BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

Set – A

School of Computing Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: ITN1504 **Time: 2 Hours**

Course Name: Internet of Things **Max. Marks: 50**

Section – A

10X01 = 10 Marks

10 objective type questions, each question carries 01 mark.

1. _____ provides virtual machines, virtual storage, virtual infrastructure, and other hardware assets.
   a) SaaS b) SaaS
   c) IaaS d) All of the mentioned

2. The huge number of devices connected to the Internet of Things has to communicate automatically, not via humans. What is this called?
   a) Skynet b) Machine 2 Machine
   c) Bot 2 Bot d) Intercloud

3. Open source software used in a SaaS is called _____ SaaS.
   a) closed b) open
   c) free d) all of the mentioned

4. Which of the following issues are considered in IoT?
   a) Security Issue b) Reliability Issue
   c) Standard Issue d) All issues

5. MQTT stands for _____
   a) MQ Telemetry Things b) MQ Telemetry Transport
   c) MQ Transport Telemetry d) MQ Transport Things

6. Which of the following category is used for business to consumer process?
   a) Industrial IoT b) Group IoT
   c) Community IoT d) Personal IoT

7. Voice recognition software and virtual assistant programs offer for _____ and _____.
   a) Communication b) Entertainment
   c) Communication and Software d) Communication and Entertainment

8. Which protocol is lightweight?
   a) HTTP b) MQTT
   c) SPI d) CoAP

9. CoAP provides which of the following requirements?
   a) Multicast support and simplicity b) Low overhead and multicast support
   c) Multicast support, Low overhead and simplicity d) Simplicity and low overhead

10. IoT is an advanced automation and analytics system which deals with?
    a) sensor, networking b) electronic
    c) cloud messaging d) All of the above

Section – B

04X04 = 16 Marks

04 short answer type questions, each question carries 04 marks.

1. What is IoT? What devices are IoT?
2. Why IoT is important for the business world today?
3. Explain different IoT analytics challenges.
4. What is IoT Middleware? Why is it called middleware?

Section – C

04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

1. Explain the various major challenges in IoT.
2. How IoT impacts mobile app development space?
3. What different types of cloud services can be used in IoT applications?
4. What is Wireless Sensor Network? Just brief its challenges and applications.

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Ans. d) All issues

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   d) Simplicity and low overhead

Ans. c) Multicast support, Low overhead and simplicity

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   b) electronic
   c) cloud messaging
   d) All of the above

Ans. d) All of the above

Section – B

04X04 = 16 Marks

04 short answer type questions, each question carries 04 marks.

1. What is IoT? What devices are IoT?

Ans. The Internet of Things (IoT) describes the network of physical objects "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. The Internet of Things refers to electronics devices that collect some kind of data from sensors that are attached to it. The device is also connected to the internet so that it can send the data it collects from sensors to a larger, more powerful processor or server.

These days, if we have a look around our surrounding, then we can see that most of the devices are IoT based. So, we listed out all the popular IoT devices, which are addicted to nowadays.

- First of all, Smart Home Automation, we check carefully, most of the houses are opting for Home Automation. As a security concern, and those who want an automatic and smart built home.
- Voice Assistants, there is no home which doesn't have Amazon- Alexa or Google Echo in them.
- home. People have started feeling these voice assistants as a part of life.
- Smart Bands or Fitness Bands.
- GPS Trackers
- Smart Smoke Alarms
- Smart Locks
- Doorbell Camera's
- Amazon Dash button
- IoT based Security Systems

All of the above devices are IoT devices.

2. Why IoT is important for the business world today?

Ans. Business Overview of Why IoT is so important

1. Increased efficiency and productivity

A business can significantly increase its productivity by knowing the needs of its customers. This can be achieved by instrumenting smart devices into operations to improve efficiency, so that more can be done in less time.

2. Inventory tracking and management

IoT has the potential to transform the way companies track and manage their inventory. Businesses that depend on manufacturing, warehousing and storage will be able to monitor changes in their inventory automatically, with the help of smart devices. This will save plenty of time for workers to perform more important, insightful and challenging tasks.

3. Data sharing

Smart devices are known to keep a track of consumer behavior, which is essential for a business to function and flourish. This gathering and exchanging information process has completely changed the way data is handled. IoT devices do not just offer access to consumer data, but also track and record their usage patterns of how a consumer interacts with these devices via machine learning.

4. Remote working
IoT is believed to open the door for remote work. The ability to connect multiple devices to the same network will allow employees working remotely to be closer and more connected to their job than ever before.

5. Shorter buying decision cycles
IoT is also going to change the way consumers purchase products, as the buying cycle is said to become shorter. The targeted advertising enabled by the technology will further facilitate buying decision-making process, which will allow customers to anticipate a faster and convenient delivery service.

6. Creating new consumer demands
In order to expand their reach, businesses will have to keep in mind that as consumers will be acquainted with IoT, they will start demanding things that they did not know they wanted before, expecting extra every time they make a new purchase. There will be a time when smart devices will become the new standard for appliances and other day-to-day usable things.

7. IoT expertise
As organizations will employ IoT into their businesses, they will also need to hire IoT experts. Just implementing the technology would not suffice. The more businesses start hiring IoT specialists, the more individuals will be willing to learn about advanced technology.

