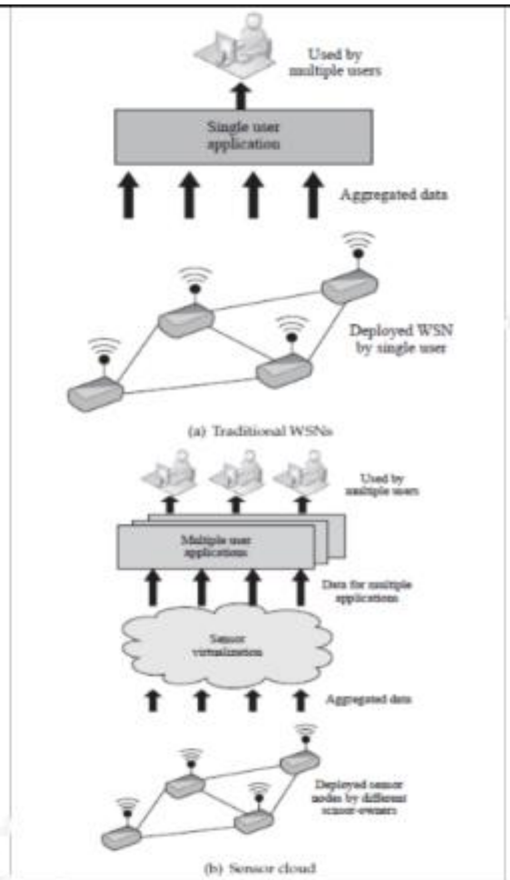
Sub:	Internet of Things							Code:	BETCK105H
Date:	/06/2025	Duration	90 mins	Max Marks:	50	Sem:	II	SECTION: I-P	

Answer any **FIVE FULL** Questions

		Marks	OBE	
			CO	RBT
1.	Discuss the typical data offloading locations in IoT systems and the key factors influencing the selection of a suitable offloading location. **Offload location** (which outlines where all the processing can be offloaded in the IoT architecture). The choice of offload location decides the applicability, cost, and sustainability of the IoT application and deployment. 1. **Edge:** Offloading processing to the edge implies that the data processing is facilitated to a location at or near the source of data generation itself. 2. **Fog:** Fog computing is a decentralized computing infrastructure that is utilized to conserve network bandwidth, reduce latencies, restrict the amount of data unnecessarily flowing through the Internet, and enable rapid mobility support for IoT devices. 3. **Remote Server:** A simple remote server with good processing power may be used with IoT-based applications to offload the processing from resource constrained IoT devices. 4. **Cloud:** Cloud computing is a configurable computer system, which can get access to configurable resources, platforms, and high-level services through a shared pool hosted remotely and can be accessed globally. **Key Factors Influencing Offloading Location in IoT:** 1. **Bandwidth**: It is the maximum data that can be transferred over a network. Higher bandwidth enables faster data offloading. 2. **Latency**: Refers to delay in data transfer or processing. Lower latency is essential for real-time IoT applications. 3. **Criticality**: The importance of the task determines the urgency. Critical tasks like fire detection require faster responses than non-critical ones. 4. **Resources**: Indicates the processing power and capabilities at the offload location. Matching resource levels to task complexity is vital. 5. **Data Volume**: Refers to the amount of data the system must handle. High-volume deployments need more robust processing and storage capacities.	[10] 5+5	CO3	L2
2.	What is cloud simulation? Explain the features of various cloud simulators used in IoT CloudSim [3] is a popular cloud simulator that was developed at the University of Melbourne. This simulator is written in a Java-based environment. In CloudSim, a user is allowed to add or remove resources dynamically during the simulation and evaluate the performance of the scenario. (b) Features: CloudSim has different features, which are listed as follows: (1) The CloudSim simulator provides various cloud computing data centers along with different data center network topologies in a simulation environment. (2) Using CloudSim, virtualization of server hosts can be done in a simulation. (3) Auser is able to allocate virtual machines (VMs) dynamically.	[10] 4+6	CO4	L1

