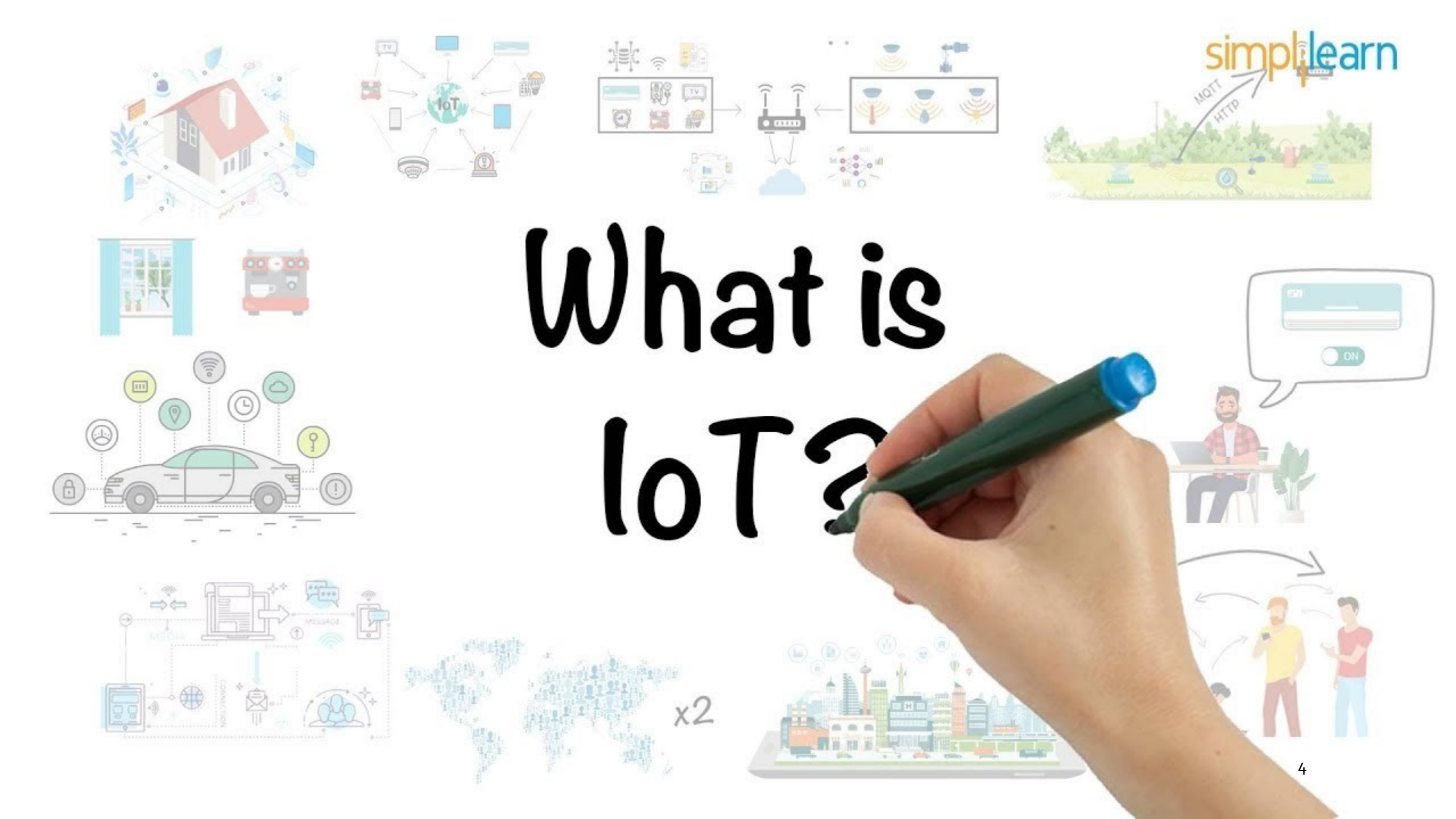

simplilearn
MQTT
HTTP
What is
IoT?
ON
x2

What is IoT?

- https://www.youtube.com/watch?v=p_R5ZVWMhzM

Proposed Course Outline

- IoT Introduction and Building Blocks
- IoT Physical Layer
- IoT Networking and Communication Layer
- IoT Cloud Computing, and Data Analytics
- IoT Security Introduction
- IoT Threat Modelling
- Targeting the IoT Ecosystem
- Intrusion Detection Systems

Internet of Things (IoT)

- There is no single definition for Internet of Things (IoT).
- IoT is simply an **extension** of the internet into the physical world.

Internet of Things (IoT)

- IoT means **anything** can communicate with **anything** in **any place** at **any time** using **any protocol.**

Internet of Things (IoT)

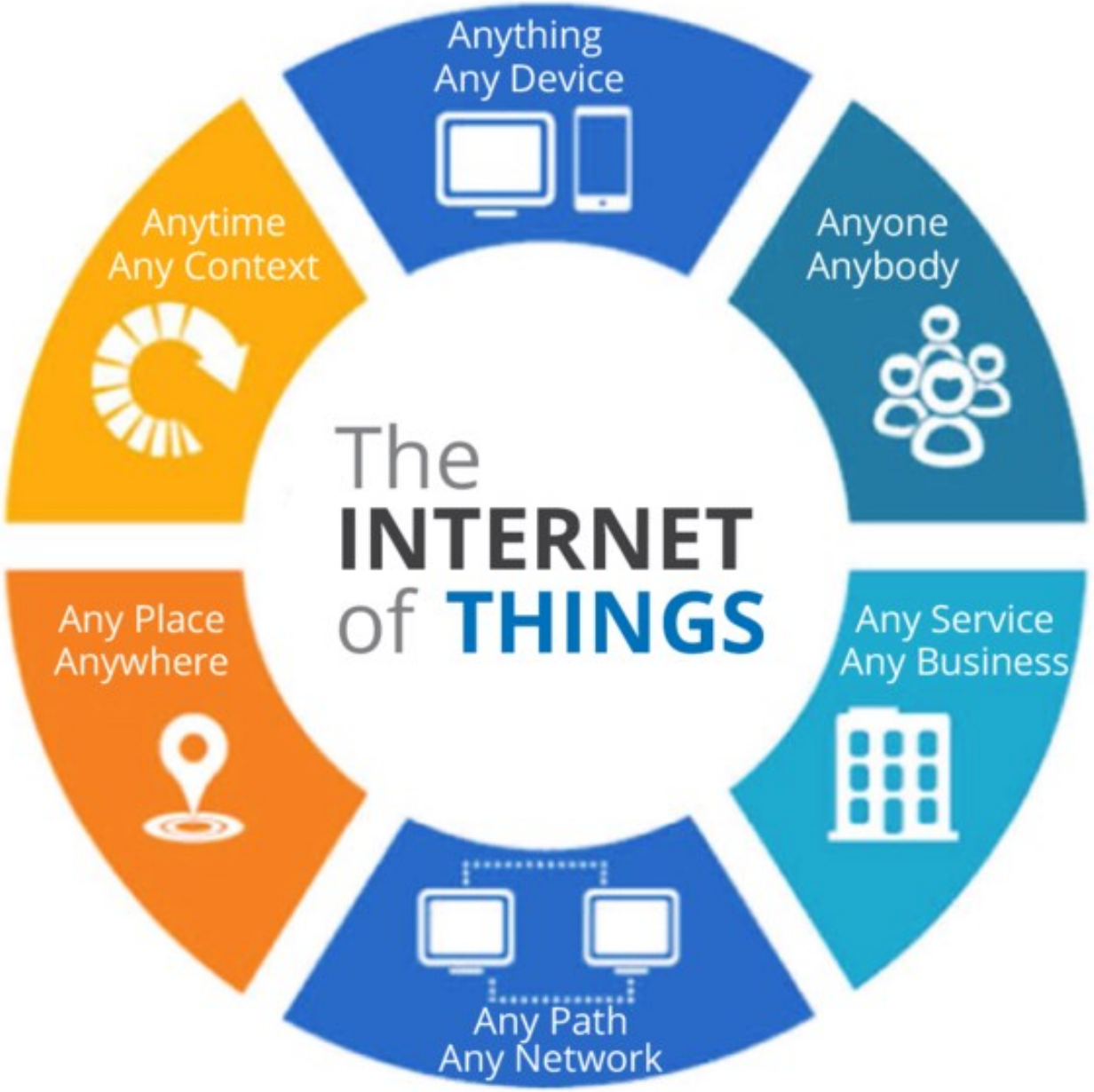
Internet of Things (IoT) is an intermediate term used to refer to the **interconnection** of physical components with the ability to **connect** and **exchange data**, **without** human interaction, due to the integration of software and electronic components.