3. Explain different IoT analytics challenges.
Ans. IoT Analytics Challenges
One way to view IoT analytics challenges is to consider a possible IoT deployment. Let's take the following scenario. A huge industrial food storage warehouse and distribution center uses Internet-connected devices to maintain the temperature of specific zones, such as a refrigeration area for items that need ongoing, non-freezing cooling, and a freezer area for items that need to be consistently frozen. Following challenges may occur:

Too much data
The total amount of data being collected may be so large that it may not be possible to move it over the network to a central location.

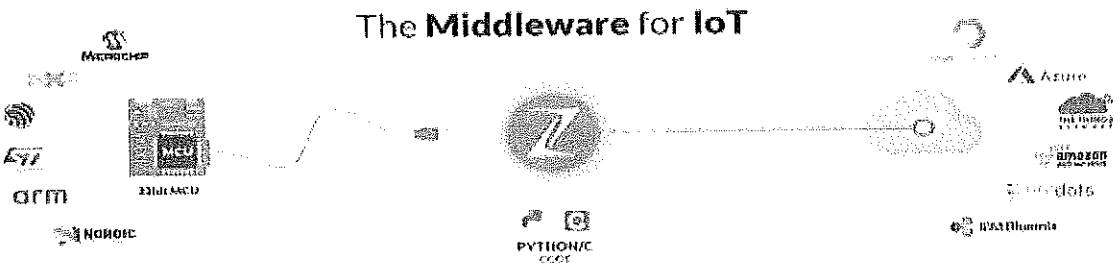
Security
It is essential for connected devices to work together for most IoT use cases, but this approach raises security issues. The overall security profile is only as effective as the weakest device. If the security on a specific vendor's outdoor sensor is weak, and the sensor is connected to other devices, situation's critical impact is high.

Misbehaving devices
These are devices or sensors that go bad and begin sending false readings to the system. This could ruin the inventory of the warehouse.

4. What is IoT Middleware? Why is it called middleware?
Ans. IoT Middleware:

- Middleware is software that is used to bridge the gap between applications and other tools or databases. Middleware sits between an operating system and the applications that run on it.
- It is effectively software that provides a method of communication and data management between applications that would otherwise not have any way to exchange data -- such as with software tools and databases.
- Middleware appears in many locations; however, organizations and developers make specific use of middleware to more efficiently build applications.
- Some examples of middleware activities include handling data and API management, authentication and messaging services.
- Internet of Things middleware is software that serves as an interface between components of the IoT, making communication possible among elements that would not otherwise be capable.
- Middleware connects different, often complex and already existing programs that were not originally designed to be connected.
- The essence of the Internet of Things is making it possible for just about anything (any Thing) to be connected and to communicate data over a network.

- Middleware is part of the architecture enabling connectivity for huge numbers of diverse Things by providing a connectivity layer for sensors and also for the application layers that provide services that ensure effective communications among software.
- Microsoft, Oracle, RedHat and WSO2 are among the companies that offer IoT middleware. These products provide API management as well as basic messaging, routing and message transformation. More comprehensive IoT platforms include middleware along with sensors and networking components.



Why is it called middleware?

- The name *middleware* stems from the fact that it is the software that sits between the client-side requests on the front end and the back-end resource being requested.
- A client can make a request with network-based interactions. That client is typically an application that resides on the front end, which is where the user interacts with software.
- Resources such as databases, message queues, NoSQL data stores and file servers are often referred to as being part of the back end. Middleware will sit between these ends.

Section – C

04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

1. Explain the various major challenges in IoT.

Ans. IoT Challenges

For the IoT industry to thrive there are three categories of challenges to overcome and this is true for any new trend in technology not only IoT:

1. Technology 2. Business 3. Society

Technology challenges: Cloud Security Alliance (CSA) listed some of the root causes of such

Technological challenges:

- Many IoT Systems are poorly designed and implemented, using diverse protocols and technologies that create complex configurations.
- Limited guidance for life cycle maintenance and management of IoT devices.
- Limited best practices available for IoT developers and lack of standards for authentication and authorization of IoT edge devices.
- Restricted interfaces available IoT devices to interact with security devices and applications.

The main technical challenge are follows:

- Security
- Connectivity
- Compatibility and longevity
- Standards
- Challenges facing the adoptions of standards within IoT

- Standard for handling unstructured data
- Technical skills to leverage newer aggregation tools
- Intelligent analysis & actions
- Real-time data processing and analysis
- Legacy systems' ability to analyze unstructured data
- Legacy systems' ability to manage real- time data
- Factors driving adoption of intelligent actions within the IoT

Business challenges

The bottom line is a big motivation for starting, investing in, and operating any business, without a sound and solid business model for IoT we will have another bubble, this model must satisfy all the requirements for all kinds of e-commerce; vertical markets, horizontal markets, and consumer markets. But this category is always a victim of regulatory and legal scrutiny. End-to-end solution providers operating in vertical industries and delivering services using cloud analytics will be the most successful at monetizing a large portion of the value in IoT. While many IoT applications may attract modest revenue, some can attract more. For little burden on the existing communication infrastructure, operators have the potential to open up a significant source of new revenue using IoT technologies.

Society challenges

Understanding IoT from the customers and regulators prospective is not an easy task for the following reasons:

- Customer demands and requirements change constantly.
- New uses for devices—as well as new devices—sprout and grows at breakneck speeds.
- Inventing and reintegrating must-have features and capabilities are expensive and take time and resources.
- The uses for Internet of Things technology are expanding and changing—often in uncharted waters.
- Consumer Confidence: Each of these problems could put a dent in consumers' desire to purchase connected products, which would prevent the IoT from fulfilling its true potential.
- Lack of understanding or education by consumers of best practices for IoT devices security to help in improving privacy, for example change default passwords of IoT devices.
- Social and legal challenges and privacy.

