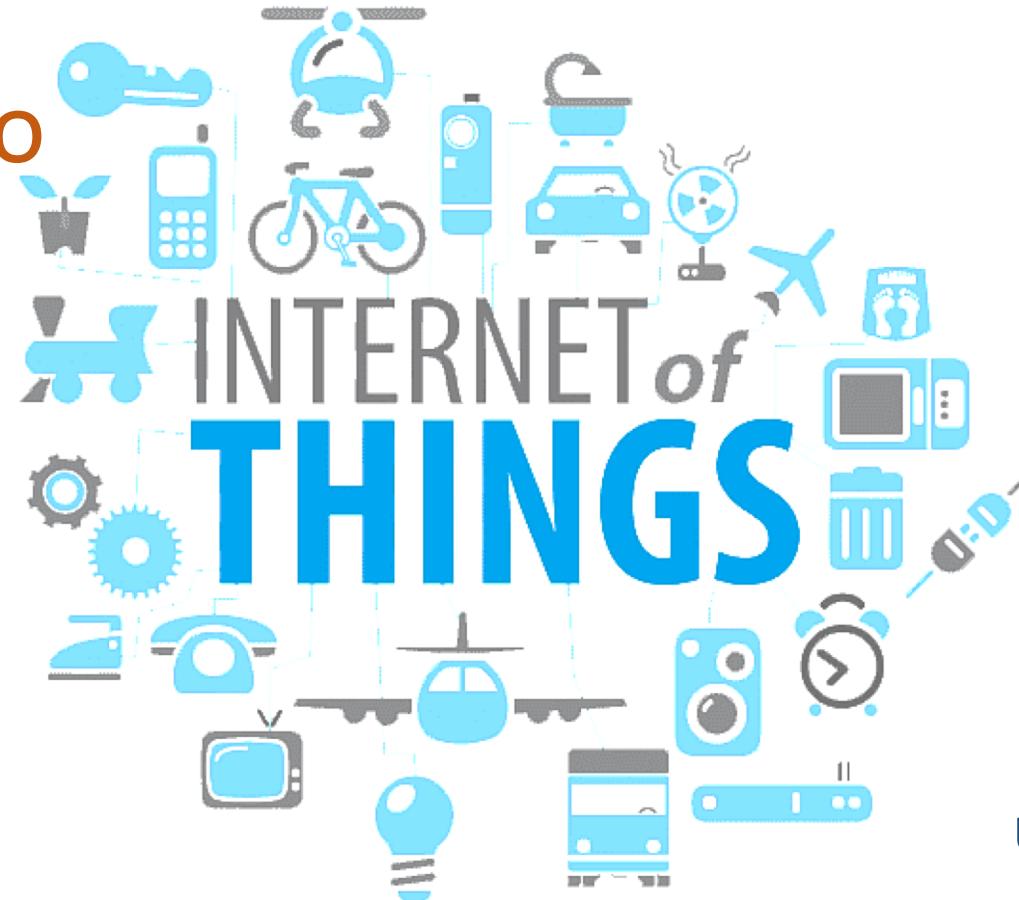




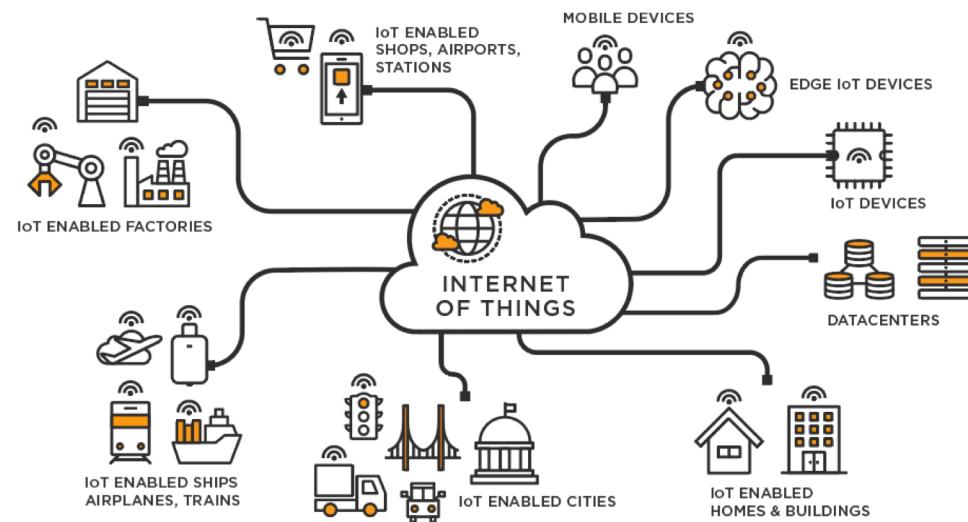
# Introduction to



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# Introduction

- Internet of Things (IoT)
  - ✓ Connecting the physical world to the digital world
  - ✗ Billions of smart devices communicating over networks
  - ✗ Foundation for smart homes, cities, healthcare, and industry



## What is the IoT? (Cont.)

- The Internet of Things (IoT) <sup>Def. ①</sup> refers to a network of physical devices, vehicles, appliances, and other physical objects that are embedded with sensors, software, and network connectivity, allowing them to collect and share data. IoT devices—also known as “smart objects” **IBM\***.

\*<https://www.ibm.com/think/topics/internet-of-things>

# What is the IoT? (Cont.)

Def ②

- The Internet of Things, or IoT, is a network of interrelated devices that connect and exchange data with other IoT devices and the cloud.
  - Things or IoT devices are embedded with technology and provided with unique identifiers (UIDs), such as:
    - sensors, software, people, animals, vehicles
    - With IoT, data can be transferred over a network without requiring human interaction. IoTAgenda\*.

\* <https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT>

## What is the IoT? (Cont.)

Def ③

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

\*<https://www.gartner.com/en/information-technology/glossary/internet-of-things>

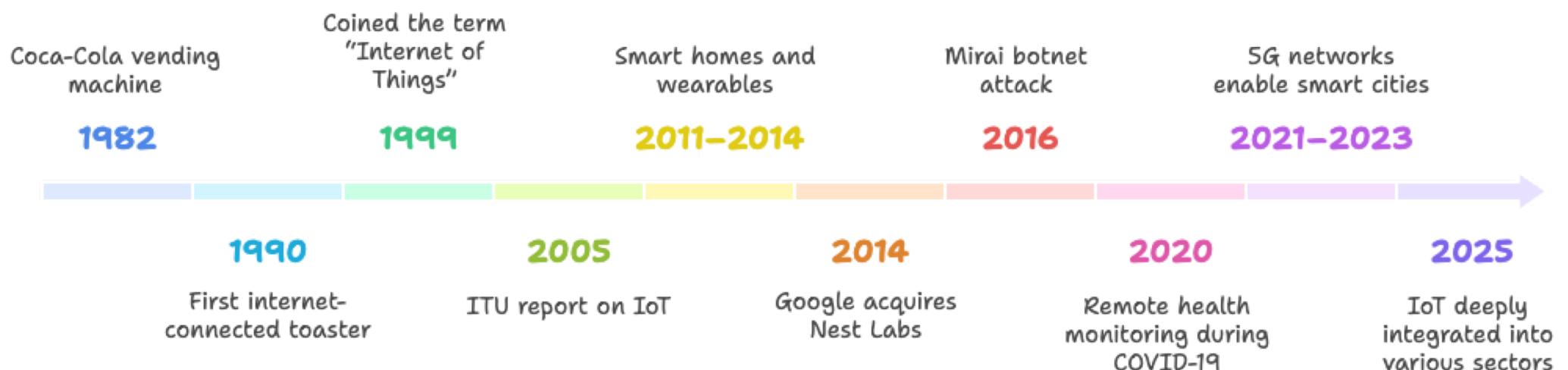
# What is the IoT?

