Tishk International University
Science Faculty
IT Department

Introduction to IoT

Lecture 01: Basics of IoT

4th Grade - Spring Semester

Instructor: Alaa Ghazi

Course Textbooks

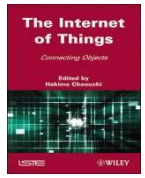
1. **"Internet of Things: A Hands-On Approach"**

   By Arshdeep Bahga, Vijay Madisetti

   Covers IoT architecture, sensors, protocols, cloud integration, and hands-on projects.

2. **"The Internet of Things: Connecting Objects to the Web"**

   By Hakima Chaouchi



   A practical introduction with real-world examples and networking concepts.

3. **"Learning Internet of Things"**

   By Peter WaherBeginner-

   Friendly introduction to IoT, covering MQTT, CoAP, and cloud integration.

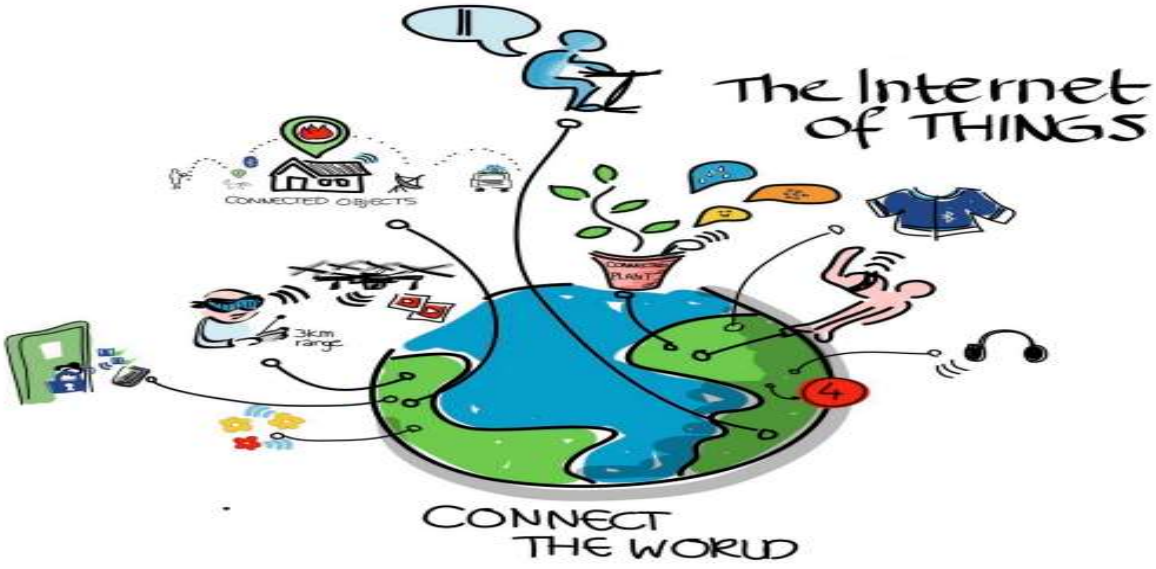
Course Topics

- Lecture 01: Basics of IoT
- Lecture 02: IoT Hardware and Devices
- Lecture 03: IoT Communication Protocols
- Lecture 04: IoT Data Management and Analytics
- Lecture 05: IoT Security and Privacy
- Lecture 06: IoT Applications and Case Studies

LAB Sessions

- Lab 1: Introduction to Raspberry Pi 4
- Lab 2: GPIO Programming
- Lab 3: Sensor Integration
- Lab 4: Network Communication
- Lab 5: Cloud Integration
- Lab 6: Mini Project

Lecture 1
Basics of IoT



Lecture Topics

1. Definition
2. Evolution and history of IoT
3. IoT architecture and reference models
4. Components of IoT systems
5. IoT application domains
6. Challenges in IoT implementation