The interconnection via the Internet of computing devices embedded in **everyday objects**, enabling them to **send** and **receive data**.

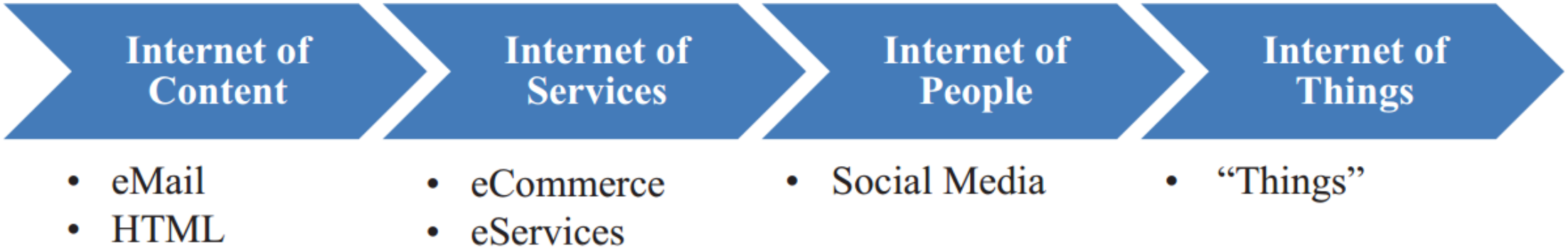
Internet of Things (IoT)

Formal Definition(s):

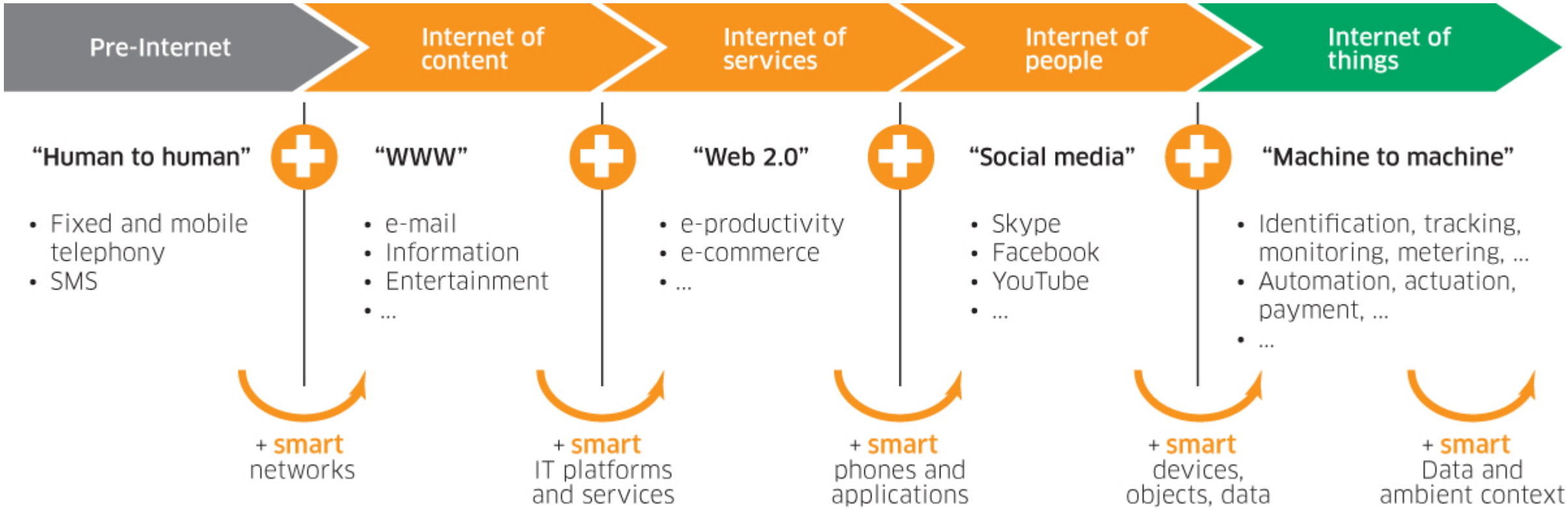
- Oxford Dictionary (Jan 2022):
  - The Internet of Things (IoT) is the **connection** of devices within everyday objects via the **internet**, enabling them to share data.
- Alliance for Internet of Things Innovations (AIOTI) (Jan 2022):
  - The term IoT describes a network of objects in your home or office that have sensors and software that enables them to **communicate** with each other using the **internet**. They are usually traditional, everyday objects such as vacuum cleaners, air conditioners and thermostats, TV sets, and refrigerators.


