

Addis Ababa Science and
Technology University

College of Mechanical and
Electrical Engineering

Introduction to Emerging
Technologies

Internet of Things

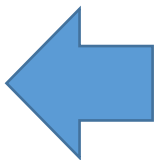
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Learning Outcomes

After successful completion of this chapter, the students be able to:

- Explain IoT
- Elaborate the advantages and disadvantages of IoT
- Explain how IoT works?
- Explain the architecture of IoT
- Describe IoT tools and platforms
- Describe IoT application in different sector



Brainstorming

What do you think about IoT?
Can you give an example?

What is IoT?

Several definitions used by different groups:

- **Internet Architecture Board's (IAB):** IoT is the networking of smart objects, meaning a huge number of devices intelligently communicating in the presence of internet protocol that cannot be directly operated by human beings but exist as components in buildings, vehicles or the environment.
- **Internet Engineering Task Force (IETF) organization's:** IoT is the networking of smart objects in which smart objects have some constraints such as limited bandwidth, power, and processing accessibility for achieving interoperability among smart objects.

...What is IoT?

Several definitions used by different groups:

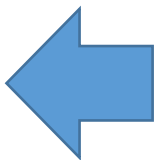
- **Oxford dictionary's:** IoT is the interaction of everyday object's computing devices through the Internet that enables the sending and receiving of useful data.
- **IEEE Communications category magazine:** IoT is a framework of all things that have a representation in the presence of the internet in such a way that new applications and services enable the interaction in the physical and virtual world in the form of Machine-to Machine (M2M) communication in the cloud.

...What is IoT?

- IoT according to 2020 conceptual framework is expressed through a simple formula such as:

$$\text{IoT} = \text{Services} + \text{Data} + \text{Networks} + \text{Sensors}$$

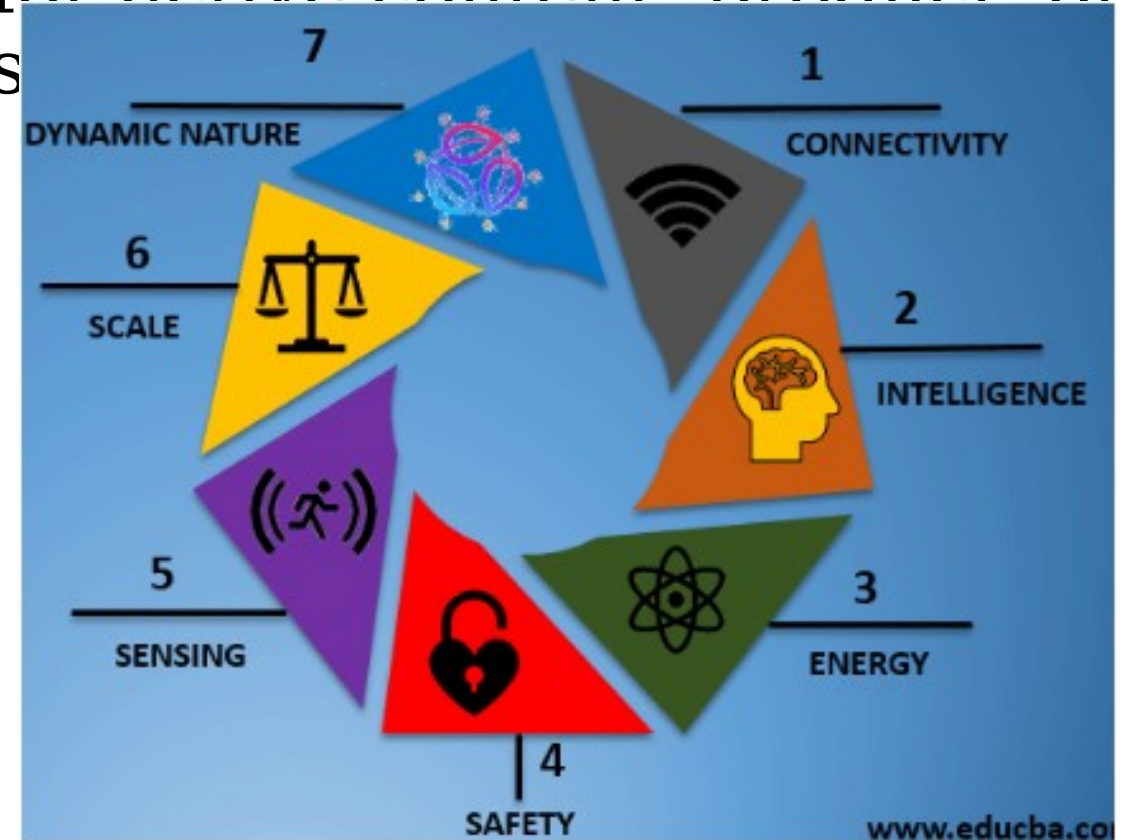
- Generally, The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.