	(4) It allows users to define their own policies for the allocation of host resources to VMs. (5) It provides flexibility to add or remove simulation components dynamically. (6) Auser can stop and resume the simulation at any instant of time			
3.	With a neat diagram explain the Architecture of vehicular IoT.  Figure 1: Architecture of vehicular IoT Vehicular IoT systems have penetrated different aspects of the transportation ecosystem, including on-road to off-road traffic management, driver safety for heavy to small vehicles, and security in public transportation. In a connected vehicular environment, vehicles are capable of communicating and sharing their information. Moreover, IoT enables a vehicle to sense its internal and external environments to make certain autonomous decisions. With the help of modern-day IoT infrastructure, a vehicle owner residing in Earth's northern hemisphere can very easily track his vehicular asset remotely, even if it is in the southern hemisphere. Figure 1 represents a simple architecture of a vehicular IoT system. The architecture of the vehicular IoT is divided into three sub layers: device, fog, and cloud. •Device: The device layer is the bottom-most layer, which consists of the basic infrastructure of the scenario of the connected vehicle. This layer includes the vehicles and road side units (RSU). These vehicles contain certain sensors which gather the internal information of the vehicles. On the other hand, the RSU works as a local centralized unit that manages the data from the vehicles. • Fog: In vehicular IoT systems, fast decision making is pertinent to avoid accidents and traffic mismanagement. In such situations, fog computing plays a crucial role by providing decisions in real-time, much near to the devices. Consequently, the fog layer helps to minimize data transmission time in a vehicular IoT system. • Cloud: Fog computing handles the data processing near the devices to take decisions instantaneously. However, for the processing of huge data, fog computing is not enough. Therefore, in such a situation, cloud computing is used. In a vehicular IoT system, cloud computing helps to handle processes that involve a huge amount of data. Further, for long-term storage, cloud computing is used as a scalable resource in vehicular IoT systems.	[10] **Diagram(4)** **Explanation** **(6)**	CO5	L1
4.	Explain the different decision-making approaches for data offloading in IoT	[10]	CO3	L2

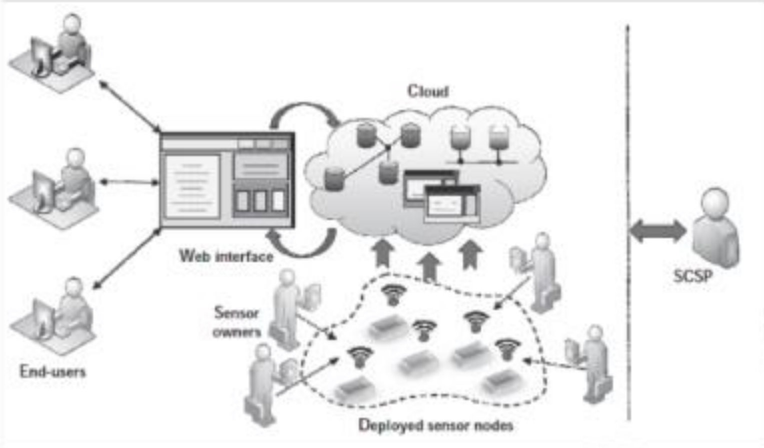
	The choice of where to offload and how much to offload is one of the major deciding factors in the deployment of an offsite-processing topology-based IoT deployment architecture. **Naive Approach**: This approach is typically a hard approach, without too much decision making. It can be considered as a rule-based approach in which the data from IoT devices are offloaded to the nearest location based on the achievement of certain offload criteria. Although easy to implement, this approach is never recommended, especially for dense deployments, or deployments where the data generation rate is high or the data being offloaded in complex to handle (multimedia or hybrid data types). Generally, statistical measures are consulted for generating the rules for offload decision making. **Bargaining based approach**: This approach, although a bit processing-intensive during the decision making stages, enables the alleviation of network traffic congestion, enhances service QoS (quality of service) parameters such as bandwidth, latencies, and others. At times, while trying to maximize multiple parameters for the whole IoT implementation, in order to provide the most optimal solution or QoS, not all parameters can be treated with equal importance. Bargaining based solutions try to maximize the QoS by trying to reach a point where the qualities of certain parameters are reduced, while the others are enhanced. This measure is undertaken so that the achieved QoS is collaboratively better for the full implementation rather than a select few devices enjoying very high QoS. Game theory is a common example of the bargaining based approach. This approach does not need to depend on historical data for decision making purposes. **Learning based approach**: Unlike the bargaining based approaches, the learning based approaches generally rely on past behavior and trends of data flow through the IoT architecture. The optimization of QoS parameters is pursued by learning from historical trends and trying to optimize previous solutions further and enhance the collective behavior of the IoT implementation. The memory requirements and processing requirements are high during the decision making stages. The most common example of a learning based approach is machine learning.	1+3*3		
5.	What is a sensor-cloud? Why is it used? Explain the architecture of a sensor-cloud platform with a neat diagram.	[10] 2+2+6	CO4	L2



