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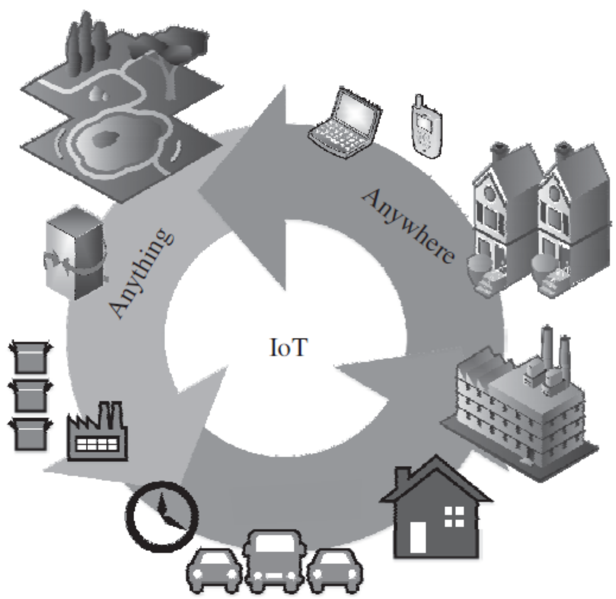
Internal Assessment Test 1 – October 2024

Sub:	Internet of Things				Sub Code:	BETCK105 H/205H	Branch:	All branches
Date:	21/11/2024	Duration:	90 min's	Max Marks: 50	Sem/Sec:	I		OBE

	Answer any FIVE FULL Questions	MARKS	CO	RBT
1a	What is IoT? Explain the characteristics of IoT.	4	CO1	L2

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.



IoT is an anytime, anywhere, and anything-network of Internet-connected physical devices or systems capable of sensing an environment and affecting the sensed environment intelligently. This is generally achieved using low-power and low-form-factor embedded processors on-board the "things" connected to the Internet. In other words, IoT may be considered to be made up of connecting devices, machines, and tools; these things are made up of sensors/actuators and processors, which connect to the Internet through wireless technologies.

1b	Explain Point to Point and Point to Multipoint topology with a neat diagram.	6	CO1	L2

Point-to -point: Point-to-point connections are used to establish direct connections between two hosts. Day-to-day systems such as a remote control for an air conditioner or television is a point to point connection, where the connection has the whole channel dedicated to it only. These networks were designed to work over duplex links and are functional for both synchronous as well as asynchronous systems.

Point-to-multipoint: In a point-to-multipoint connection, more than two hosts share the same link. This type of configuration is similar to the one-to-many connection type. Point-to-multipoint connections find popular use in wireless networks and IP telephony. The channel is shared between the various hosts, either spatially or temporally. One common scheme of spatial sharing of the