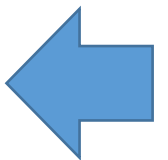
Most important features of IoT

- AI makes virtually anything “smart”,
- Connectivity creates these small networks between its system devices.
- Sensors transform IoT from a standard passive network of devices into an active system capable of real-world integration.
- Active engagement introduces a new paradigm

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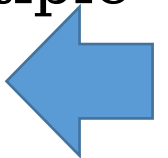


Source: internet



History of IoT?

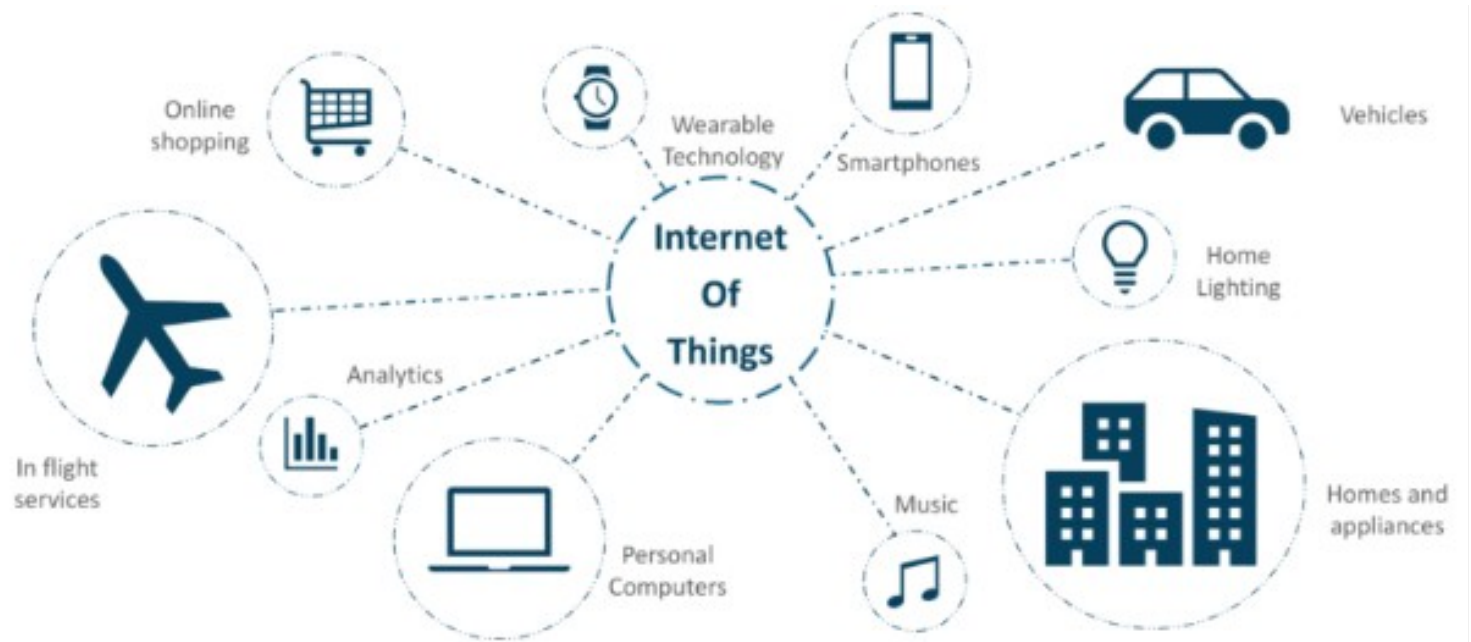
- Telegraph (the first landline) - 1830s
- “wireless telegraphy,” the first radio voice transmission - June 3, 1900
- Computers development - 1950s.
- The Internet, by DARPA (Defense Advanced Research Projects Agency) in 1962 and evolved into ARPANET in 1969 – commercialized in 1980s.
- Global Positioning Satellites (GPS) - 1993, by the Department of Defense
- The first examples of an Internet of Things is in the early 1980s and was a Coca Cola machine, located at the Carnegie Mellon University .
- Kevin Ashton, the Executive Director of Auto-ID Labs at MIT, was the first to describe the Internet of Things, during his 1999 speech.
- 2013, the Internet of Things had evolved into a system using multiple technologies