- 1 • Network of physical objects (“Things”) connected to the Internet.
- 2 • IoT embedded system
- 3 • Equipped with sensors, memory, processors, and communication units.
- 4 • Capable of collecting, sharing, and analyzing data
- 5 • Enables interaction: people ↔ devices ↔ systems/ application

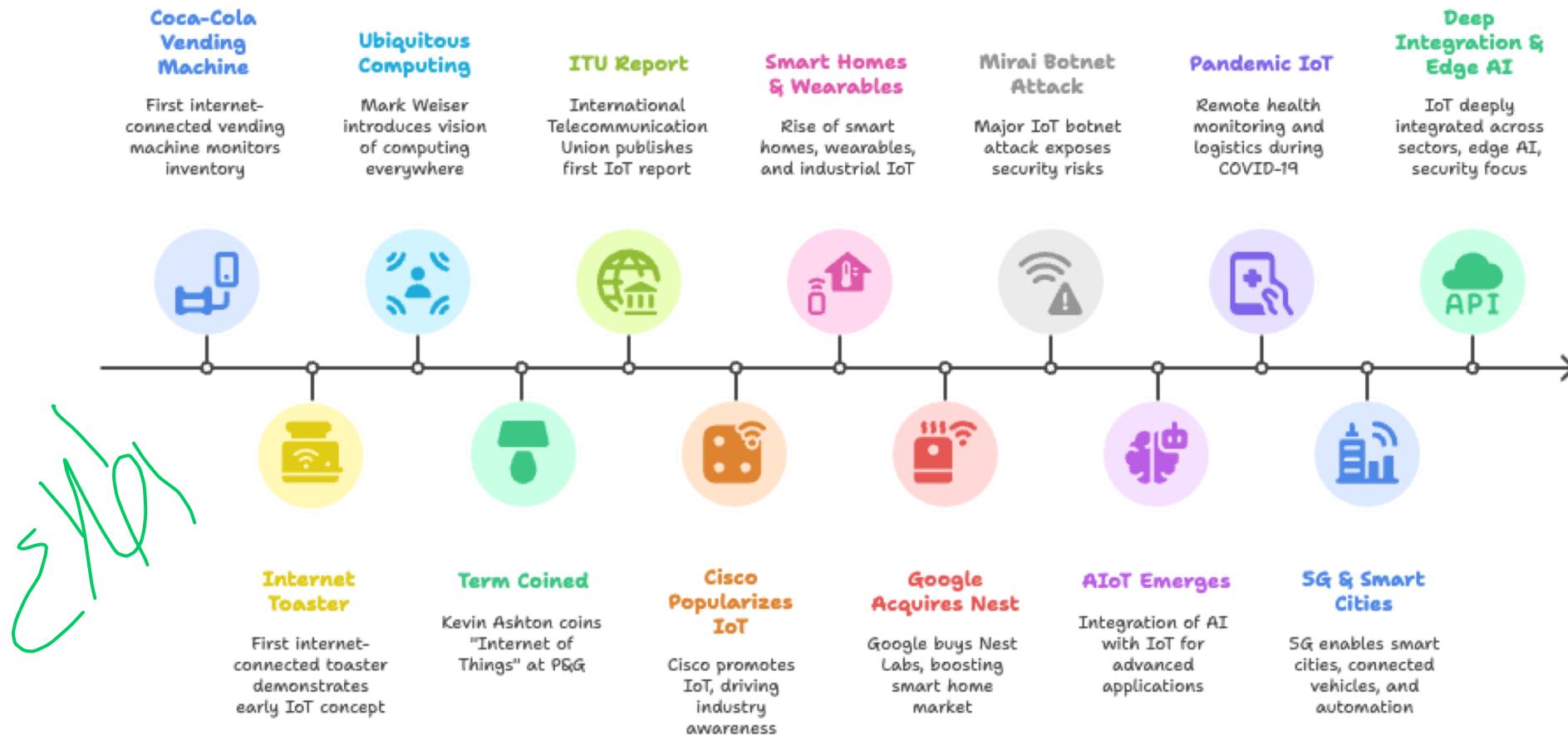
# Evolution of IoT (Cont.)

EXPO

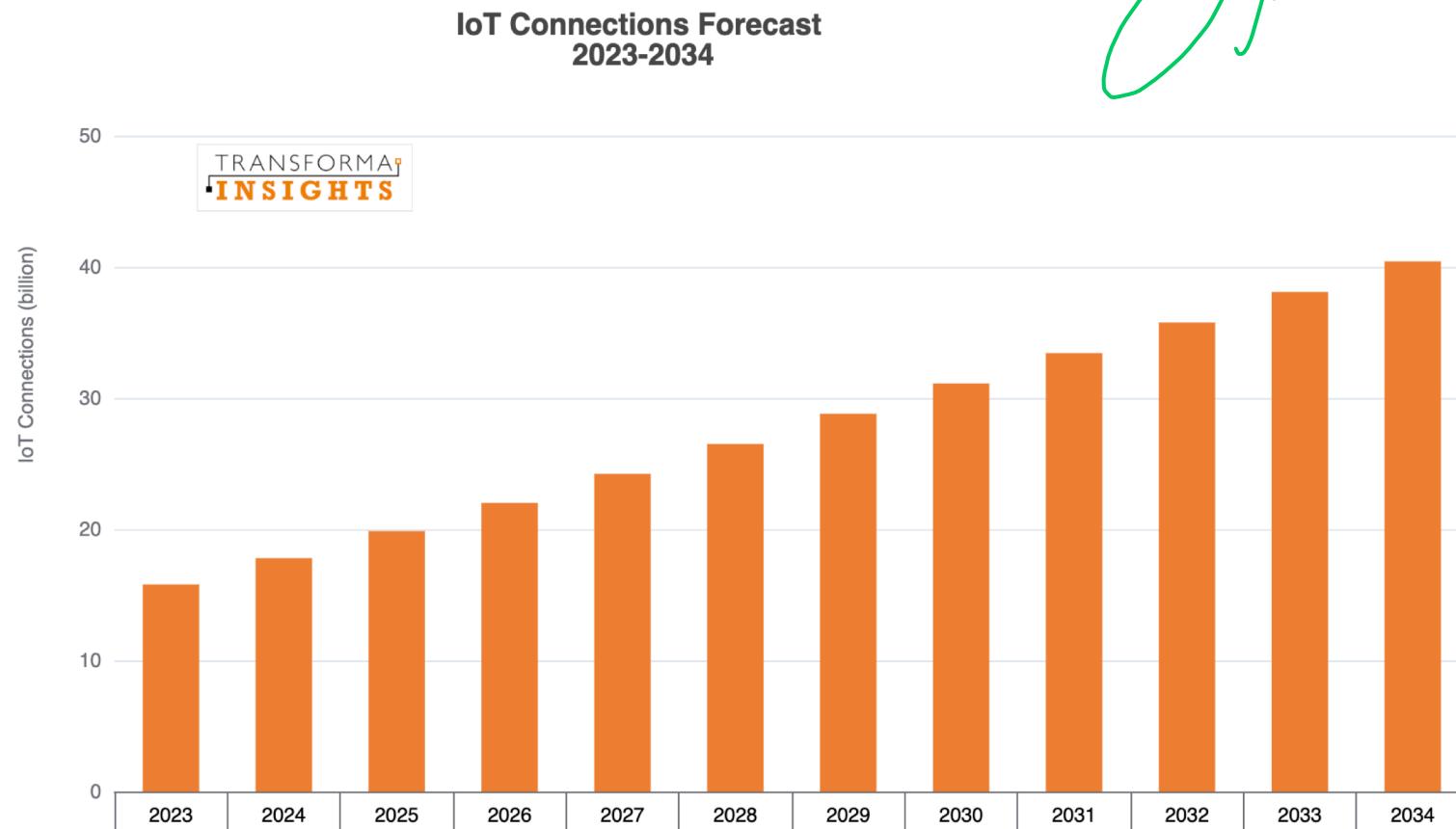
- IoT began as experimental connected devices in the 1980s, was conceptualized in the late 1990s, expanded with wireless tech in the 2000s, grew into smart homes/industries in the 2010s, and today (2020s) is powered by AI, edge computing, and 5G.