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

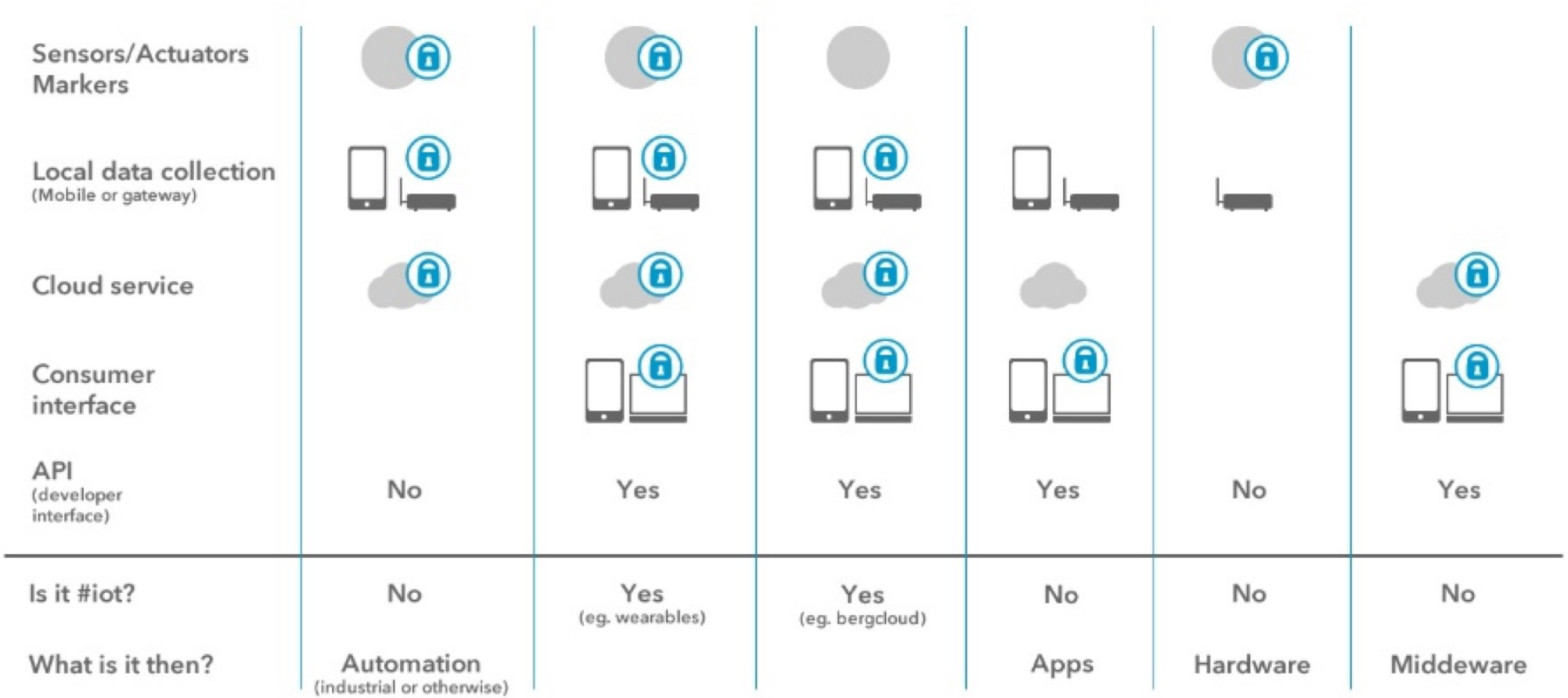
Evolution of IoT



Evolution of IoT



Smart vs connected.



Comparison between Traditional Network and IoT

Topic	Traditional Internet	IoT
Who creates contents?	Human	Machine
How is the content combined?	Using explicitly defined links	Through explicitly defined operations
How is the content consumed?	By request	By pushing information and triggering actions
What is the value	Answer questions	Action and timely information
What was done so far?	Both content creation (HTML) and content consumption (search engine)	Mainly content creation