2. How IoT impacts mobile app development space?

Ans. The following are the major impact we are likely to experience from IoT in mobile app development:

1) New opportunities, unusual power

- IoT developers are most likely to meet new challenges that will drive them towards new opportunities of app development. With IoT offering great promises, businesses will take a leap of faith, knocking the doors of a capable IoT app development company to discover innovative solutions that connect them well with their customers.
- As IoT grows and advances even more, mobile app developers will be able to build better apps that improve connectivity among people just like Uber.

2) The demand for more evolved skills

- As the mobile apps rolled out by developers have vague future and limited attention span, to stay competitive in the relevant market, IoT-powered apps have to be adaptable to device functionality, smartphone platform and new updates. With apps, there is usually a big chance of being obsolete if a new technology arrives to change the game.

3) Five-tier IoT development process

- Another considerable impact to notice is the segregation of the entire development process. Presumably, five-tier approach for multistage IoT development would be preferable. The process will encompass diverse stages based on device, gateway, data, analytics and application, thus making the development complete and mature.

4) Use of ready-to-deploy Third-party platforms

- In order to save time spent on IoT mobile app development, it is advisable to opt for readymade IoT platform that enables rapid deployment of apps. These third-party

platforms are born-ready to interact and mingle with diverse range of smart objects to be connected in an IoT system. By 2022, the number tools in considered to increase from 120 million from 2017 to 44 million.

- We already saw widely used IoT development tools that help accelerate development process. All developers need to do is to learn how to use APIs to connect to these readily available platforms.

5) Device Specificity

- In IoT network, what matters most is app's ability to remain compatible with the nature of device it is integrated with. It is therefore important for developers to make sure they know the exact functionality and tendencies about device environment they are designing the apps for.
- Before embarking on building IoT apps, Software engineers must have profound insight into the technology of things connected in IoT as well as the ways to connect with the app.

6) Dawn of developers with dedicated IoT expertise

- With IoT growing to resonate with the mainstream hybrid mobile app development market, soon there will be a demand for a much unified IoT approach and niche developers to build dedicated project-specific IoT expertise.
- This signifies how the current trend of businesses expecting versatility instead of specialized IoT skills will fade away. There would be no one-developer-for-all lookout.
- When the technology reaches the pinnacle of maturity and usage, enterprises of any scale will emphasize the idea of hiring developers with specialized IoT knowledge.
- IoT technology, thus, puts a larger impact on mobile app development industry, ready to pioneer the revolutionary trend.

7) Enhanced security strength

- Of course, security has always been a big question for mobile app users who think mobile apps pose a constant threat to the data security in the existing online ecosystem. But as IoT expands in its strength and prevalence, it is most likely to influence the current status quo of security concerns.
- IoT domain is greatly active and constantly updated, which will help an IoT app developer improve the defensive structure for mobile apps and create a mighty barrier to fight security threats.
- Though device system can remain fairly accessible to developers as an entry gate, Data encryption and stronger authentication system will increase the overall protection of sensitive data by means of four tier IoT dev components.

8)Mobile is the main fuel

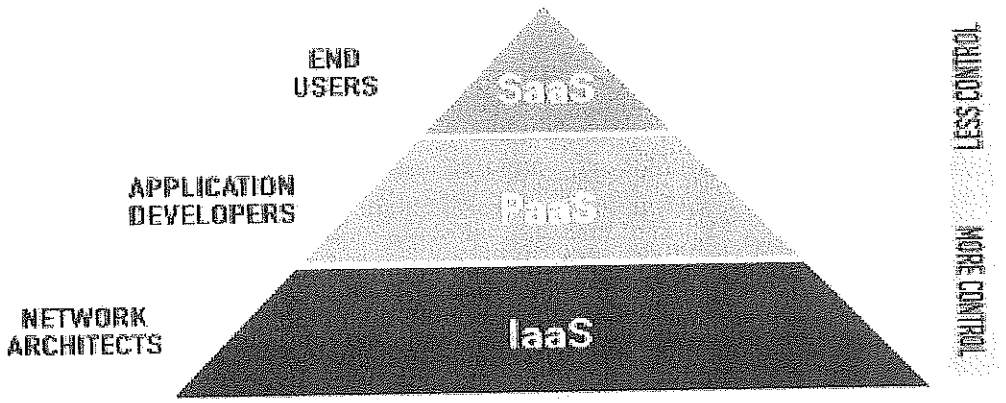
- As businesses seeking lucrative opportunities are curious to dive into the IoT Ocean and connected things are becoming the future of mobile app development, IoT application development has increased potential to bloom in the space of enterprise-focused and consumer-oriented mobile apps.
- Since mobile devices offer superior control, immense convenience and technical compatibility for building IoT apps, it is unquestionable that mobile devices will be the major factor to fuel the IoT app development trends.

3. What different types of cloud services can be used in IoT applications?

Ans. The future of computing is in the cloud. What it implies is that you adapt your business to fit in the cloud model. Missing out on it can leave your business behind, especially in today's world, where technology is imperative and unavoidable. The cloud is a hot topic for small businesses all the way to global enterprises, but remains a broad concept that covers a lot of online territory.