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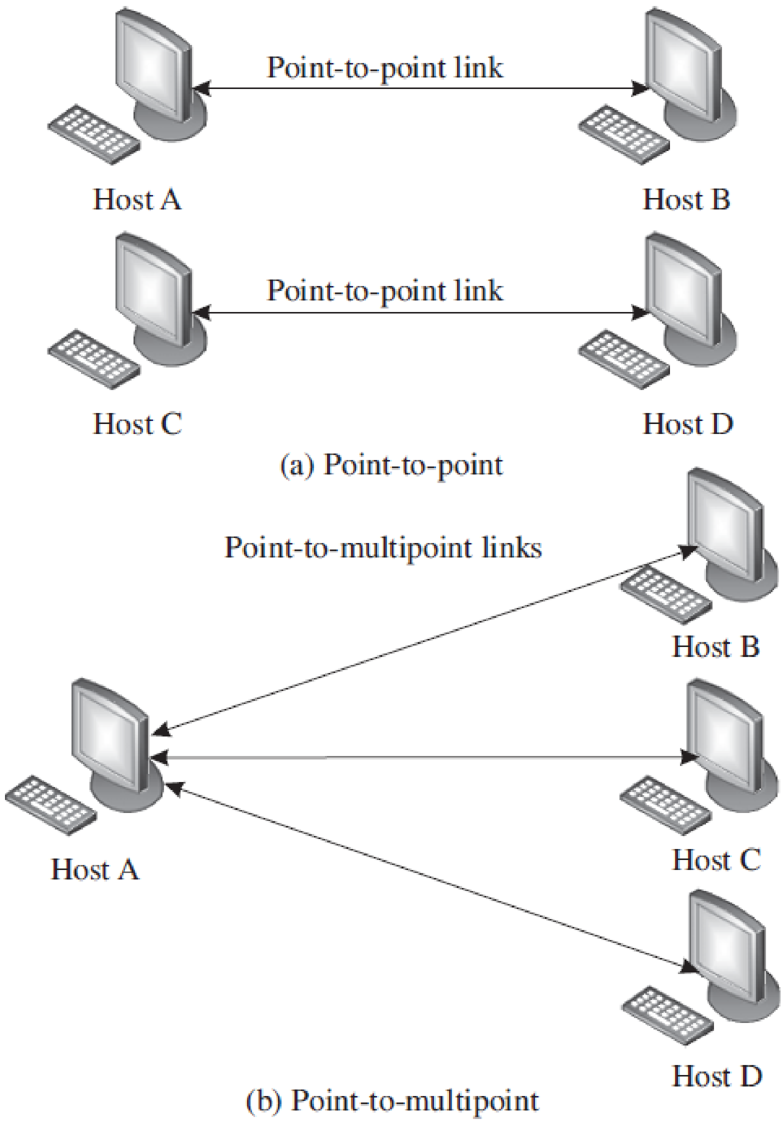
<td>channel is frequency division multiple access (FDMA). Temporal sharing of channels include approaches such as time division multiple access (TDMA). Point-to-multipoint connections find popular use in present-day networks, especially while enabling communication between a massive number of connected devices.



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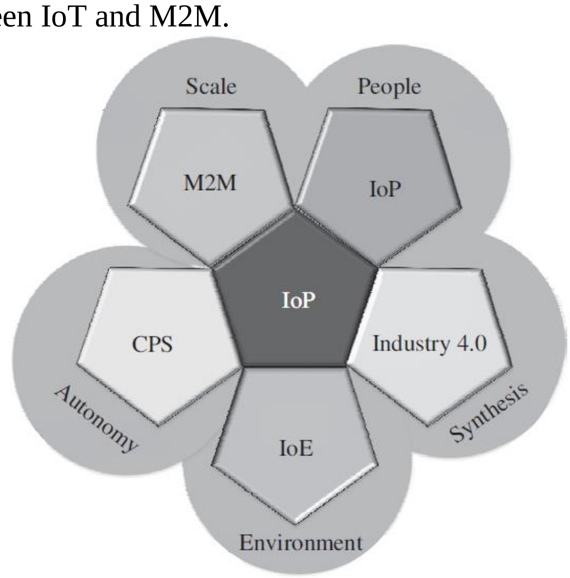
<td>2a</td>
<td>Differentiate between IoT and M2M.