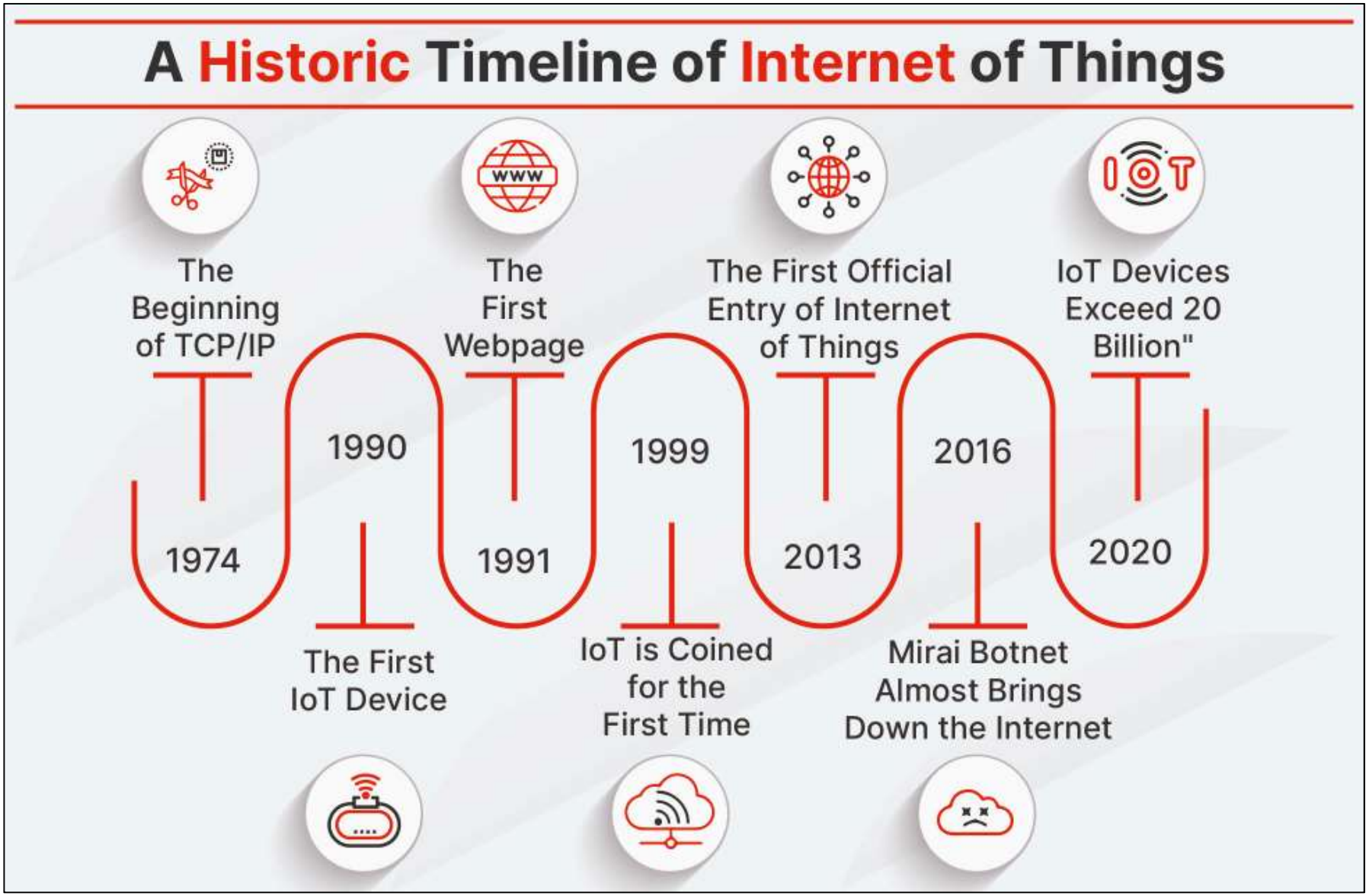
Definition

- **Internet of Things (IoT)** is a network of physical things (objects) sending, receiving, or communicating information using the Internet or other communication technologies enabling the monitoring, coordinating or controlling process across the Internet or another data network.

Evolution and History

- The concept of the Internet of Things first became popular in 1999, through the Auto-ID Center at MIT and related market analysis publications.
- Radio-frequency identification (RFID) was seen as a prerequisite for the IoT at that point. If all objects and people in daily life were equipped with identifiers, computers could manage and inventory them.
- Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes, blue-tooth, and digital watermarking.