# Evolution of IoT (Cont.)



# Evolution of IoT (Cont.)

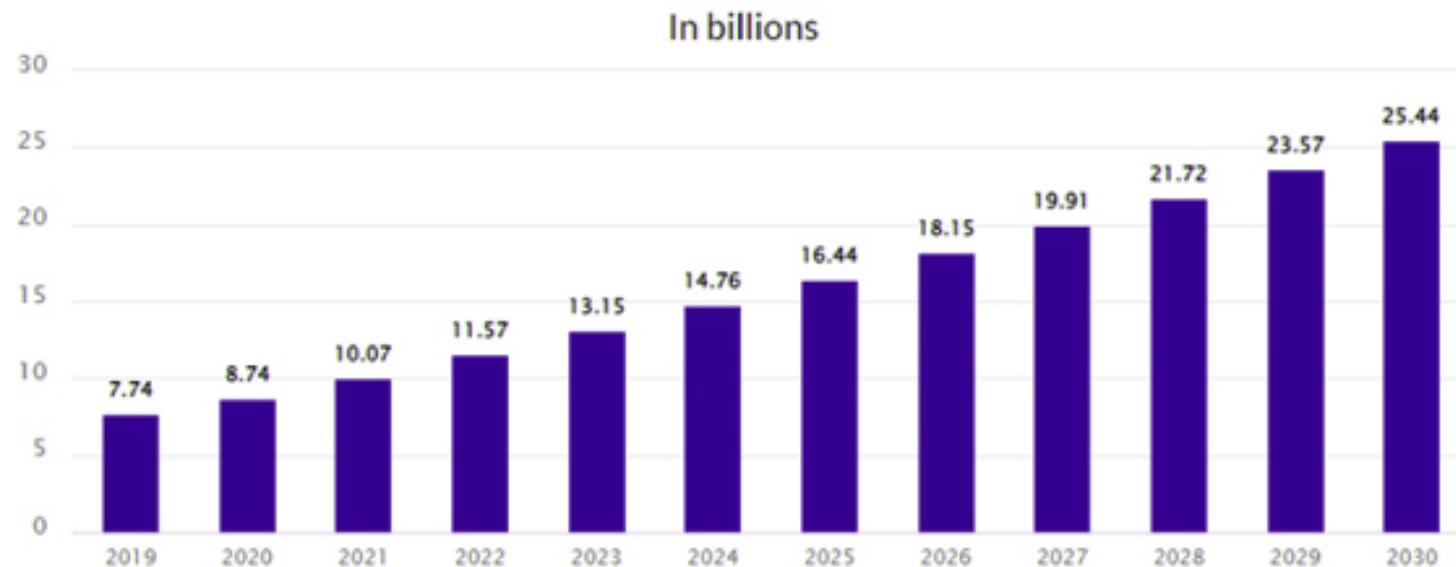


<https://transformainsights.com/research/forecast/highlights>

# Evolution of IoT

EVOLVING

**Number of IoT-connected devices worldwide, 2019 to 2030**



<https://transformainsights.com/>

# Importance of IoT (Cont.)

- 1 • **Improves Efficiency**
  - Automates tasks and reduces manual work.
- 2 • **Enhances Decision-Making**
  - Provides real-time data and analytics for smarter, faster business and personal decisions.
- 3 • **Reduces Costs**
  - Optimizes resource usage (energy, manpower, materials).
- 4 • **Increases Productivity**
  - Helps do more work in less time.

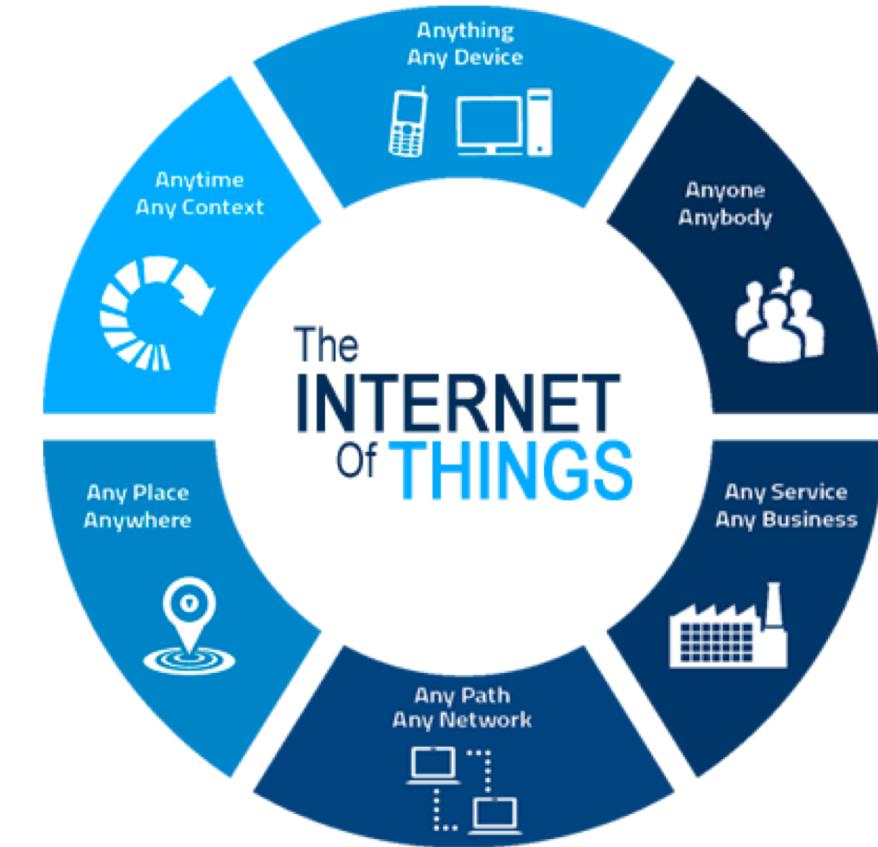
# Importance of IoT

- 5 • **Enables Connectivity**
  - Connects people, devices, and systems to share information easily.
- 6 • **Supports Innovation**
  - Creates new ideas, services, and smart solutions (e.g., smart cities, healthcare).
- 7 • **Enhances Quality of Life**
  - Makes life safer, easier, and more comfortable.
- 8 • **Ensures Safety and Security**
  - Real-time monitoring in industries, cities, and homes increases safety and reduces risks.