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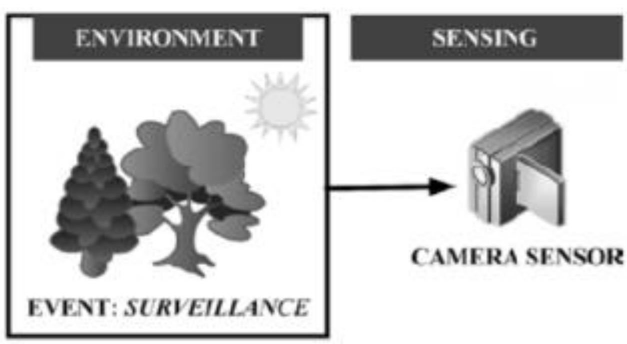
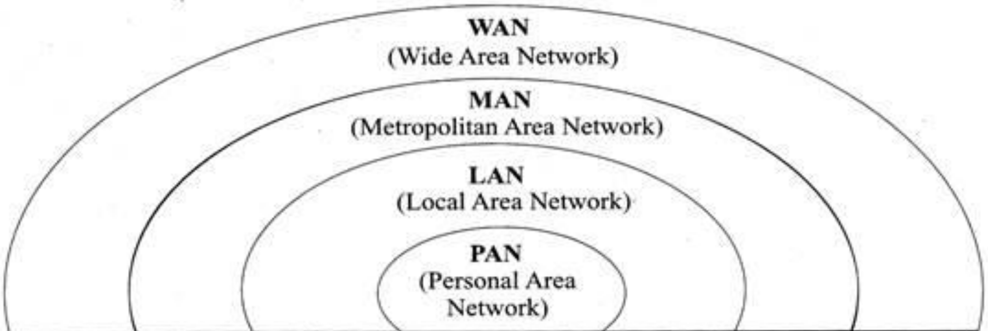
	M2M or the machine-to-machine paradigm refers to communications and interactions between various machines and devices. These interactions can be enabled through a cloud computing infrastructure, a server, or simply a local network hub. M2M collects data from machinery and sensors, while also enabling device management and device interaction. Telecommunication services providers introduced the term M2M, and technically emphasized on machine interactions via one or more communication networks (e.g., 3G, 4G, 5G, satellite, public networks). M2M is part of the IoT and is considered as one of its sub-domains. M2M standards occupy a core place in the IoT landscape. However, in terms of operational and functional scope, IoT is vaster than M2M and comprises a broader range of interactions such as the interactions between devices/things, things, and people, things and applications, and people with applications.			
2b	With a neat block diagram, explain Multimedia Sensing mechanism.  (b) Multimedia sensing Multimedia sensing encompasses the sensing of features that have a spatial variance property associated with the property of temporal variance. Unlike scalar sensors, multimedia sensors are used for capturing the changes in amplitude of a quantifiable property concerning space (spatial) as well as time (temporal).Quantities such as images, direction, flow, speed, acceleration, sound, force, mass, energy, and momentum have both directions as well as a magnitude. Additionally, these quantities follow the vector law of addition and hence are designated as vector quantities. They might have different values in different directions for the same working condition at the same time. The sensors used for measuring these quantities are known as vector sensors. A simple camera-based multimedia sensing using surveillance as an example for multimedia sensing.	5	CO1	L2
3	Explain the factors affecting Sensorial Deviations. Sensorial Deviations: Most of the sensing in IoT is non-critical, where minor deviations in sensorial outputs seldom change the nature of the undertaken tasks. However, some critical applications of IoT, such as health care, industrial process monitoring, and others, do require sensors with high-quality measurement capabilities. As the quality of the measurement obtained from a sensor is dependent on a large number off actors, there are a few primary considerations that must be incorporated during the sensing of critical systems. In the event of a sensor's output signal going beyond its designed maximum and minimum capacity for measurement, the sensor output is truncated to its	10	CO1	L2

maximum or minimum value, which is also the sensor's limits. The measurement range between a sensor's characterized minimum and maximum values is also referred to as the full scale range of that sensor. Under real conditions, the sensitivity of a sensor may differ from the value specified for that sensor leading to sensitivity error. This deviation is mostly attributed to sensor fabrication errors and its calibration. If the output of a sensor differs from the actual value to be measured by a constant, the sensor is said to have an offset error or bias. For example, while measuring an actual temperature of 0C, a temperature sensor outputs 1:1 C every time. In this case, the sensor is said to have an offset error or bias of 1:1C.

