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Internal Assessment Test 1 – Jan 2023

| Sub: | Internet of Things | | | | | Sub Code: | 22ETC15H | Branch: | |
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| Date: | 24/1/2023 | Duration: | 90 min's | Max Marks: | 50 | Sem/Sec: | I / A, B, C, D, E, F and G | OBE | |

**Answer any FIVE FULL Questions**

| | | MARKS | CO | RBT |
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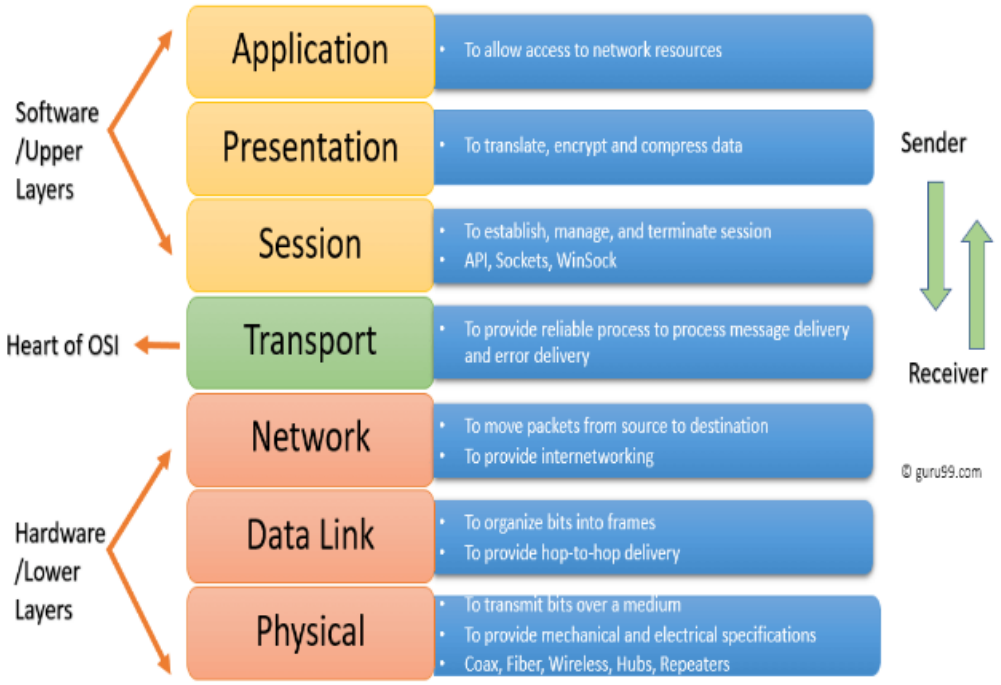
| 1 | Explain the following PAN, WAN, LAN and MAN.<br>**Solution:**<br>**Personal Area Networks (PAN):** PANs, as the name suggests, are mostly restricted to individual usage.<br>• A good example of PANs may be connected wireless headphones, wireless speakers, laptops, smartphones, wireless keyboards, wireless mouse, and printers within a house.<br>• Generally, PANs are wireless networks, which make use of low-range and lowpower technologies such as Bluetooth.<br>• The reachability of PANs lies in the range of a few centimeters to a few meters.<br>**Local Area Networks (LAN):** A LAN is a collection of hosts linked to a single network through wired or wireless connections.<br>• 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;<br>• The lines are further redistributed to multiple hosts within the LAN enabling hosts. The hosts are much more in number than the actual direct lines to the Internet to access the web from within the organization. This also allows the organization to define various access control policies for web access within its hierarchy.<br>• Typically, the present-day data access rates within the LANs range from 100 Mbps to 1000 Mbps, with very high fault-tolerance levels. Commonly used network components in a LAN are servers, hubs, routers, switches, terminals, and computers.<br>**Metropolitan Area Networks (MAN):** The reachability of a MAN lies between that of a LAN and a WAN.<br>• MANs connect various organizations or buildings within a given geographic location or city.<br>• An excellent example of a MAN is an Internet service provider (ISP) supplying Internet connectivity to various organizations within a city.<br>• As MANs are costly, they may not be owned by individuals or even single organizations.<br>• Typical networking devices/components in MANs are modems and cables. MANs tend to have moderate fault tolerance levels.<br>**Wide Area Networks (WAN):** WANs typically connect diverse geographic locations. However, they are restricted within the boundaries of a state or country.<br>• The data rate of WANs is in the order of a fraction of LAN's data rate.<br>• Typically, WANs connecting two LANs or MANs may use public switched telephone networks (PSTNs) or satellite-based links.<br>• Due to the long transmission ranges, WANs tend to have more errors and noise during transmission and are very costly to maintain. The fault tolerance of WANs are also generally low. | 10 | CO1 | L2 |
| 2 | Explain layers of OSI model in detail with a neat diagram<br>**Solution:** | 10 | CO1 | L2 |