Evolution and History



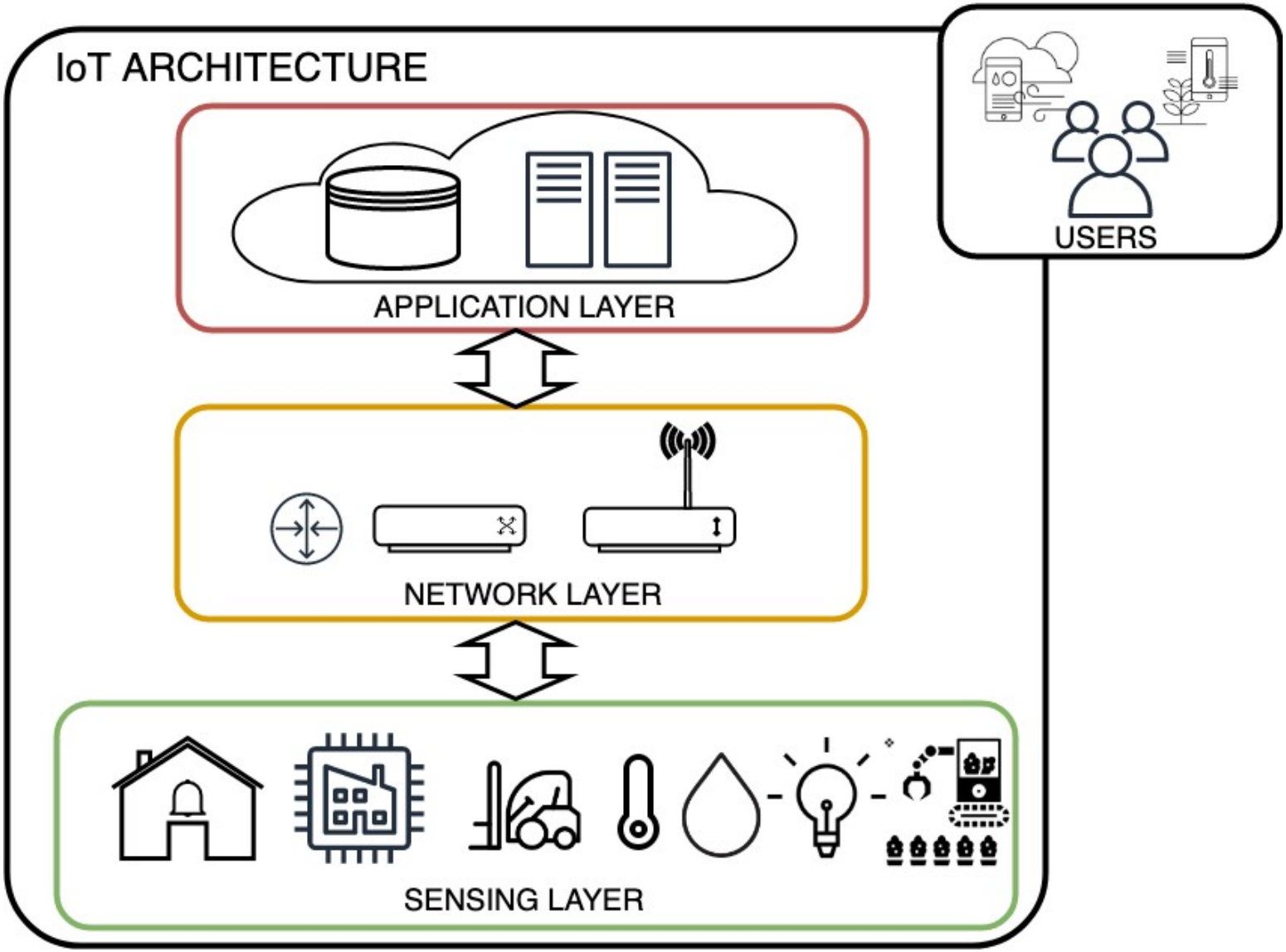
IoT Architecture

- IoT technologies can be classified according to their roles to three layers:

1. Perception (Sensing) Layer
2. Network Layer
3. Application Layer

In the Three-layer Internet of Things (IoT) architecture, the data is collected through the sensing layer and transferred over the network layer to cloud servers and users connect to the system through application layer.