Advantages and disadvantages of IoT

Advantages:

- Improved Customer Engagement
- Technology Optimization
- Reduced Waste
- Enhanced Data Collection



Source: internet

Advantages and disadvantages of IoT

Disadvantages

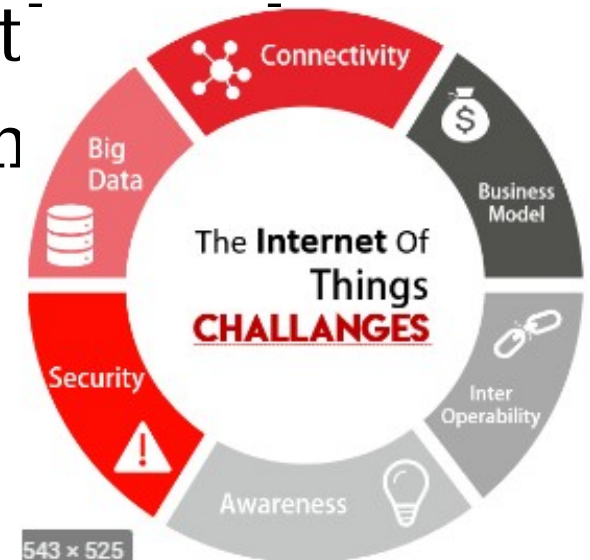
- Potential that a hacker could steal confidential information
- A bug in the system, potentially corrupt every connected device
- Difficulty for devices from different manufacturers to communicate with each other



Source: internet

Challenges of IoT?

- Security □ users can be exposed to various attackers or hackers
- Privacy □ make substantial personal data in extreme detail without the user's active participation
- Complexity □ complication in terms of design, deployment, and maintenance given their use of multiple technologies
- Flexibility □ difficulty to integrate easily with existing systems.
- Compliance □ challenging issue of compliance

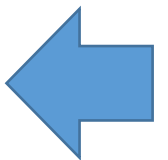


How does IoT works?

An IoT ecosystem consist:

- A. Web-enabled smart devices that use embedded processors and connected to sensors, actuators and internet,
- B. Sensors to collect data from the environment and send it back to the end smart deice for analyzation
- C. Communication protocols used by the smart device to send data to the cloud to be analyze and provide remote access

The devices do most of the work without human intervention, although people can interact with the devices.