OSI Layered Network Models:

• OSI stands for Open Systems Interconnection.

• It has been developed by ISO – 'International Organization for Standardization', in the year 1984.

• It is 7 layer architecture with each layer having specific functionality to perform.




**1. Physical Layer:**

• It is responsible for the actual physical connection between the devices.

• The physical layer contains information in the form of bits.

• The functions of the physical layer are as follows:

Bit synchronization:

Bit rate control:

Physical topologies:

Transmission mode:

**2. Data Link Layer (DLL) :**

• The data link layer is responsible for the node-to-node delivery of the message.

• The main function of this layer is to make sure data transfer is error-free from one node to another, over the physical layer.

• Data Link Layer is divided into two sub layers: Logical Link Control (LLC) Media Access Control (MAC)

• The functions of the Data Link layer are :

Framing: Physical addressing:

Error control:

Flow Control:

Access control:

**3. Network Layer:**

• The network layer works for the transmission of data from one host to the other located in different networks.

• It also takes care of packet routing i.e. selection of the shortest path to transmit the packet, from the number of routes available.

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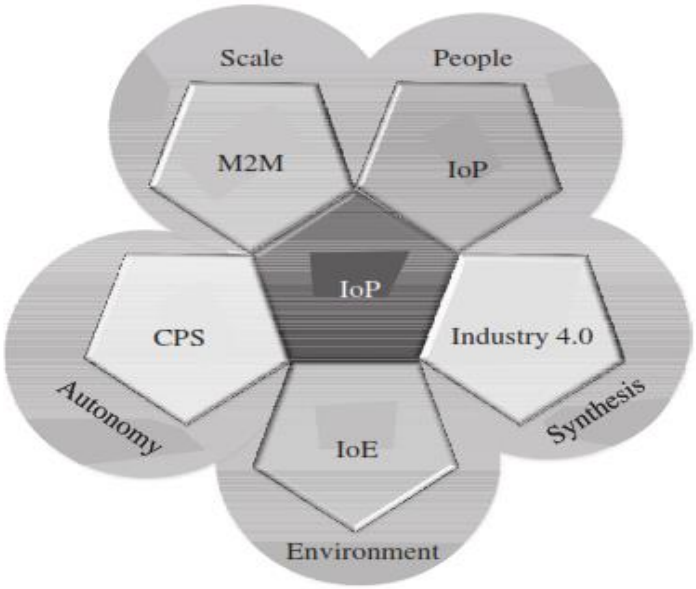
| | • The sender & receiver's IP addresses are placed in the header by the network layer.<br>• The functions of the Network layer are : Routing: Logical Addressing:<br>**4. Transport Layer:**<br>• The transport layer provides services to the application layer and takes services from the network layer.<br>• The data in the transport layer is referred to as Segments.<br>• The transport layer also provides the acknowledgement of the successful data transmission and re-transmits the data if an error is found.<br>• At sender's side: Transport layer receives the formatted data from the upper layers, performs Segmentation, and also implements Flow & Error control to ensure proper data transmission.<br>• At receiver's side: Transport Layer reads the port number from its header and forwards the Data which it has received to the respective application. It also performs sequencing and reassembling of the segmented data.<br>• The functions of the transport layer are as follows:<br>Segmentation and Reassembly:<br>Service Point Addressing:<br>• The services provided by the transport layer : A. Connection-Oriented Service: It is a three-phase process that includes Connection Establishment Data Transfer Termination / disconnection<br>• In this type of transmission, the receiving device sends an acknowledgement, back to the source after a packet or group of packets is received. This type of transmission is reliable and secure.<br>**5. Session Layer:**<br>• This layer is responsible for the establishment of connection, maintenance of sessions, authentication, and also ensures security.<br>• The functions of the session layer are : Session establishment, maintenance, and termination: Synchronization: Dialog Controller:<br>**6. Presentation Layer:**<br>• The data from the application layer is extracted here and manipulated as per the required format to transmit over the network.<br>• The functions of the presentation layer are : Translation: Encryption/ Decryption: Compression:<br>**7. Application Layer:**<br>• This layer serves as a window for the application services to access the network and for displaying the received information to the user.<br>• The functions of the Application layer are : FTAM-File transfer access and management Mail Services Directory Services | | | |
| 3 | Explain the following i) IoT versus M2M ii) IoT versus CPS iii) IoT versus WoT<br>**Solution:** | 10 | CO1 | L3 |




