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Internal Assessment Test 2 – August 2023

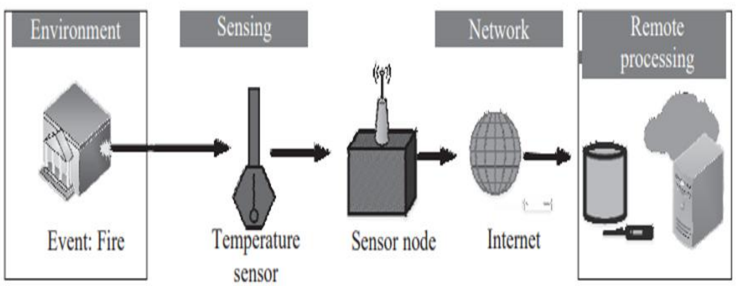
Sub:	Internet of Things				Sub Code:	22ETC15H	Branch:	
Date:	07/03/2023	Duration:	90 min's	Max Marks: 50	Sem/Sec:	III / A, B, C, D, E, F and G		OBE

	Answer any FIVE FULL Questions	MARKS	CO	RBT
1	How is collaborative processing different from remote processing?	10	CO3	L2

Solution:

Remote Processing :

- This is one of the most common processing topologies in the present-day IoT solutions.
- Sensor nodes will sense the data, then forwarded it to a remote server or a cloud-based infrastructure for further processing and analytics.
- Data collected from hundreds and thousands of sensor nodes can be simultaneously processed in to a single, powerful computing platform.
- Due to this
  - Cost and energy savings is achieved,
  - Resources can be reused and reallocated
  - Deployment of smaller and simpler processing nodes can be done.
- This setup provide scalability of solutions.
- This topology use up a lot of network bandwidth and relies heavily on the presence of network connectivity between the sensor nodes and the remote processing infrastructure.



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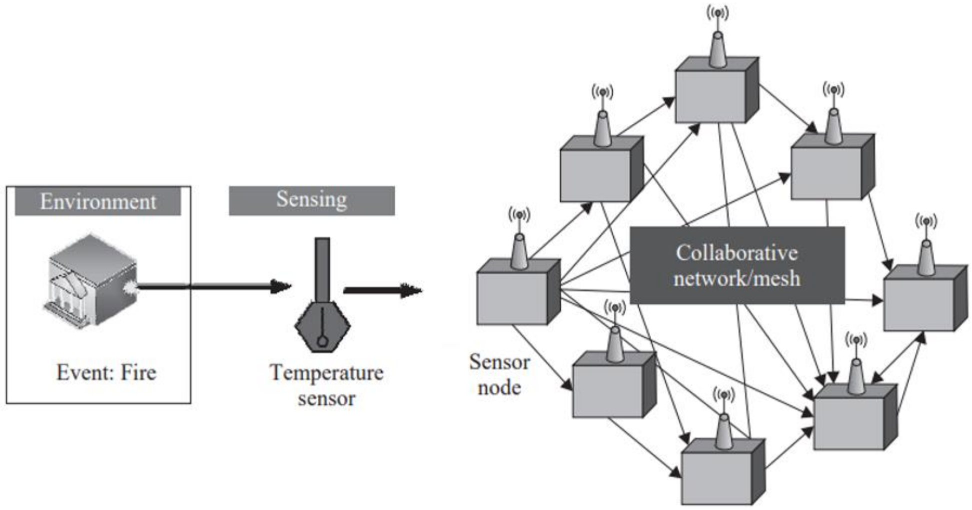
Collaborative Processing

- This processing topology is useful in a situation
  - With limited or no network connectivity
  - No access to a remote infrastructure
- In such scenarios, the simplest solution is to club together nearby processing nodes and collaboratively process the data at the data source itself.
- This approach reduces latencies(delays) and conserves bandwidth of the network.
- This topology can be quite beneficial for applications such as agriculture, where data is entered after long intervals (in the range of hours).
- Mesh networks for useful for easy implementation of this topology.

				
2	What are the critical factors to be considered during the design of IoT devices? **Solution:** ● The main consideration of defining an IoT solution is the selection of the processor for a sensor node. ● This selection is important because it will affect the usability, design, and affordability(cost) of the designed IoT sensing and processing solution. ● The important considerations are as follows ◦ Size ◦ Energy ◦ Cost ◦ Memory ◦ Processing power ◦ I/O rating ◦ Add-ons **Size** ● Size is one of the crucial factors for deciding the form factor(entire system) and the energy consumption of a sensor node. ● It has been observed that larger the form factor, larger is the energy consumption of the hardware. ● Large form factors are not suitable for most of the IoT applications, which rely on minimal form factor solutions (e.g., wearables). ● Thus the size should be small. **Energy** ● Higher the energy requirements of a processor, higher is the energy source (battery) replacement frequency. ● More replacements will result in reduced lifetime of sensing hardware, especially for IoT-based applications. ● So processor should consume low energy. **Cost** ● The cost of a processor, will decide how many sensor nodes are to be used for IoT-based solutions.	10	CO3	L2