The IoT Equation

Physical Object

+

Controller, Sensor and Actuator

+

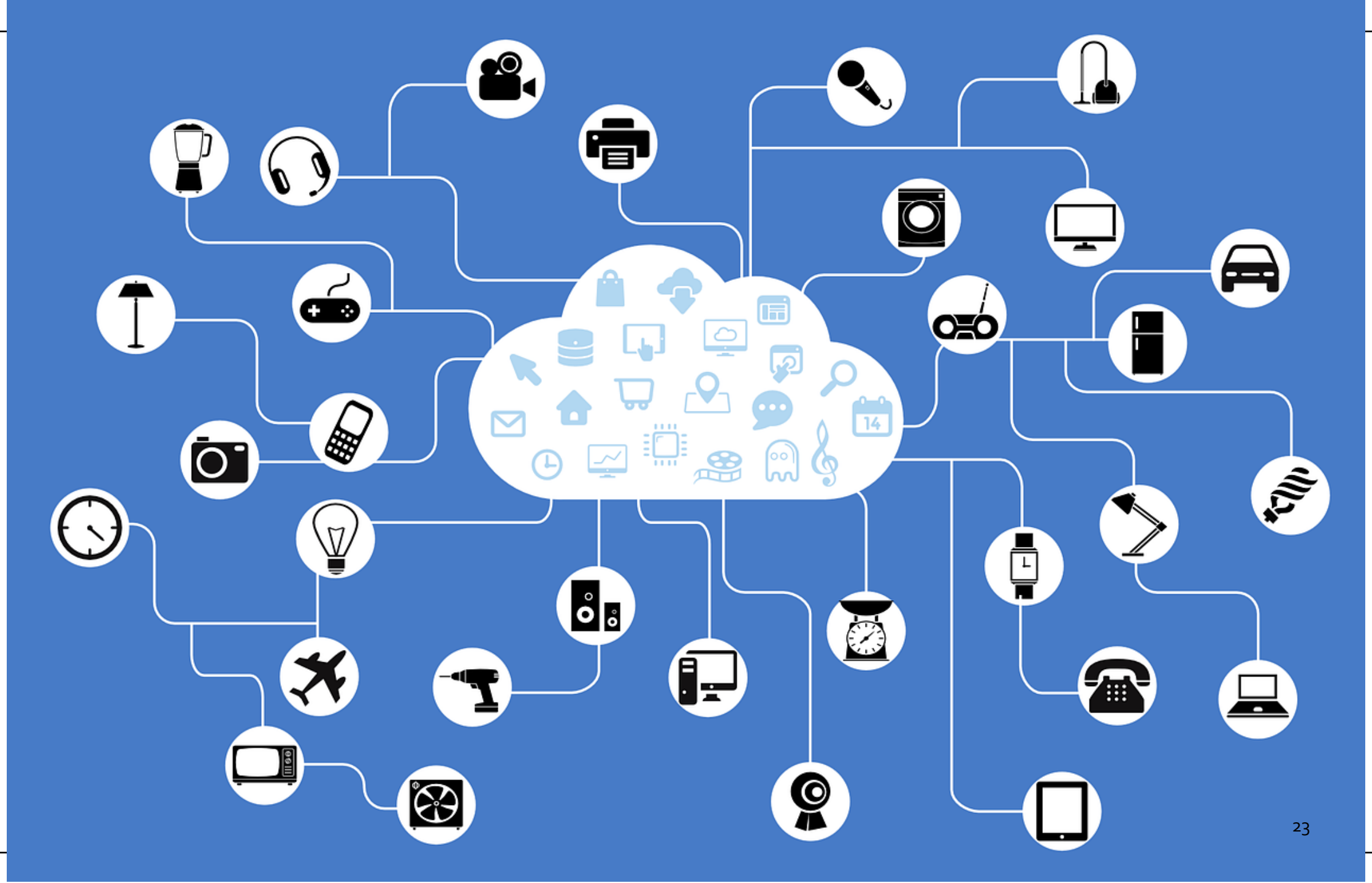
Internet

=

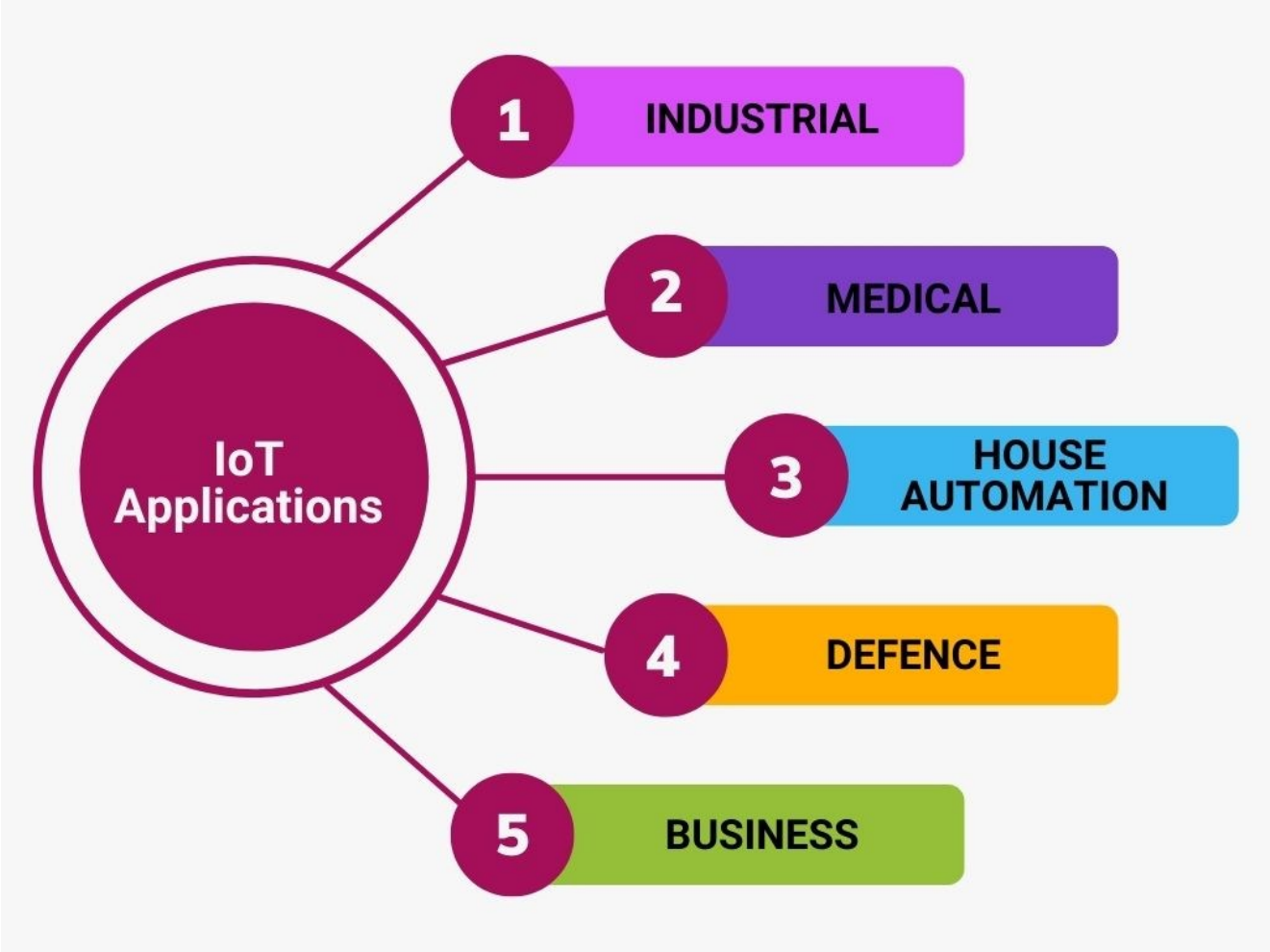
Internet-of-Things

Concepts Close to IoT

- Ambient Intelligence (AmI)
  - Electronic environments that are sensitive and responsive to the presence of people
- Machine-to-Machine (M2M)
  - A concept which refers to direct communication between devices using any communications channel, including wired and wireless