6.2 Architecture of a sensor-cloud platform: The THREE main components of sensor-cloud architecture are (i) End-user (ii) Sensor Owner (iii) Sensor-Cloud Servi Provider (SCSP). The detailed architecture of a sensor cloud is depicted in Figure 6.2

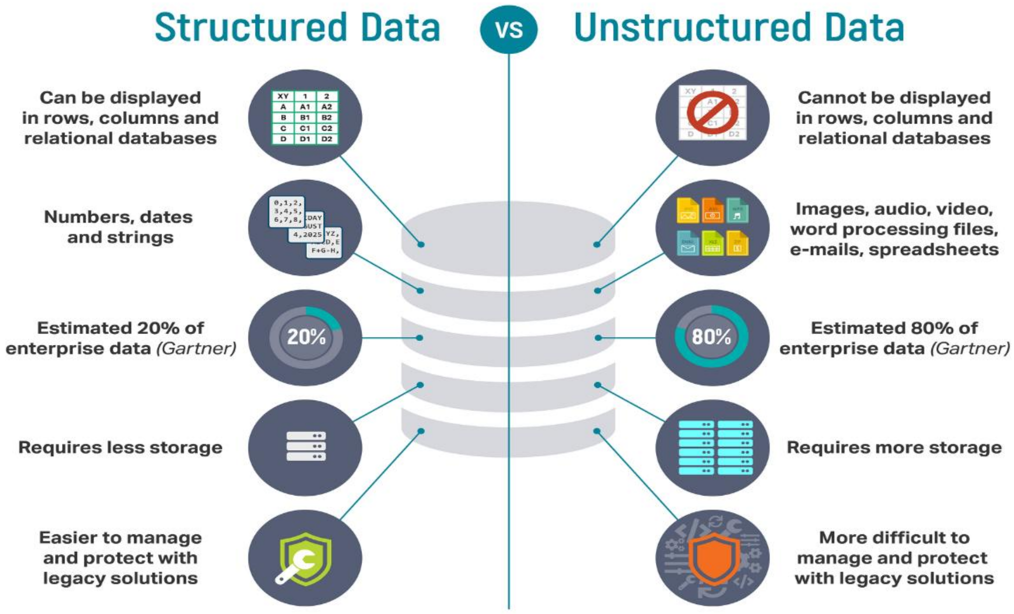
(i) End User:

- The end user is also known as a customer of the sensor-cloud services.
- An end user registers him/herself with the infrastructure through a Web porta
- He/she chooses the template of the services that are available in the senso cloud architecture to which he/she is registered.
- Through the Web portal, the end user receives the services, as shown in Fig 6 Based on the type and usage duration of service, the end user pays the charg to the SCSP.