4	Explain the four broad categories of networks based upon reachability.	10	CO1	L2



	PAN	LAN	MAN	WAN
Standards	Bluetooth, UWB	802,11 HiperLAN2	802, 16 MMDS, LMDS	GSM, GPRS, CDMA, 2.5-3G,802.16
Speed	< 1 Mbps	11 to 54 Mbps	11 to 100 + Mbps	100 to 384Mbps
Range	Short	Medium	Medium-Long	Long
Applications	Peer-to-Peer Device-to-Device	Enterprise networks	T1 replacement, last mile access	PDAs, Mobile Phones, cellular access

Personal Area Networks (PAN): PANs, as the name suggests, are mostly restricted to individual usage.
A good example of PANs may be connected wireless headphones, wireless speakers, laptops, smartphones, wireless keyboards, wireless mouse, and printers within a house. Generally, PANs are wireless networks, which make use of low-range and low-power technologies such as Bluetooth. The reachability of PANs lies in the range of a few centimeters to a few meters.

Local Area Networks (LAN): A LAN is a collection of hosts linked to a single network through wired or wireless connections. However, LANs are restricted to buildings, organizations, or campuses. Typically, a few leased lines connected to the Internet provide web access to the whole organization or a campus; the lines are further redistributed to multiple hosts within the LAN enabling hosts. Commonly used network components in a LAN are servers, hubs, routers, switches, terminals, and computers.

Metropolitan Area Networks (MAN): The reachability of a MAN lies between that of a LAN and a WAN. Typically, MANs connect various organizations or buildings within a given geographic location or city. An excellent example of a MAN is an Internet service provider (ISP) supplying Internet connectivity to various organizations within a city. As MANs are costly, they may not be owned by individuals or even single organizations.

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<tr><td></td><td>Wide Area Networks (WAN): WANs typically connect diverse geographic locations. However, they are restricted within the boundaries of a state or country. The data rate of WANs is in the order of a fraction of LAN's data rate. Typically, WANs connecting two LANs or MANs may use public switched telephone networks (PSTNs) or satellite-based links.</td><td></td><td></td><td></td></tr>
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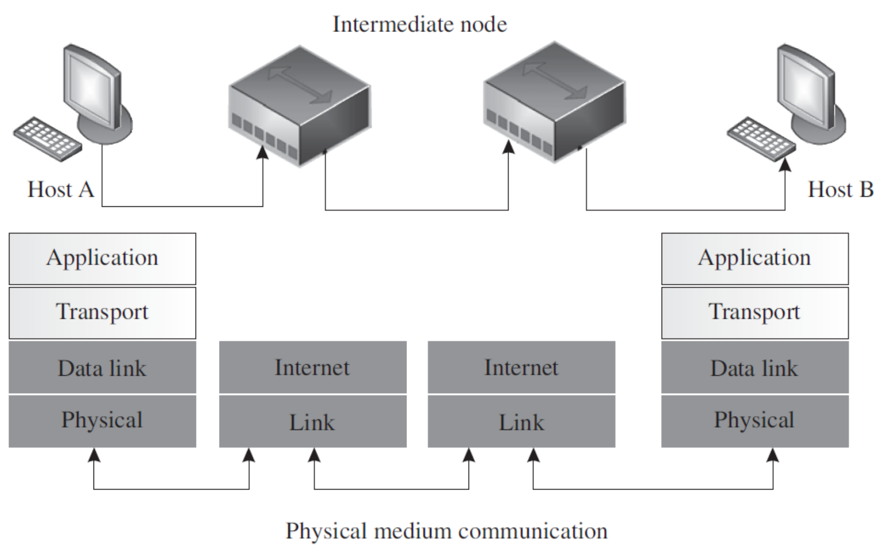
With a neat diagram explain the network communication between two hosts following the OSI model.



Application Layer: The functionalities of the application layer, layer 4, of the TCP/IP protocol suite are synonymous with the collective functionalities of the OSI model's session, presentation, and application layers. This layer enables an end-user to access the services of the underlying layers and defines the protocols for the transfer of data. Hypertext transfer protocol (HTTP), file transfer protocol (FTP), simple mail transfer protocol (SMTP), domain name system (DNS), routing information protocol (RIP), and simple network management protocol (SNMP) are some of the core protocols associated with this layer.