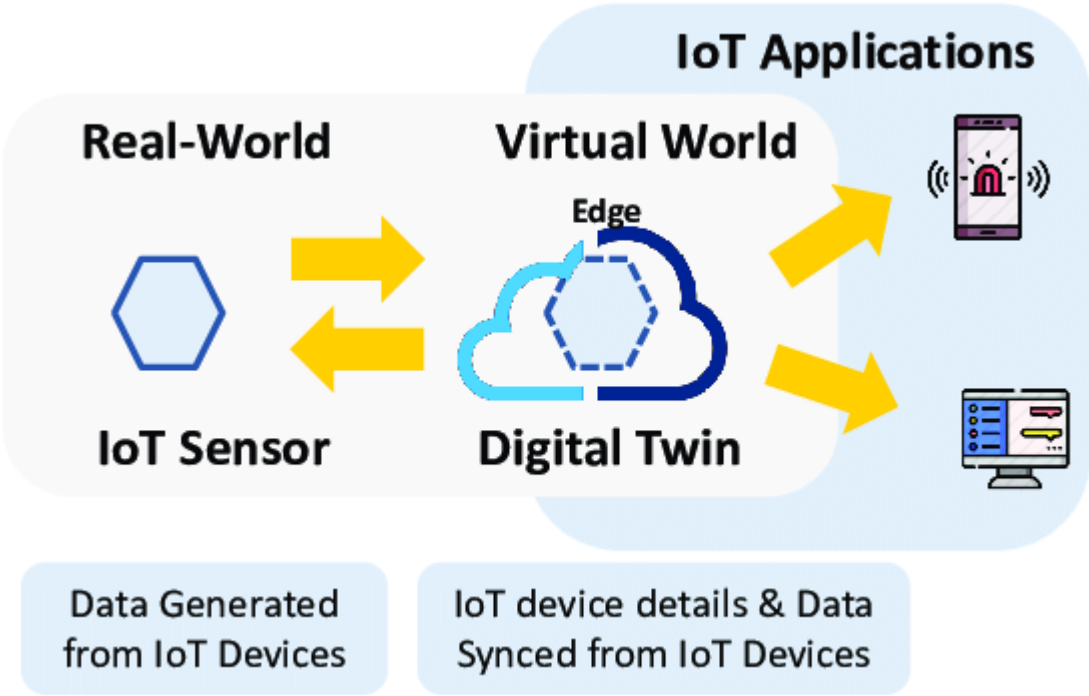


IoT Application Domains

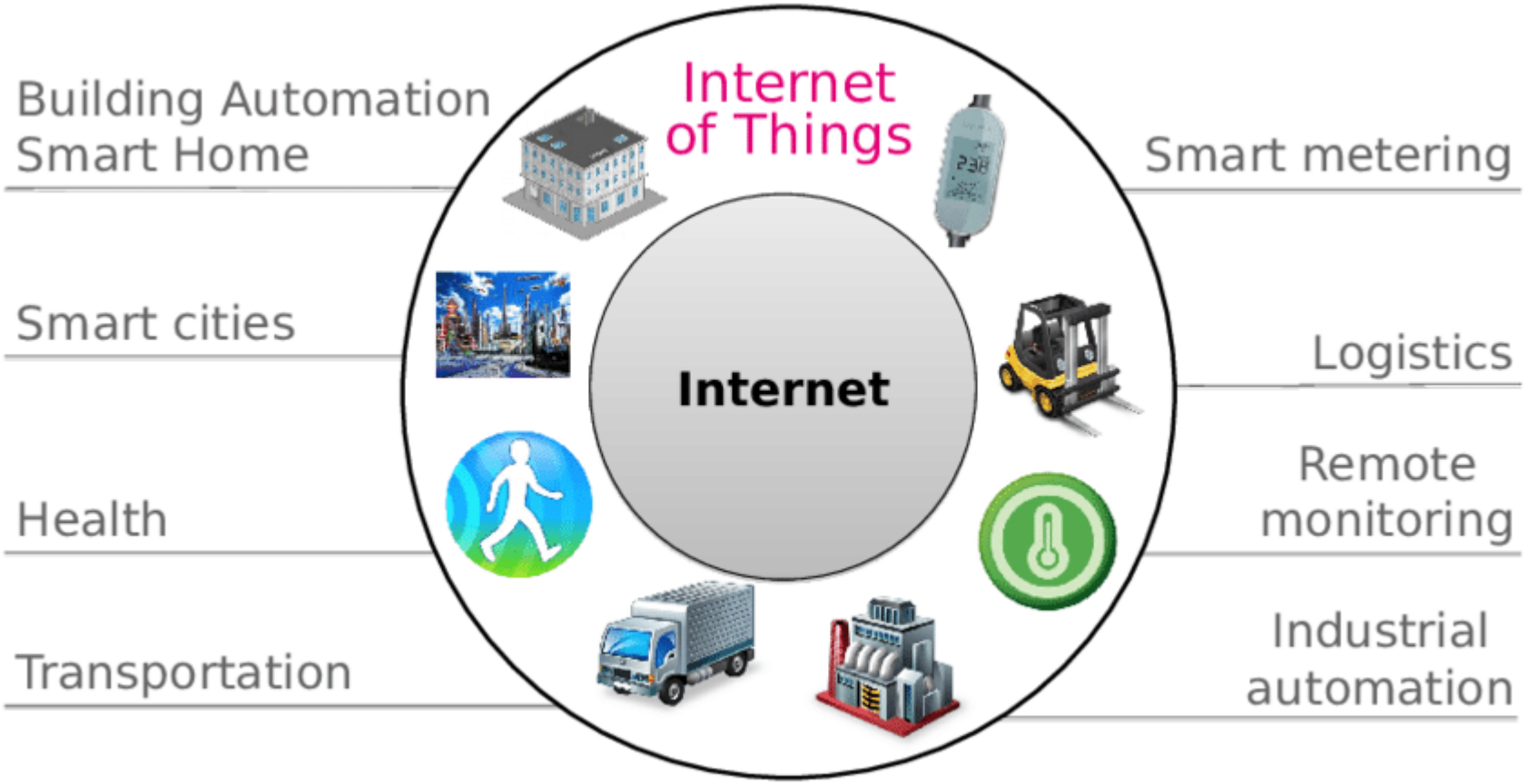


Digital Twins

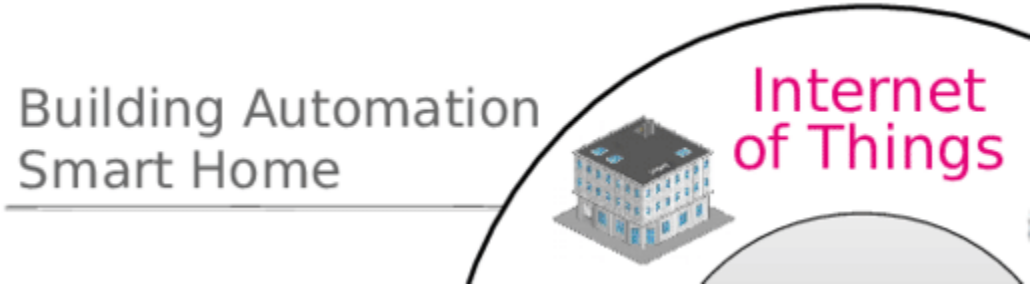
Each physical system has a digital simulation twin that can simulate real-time sensor data that enters to the physical system and generates recommendations to improve the performance at real time.



Domain of IoT Usage & Applications



Domain of IoT Usage & Applications



- Facial and biomedical recognition
- Control and home security
- Intelligent systems maintenance
- Intelligent heating and cooling systems
- Control and monitoring of energy consumption (water, electricity, gas)

Domain of IoT Usage & Applications

- Intelligent monitoring
- Automatic transport
- The exact energy management systems
- Environmental monitoring

Domain of IoT Usage & Applications

- Patients Surveillance
- Sportsmen Care
- Ultraviolet Radiation
- Smart hospitals

Domain of IoT Usage & Applications

- Intelligent traffic control systems
- Intelligent systems for maintenance of roads (land, air and sea)
