# EMERGING TECHNOLOGIES

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# OBJECTIVES

1. Understand the impact that emerging technologies will have in the future.
2. Define the use of emerging technologies –
   a) Cloud Computing,
   b) Big data concept and analytics,
   c) Data Centre and virtualization,
   d) internet of things,
   e) 4G/5g Mobile technologies,
   f) optical computing,
   g) quantum computing and quantum cryptography,
   h) virtual reality and wearable computing.
4. Define the ways in which certain technologies will impact homes of the future.
5. Describe some emerging technologies and their uses that are extreme.

# INTERNET OF THINGS (IoT)

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# INTERNET OF THINGS (IoT)

## What is the Internet of Things?

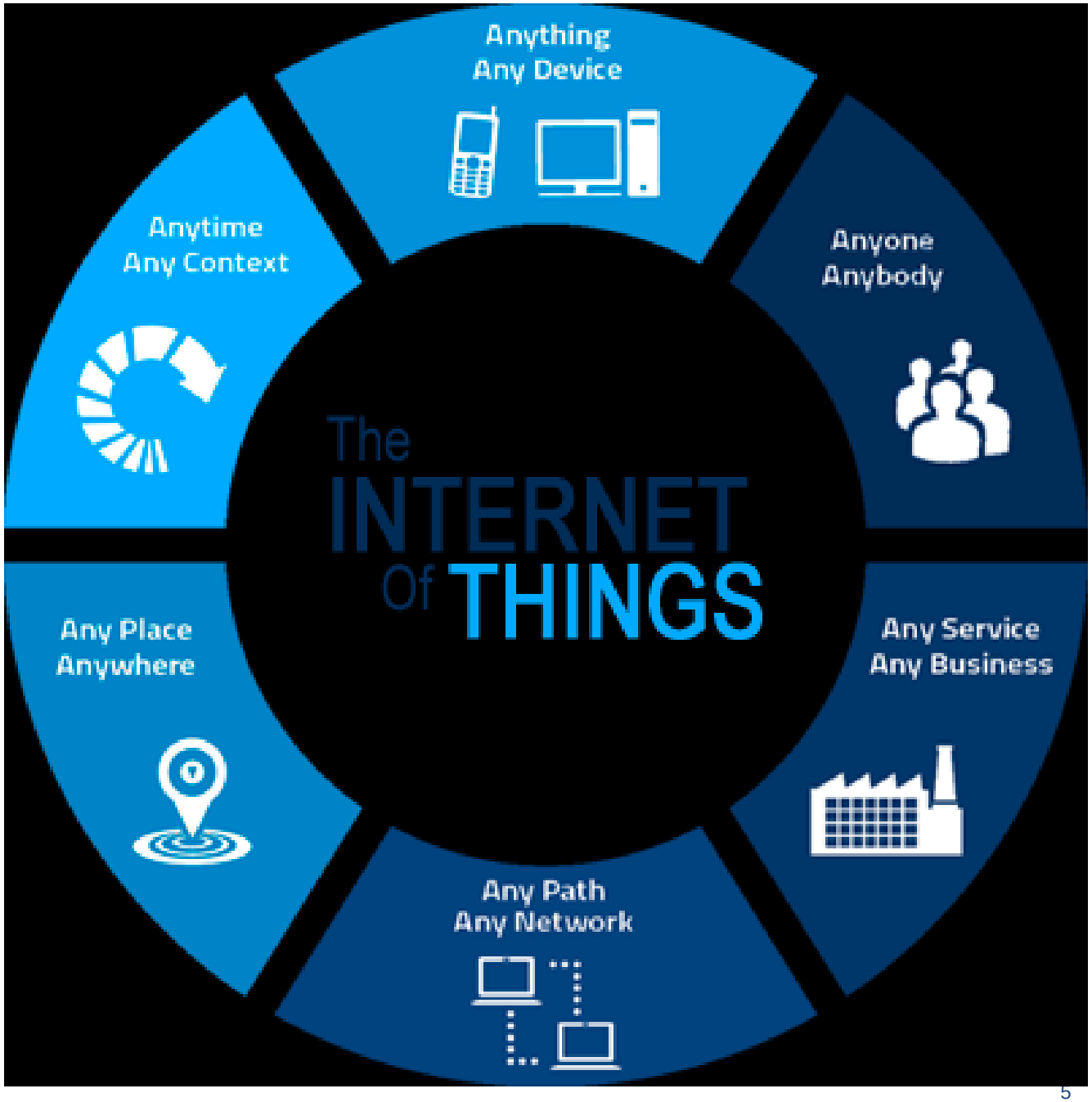
- Internet connects all people → “Internet of People”
- Internet connect all things → “Internet of Things”

Interconnection of Things or Object or Machines

*E.g. sensors, mobile phones, electronic devices, home appliances, any existing items*

*and interact with each other via the Internet.*

- IoT (Internet of Things) is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service.
- These systems allow greater transparency, control, and performance when applied to any industry or system.