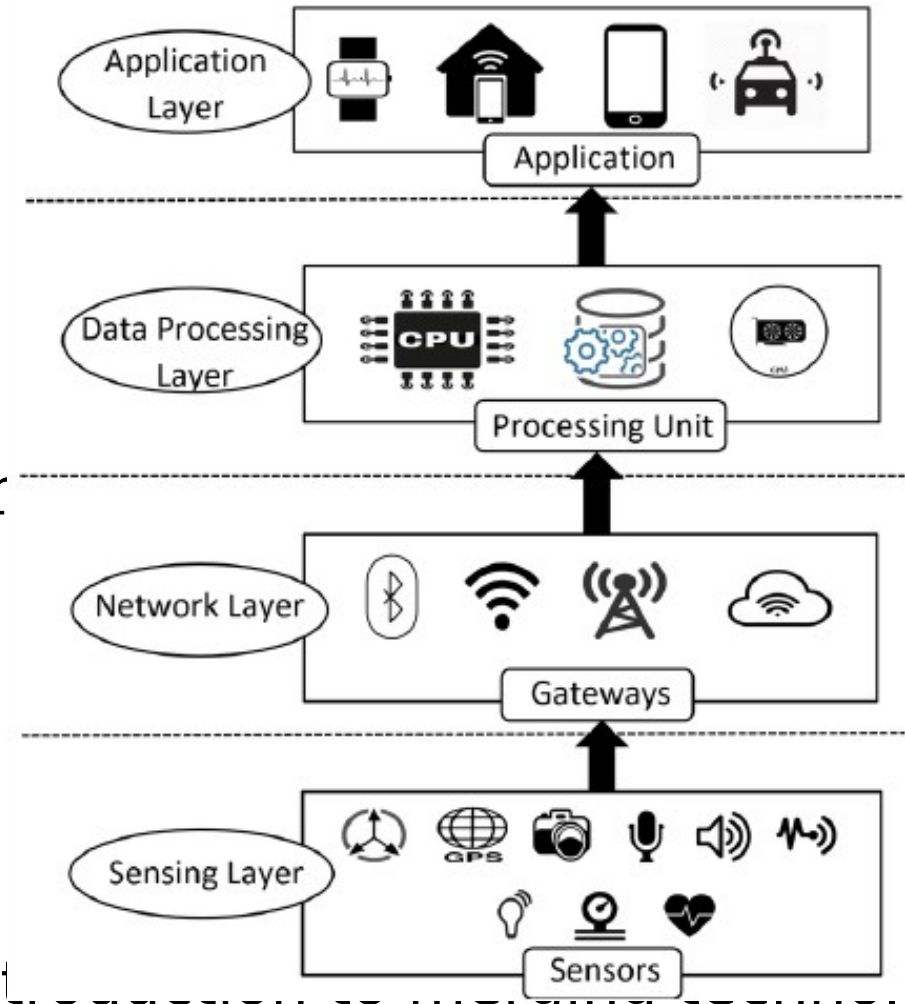
Architecture of IoT

An IoT device consists:

- Hardware,
- Software,
- Network connectivity, and
- Sensors.

Hence, the architecture of IoT comprises

- Sensing layer,
- Network layer,
- Data processing layer, and
- Application layers



Source: Introduction to IoT Technologies



Devices and Networks

IoT devices can be categorized into three main groups: consumer, enterprise and industrial.

- Consumer connected devices include smart TVs, smart speakers, toys, wearables, and smart appliances, smart meters, commercial security systems...
- Enterprise and Industrial devices include smart city technologies such as those used to monitor traffic and weather conditions, smart sensors in conference room, smart air conditioning, smart thermostats, smart lighting, smart security...