- Intelligent Systems Parking
- RFID tags communication

Domain of IoT Usage & Applications

- Detailed monitoring of energy production (by wind, solar, etc.)
- Detailed monitoring of consumption (in homes, offices, vehicles, factories)

Domain of IoT Usage & Applications

- Supply Chain Control
- Intelligent Shopping Applications
- Smart Product Management
- Inventory tracking
- Point-of-sale terminals
- Vending machines

Domain of IoT Usage & Applications

- Indoor Air Quality
- Temperature Monitoring
- Ozone Presence
- Indoor Location
- Vehicle Auto-diagnosis
- Sensors check the soil moisture and temperature.

IoT Components

Thing

+

Intelligence (local)
sensors/actuators

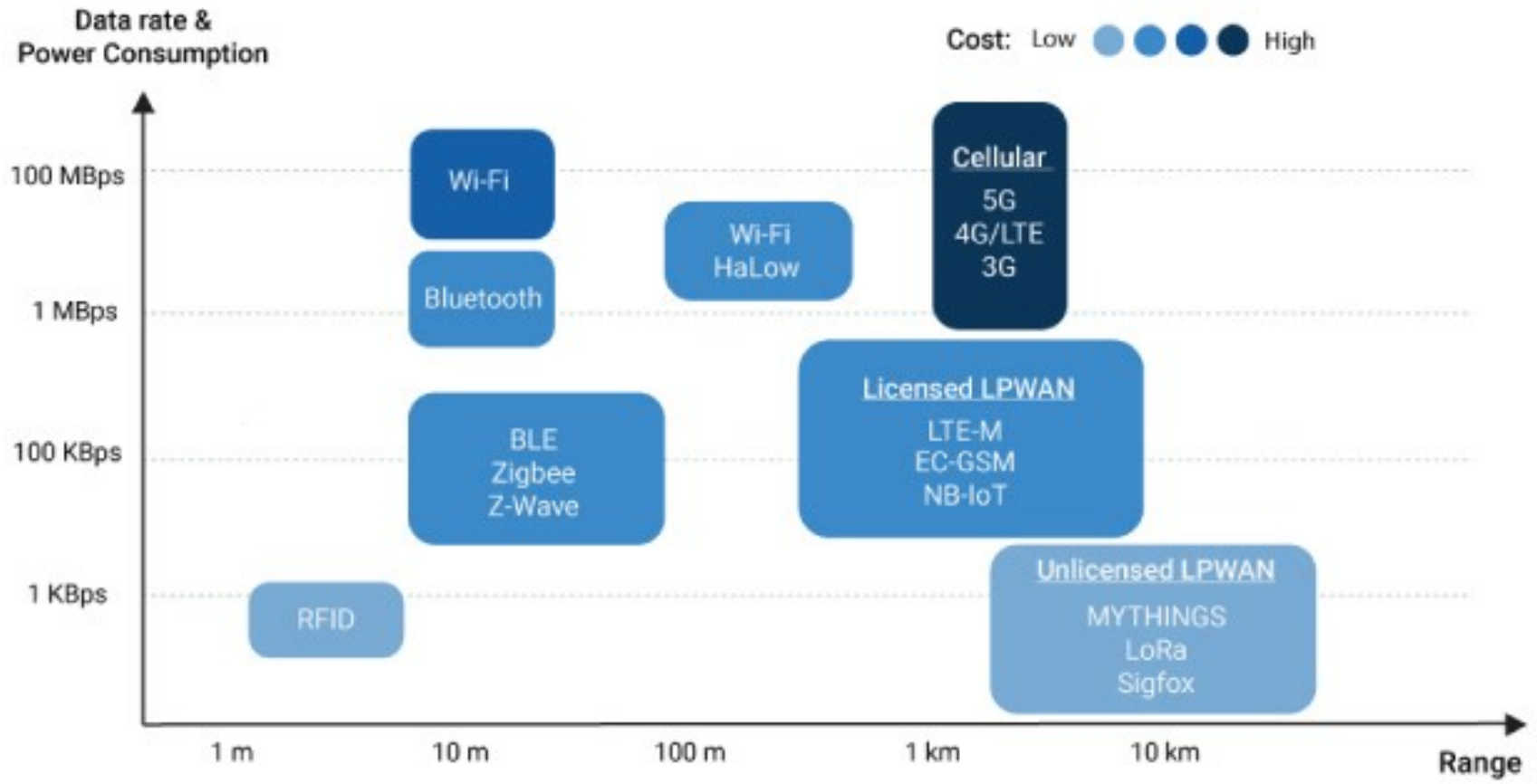
+

Network (global)

IoT Components

- Sensors can be real sensors or virtual sensors.
- Control is done using FPGA, ASIC, or processors.
- Communication can be done using many types of protocols such as RFID, AD-HOC, Ethernet, Wi-Fi, 3G, 4G, Bluetooth, ZigBee, USB, WSN, and IPv6, which are ranging from short-range to long-range communications.