Though as-a-service types are growing by the day, there are usually three models of cloud service to compare:

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)



Infrastructure as a service (IaaS)

- Infrastructure as a service (IaaS) is a cloud computing offering in which a vendor provides users access to computing resources such as servers, storage and networking. Organizations use their own platforms and applications within a service provider's infrastructure.
- IaaS is fully self-service for accessing and monitoring computers, networking, storage, and other services. IaaS allows businesses to purchase resources on-demand and as-needed instead of having to buy hardware outright.
- IaaS delivers cloud computing infrastructure, including servers, network, operating systems, and storage, through virtualization technology. These cloud servers are typically provided to the organization through a dashboard or an API (Application Programming Interface), giving IaaS clients complete control over the entire infrastructure.
- IaaS provides the same technologies and capabilities as a traditional data center without having to physically maintain or manage all of it.
- IaaS clients can still access their servers and storage directly, but it is all outsourced through a "virtual data center" in the cloud.
- Providers of the IaaS manage the servers, hard drives, networking, virtualization, and storage. Some providers even offer more services beyond the virtualization layer, such as databases or message queuing.

Popular examples of IaaS include: DigitalOcean, Linode, Rackspace, Amazon Web Services, Cisco Metacloud, Microsoft Azure and Google Compute Engine (GCE).

Platform as a service (PaaS)

- PaaS is a cloud computing offering that provides users with a cloud environment in which they can develop, manage and deliver applications.
- In addition to storage and other computing resources, users are able to use a suite of prebuilt tools to develop, customize and test their own applications.
- PaaS delivers a framework for developers that they can build upon and use to create customized applications.
- All servers, storage, and networking can be managed by the enterprise or a third-party provider while the developers can maintain management of the applications.
- The delivery model of PaaS is similar to SaaS, except instead of delivering the software over the internet, PaaS provides a platform for software creation.
- This platform is delivered via the web, giving developers the freedom to concentrate on building the software without having to worry about operating systems, software updates, storage, or infrastructure.
- PaaS allows businesses to design and create applications that are built into the PaaS with special software components.
- These applications, sometimes called middleware, are scalable and highly available as they take on certain cloud characteristics.

Popular examples of PaaS include: AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine and OpenShift.

Software as a service (SaaS)

- Software as a Service, also known as cloud application services, represents the most commonly utilized option for businesses in the cloud market.

- SaaS utilizes the internet to deliver applications, which are managed by a third-party vendor, to its users.
- A majority of SaaS applications run directly through your web browser, which means they do not require any downloads or installations on the client side.
- Due to its web delivery model, SaaS eliminates the need to have IT staff download and install applications on each individual computer.
- With SaaS, vendors manage all potential technical issues, such as data, middleware, servers, and storage, resulting in streamlined maintenance and support for the business.

Popular examples of SaaS include: Google Workspace, Dropbox, Salesforce, Cisco WebEx, SAP Concur and GoToMeeting.

4. What is Wireless Sensor Network? Just brief its challenges and applications.

Ans. WSN is a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSNs measure environmental conditions like temperature, sound, pollution levels, humidity, wind, and so on.

Challenges in WSN

Energy efficiency

- Offering guarantees in terms of bandwidth, delay, jitter, packet loss probability.
- Limited bandwidth, unpredictable changes in RF channel characteristics.

Security

- Open medium.
- Nodes prone to malicious attacks, infiltration, eavesdropping, interference.

Scalability

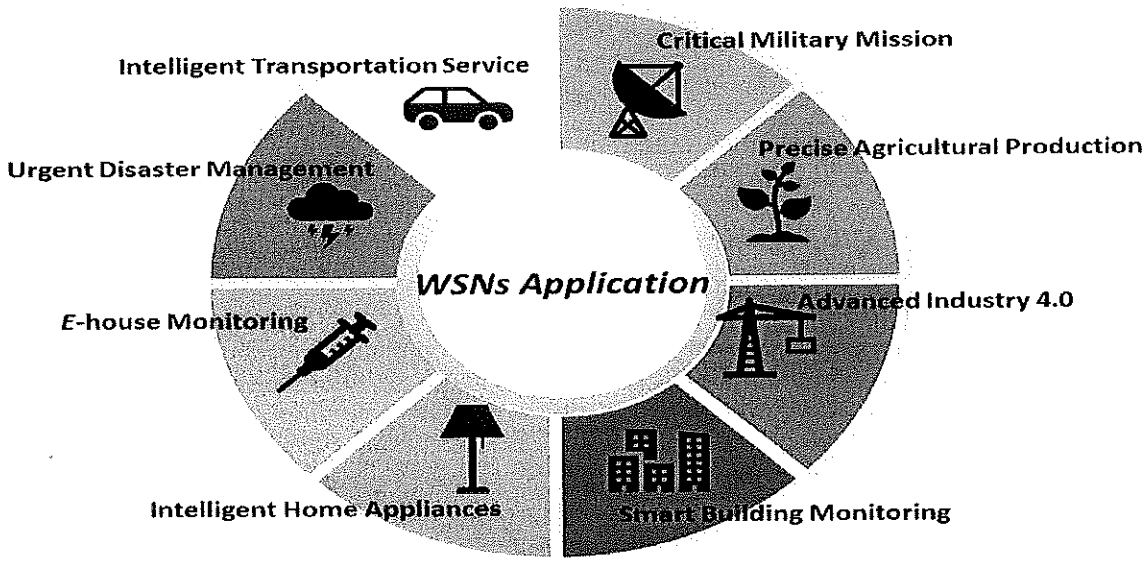
- Providing acceptable levels of services in the presence of large number of nodes.
- Typically, throughput decreases at a rate of $1/\sqrt{N}$, N=number of nodes.