Transport Layer: Layer 3 of the TCP/IP protocol suite is functionally synonymous with the transport layer of the OSI model. This layer is tasked with the functions of error control, flow control, congestion control, segmentation, and addressing in an end-to-end manner; it is also independent of the underlying network. Transmission control protocol (TCP) and user datagram protocol (UDP) are the core protocols upon which this layer is built, which in turn enables it to have the choice of providing connection-oriented or connectionless services between two or more hosts or networked devices.

Internet Layer: Layer 2 of the TCP/IP protocol suite is somewhat synonymous to the network layer of the OSI model. It is responsible for addressing, address translation, data packaging, data disassembly and assembly, routing, and packet delivery tracking operations. Some core protocols associated with this layer are address resolution protocol (ARP), Internet protocol (IP), Internet control message protocol (ICMP), and Internet group management protocol (IGMP). Traditionally, this layer was built upon IPv4, which is gradually shifting to IPv6, enabling the accommodation of a much more significant number of addresses and security measures.

</td><td>10</td><td>CO2</td><td>L2</td></tr>
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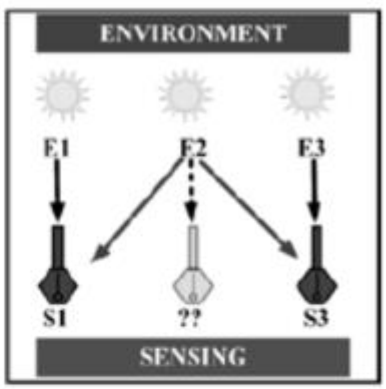
Link Layer: The first and base layer of the TCP/IP protocol suite is also known as the network interface layer. This layer is synonymous with the collective physical and data link layer of the OSI model. It enables the transmission of TCP/IP packets over the physical medium. According to its design principles, the link layer is independent of the medium in use, frame format, and network access, enabling it to be used with a wide range of technologies such as the Ethernet, wireless LAN, and the asynchronous transfer mode (ATM).

6a	Differentiate between OSI and TCP/IP model.	5	CO2	L2

Aspect	OSI Model	TCP/IP Model
Development Purpose	A theoretical model designed to standardize network communication.	A practical model created for real-world implementation of internet communication.
Layers	Has 7 layers: Application, Presentation, Session, Transport, Network, Data Link, and Physical.	Has 4 layers: Application, Transport, Internet, and Network Interface.
Flexibility	More general and adaptable to various technologies, but less used in practice.	Designed specifically for the internet; simpler and widely adopted.
Abstraction Detail	Provides a detailed and modular breakdown of networking functions.	Combines several OSI layers into fewer, broader layers.
Usage	Mainly used as a reference model for learning and analysis.	Actively used in real-world networking, especially in internet-based systems.

6b	Explain Virtual Sensing with a neat diagram.	5	CO2	L2



(d) Virtual sensing

Virtual sensing: Many a time, there is a need for very dense and large-scale deployment of sensor nodes spread over a large area for monitoring of parameters. One such domain is agriculture. Here, often, the parameters being measured, such as soil moisture, soil temperature, and water level, do not show significant spatial variations. Hence, if sensors are deployed in the fields of farmer A, it is highly likely that the measurements from his sensors will be able to provide almost concise measurements of his neighbor B's fields; this is especially true of fields which are immediately surrounding A's fields. Exploiting this property, if the data from A's field is digitized using an IoT infrastructure and this system advises him regarding the appropriate watering, fertilizer, and pesticide regimen for his crops, this advisory can also be used by B for maintaining his crops. In short, A's sensors are being used for actual measurement of parameters; whereas virtual data (which does not have actual physical sensors but uses extrapolation-based measurements) is being used for advising B. This is the virtual sensing paradigm.