Anything
Any Device
Anyone
Anybody
Any Service
Any Business
Any Path
Any Network
Any Place
Anywhere
Anytime
Any Context
The
INTERNET
Of THINGS

# What is the Internet of Things?

- The Internet of Things (IoT) is the network of physical objects or “things” embedded with electronics, software, sensors, and network connectivity, which enables these object to collect and exchange data.
- A “**Thing**” in the context of the Internet of things (IoT), is an entity or physical object that has a Unique identifier, an embedded system and the ability to transfer data over a network.
  - *Heart monitoring implants*
  - *Biochip transponders on farm animals*
  - *Automobiles with built-in sensors*
  - *DNA analysis devices & Other Wearables etc.*
- These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices.


- IoT exploits recent advances in software, falling hardware prices, and modern attitudes towards technology.
- Its new and advanced elements bring major changes in the delivery of products, goods, and services; and the social, economic, and political impact of those changes.

# IoT – Key Features

- **AI** – IoT essentially makes virtually anything “smart”, meaning it enhances every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can mean something as simple as enhancing your refrigerator and cabinets to detect when milk and your favorite cereal run low, and then place an order with your preferred product.

- **Connectivity** – New enabling technologies for networking, and specifically IoT networking, mean networks are no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its system devices.

# IoT – Key Features

- **Sensors** − IoT loses its distinction without sensors. They act as defining instruments which transform IoT from a standard passive network of devices into an active system capable of real-world integration.

- **Active Engagement –** Much of today's interaction with connected technology happens through passive engagement. IoT introduces a new paradigm for active content, product, or service engagement.

- **Small Devices –** Devices, as predicted, have become smaller, cheaper, and more powerful over time. IoT exploits purpose-built small devices to deliver its precision, scalability, and versatility.

# IoT – Hardware

The hardware utilized in IoT systems includes devices for a

- **remote dashboard**
- **devices for control**
- **servers**
- **a routing or bridge device**
- **and sensors.**

These devices manage key tasks and functions such as

- **system activation,**
- **action specifications,**
- **security,**
- **communication, and**
- **detection to support-specific goals and actions.**

# IoT – Hardware

**Sensors** – might be the most important hardware

- These devices consist of energy modules, power management modules, RF modules, and sensing modules. RF modules manage communications through their signal processing, WiFi, Bluetooth, radio transceiver, etc.

The sensing module manages sensing through assorted active and passive measurement devices. Here is a list of some of the measurement devices used in IoT –

# IoT – Hardware

- **Wearable Electronics -** devices are small devices worn on the head, neck, arms, torso, and feet.
- *Smartwatches not only help us stay connected, but as a part of an IoT system, they allow access needed for improved productivity.*
- *Smart glasses help us enjoy more of the media and services we value, and when part of an IoT system, they allow a new approach to productivity.*


# IoT – Hardware

- **Standard Devices -**

The desktop, tablet, and cellphone remain integral parts of IoT as the command center and remotes.

- *The desktop provides the user with the highest level of control over the system and its settings.*
- *The tablet provides access to the key features of the system in a way resembling the desktop, and also acts as a remote.*
- *The cellphone allows some essential settings modification and also provides remote functionality.*
- *Other key connected devices include standard network devices like routers and switches.*

# IoT – Software

IoT software addresses its key areas of networking and action through platforms, embedded systems, partner systems, and middleware.

- ***Data Collection***
- This software manages sensing, measurements, light data filtering, light data security, and aggregation of data. It uses certain protocols to aid sensors in connecting with real-time, machine-to-machine networks. Then it collects data from multiple devices and distributes it in accordance with settings. It also works in reverse by distributing data over devices. The system eventually transmits all collected data to a central server.
- ***Device Integration***
- Software supporting integration binds (dependent relationships) all system devices to create the body of the IoT system. It ensures the necessary cooperation and stable networking between devices. These applications are the defining software technology of the IoT network because without them, it is not an IoT system. They

# IoT – Software

***Real-Time Analytics***

- These applications take data or input from various devices and convert it into viable actions or clear patterns for human analysis. They analyze information based on various settings and designs in order to perform automation-related tasks or provide the data required by industry.

***Application and Process Extension***

- These applications extend the reach of existing systems and software to allow a wider, more effective system. They integrate predefined devices for specific purposes such as allowing certain mobile devices or engineering instruments access. It supports improved productivity and more accurate data collection.

# IoT – Advantages

- **Improved Customer Engagement** − Current analytics suffer from blind-spots and significant flaws in accuracy; and as noted, engagement remains passive. IoT completely transforms this to achieve richer and more effective engagement with audiences.
- **Technology Optimization** − The same technologies and data which improve the customer experience also improve device use, and aid in more potent improvements to technology. IoT unlocks a world of critical functional and field data.
- **Reduced Waste** − IoT makes areas of improvement clear. Current analytics give us superficial insight, but IoT provides real-world information leading to more effective management of resources.
- **Enhanced Data Collection** − Modern data collection suffers from its limitations and its design for passive use. IoT breaks it out of those spaces, and places it exactly where humans really want to go to analyze our world. It allows an accurate picture of everything.