IoT Communication Protocols

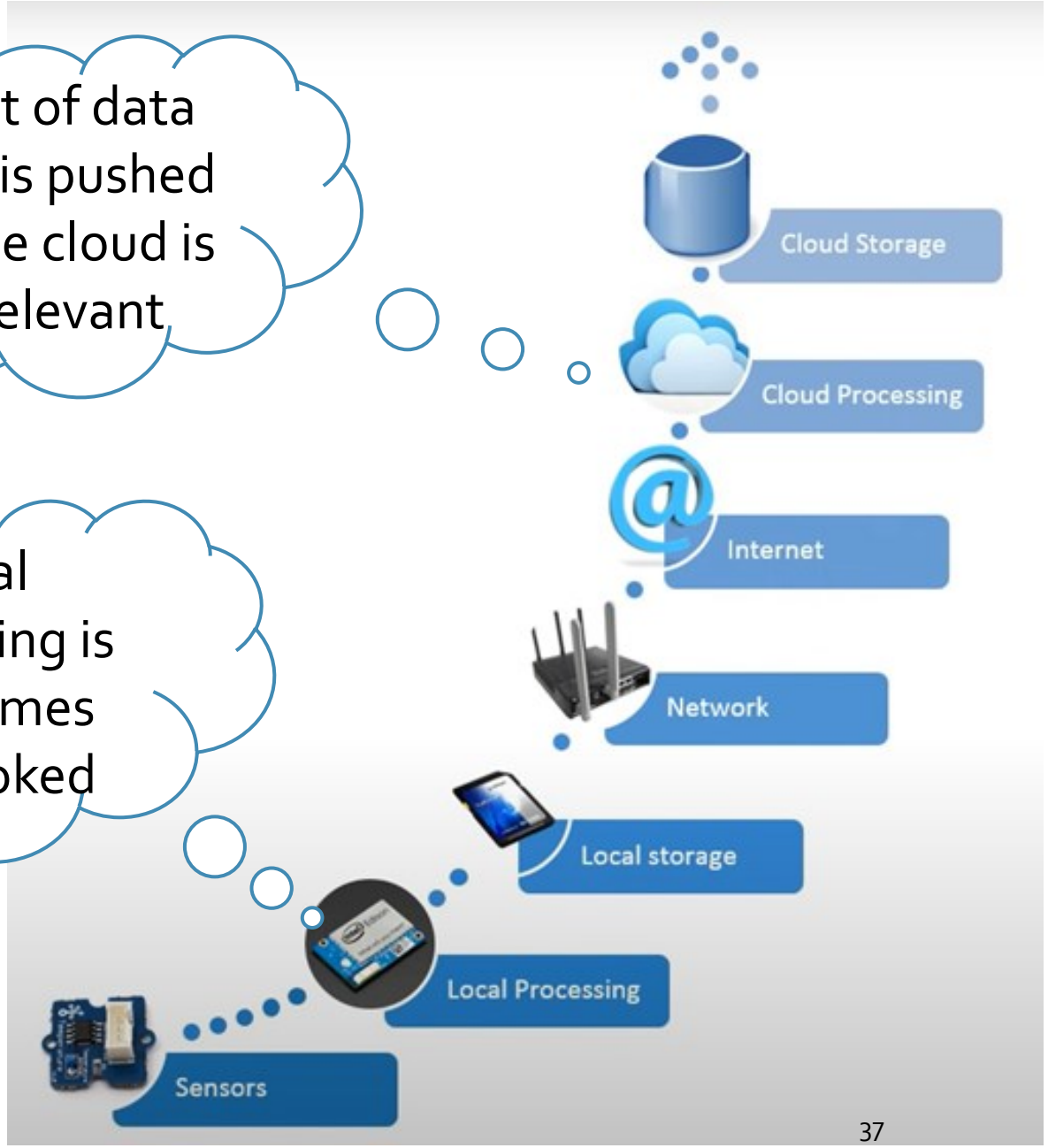


IoT Stack

This is the ideal schematic

A lot of data that is pushed to the cloud is irrelevant

Local processing is sometimes overlooked



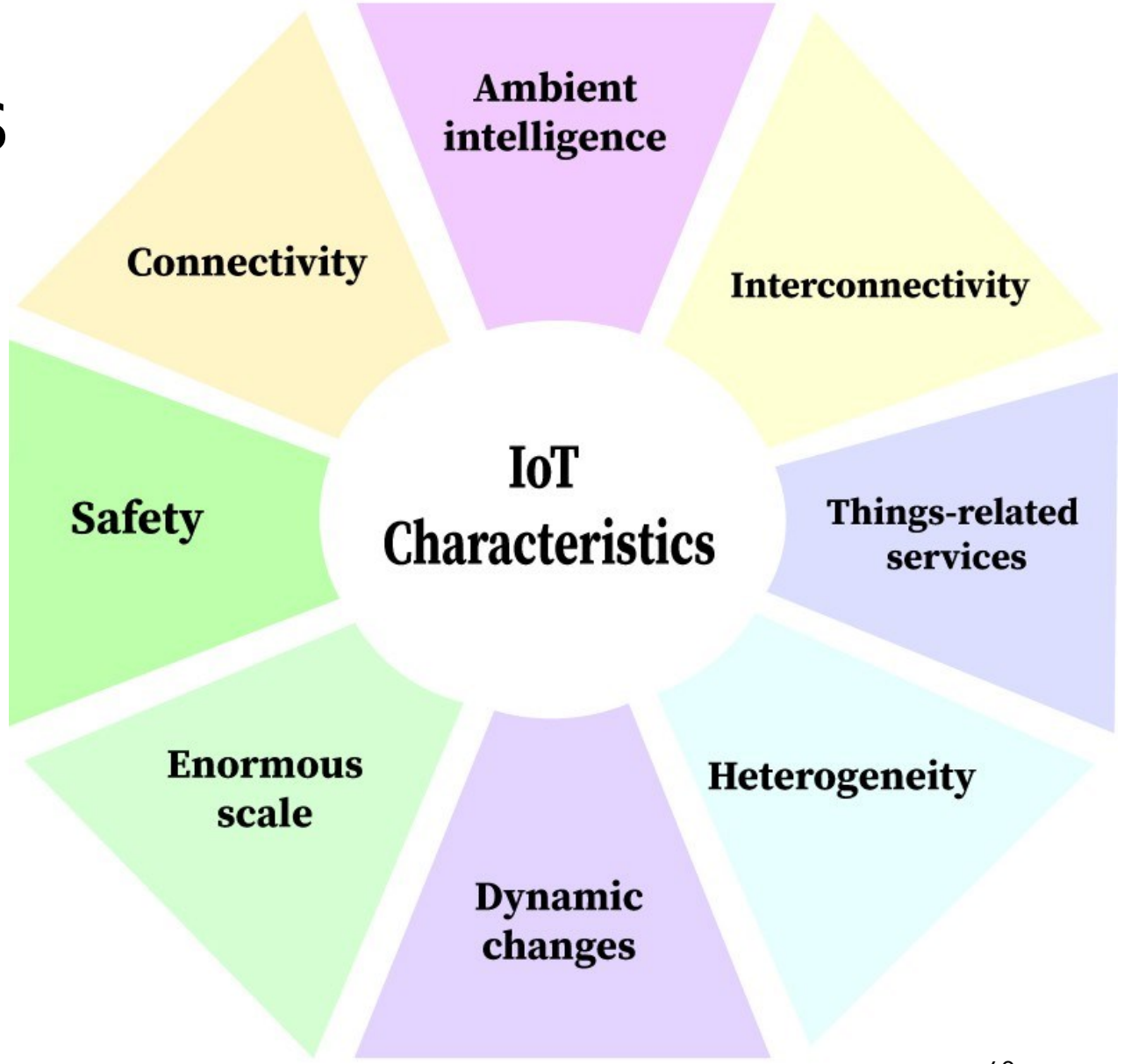
IoT Enabling Technologies

- Wireless Sensor Network
- Cloud Computing
- Big Data Analytics
- Communication Protocols
- Embedded Systems

IoT Characteristics

+

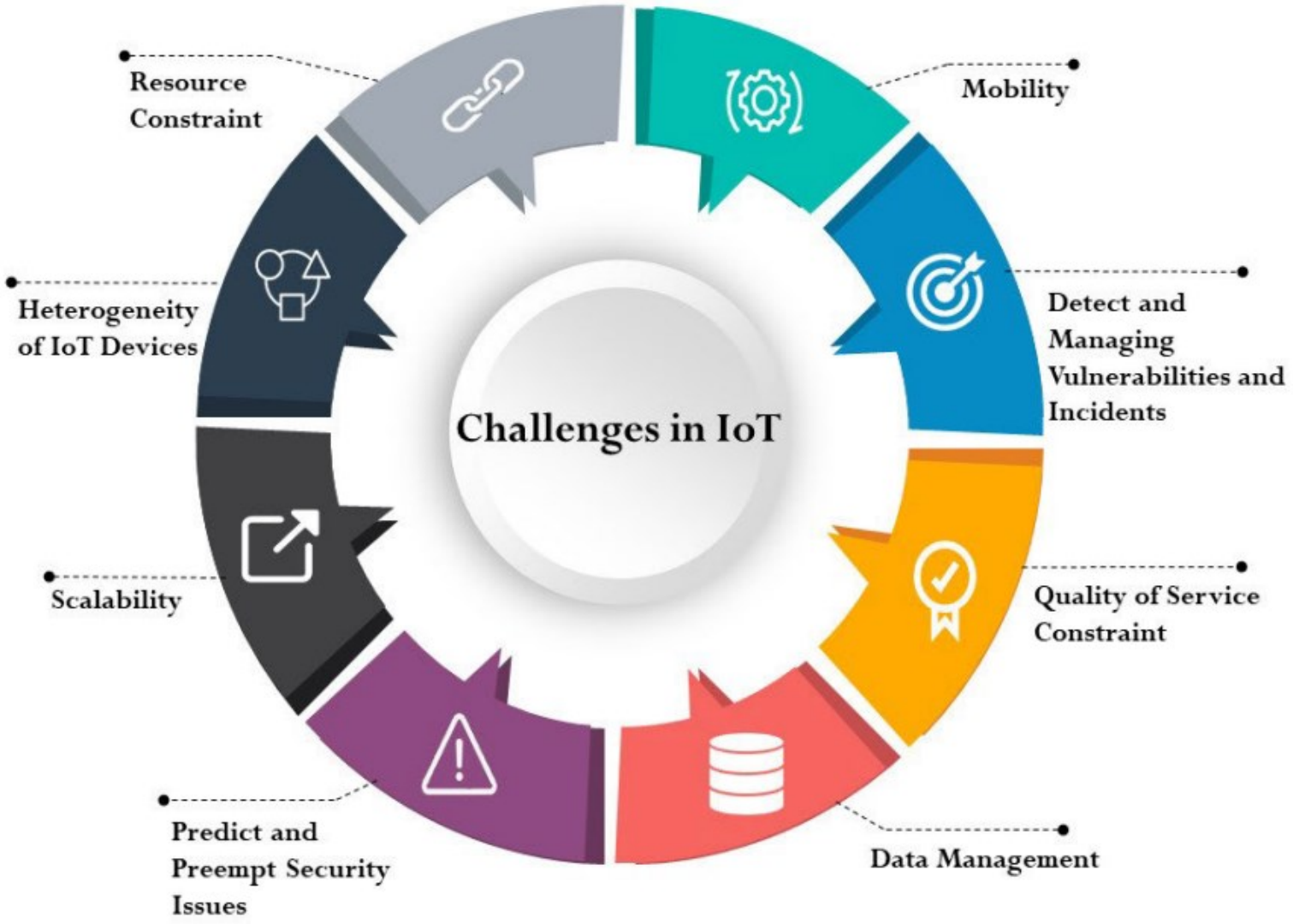
- Minimal human intervention during operation or configuration.
- Long battery lifetime as most of IoT devices are battery-operated devices.



IoT 4s's Rule

- Any IoT system should satisfy 4s's rule:
  - **S**imple,
  - **S**ecure,
  - **S**mart,
  - **S**calable