...Devices and Networks

IoT network devices are massively deployed over range of areas like smart cities, industries.. And in hard-to-reach areas like hazardous zones;

IoT network challenges

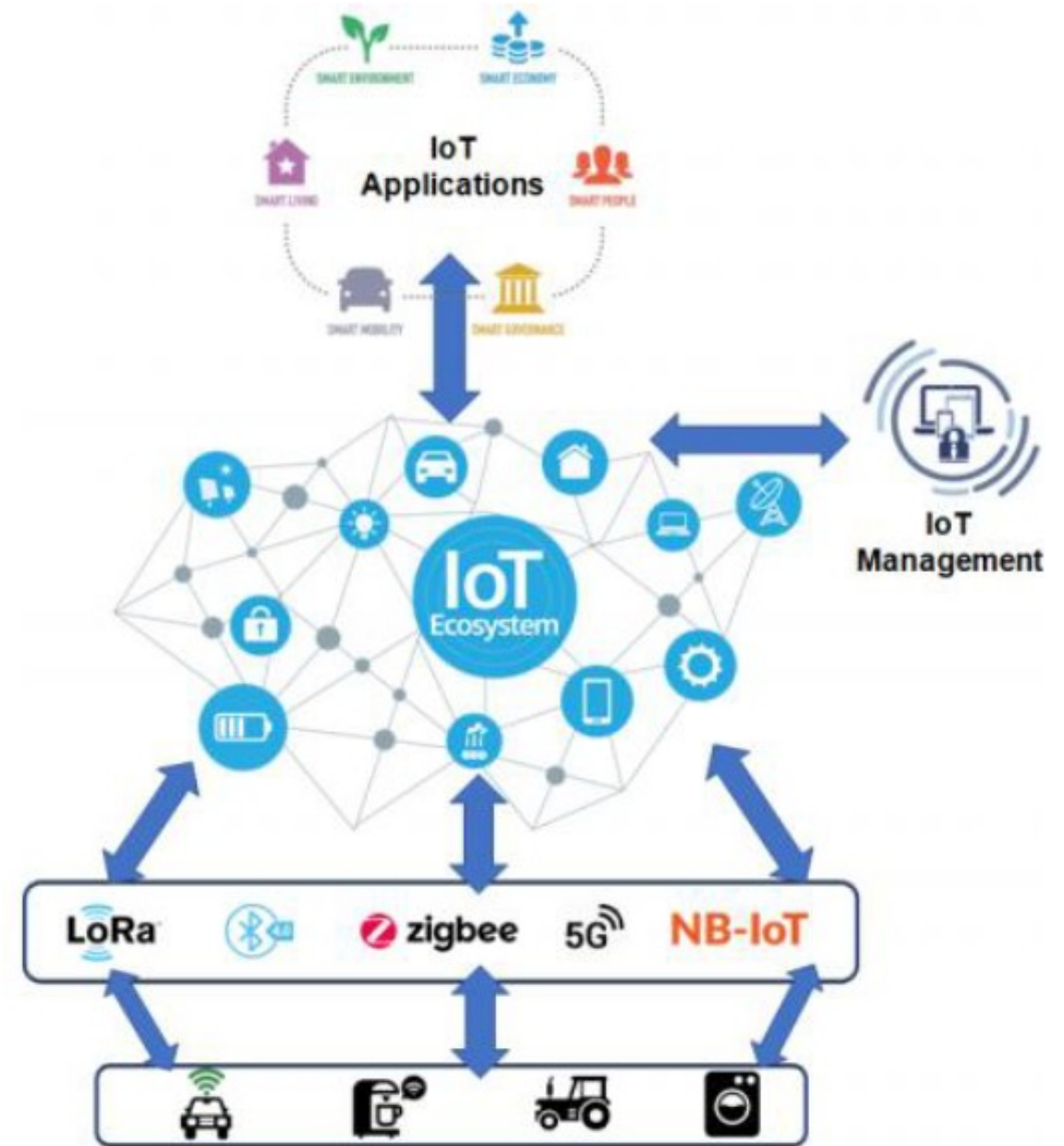
- scalability,
- interoperability,
- energy efficiency,
- topology control,
- Quality of Service (QoS),
- fault tolerance, and
- security.

Therefore, efficient and autonomic management of IoT networks is needed.

...Devices and Networks ...