# Key characteristics of IoT accessibility (Cont.)

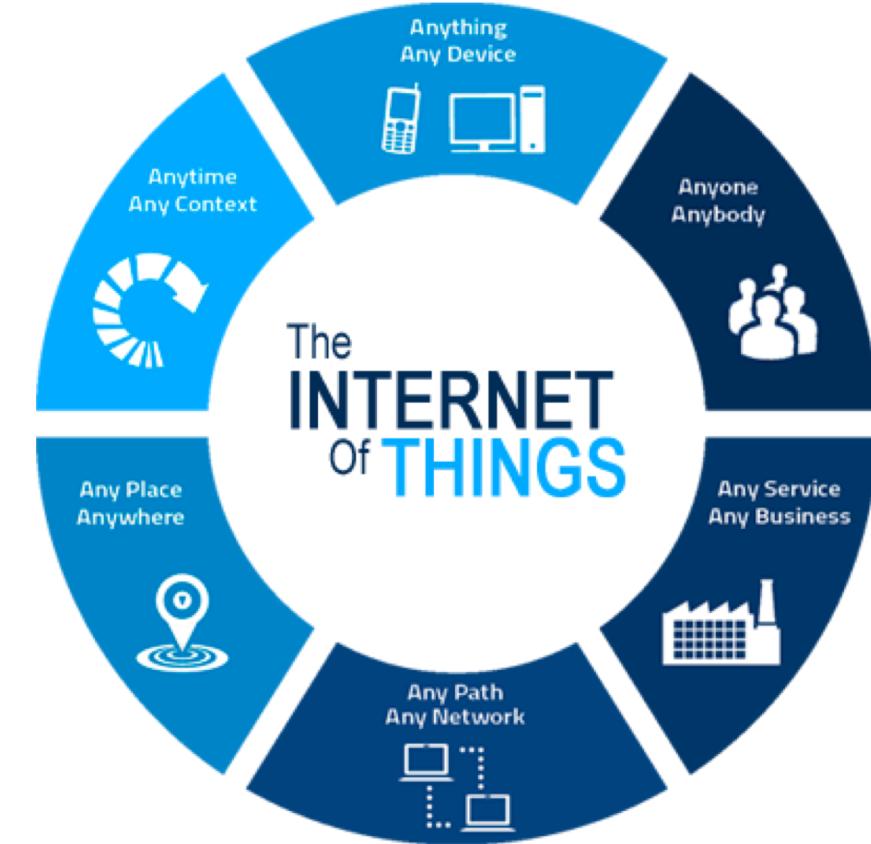
- IoT enables access to data and services:

- At any time, regardless of day or night.
- From anywhere, without geographical limitations.
- Through any path, any network (Wi-Fi, Bluetooth, Zigbee, 5G, LoRa, etc.).



# Key characteristics of IoT accessibility

- By **anyone**, different types of users (individuals, organizations, governments).
- By **any device**, any physical object (vehicles, buildings, machines, wearables, sensors, smartphones, actuators, embedded systems).
- At **any service**, smart homes and healthcare to industrial automation and smart cities.



# Key features of IoT (Cont.)

- 1 • **Connectivity**
  - Devices can connect to the internet or other networks.
- 2 • **Sensing**
  - IoT devices can detect or measure physical conditions (temperature, motion, light, etc.).
- 3 • **Data Processing**
  - Collected data is processed to make decisions.
- 4 • **Automation and Control**
  - Devices can act automatically based on the data.

# Key features of IoT

- 5 • **Scalability**
  - IoT can support many devices working together.
- 6 • **Interoperability**
  - Devices from different manufacturers can work together.
- 7 • **Real-time Monitoring**
  - Continuous tracking and instant feedback.
- 8 • **Efficiency**
  - Optimizes resources, saves time, and reduces human effort.
- 9 • **Security**
  - Protects data and device communication.

# Components of IoT system (Cont.)

1

## • Devices and Sensors

- Physical objects with sensors/actuators to collect data from the environment (temperature, motion, pressure, etc.).

2

## • Connectivity

- Communication technologies (Wi-Fi, Bluetooth, Zigbee, 5G, LoRa, etc.) that connect devices to networks.

3

## • Edge Devices / Gateways

- Intermediate devices that process, filter, or secure data before sending it to the cloud.

# Components of IoT system (Cont.)

4

## • Cloud / Data Storage

- Centralized platforms to store massive amounts of IoT data.

5

## • Data Processing and Analytics

- Turning raw data into useful insights using AI, ML, and analytics tools.

6

## • User Interface

- Applications (mobile, web dashboards) for users to monitor, control, and interact with IoT devices.

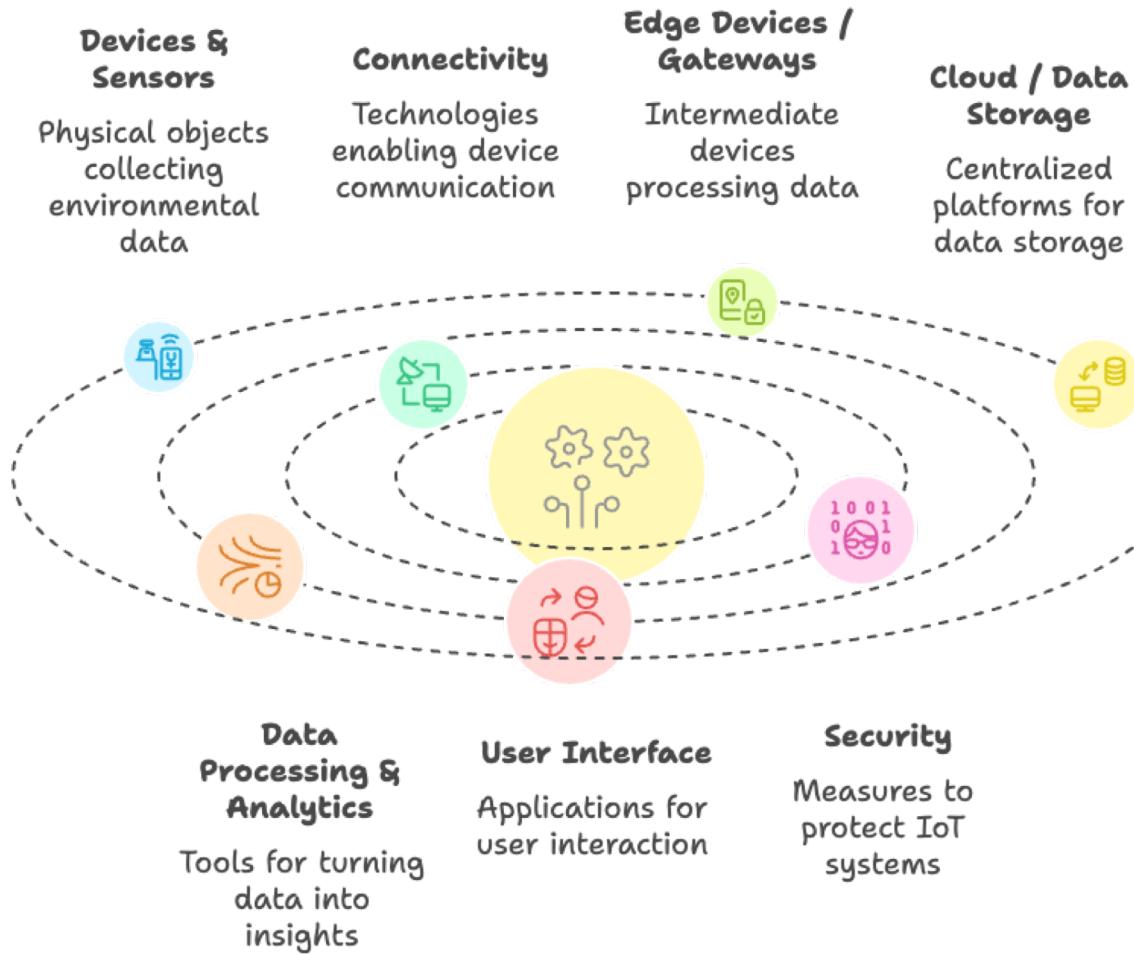
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## • Security