IoT Architecture

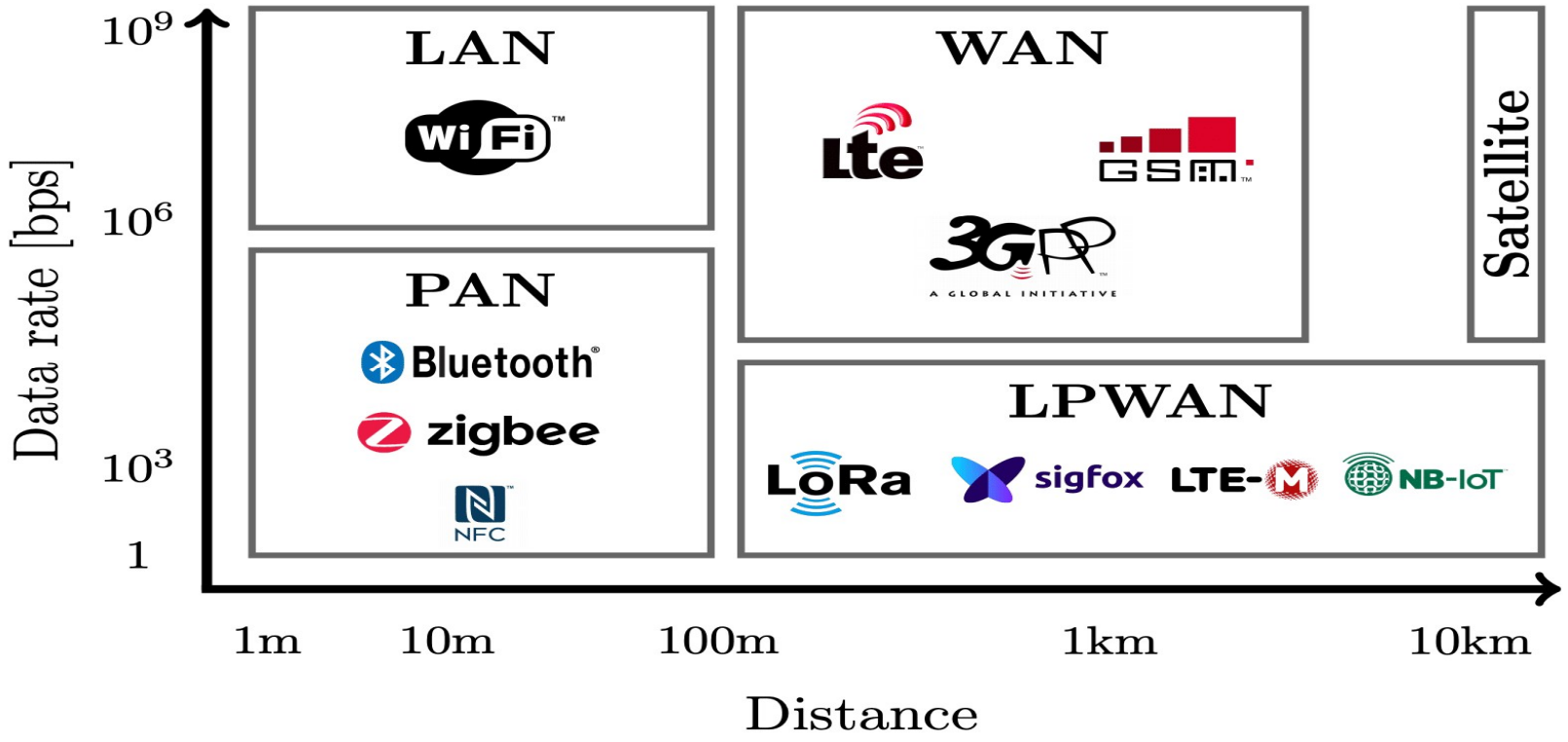


1. Perception (Sensing) Layer

- Perception (Sensing) Layer: is responsible for collecting data from different sources. This layer includes sensors and actuators that are placed in the environment to gather information about temperature, humidity, light, sound, and other physical parameters. Most commonly used sensors in the IoT devices are:
- Temperature Sensor
- Pressure Sensor
- Proximity Sensor
- Accelerometer and Gyroscope Sensor
- IR Sensor
- Optical Sensor
- Gas Sensor
- Smoke Sensor