- Management for Device and Network in the Internet of Things (M4DNIoT):integrates and controls the individual functionalities of the devices in an IoT network as well as the status and characteristics of this network.
- IoT network management structure scopes:
 - local management, where the platform runs in the same environment as the devices,
 - remote management, where the platform controls the devices in different networks.
- IoT minimum network requirements
 - Expandable
 - Provide standard web service (device discovery, data storage, and user authorities)

Examples of IoT Device and networks



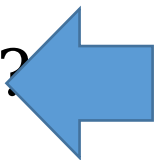
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IoT tools and platforms

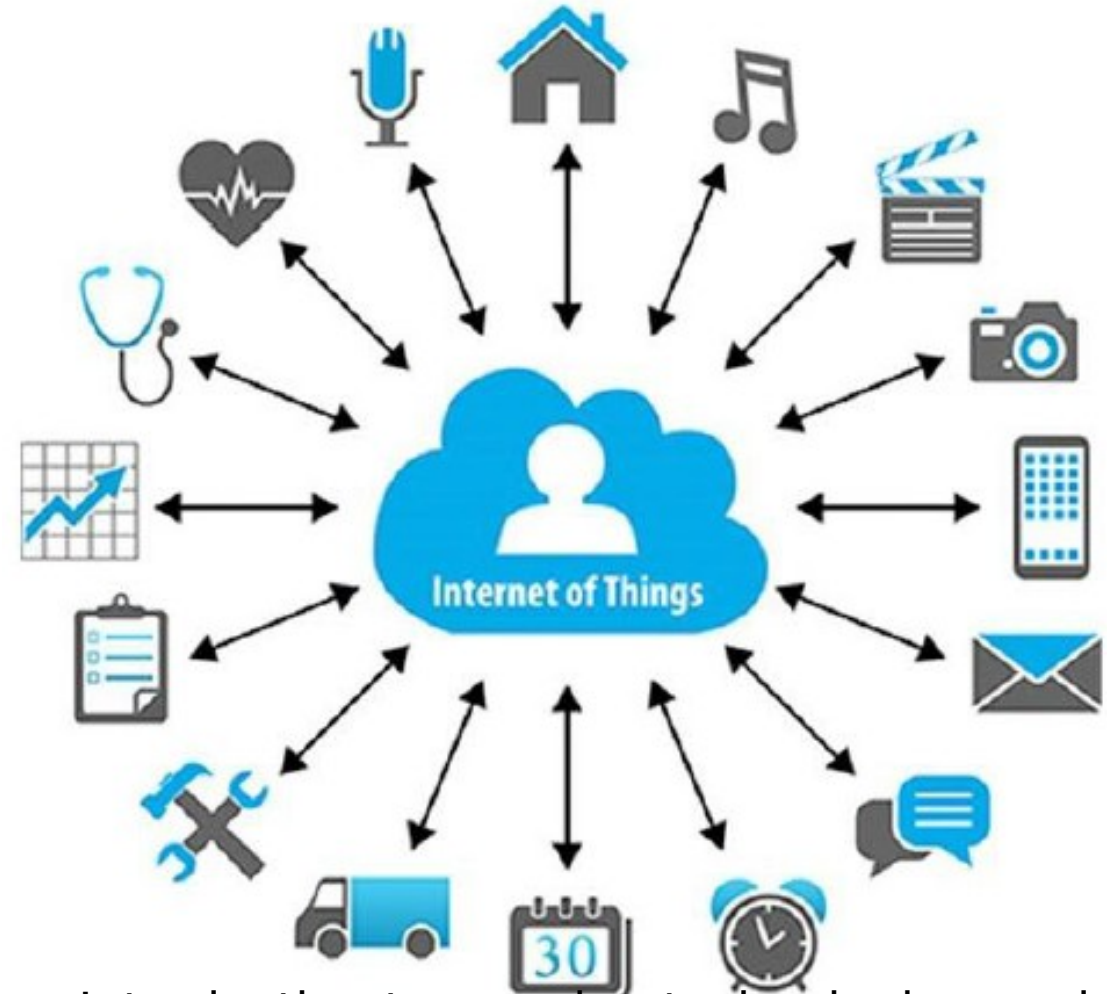
- IoT Platform are based on the Internet of Things and cloud technology.
- The following are some IoT platform vendors
 - KAA
 - SiteWhere
 - ThingSpeak
 - DeviceHive
 - Zetta

Discuss some of the key features provided by the above vendors?