	 ***Figure 6.2 Architecture of a sensor-cloud platform*** ***(ii) Sensor Owner:*** – A particular sensor owner can own multiple homogeneous or heterogen sensor nodes. – Based on the requirements of the users, these sensor nodes are virtualizec assigned to serve multiple applications at the same time. – The sensor owner receives rent depending upon the duration and usa his/her sensor node(s). ***(iii) Sensor-Cloud Service Provider (SCSP):*** – An SCSP is responsible for managing the entire sensor-cloud infrastructure. – The SCSP receives rent from end users with the help of a pre-defined pı model. – The pricing scheme may include the infrastructure cost, sensor owners' and the revenue of the SCSP. – The SCSP receives the rent from the end users and shares a partial amount the sensor owners. The remaining amount is used for maintaining infrastructure.			
6.	Explain the concepts of (i) Supervised Learning, (ii) Unsupervised Learning, and (iii) Reinforcement Learning. ◆ **1. Supervised Learning** • Uses **labeled data** for training. • The system learns from input-output pairs. • Commonly used for **classification** (e.g., KNN, Decision Trees, Random Forest) and **regression** (predicting numerical values). • **Example**: Predicting house prices based on area, location, etc.	[10] 2+(2*4)	CO5	L2
	◆ **2. Unsupervised Learning** • Works with **unlabeled data**. • Finds hidden patterns or groupings in data. • Used for **clustering** (e.g., K-Means) and **association** (e.g., Market Basket Analysis). • **Example**: Customer segmentation in marketing.			
	◆ **3. Semi-Supervised Learning** • Uses a **small amount of labeled data** and a large amount of **unlabeled data**. • Less expensive and useful when labeling is costly or time-consuming. • Bridges the gap between supervised and unsupervised learning.			
	◆ **4. Reinforcement Learning** • The system learns by **interacting with an environment**.			

- Based on a **reward and punishment** mechanism.
- Useful in **robotics, gaming, and self-driving cars**.
- Learns optimal actions over time using trial and error.

7.a) What is the difference between structured and unstructured data? Provide examples and explain their relevance in IoT applications. [05] CO3 L1



🔹 **Structured Data in IoT:**

- **Smart Meter Readings**: Energy consumption data every 15 minutes.
- **GPS Coordinates**: Latitude and longitude data from a delivery vehicle.
- **Environmental Sensors**: Data like humidity, temperature, pressure.

🔸 **Unstructured Data in IoT:**

- **Surveillance Video**: Footage captured by security cameras.
- **Voice Commands**: Audio commands given to smart home assistants.
- **Images from Drones**: Aerial photos for agricultural monitoring.

Relevance in IoT Applications:

Structured Data	Unstructured Data
Used for **real-time monitoring, alerts,** and **dashboards**	Supports **advanced analysis** like image recognition, NLP
Helps in **reporting and automation**	Used in **AI/ML-based decision making**
Easier for **predictive analytics** using historical data	Needs deep learning to extract useful information

b) List and explain the various types of virtualization commonly used in cloud. [05] CO4 L1

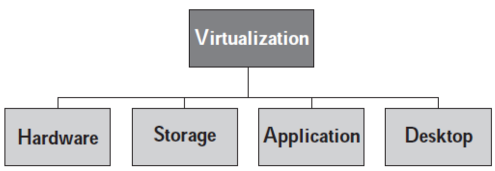


Fig8a: 3 Types of virtualization

Hardware Virtualization:

- This type of virtualization indicates the sharing of hardware resources among multiple users.
- For example, a single processor appears as many different processors in a cloud computing architecture.

	• Different operating systems can be installed in these processors and each of them can work as stand-alone machines. **Storage Virtualization:** • In storage virtualization, the storage space from different entities are accumulated virtually, and seem like a single storage location. • Through storage virtualization, a user’s documents or files exist in different locations in a distributed fashion. • However, the users are under the impression that they have a single dedicated storage space provided to them. **Application Virtualization:** • A single application is stored at the cloud end. • However, as per requirement, a user can use the application in his/her local computer without ever actually installing the application. **Desktop Virtualization:** • This type of virtualization allows a user to access and utilize the services of a desktop that resides at the cloud. • The users can use the desktop from their local desktop.			