Quality of services

- Offering guarantees in terms of bandwidth, delay, jitter, packet loss probability.
- Limited bandwidth, unpredictable changes in RF channel characteristics.

Limited bandwidth
Node cost
Deployment
Decision constraints

WSN Applications: there are so many applications of wireless sensor network.



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Course Code: ITN1504 **Time: 2 Hours**

Course Name: Internet of Things (IoT) **Max. Marks: 50**

Section – A

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1. _____ as a Service is a cloud computing infrastructure that creates a development environment upon which applications may be build.
   a) Infrastructure b) Platform
   c) Service d) All of the mentioned

2. Which of the following layer is called a port layer in OSI model?
   a) Application b) Session
   c) Presentation d) Transport

3. _____ is a cloud computing service model in which hardware is virtualized in the cloud.
   a) CaaS b) PaaS
   c) IaaS d) None of the mentioned

4. Which sensor is LM35?
   a) Pressure sensor b) Touch sensor
   c) Humidity sensor d) Temperature sensor

5. Gateway provides the connection between _____ and _____
   a) Network and Cloud b) Network and Controller
   c) Cloud and controller d) Controller and device

6. MQTT is _____ oriented.
   a) Data b) Network
   c) Message d) Device

7. In IoT, most common application for voice control application are _____
   a) Home security and health monitoring b) Home security
   c) Family health monitoring d) Business

8. What is the main responsibility of application layer?
   a) Web surfing b) Virtual terminal
   c) Error handling d) Network data sharing

9. PIR stands for ____
   a) Pulsating Infrared b) Pulsating ratio
   c) Passive Infrared d) Pulse is radiation

10. What is the main function of IoT gateway
   a) Performs application layer functions between IoT nodes and other entities
   b) Forwarding packets between LAN and WAN on the IP layer
   c) Enables local, short-range communication between IoT devices
   d) All of these

Section – B

04X04 = 16 Marks

04 short answer type questions, each question carries 04 marks.

1. What is actuator? Write down the difference between actuator and sensor.
2. What are the Machine to Machine (M2M) applications?
3. What is IoT middleware? Explain different types of IoT middleware.
4. Explain IoT cloud service model.

Section – C

04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

1. What are the different categories of IoT platforms across the IoT technology stack?
2. What is IoT analytics? Just brief types of IoT analytics.
3. Explain different IoT applications.
4. What important things need to keep in mind while designing an IoT app?

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Ans. b) Forwarding packets between LAN and WAN on the IP layer

Section – B

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1. What is actuator? Write down the difference between actuator and sensor.

Ans. Actuators convert an electrical signal into a corresponding physical quantity such as movement, force, sound etc. An actuator is also classified as a transducer because it changes one type of physical quantity into another and is usually activated or operated by a low voltage command signal.

Difference between actuator and sensor:

SENSOR	ACTUATOR
It converts physical characteristics into electrical signals.	It converts electrical signals into physical characteristics.
It takes input from environment.	It takes input from output conditioning unit of system.
It gives output to input conditioning unit of system.	It gives output to environment.
Sensor generated electrical signals.	Actuator generates heat or motion.
It is placed at input port of the system.	It is placed at output port of the system.
It is used to measure the physical quantity.	It is used to measure the continuous and discrete process parameters.
It gives information to the system about environment.	It accepts command to perform a function.
Example: Photo-voltaic cell which converts light energy into electrical energy.	Example: Stepper motor where electrical energy drives the motor.

2. What are the Machine to Machine (M2M) applications?

Ans. M2M Applications

The possibilities in the field of M2M can be seen in four major use cases, which we've detailed below:

Manufacturing

Every manufacturing environment—whether it's food processing or general product manufacturing—relies on technology to ensure costs are managed properly and processes are executed efficiently. Automating manufacturing processes within such a fast-paced environment is expected to improve processes even more.

Home appliances

IoT already affects home appliance connectivity through platforms like Nest. However, M2M is expected to take home-based IoT to the next level. An M2M-capable washing machine could send alerts to the owners' smart devices once it finishes washing or drying, and a smart refrigerator could automatically order groceries from Amazon once its inventory is depleted.

Healthcare device management

One of the biggest opportunities for M2M technology is in the field of health care. With M2M technology, hospitals can automate processes to ensure the highest levels of treatment.

Smart utility management

In the new age of energy efficiency, automation will quickly become the new normal. As energy companies look for new ways to automate the metering process, M2M comes to the rescue, helping energy companies automatically gather energy consumption data, so they can accurately bill customers.

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Ans. IoT middleware: Middleware is software that is used to bridge the gap between applications and other tools or databases. Middleware sits between an operating system and the applications that run on it. It is effectively software that provides a method of communication and data management between applications that would otherwise not have any way to exchange data such as with software tools and databases. Middleware appears in many locations; however, organizations and developers make specific use of middleware to more efficiently build applications.