## IoT versus M2M

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. . 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; M2M enables the amalgamation of workflows comprising such interactions within IoT. Internet connectivity is central to the IoT theme but is not necessarily focused on the use of telecom networks.

## IoT versus CPS

Cyber physical systems (CPS) encompasses sensing, control, actuation, and feedback as a complete package. In other words, a digital twin is attached to a CPS-based system. As mentioned earlier, a digital twin is a virtual system–model relation, in which the system signifies a physical system or equipment or a piece of machinery, while the model represents the mathematical model or representation of the physical system's behavior or operation. Many a time, a digital twin is used parallel to a physical system, especially in CPS as it allows for the comparison of the physical system's output, performance, and health. Based on feedback from the digital twin, a physical system can be easily given corrective directions/commands to obtain desirable outputs.

## IoT versus WoT

From a developer's perspective, the Web of Things (WoT) paradigm enables access and control over IoT resources and applications. These resources and applications are generally built using technologies such as HTML 5.0, JavaScript, Ajax, PHP, and others. REST (representational state transfer) is one

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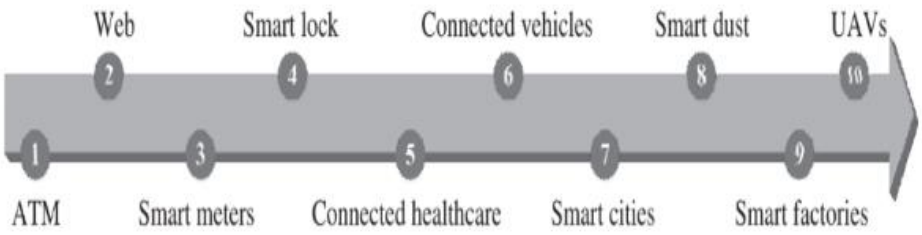
| | of the key enablers of WoT. The use of RESTful principles and RESTful APIs (application program interface) enables both developers and deployers to benefit from the recognition, acceptance, and maturity of existing web technologies without having to redesign and redeploy solutions from scratch. | | | |
| 4 | With a neat diagram explain the evolution of IOT<br>**Solution:**<br>  <br><br>The sequence of technological developments leading to the shaping of the modern-day IoT<br>• ATM: ATMs or automated teller machines are cash distribution machines, which are linked to a user's bank account. ATMs dispense cash upon verification of the identity of a user and their account through a specially coded card. The first ATM became operational and connected online for the first time in 1974.<br>• Web: World Wide Web is a global information sharing and communication platform. The Web became operational for the first time in 1991. Since then, it has been massively responsible for the many revolutions in the field of computing and communication.<br>• Smart Meters: The earliest smart meter was a power meter, which became operational in early 2000. These power meters were capable of communicating remotely with the power grid. They enabled remote monitoring of subscribers' power usage and eased the process of billing and power allocation from grids.<br>• Digital Locks: Digital locks can be considered as one of the earlier attempts at connected home-automation systems. Present-day digital locks are so robust that smart phones can be used to control them.<br>Connected Healthcare: Here, healthcare devices connect to hospitals, doctors, and relatives to alert them of medical emergencies and take preventive measures. The devices may be simple wearable appliances, monitoring just the heart rate and pulse of the wearer, as well as regular medical devices and monitors in hospitals.<br>• Connected Vehicles: Connected vehicles may communicate to the Internet or with other vehicles, or even with sensors and actuators contained within it. These vehicles self-diagnose themselves and alert owners about system failures.<br>• Smart Cities: This is a city-wide implementation of smart sensing, monitoring, and actuation systems. The city-wide infrastructure communicating amongst themselves enables unified and synchronized operations and information dissemination. Some of the facilities which may benefit are parking, transportation, and others.<br>• Smart Dust: These are microscopic computers. Smaller than a grain of sand each, they can be used in numerous beneficial ways, where regular computers cannot operate. For example, smart dust can be sprayed to measure chemicals in the soil or even to diagnose problems in the human body.<br>• Smart Factories: These factories can monitor plant processes, assembly lines, distribution lines, and manage factory floors all on their own. The reduction in mishaps due to human errors in judgment or unoptimized processes is drastically reduced.<br>• UAVs: UAVs or unmanned aerial vehicles have emerged as robust publicdomain | 10 | CO1 | L2 |