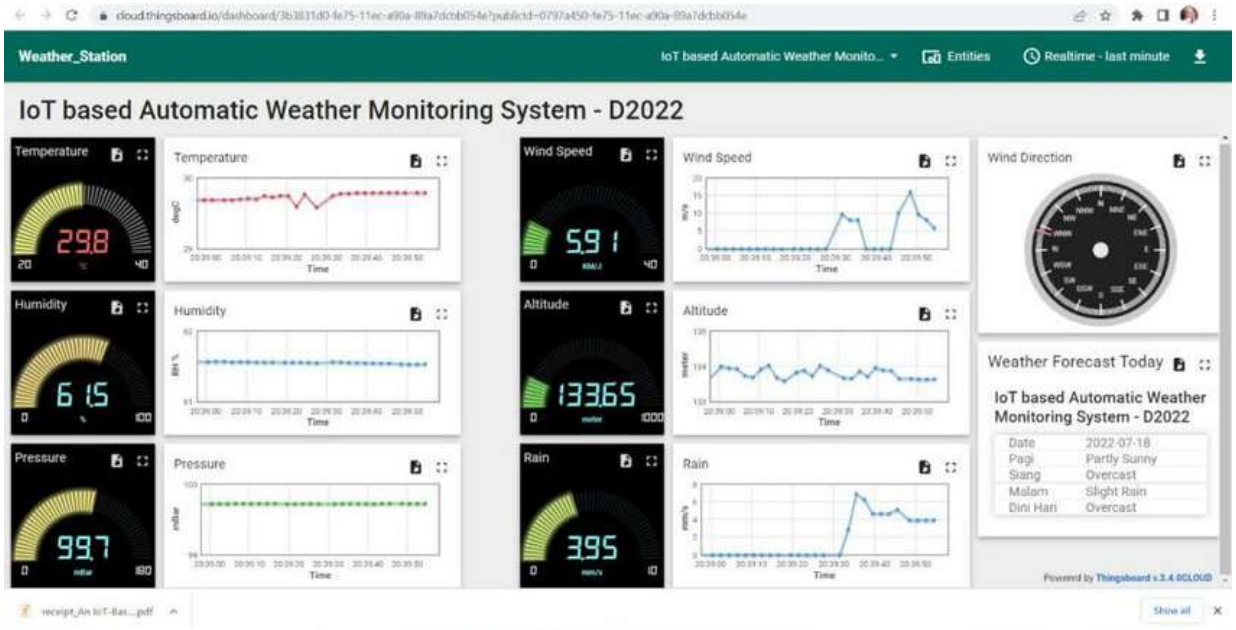
2. Network Layer

- Network Layer: is responsible for providing communication and connectivity between devices in the IoT system. It includes protocols and technologies that enable devices to connect and communicate with each other and with the wider internet.



3. Application Layer

- Application Layer: is responsible for providing user-friendly interfaces and functionalities that enable users to access and control IoT devices. It includes various software and applications such as mobile apps, web portals, and other user interfaces that are designed to interact with the underlying IoT infrastructure.



IoT Components and their Challenges

- Sensors
- Networks
- Intelligent Analysis

Sensors

- An electronic device that produces electrical, optical, or digital data derived from a physical condition or event. Data produced from sensors is then electronically transformed, by another device, into information (output) that is useful in decision making done by “intelligent” devices or individuals (people).
- Selection Factors:
  - Purpose (Temperature, Motion, Bio…etc.)
  - Range, Accuracy & Resolution
  - Reliability
- Challenges facing IoT sensors:
  - Power consumption
  - Size and Weight
  - Interoperability

Networks

- The second step of this implementation is to transmit the signals collected by sensors over networks with all the different components of a typical network including routers, bridges in different topologies, including LAN, MAN and WAN.
- Selection Factors:
  - Data Rate
  - Range
  - Available Infrastructure
- Challenges facing IoT Networks:
  - Power consumption
  - Security
  - Growth in connected devices
  - Availability of networks coverage