Types of middleware:

There are many examples of middleware, each created to fulfill specific functions in connecting applications, web and cloud services. Here are some commonly used types of middleware:

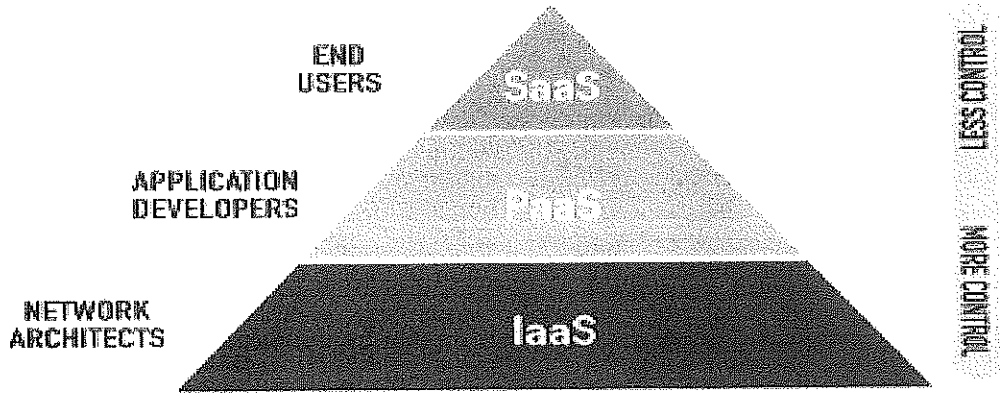
- **Messaging middleware** facilitates communications between distributed applications and services.
- **Object or ORB** (object request broker) **middleware** enables software components or objects to communicate and interact with a program -- such as containers -- across distributed systems.
- **Remote Procedure Call (RPC)** middleware provides a protocol that allows a program to request a service from another program located on another computer or network.
- **Data or database middleware** enables direct access to, and interaction with, databases; it typically includes SQL database software.
- **Transaction or transactional middleware** ensures transactions move from one phase to the next via transaction process monitoring.
- **Content-centric middleware** allows client-side requests for specific content and abstracts and delivers it; it's similar to publish/subscribe middleware like Apache Kafka.
- **Embedded middleware** facilitates communication and integration between embedded apps and real-time operating systems.

4. Explain IoT cloud service model.

Ans. The future of computing is in the cloud. What it implies is that you adapt your business to fit in the cloud model. Missing out on it can leave your business behind, especially in today's world, where technology is imperative and unavoidable. The cloud is a hot topic for small businesses all the way to global enterprises, but remains a broad concept that covers a lot of online territory.

Though as-a-service types are growing by the day, there are usually three models of cloud service to compare:

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)



Infrastructure as a service (IaaS)

- Infrastructure as a service (IaaS) is a cloud computing offering in which a vendor provides users access to computing resources such as servers, storage and networking. Organizations use their own platforms and applications within a service provider's infrastructure.
- IaaS delivers cloud computing infrastructure, including servers, network, operating systems, and storage, through virtualization technology. These cloud servers are typically provided to the organization through a dashboard or an API (Application Programming Interface), giving IaaS clients complete control over the entire infrastructure.

Platform as a service (PaaS)

- Platform as a service (PaaS) is a cloud computing offering that provides users with a cloud environment in which they can develop, manage and deliver applications.
- In addition to storage and other computing resources, users are able to use a suite of prebuilt tools to develop, customize and test their own applications.
- PaaS delivers a framework for developers that they can build upon and use to create customized applications.
- These applications, sometimes called middleware, are scalable and highly available as they take on certain cloud characteristics.

Software as a service (SaaS)

- A majority of SaaS applications run directly through your web browser, which means they do not require any downloads or installations on the client side.
- With SaaS, vendors manage all potential technical issues, such as data, middleware, servers, and storage, resulting in streamlined maintenance and support for the business.

Section – C

04X06 = 24 Marks

04 long type questions, each question carries 06 marks.

1. What are the different categories of IoT platforms across the IoT technology stack?
Ans. Categories of IoT Platforms

IoT products are very complex because they have to integrate multiple components across the five layers of the IoT technology stack as device hardware, device software, communications, cloud platform and cloud platform. Given this complexity, it is not likely that you'll find one single IoT platform that covers all areas of the IoT technology stack. Therefore, you will need a few different types of IoT platforms to cover the whole spectrum.

The most common categories of IoT platforms are:

- IoT Cloud platforms
- IoT connectivity platforms
- IoT device platforms

- IoT Analytics platforms

IoT Cloud Platforms

This category of IoT platforms provides the core building blocks for your product, including consuming, transporting, storing, analyzing, and displaying data. As the name implies, their aim is to enable the rapid development of your application by abstracting the complexities of building an IoT solution. Application enablement platforms come in all flavors, including: Industrial platforms, Consumer platforms, Platforms targeting developers, Platforms focusing on specific verticals etc.

Cloud platforms: Microsoft Azure IoT, AWS IoT, Google Cloud's IoT Platform etc.

IoT Connectivity Platforms

- Connectivity is an integral part of the IoT technology stack, linking on-the-ground IoT devices to the Cloud or any other big data repository.
- Many IoT products rely on Wi-Fi to connect to the Internet. For these products, connectivity management might be included in their application enablement platform. Therefore, spending the extra time and effort to guarantee connectivity may not be worth the investment.
- On the other hand, products that are part of what's called "critical IoT," such as manufacturing equipment, connected cars, or the smart grid require more robust communication technologies to reach the Internet. For example, many of these IoT devices rely on cellular technologies like 4G, 5G, or NB-IoT (Barrow Band IoT)

Connectivity platforms : SIGFOX, Hologram, Jasper by Cisco etc.