- Protecting IoT data, devices, and networks against cyberattacks and unauthorized access.

# Components of IoT system

1



Edu 1

# How IoT works? (Cont.)

1

## • Devices/Things

- Physical objects like sensors, smart appliances, or wearables collect data from their environment.

2

## • Connectivity

- These devices connect to the internet or other networks via Wi-Fi, Bluetooth, cellular networks, or other protocols.

3

## • Data Processing

- Collected data is sent to cloud servers or edge devices where it's processed and analyzed.

# How IoT works? (Cont.)

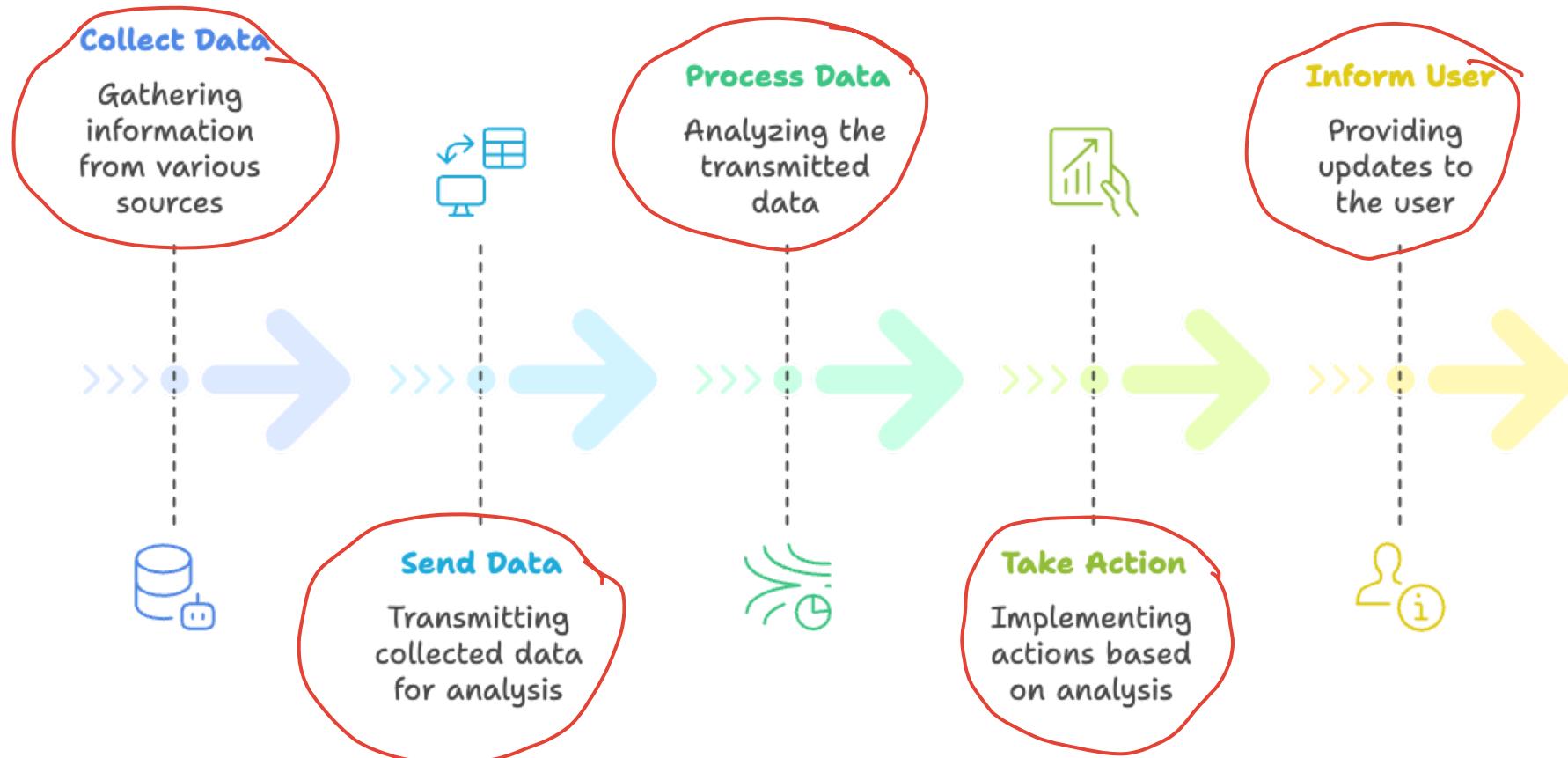
## 4 • Action/Automation

- Based on the analysis, devices can take actions automatically (like turning on a light) or send alerts to users.

## 5 • User Interaction

- Users can monitor and control devices through apps, dashboards, or voice assistants.