7	Explain the two types of Processing Topologies with neat diagrams.	10	CO3	L2

A properly designed IoT architecture would result in massive savings in network bandwidth and conserve significant amounts of overall energy in the architecture while providing the proper and allowable processing latencies for the solutions associated with the architecture.

we can divide the various processing solutions into two large topologies:

On-site

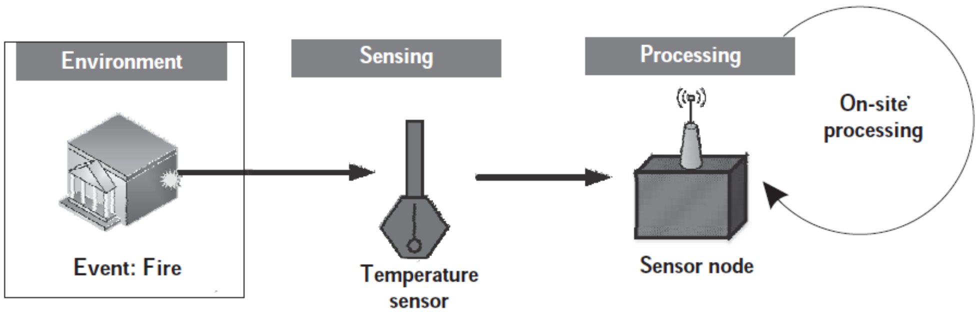
Off-site.

The off-site processing topology can be further divided into the following:

Remote processing

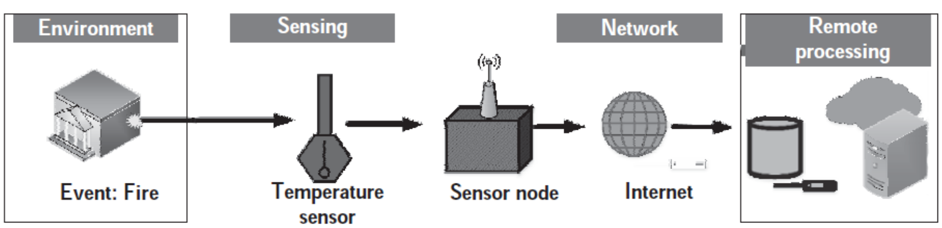
Collaborative processing

Onsite processing:



As evident from the name, the on-site processing topology signifies that the data is processed at the source itself. This is crucial in applications that have a very low tolerance for latencies. These latencies may result from the processing hardware or the network (during transmission of the data for processing away from the processor).

Off-site processing:



Allows for latencies (due to processing or network latencies); it is significantly cheaper than on-site processing topologies. In the off-site processing topology, the sensor node is responsible for the collection and framing of data that is eventually to be transmitted to another location for processing. In the off-site topology, the data from these sensor nodes (data generating sources) is transmitted either to a remote location (which can either be a server or a cloud) or to multiple processing nodes. Multiple nodes can come together to share their processing power in order to collaboratively process the data (which is important in case a feasible communication pathway or connection to a remote location cannot be established by a single node).

Remote processing: This is one of the most common processing topologies prevalent in present-day IoT solutions.

It involves sensing of data by various sensor nodes; the data is then forwarded to a remote server or a cloud-based infrastructure for further processing and analytics.

The processing of data from hundreds and thousands of sensor nodes can be simultaneously offloaded to a single, powerful computing platform; this results in massive cost and energy savings by enabling the reuse and reallocation of the same processing resource while also enabling the deployment of smaller and simpler processing nodes at the site of deployment.

Collaborative processing: This processing topology typically finds use in scenarios with limited or no network connectivity, especially systems lacking a backbone network. This topology can be quite beneficial for applications such as agriculture, where an intense and temporally high frequency of data processing is not required as agricultural data is generally logged after significantly long intervals (in the range of hours).