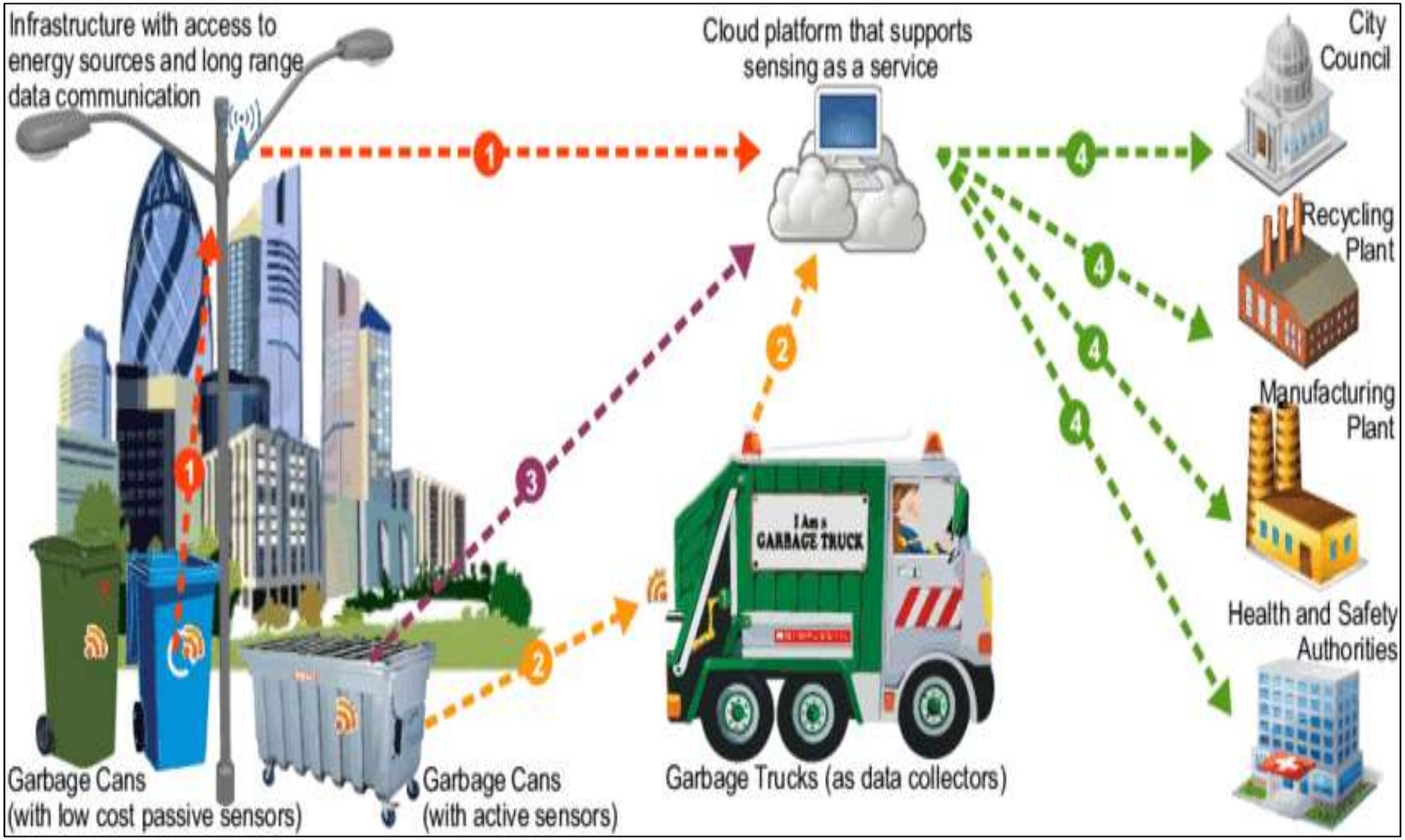
Intelligent Analysis

- Intelligent Analysis is extracting insight from data for analysis, Analysis is driven by cognitive technologies and the accompanying models that facilitate the use of cognitive technologies.
- Challenges facing IoT Intelligent Analysis:
  - Inaccurate analysis due to flaws in the data and/or model
  - Legacy systems are well suited to handle structured data
  - Traditional analytics software generally works on batch-oriented processing

IoT Application Domains

- Smart Cities
- Building and Home automation
- Manufacturing
- Medical and Healthcare systems
- Media
- Environmental monitoring
- Infrastructure management
- Energy management
- Transportation
- Agriculture and Animal Farms

Example 1: Efficient waste management in Smart Cities



Example 2: Effective livestock monitoring