IoT Device Platforms

IoT device platforms provide hardware building blocks for developing IoT devices. And considering that hardware is usually the "long pole in the tent" for IoT product development, it is important to consider what already exists in the market to accelerate your efforts. Selecting the right IoT device platform depends on where you are in the IoT product adoption curve. Keep in mind that an IoT product should integrate seamlessly from the IoT device, all the way to the Cloud. To do so, you'll need to run specialized software on your IoT device.

IoT Analytics Platforms

- The goal of an IoT product is not to collect data. It is to provide actionable insights to your users. That's why analyzing the data is as important than collecting the data.
- Most of the Cloud platforms already include analysis tools, which may be enough for many applications.
- But if your application has additional requirements around visualization, data processing, digital twins, artificial intelligence (A.I), or machine learning (ML), an IoT analytics platform can accelerate your IoT development.
- Some of these platforms offer generic analytics capabilities that you can customize, while others offer specialized, vertical-specific capabilities such as logistics, asset tracking, or predictive maintenance.

Analytics platforms: Watson by IBM, C3 AI, SparkCognition etc.

2. What is IoT analytics? Just brief types of IoT analytics.

Ans. IoT Analytics

IoT analytics is the method to gain value from large volumes of data generated by devices connected via the Internet of Things (IoT). Organizations can derive a number of benefits from it: optimize operations, control processes automatically, engage more customers, and empower employees. Organizations use Industrial IoT to collect and analyze data from pipelines, weather stations, sensors on manufacturing equipment, smart meters, delivery trucks, and other machinery. IoT analytics is also used in retail, data center management, healthcare.

Types of IoT Analytics

Descriptive analytics on IoT data

Focuses on what's happening, by monitoring the status of IoT devices, machines, products and assets. Determines if things are going as planned, and notifies if anomalies occur. Descriptive analytics is generally implemented as dashboards that show current and historical sensor data, key performance indicators (KPIs), statistics and alerts.

Diagnostic analytics on IoT data

Analyzes IoT data to identify core problems and to fix or improve a service, product or process.

Diagnostic capabilities are typically extensions to dashboards that permit users to drill into data, compare it, and visualize correlations and trends in an ad-hoc manner. Many organizations employ domain experts knowledgeable about a specific process, machine, device or product, rather than data scientists, to perform diagnostics on data.

Predictive analytics on IoT data

Assesses the likelihood that something will happen within a specific timeframe, according to historical data. The aim is to proactively take corrective action before an undesired outcome occurs, to mitigate risk, or to isolate opportunities.

Prescriptive analytics on IoT data

Suggests actions based on the result of a prediction or diagnosis, or provides some visibility to the rationale behind a prediction or diagnostic. Recommendations tend to be about how to optimize or fix something.

3. Explain different IoT applications.

Ans. IoT has many applications

Smart Home: Whenever we think of IoT systems, the most important and efficient application that stands out is the smart home, ranking the highest IoT application on all channels. The interesting thing is that the database of smart homes for IoT analytics includes 256 companies and startups. More companies are now actively involved in smart homes, as well as similar applications in the field.

Wearables: Just like smart homes, wearables remain a hot topic among potential IoT. Every year, consumers all across the globe await the release of the latest Apple smartwatch. Apart from this, there are plenty of other wearable devices that make our life easy such as the Sony Smart B Trainer, Look see bracelet, fitness band.

Smart City: Smart cities, like its name suggests, is a big innovation and spans a wide variety of use cases, from water distribution and traffic management to waste management and environmental monitoring. The reason why it is so popular is that it tries to remove the discomfort and problems of people who live in cities. IoT solutions offered in the smart city sector solve various city-related problems, comprising of traffic, reducing air and noise pollution, and helping to make cities safer.

Smart Grids: Smart grids are another area of IoT technology that stands out. A smart grid basically promises to extract information on the behaviors of consumers and electricity suppliers in an automated fashion to improve the efficiency, economics, and reliability of electricity distribution.

Industrial Internet: One way to think of the Industrial Internet is by looking at connected machines and devices in industries such as power generation, oil, gas, and healthcare. It also makes use of situations where unplanned downtime and system failures can result in life-threatening situations. A system embedded with the IoT tends to include devices such as fitness bands for heart monitoring or smart home appliances. These systems are functional and can provide ease of use but are not reliable because they do not typically create emergency situations if a downtime was to occur.

Connected Car: Connected car technology is a vast and an extensive network of multiple sensors, antennas, embedded software, and technologies that assist in communication to navigate in our complex world. It has the responsibility of making decisions with consistency, accuracy, and speed. It also has to be reliable. These requirements will become even more critical when humans give up control of the steering wheel and brakes to the autonomous vehicles that are being tested on our highways right now.

Connected Health (Digital Health/Telehealth/Telemedicine): IoT has various applications in healthcare, which are from remote monitoring equipment to advance and smart sensors to equipment integration. It has the potential to improve how physicians deliver care and also keep patients safe and healthy. Healthcare IoT can allow patients to spend more time interacting with their doctors, which can boost patient engagement and satisfaction. From personal fitness sensors to surgical robots, IoT in healthcare brings new tools updated with the latest technology in the ecosystem that helps in developing better healthcare. IoT helps to revolutionize healthcare and provide pocket-friendly solutions for both the patient and healthcare professional.