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| | solutions tasked with applications ranging from agriculture, surveys, surveillance, deliveries, stock maintenance, asset management, and other tasks. | | | |
| 5 | Differentiate between OSI and TCP/IP<br>Differentiate between sensors, transducers and actuators<br>**Solutions:** | 10 | CO2 | L3 |
| 6 | Explain different sensing types of sensors?<br>**Solution:**<br>**Scalar sensing**<br>Scalar sensing encompasses the sensing of features that can be quantified simply by measuring changes in the amplitude of the measured values with respect to time. Quantities such as ambient temperature, current, atmospheric | 10 | CO2 | L2 |

| TCP/IP | OSI |
|---|---|
| Implementation of OSI model | Reference model |
| Model around which Internet is developed | This is a theoretical model |
| Has only 4 layers | Has 7 layers |
| Considered more reliable | Considered a reference tool |
| Protocols are not strictly defined | Stricter boundaries for the protocols |
| Horizontal approach | Vertical approach |
| Combines the session and presentation layer in the application layer | Has separate session and presentation layer |
| Protocols were developed first and then the model was developed | Model was developed before the development of protocols |
| Supports only connectionless communication in the network layer | Supports connectionless and connection-oriented communication in the network layer |

| Parameters | Transducers | Sensors | Actuators |
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| Definition | Converts energy from one form to another. | Converts various forms of energy into electrical signals. | Converts electrical signals into various forms of energy, typically mechanical energy. |
| Domain | Can be used to represent a sensor as well as an actuator. | It is an input transducer. | It is an output transducer. |
| Function | Can work as a sensor or an actuator but not simultaneously. | Used for quantifying environmental stimuli into signals. | Used for converting signals into proportional mechanical or electrical outputs. |
| Examples | Any sensor or actuator | Humidity sensors, Temperature sensors, Anemometers (measures flow velocity), Manometers (measures fluid pressure), Accelerometers (measures the acceleration of a body), Gas sensors (measures concentration of specific gas or gases), and others | Motors (convert electrical energy to rotary motion), Force heads (which impose a force), Pumps (which convert rotary motion of shafts into either a pressure or a fluid |

pressure, rainfall, light, humidity, flux, and others are considered as scalar values as they normally do not have a directional or spatial property assigned with them. Simply measuring the changes in their values with passing time provides enough information about these quantities. The sensors used for measuring these scalar quantities are referred to as scalar sensors, and the act is known as scalar sensing.

**Multimedia sensing**

Multimedia sensing encompasses the sensing of features that have a spatial variance property associated with the property of temporal variance [4]. 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.

**Hybrid sensing**

The act of using scalar as well as multimedia sensing at the same time is referred to as hybrid sensing. Many a time, there is a need to measure certain vector as well as scalar properties of an environment at the same time. Under these conditions, a range of various sensors are employed to measure the various properties of that environment at any instant of time, and temporally map the collected information to generate new information. For example, in an agricultural field, it is required to measure the soil conditions at regular intervals of time to determine plant health. Sensors such as soil moisture and soil temperature are deployed underground to estimate the soil's water retention capacity and the moisture being held by the soil at any instant of time. However, this setup only determines whether the plant is getting enough water or not. There may be a host of other factors besides water availability, which may affect a plant's health. The additional inclusion of a camera sensor with the plant may be able to determine the actual condition of a plant by additionally determining the color of leaves. The aggregate information from soil moisture, soil temperature, and the camera sensor will be able to collectively determine a plant's health at any instant of time.

**Virtual sensing**

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

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