# IoT – Disadvantages

- **Security** − IoT creates an ecosystem of constantly connected devices communicating over networks. The system offers little control despite any security measures. This leaves users exposed to various kinds of attackers.
- **Privacy** − The sophistication of IoT provides substantial personal data in extreme detail without the user's active participation.
- **Complexity** − Some find IoT systems complicated in terms of design, deployment, and maintenance given their use of multiple technologies and a large set of new enabling technologies.
- **Flexibility** − Many are concerned about the flexibility of an IoT system to integrate easily with another. They worry about finding themselves with several conflicting or locked systems.
- **Compliance** − IoT, like any other technology in the realm of business, must comply with regulations. Its complexity makes the issue of compliance seem incredibly challenging when many consider standard software compliance a battle.

# THE INTERNET OF THINGS LIFECYCLE

# COLLECTION

- **Devices** and **Sensors** are collecting data everywhere.
  - *At your home*
  - *In your car*
  - *At the office*
  - *In the manufacturing plant*

# COMMUNICATION

- Sending **data** and events through **networks** to some destination
  - *A cloud platform*
  - *Private data center*
  - *Home network*

# ANALYSIS

- Creating **information** from the data
  - *Visualizing reports*
  - *Building reports*
  - *Filtering data (paring it down)*

# ACTION

- Taking action based on the information and data
  - *Communicate with another machine (m2m)*
  - *Send a notification (sms, email, text)*
  - *Talk to another system*

# HOW IOT WORKS?

- The Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the **web-enabled devices** that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called "connected" or "smart" devices, can sometimes talk to other related devices, a process called **machine-to-machine** (M2M) communication, and act on the information they get from one another.
- Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always online nature of our home and business networks.

# HOW IOT WORKS?

| RFID | Sensor | Smart Tech | Nano Tech |
| --- | --- | --- | --- |
| To identify and track the data of things | To collect and process the data to detect the changes in the physical status of things | To enhance the power of the network by developing processing capabilities to different part of the network. | To make the smaller and smaller things have the ability to connect and interact. |

# THE STRUCTURE OF IoT

- The IoT can be viewed as a gigantic network consisting of networks of devices and computers connected through a series of intermediate technologies where numerous technologies like RFIDs, wireless connections may act as enablers of this connectivity.
- ***Tagging Things :*** Real-time item traceability and addressability by ***RFID***s.
- ***Feeling Things : Sensors*** act as primary devices to collect data from the environment.
- ***Shrinking Things :*** *M*iniaturization and ***Nanotechnology*** has provoked the ability of smaller things to interact and connect within the “things” or “smart devices.”
- ***Thinking Things : Embedded intelligence*** in devices through sensors has formed the network connection to the Internet. It can make the “things” realizing the intelligent control

# SOME APPLICATIONS OF IoT

- Building and Home automation
- Manufacturing
- Medical and Healthcare systems
- Media
- Environmental monitoring
- Infrastructure management
- Energy management
- Transportation
- Better quality of life for elderly

# TECHNOLOGICAL CHALLENGES OF IoT

**At present IoT is faced with many challenges, such as**

- Scalability
- Technological Standardization
- Inter operability
- Discovery
- Software complexity
- Data volumes and interpretation
- Power Supply
- Interaction and short-range communication
- Wireless communication
- Fault tolerance

# CONTROVERSIES OF IOT

**Scholars and social observers and pessimists have doubts about the promises of the ubiquitous computing revolution, in the areas as:**

- Privacy
- Security
- Autonomy and Control
- Social control
- Political manipulation
- Design
- Environmental impact
- Influences human moral decision making

# Some examples in the industries using IoT

- Joan is a nurse in an emergency room. A call has come in for a man wounded in an altercation. The system recognized the patient and pulls his records. On the scene, paramedic equipment captures critical information automatically sent to the receiving parties at the hospital. The system analyzes the new data and current records to deliver a guiding solution. The status of the patient is updated every second in the system during his transport. The system prompts Joan to approve system actions for medicine distribution and medical equipment preparation.
- Joan works in advertising. She enters her office, and it recognizes her face. It adjusts the lighting and temperature to her preference. It turns on her devices and opens applications to her last working points.
- Her office door detected and recognized a colleague visiting her office multiple times before she arrived. Joan's system opens this visitor's messages automatically.
- Joan lives in a small city. She's heard about a recent spike in crime in her area, and worries about coming home late at night.
- Local law enforcement has been alerted about the new "hot" zone through system flags, and they've increases their presence. Area monitoring devices have detected suspicious behavior, and law enforcement has investigated these leads to prevent crimes
- Joan runs a manufacturing facility that makes shields for manufacturing equipment. When regulations change for the composition and function of the shields, the new appropriate requirements are automatically programmed in production robotics, and engineers are alerted about their approval of the changes.

# Assignment – Not to be submitted but try it

State the common uses of IoT in the following below

1. Engineering, Industry, and Infrastructure
2. Government and Safety
3. Home and Office
4. Health and Medicine
5. School and Students