Applications of IoT

- Agriculture
- Consumer Use
- Healthcare
- Insurance
- Manufacturing
- Retail
- Transportation
- Utilities

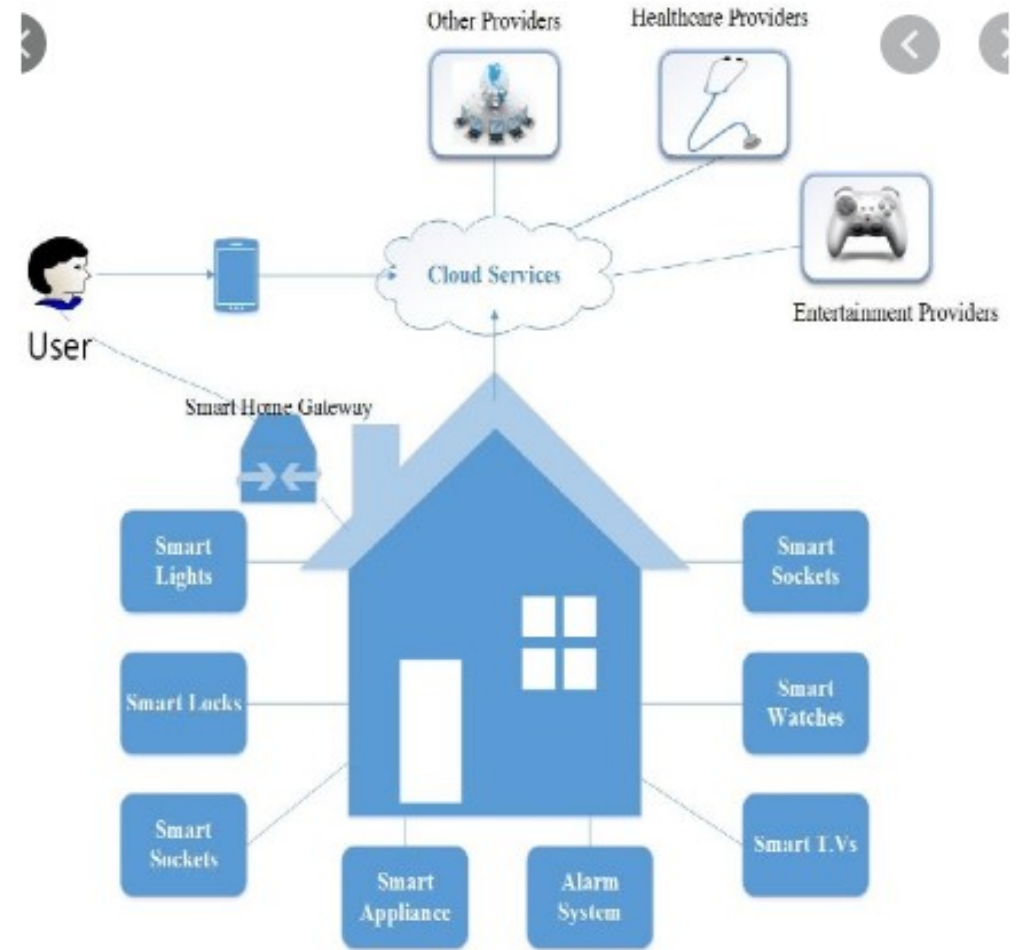


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IoT Based Smart Home

It includes:

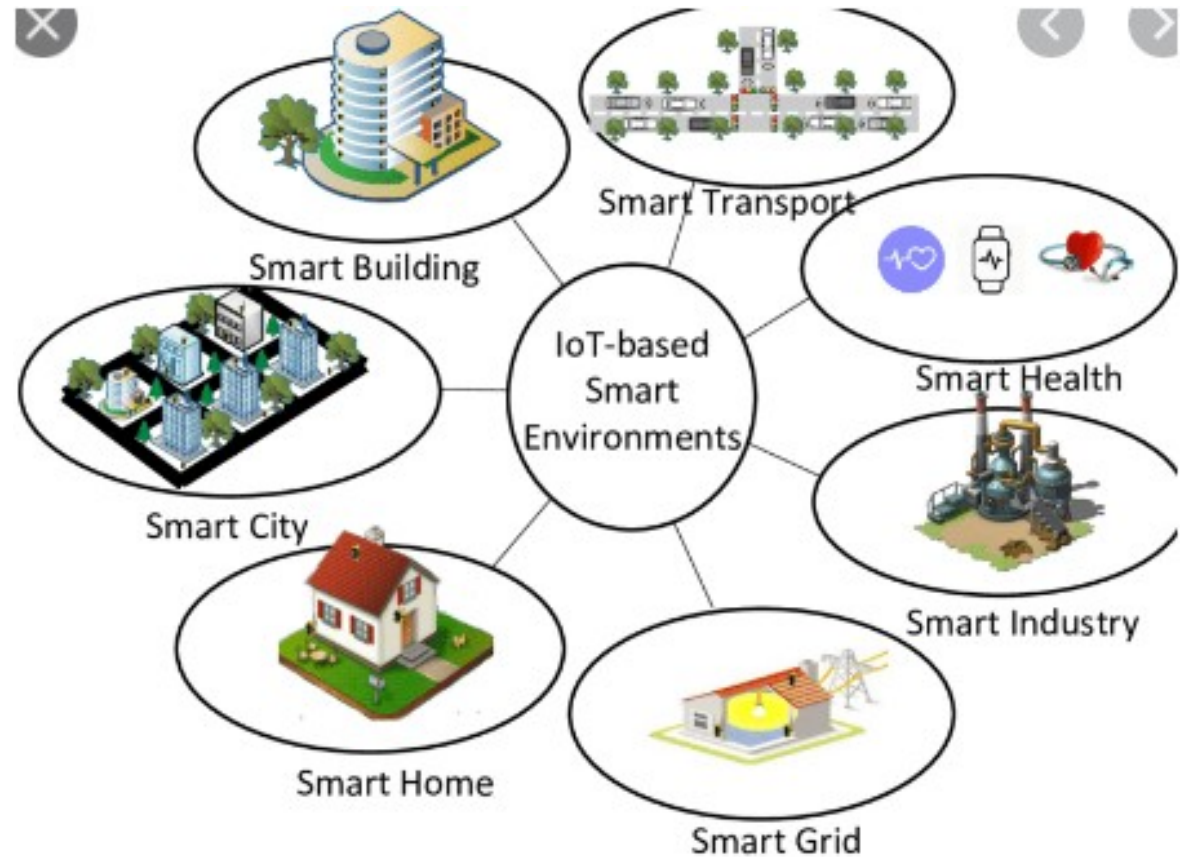
- Remote Control Appliances
- Weather
- Smart Home Appliances
- Safety Monitoring
- Intrusion Detection Systems
- Energy and Water Use



IoT Based Smart City

It includes:

- Structural Health
- Lightning
- Safety
- Transportation
- Smart Parking
- Waste Management



IoT Based Smart Farming

It includes:

- Green Houses
- Compost
- Animal Farming/Tracking
- Offspring Care
- Field Monitoring



Review Questions

- Briefly explain IoT
- Briefly explain the architecture of IoT and how IoT works?
- Write down application of IoT in smart city, home and farming?
- Write down some IoT devices?
- What are the challenges of IoT?
- List down some IoT tools and platforms?

END!!