# How IoT works?



# Example of IoT applications (Cont.)

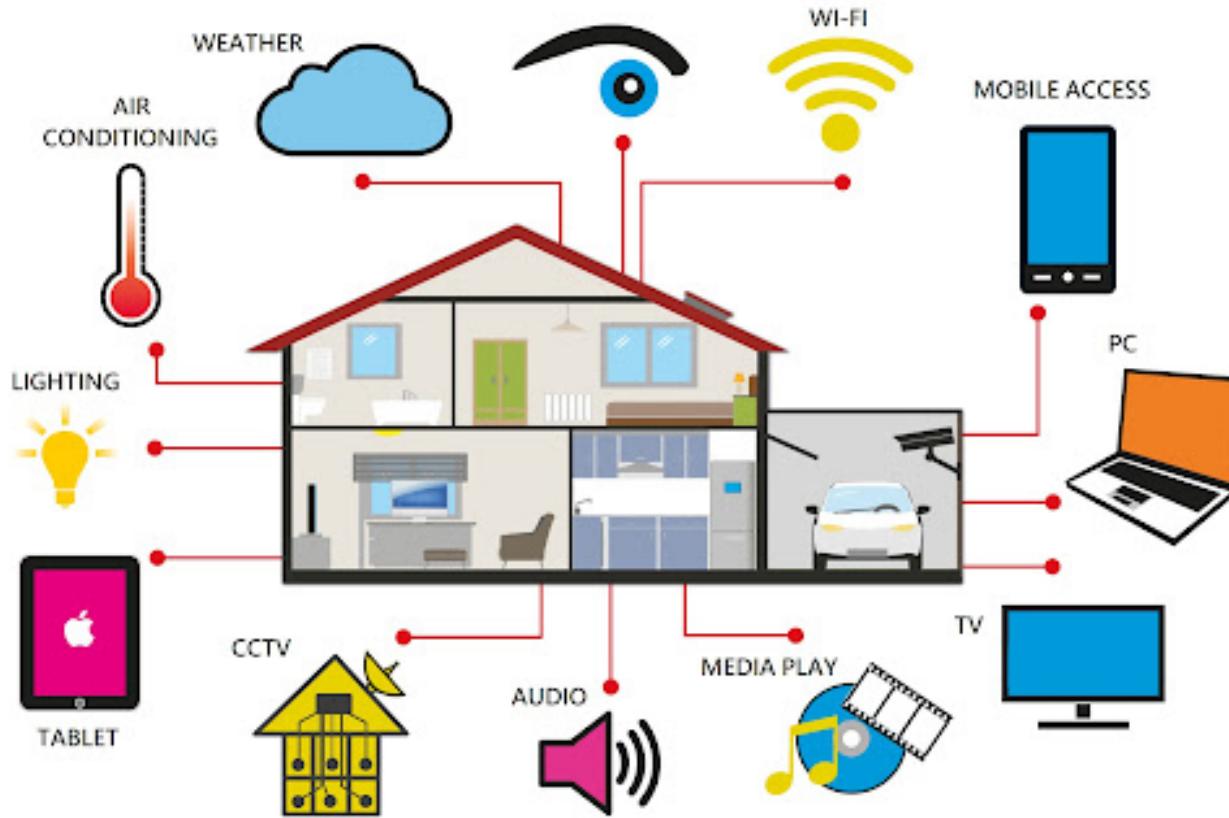
- Smart Homes 
- Smart Cities 
- Healthcare 
- Agriculture 
- Transportation 
- Retail 
- Industrial IoT (IIoT) 

EYD)

# Smart Home

- Smart Homes 

- Smart thermostats, lights, and security systems for comfort and energy savings.



# Smart City

- Smart Cities



- Connected traffic lights, waste management, and surveillance systems to improve life.