Smart Retail: Retailers have started adopting IoT solutions and using IoT embedded systems across a number of applications that improve store operations, increasing purchases, reducing theft, enabling inventory management, and enhancing the consumer's shopping experience.

Through IoT physical retailers can compete against online challengers more strongly. They can regain their lost market share and attract consumers into the store, thus making it easier for them to buy more while saving money.

Smart Supply Chain: Supply chains have already been getting smarter for a couple of years. Offering solutions to problems like tracking of goods while they are on the road or in transit or helping suppliers exchange inventory information are some of the popular offerings. With an IoT enabled system, factory equipment that contains embedded sensors communicate data about different parameters, such as pressure, temperature, and utilization of the machine. The IoT system can also process workflow and change equipment settings to optimize performance.

Smart Farming: Smart farming is an often overlooked in IoT applications. However, because the number of farming operations is usually remote and the large number of livestock that farmers work on, all of this can be monitored by the Internet of Things and can revolutionize the way farmers operate day to day. But, this idea is yet to reach a large-scale attention. Nevertheless, it still remains one of the IoT applications that should not be underestimated. Smart farming has the potential to become an important application field, specifically in the agricultural-product exporting countries. The smart greenhouse is a revolution in agriculture, creating a self-regulating, microclimate suitable for plant growth through the use of sensors, actuators, and monitoring and control systems that optimize growth conditions and automate the growing process.

4. What important things need to keep in mind while designing an IoT app?

Ans. Things to keep in mind while designing an IoT app

In order to design a perfect structure of IoT apps, there are certain guideline and tips that IoT designers and business innovators should ponder sincerely to get the best out of this resurgent technology.

Research and explore before developing IoT apps

- Before you draw towards the action of development, it's important to first think over the requirements and suitability of the IoT apps and future challenges it is going to bring.
- The best way to gain the insight is to research in deep and explore the IoT market and understand how inter-connected things should really work.

Think about data management and analytics

- In this subsequent layer, you can think of all the ways to organize and receive the data coming from devices and sensors. Following this is Analytics tier which entails the process of processing the data organized in the previously.
- Then comes the app used by end-users. For designing purpose, IoT app developer needs to focus on more on understanding the end-user experience and data analytics part.

Hardware compatibility of mobile devices

- Building an IoT app should also involve checking the suitability and compatibility of mobile devices with IoT app. Be it IoT iOS app or android apps, the app's overall performance depends on the type of hardware OS environment you have chosen.
- A lot of precaution and considerations go into IoT development strategy when it comes to making it compatible for device hardware platform since the design rework may get expensive and tiring if the app does not function harmoniously as an IoT android app or iOS app.

Determine the scalability of apps

- Over time, as businesses flourish in the market and technology evolves, a business would have to collaborate with an IoT designer or a suitable IoT app development company to figure out scalability options for apps.
- This is one of most crucial factors while designing an IoT app especially when project is aimed at putting bigger impact on wide consumer base.

Ensure the better security of IoT devices

As it has always been, the aspect of IoT system security is still questioned by world-spread businesses that expect zero tolerance to data loss and vulnerability. If adopted on a prodigious scale, IoT security becomes an essential factor freshly built IoT apps need to address. Some of the strategic implementations to be taken to fight system vulnerability generically include:

- Sturdy encryption methods

- Robust yet user-friendly authentication features
- Knowledge of underlying ecosystem of each device in use
- Easy-to-use and clear security features
- Understanding and protection of digital touch points of end users
- Multilayered approach of building firmware protection
- Security of each hardware component in place

IoT applications, as opposed to regular applications, conduct interactions with hardware and not humans, which mean the firmware used by IoT mobile application development experts should ensure proper security with frequent updates.

Recognize the difference between usual mobile apps and IoT apps

- Mobile app we use today are focused on end users unlike IoT apps. Usually mobile app development revolves around a niche market and reaps responses based on a specific function.
- But IoT technology bases its functioning on objects and processes the communication across industries and systems.
- It is therefore important to consider the future IoT-powered vision of fully automated smart home or the rise of smart city and other similar disruptions.
- IoT app developer should recognize the fact that IoT system straddles beyond mobile app technology and enables controlled communications with security and utility industries to facilitate larger operations such as efficiency measurement, energy consumption optimization, peak load management, etc.

Conjure the future picture over instant profits

- If you have already set eyes on IoT mobile application development, conjure a big future picture of how IoT is going to be beneficial in long term.
- While the job of building IoT applications is quite onerous, the results you get will be impactful and help your business thrive down the future road. Think of a smart automated home blended technologically with an evolved version of smart city.
- In a way, the technology is still in into embryonic mode and growing. We are likely to see more of IoT apps in terms of growth, performance and innovations in the coming years.
- Hence, keep the product open for future scalability to secure more benefits and stability in the market. Keep your vision about IoT app development futuristic and supple.

Choose the right developers for an IoT development team

- Though listed at the last, this comes down as the primary job: collaborating with the right developers and making a stalwart IoT development team. Make sure the IoT app developer you choose has project-specific resources and hands-on knowledge to identify potential security risks and is versed in profound aspects and challenges of IoT development.
- Take a logical decision while emphasizing on quality and relevance and not price as you look for the competent leaders in the IoT market.