	• If Cheaper cost hardware is used for design then it will increase the density of hardware for an IoT solution. • For example, cheaper gas and fire detection solutions would enable users to include much more sensing hardware. **Memory** • The memory requirements (both volatile and non-volatile memory) of IoT devices determines the capabilities the device has. • Features such as local data processing, data storage, data filtering, data formatting, and a bunch of other features rely heavily on the memory capabilities of devices. • Devices with higher memory tend to be costlier. **Processing power** • The processing power decides the type of applications the device can be associated with. • Applications that handle video and image data require IoT devices with higher processing power as compared to applications requiring simple sensing of the environment. **I/O rating** • The input–output (I/O) rating of the processor, is the deciding factor in determining the circuit complexity, energy usage, and requirements for support of various sensing solutions and sensor types. • Newer processors have a restricted I/O voltage rating of 3.3 V, as compared to 5 V for the somewhat older processors. **Add-ons** • The support of various add-ons for a processor for an IoT device will be ◦ Analog to digital conversion (ADC) units ◦ In-built clock circuits ◦ Connections to USB and Ethernet ◦ Inbuilt wireless access capabilities • Add-ons support define the robustness and usability of a processor or IoT device in various application scenarios. • add-ons also decides how fast a solution can be developed, for hardware part of the whole IoT application. • Designing of interfacing and integration of systems at the circuit level will be difficult but due to add-ons this is possible in later stages and it will make processor or device profitable to the users/ developers.			
3	What are the various decision making approaches chosen for offloading data in IoT? **Solution:** • Data offloading is divided into three parts: ◦ 1) offload location (where to offload (move) the processing in the IoT architecture), ◦ 2) offload decision making (how to choose where to offload(move) the processing to and by how much), ◦ 3) offloading considerations (deciding when to offload).	10	CO3	L2

Offload decision making

- The choice of where to offload and how much to offload decides the deployment(working state) of an offsite-processing topology.
- The decision making is done by considering
    - Data generation rate
    - Network bandwidth
    - Criticality of applications
    - Processing resource available at the offload site
- Some approaches are as follows
    - Naive Approach
    - Bargaining based approach
    - Learning based approach

Naive Approach

- This approach is typically a hard approach, without too much decision making.
- It is a rule-based approach.
- In this method data from IoT devices are offloaded(moved) to the nearest location when certain offload criteria is fulfilled.
- This approach is never recommended
    - for dense deployments
    - deployments where the data generation rate is high
    - complex to handle data types(multimedia or hybrid).
- In this approach Statistical measures are used for generating the rules.

Bargaining based approach

- This approach is processing-intensive during the decision making stages.
- This method gives importance's to
    - Network traffic congestion
    - Enhancement of service QoS (quality of service) by considering its
        - Parameters such as
            - Bandwidth
            - Latencies
- Bargaining based solutions try to maximize the QoS by considering qualities of parameters.
- Certain qualities of parameters are reduced, while the others are enhanced.
- This step is done to distribute QoS to the entire system.
- Game theory is a common example of the bargaining based approach.
- This approach will not depend on historical data for decision making purposes.

Learning based approach

- The learning based approaches rely on past behavior and trends of data flow through the IoT architecture.
- In this method optimization(best) of QoS parameters is pursued(attained)