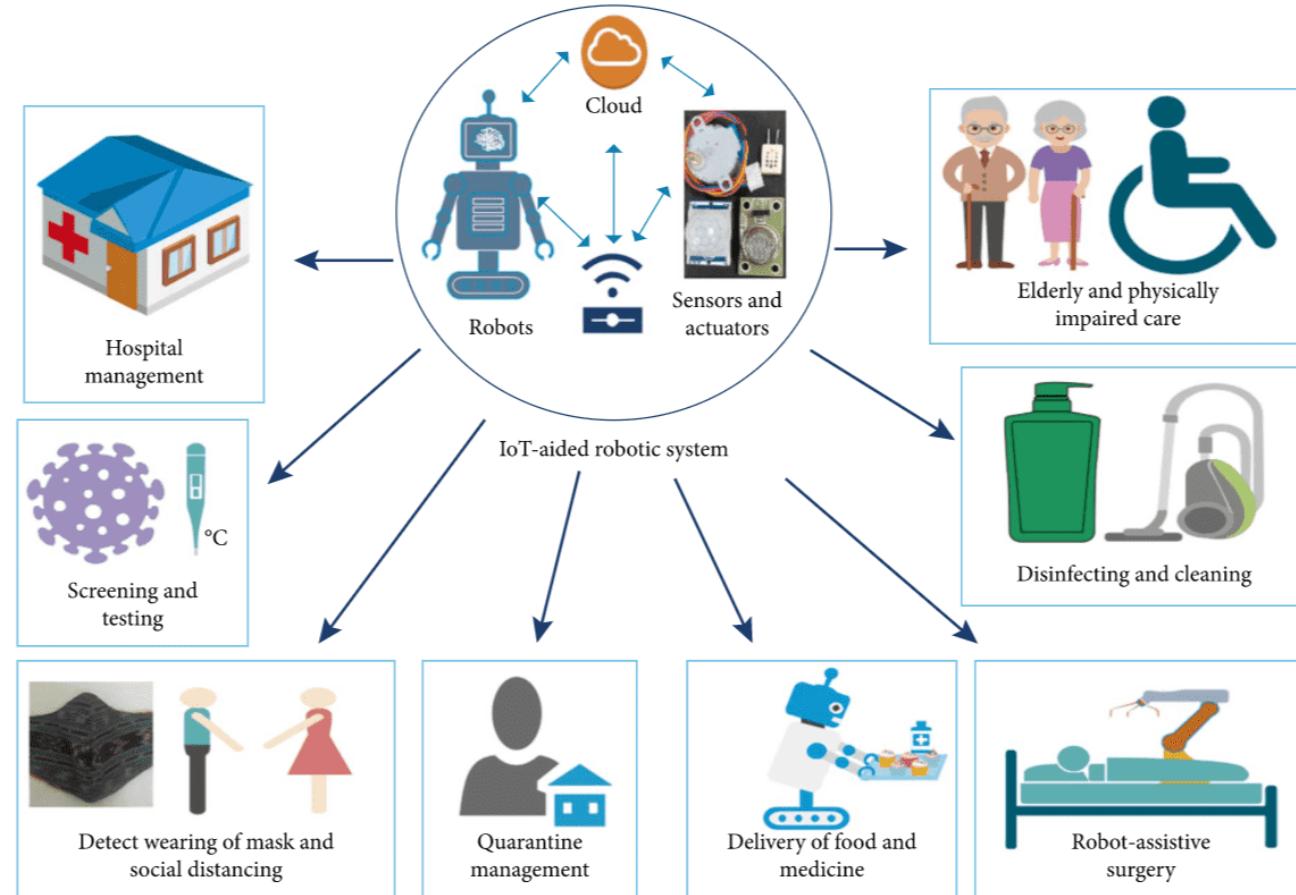
EXPO



# Healthcare

- **Healthcare** 

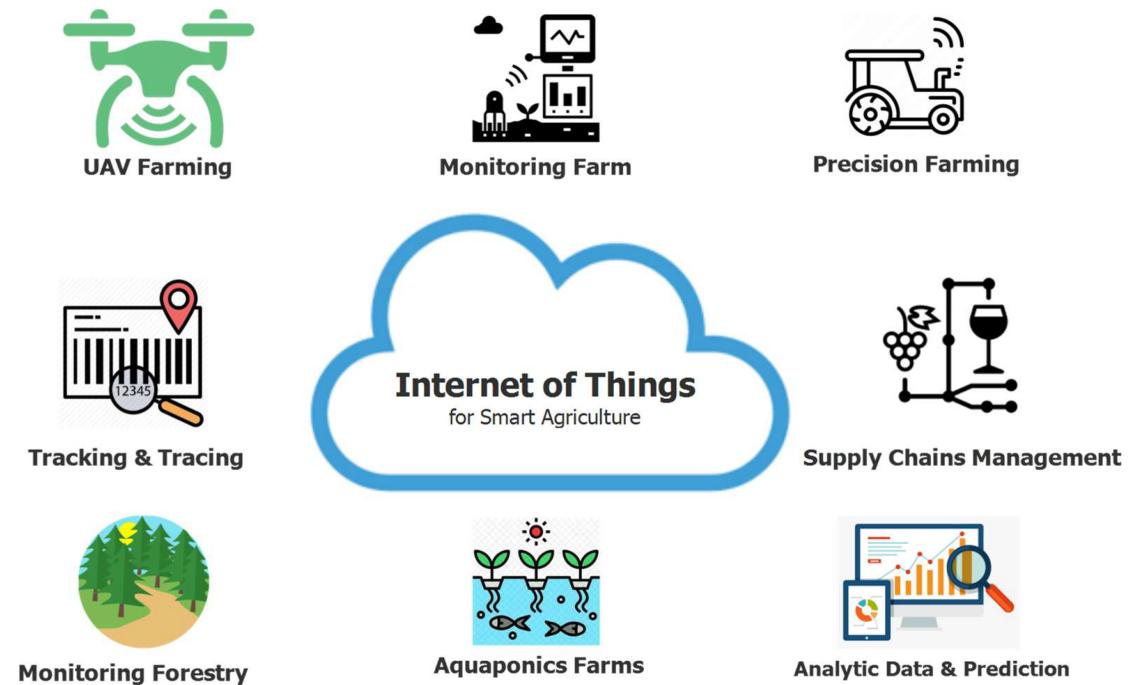
- Wearables and remote patient monitoring devices that track heart rate, blood pressure, or glucose levels.



# Agricultural

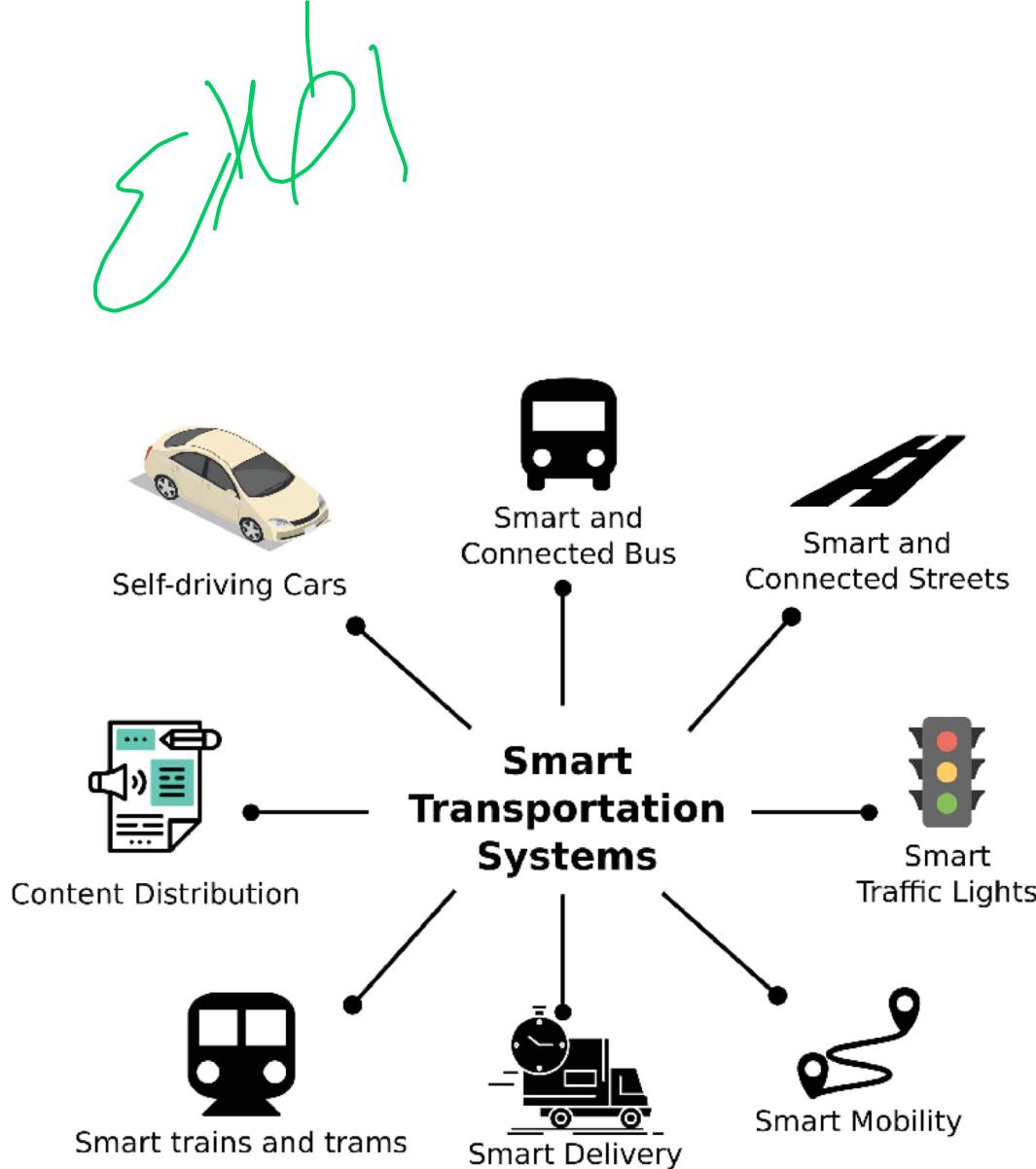
- **Agriculture** 

- Smart irrigation systems and soil sensors to optimize water use and boost crop yield.



# Transportation

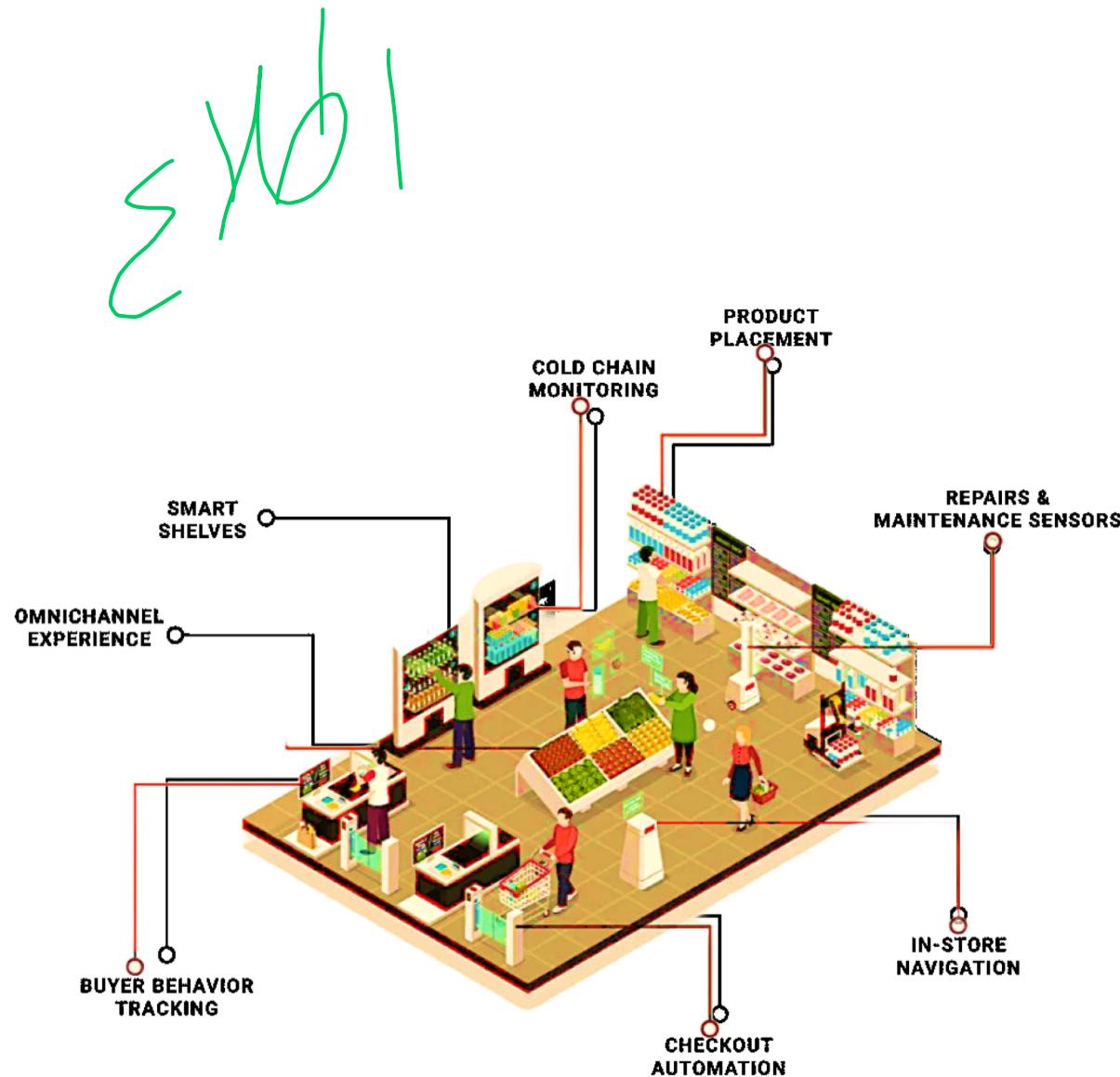
- **Transportation** 
  - The use of connected devices and sensors in vehicles, roads, and traffic systems.



# Retail

- **Retail** 

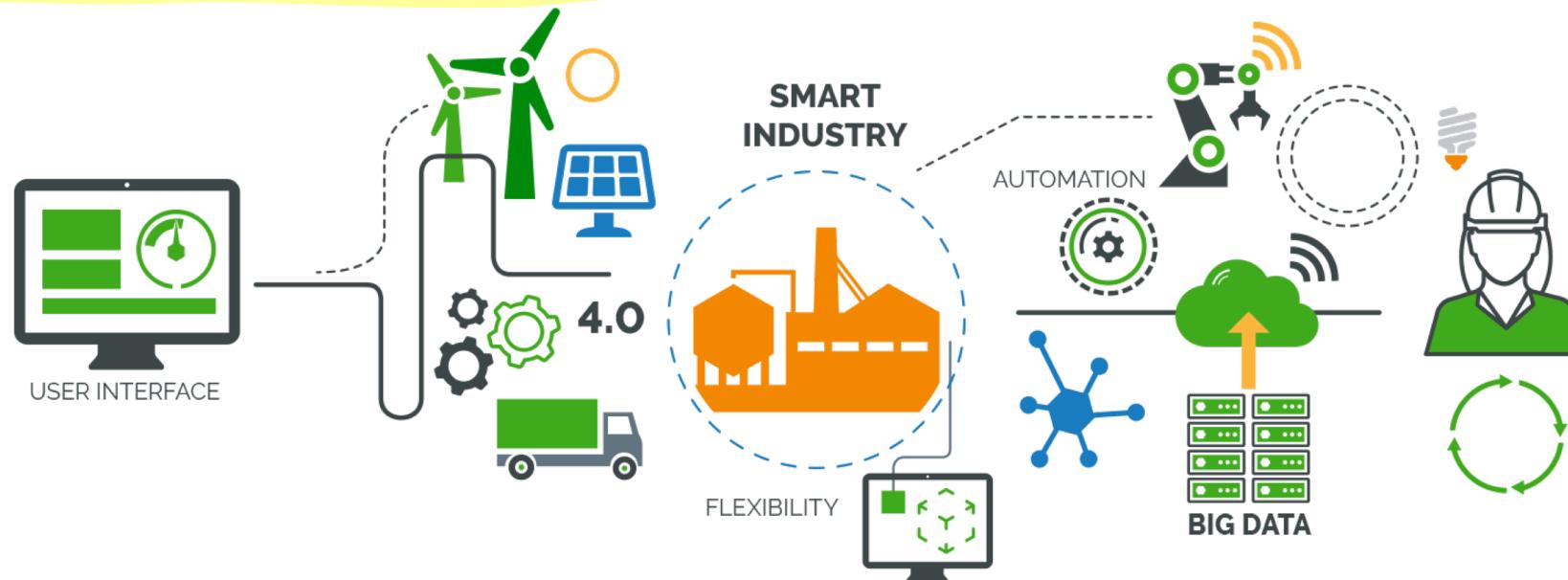
- Smart shelves, inventory tracking, and personalized shopping experiences.



# Industrial IoT (IIoT)

- **Industrial IoT (IIoT)** 

- The use of IoT technology in industries like manufacturing and energy to monitor, control, and optimize operations.



# IoT extension domains (Cont.)

- **IIoT (Industrial Internet of Things)**
  - IoT in factories and industries for automation, monitoring, and predictive maintenance.
- **AIoT (Artificial Intelligence of Things)**
  - Combines AI + IoT so devices can analyze data and make smart decisions.
- **IoMT (Internet of Medical Things)**
  - IoT used in healthcare for monitoring patients, wearable sensors, and remote diagnosis.
- **SIoT (Social Internet of Things)**
  - IoT devices that build social relationships among each other (like human social networks).

# IoT extension domains

- **BloT (Building Internet of Things)**
  - Smart buildings with sensors for **energy efficiency, lighting, and security control.**
- **VIoT (Vehicular Internet of Things)**
  - IoT in **vehicles** for traffic monitoring, navigation, and safety systems.
- **Agri-IoT (Agricultural IoT)**
  - Smart farming using sensors for **soil, water, and crop monitoring.**
- **IoE (Internet of Everything)**
  - **connects people, data, processes, and things** for a fully connected world.

# Challenges of IoT

- **Sensors:** limited resources and types of sensors
- **Scale:** millions of devices are connected to form IoT
- **Low Power Network:** high network latency
- **Interoperability:** various protocols and architectures, and different technologies
- **Privacy:** how to control which personal data to share with whom
- **Big data and Data analytics:** a massive amount of sensor data, different sources, and extract intelligence objects
- **Security:** Complex security of connected “Things”

Thank you!