<table>
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Learning from historical trends
Trying to optimize previous solutions further
Enhance the collective behavior of the IoT implementation.
During the decision making stages the memory requirements and processing requirements are high.
The most common example of a learning based approach is machine learning.</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>What is an SLA? Why it is important in cloud computing? What are the metrics used for the construction of SLA?
Solution:
Service-Level Agreement in Cloud Computing
An understanding or an agreement made between CSP and the customer about the services is known as service-level agreement (SLA).
An SLA provides a detailed description of the services that will be received by the customer.
Importance of SLA
An SLA is important from two point of views:
Customer Point of View
CSP Point of View
Customer Point of View
Each CSP has its SLA, which contains a detailed description of the services.
If a customer wants to use a cloud service, he/she can compare the SLAs of different organizations and can choose a preferred CSP based on the SLAs.
CSP Point of View
In some cases, if certain performance issues may occur for a particular service, then CSP may not be able to provide the services efficiently.
Thus, in such a situation, a CSP can explicitly mention in the SLA that they are not responsible for inefficient service.
Metrics for SLA
A few common metrics that are required for constructing an SLA are as follows:
(i) Availability
(ii) Response Time
(iii) Portability
(iv) Problem Reporting
(v) Penalty
Availability: This metric signifies the amount of time the service will be accessible for the customer.(for how much time a customer can use the service)
Response Time: The maximum time that will be taken for responding to a customer request is measured by response time.
Portability: This metric indicates the flexibility of transferring the data to another service.
Problem Reporting: How to report a problem, whom and how to be contacted, is explained in this metric.
Penalty: The penalty for not meeting the promises mentioned in the SLA</td><td>10</td><td>CO4</td><td>L2</td></tr>
<tr><td>5</td><td>What is cloud simulation? Explain the features of greencloud simulator?
Solutions:</td><td>10</td><td>CO4</td><td>L3</td></tr>
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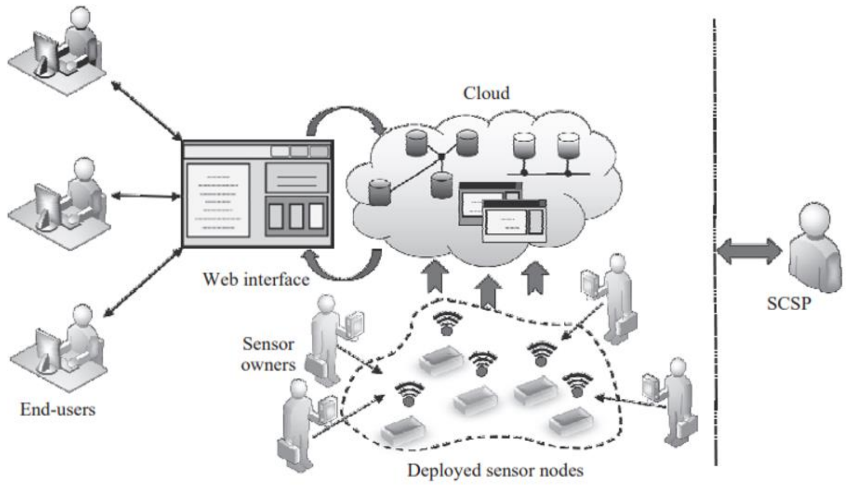
	Cloud simulation ● Before real implementation of an IoT system with the cloud estimating the performance is challenging. ● Real deployment of the cloud is a complex and costly procedure. ● Thus, there is a requirement for simulating the system through a cloud simulator before real implementation. ● There are many cloud simulators that provide pre-deployment test to evaluate system by repeating the tests. ● Different types of cloud simulators are available. ● A few cloud simulators are ◦ CloudSim ◦ CloudAnalyst ◦ GreenCloud **GreenCloud** ● **Description:** ◦ GreenCloud is developed as an extension of a packet-level network simulator, NS2. ◦ This simulator can monitor the energy consumption of different network components such as servers and switches. ● **Features:** ◦ (1) GreenCloud is an open-source simulator with user-friendly GUI. ◦ (2) It provides the facility for monitoring the energy consumption of the network and its various components. ◦ (3) It supports the simulations of cloud network components. ◦ (4) It enables improved power management schemes. ◦ (5) It allows a user to manage and configure devices, dynamically, in simulation			
6	Explain about the architecture of a sensor cloud platform. **Solution:** **Architecture of a sensor-cloud platform** ● In a traditional cloud computing architecture, two actors, cloud service provider (CSP) and end users (customer) play the key role. Unlike cloud computing, in sensor-cloud architecture, the sensor owners play an important role along with the service provider and end users. A service provider in sensor-cloud architecture is known as a sensor-cloud service provider (SCSP).	10	CO4	L2



Actors in sensor-cloud architecture

In a sensor-cloud architecture, three actors are present

- End User
- Sensor Owner
- Sensor-Cloud Service Provider (SCSP)

End User

- This actor is also known as a customer of the sensor-cloud services. An end user registers him/herself with the infrastructure through a Web portal. Then he/she chooses the template of the services that are available in the sensor-cloud architecture to which he/she is registered. Finally, through the Web portal, the end user receives the services. Based on the type and usage duration of service, the end user pays the charges to the SCSP.

Sensor Owner

- Deployment of the sensors is essential in order to provide services to the end users. These sensors in a sensor- cloud architecture are owned and deployed by the sensor owners. A particular sensor owner can own multiple homogeneous or heterogeneous sensor nodes. Based on the requirements of the users, these sensor nodes are virtualized and assigned to serving multiple applications at the same time.A sensor owner receives rent depending upon the duration and usage of his/her sensor node(s).

SCSP

- An SCSP is responsible for managing the entire sensor-cloud infrastructure (including management of sensor owners and end users handling, resource handling, database management, cloud handling etc.), centrally. The SCSP receives rent from end users with the help of a pre-defined pricing model. The pricing scheme may include the infrastructure cost, sensor owners' rent, and the revenue of the SCSP. Different algorithms are used for managing the entire infrastructure. The SCSP receives the rent from the end users and shares a partial amount with the sensor owners. The remaining amount is used for maintaining the infrastructure. In the process, the SCSP earns a certain amount of revenue from the payment of the end users

Sensor-Cloud Architecture from Different Viewpoints

	• Two view points: • (i) User Organizational View And • (Ii) Real Architectural View			