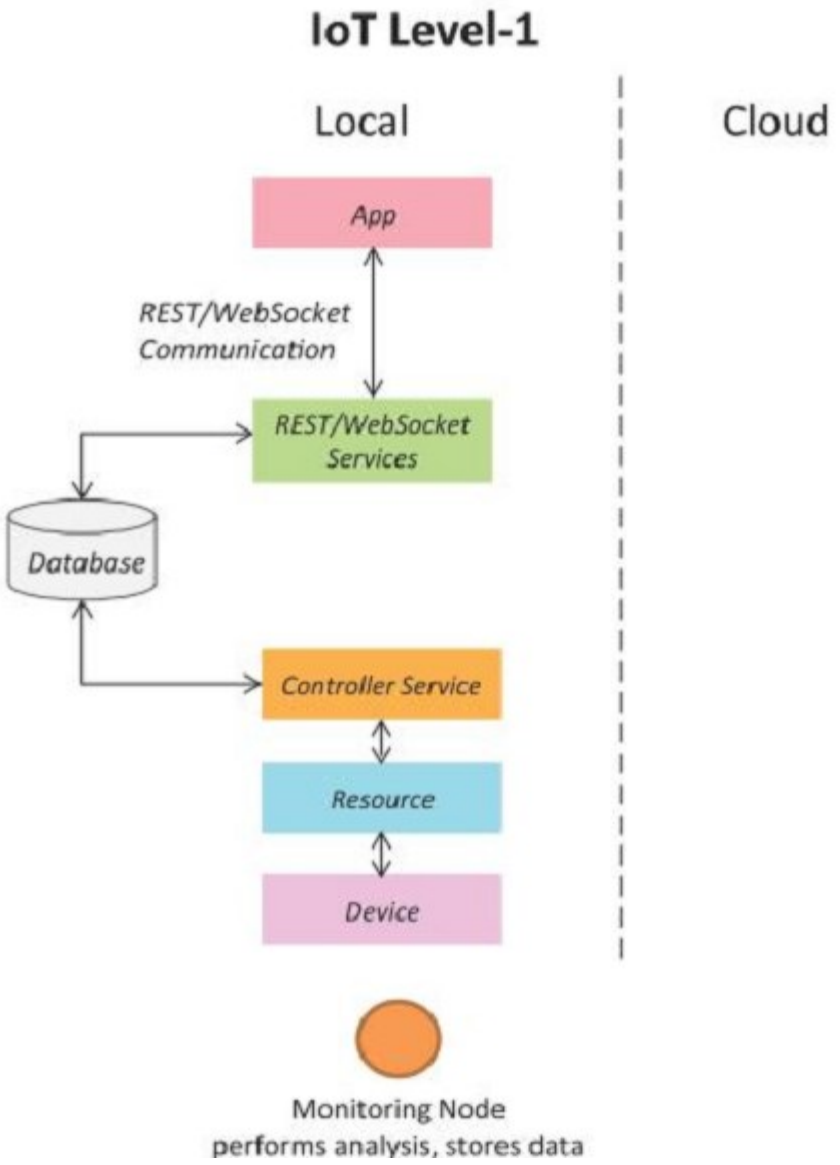
IoT Challenges



IoT Levels & Deployment Templates

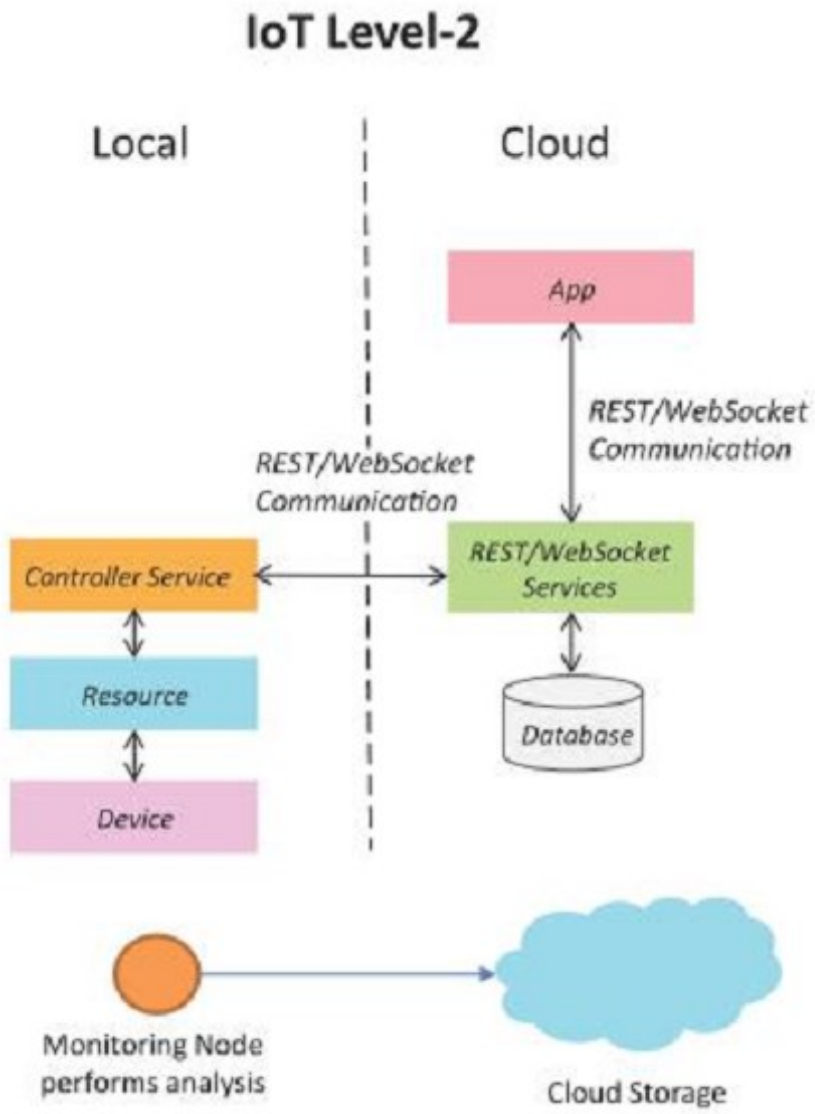
IoT Level-1
Device Level

- A level-1 IoT system has a single node/device that performs sensing and/or actuation, stores data, performs analysis and hosts the application
- Level-1 IoT systems are suitable for modeling **low-cost** and **low-complexity** solutions where the data involved is not big and the analysis requirements are not computationally intensive.



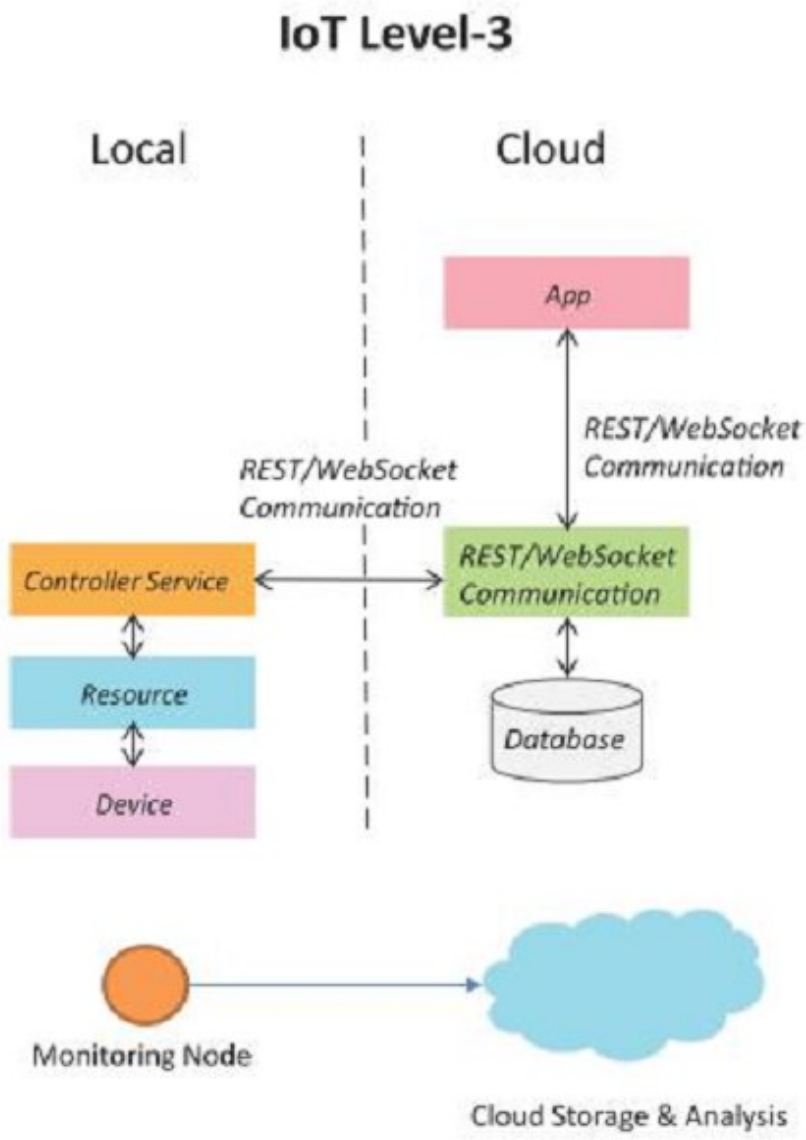
IoT Level-2
Device and Local Analysis

- A level-2 IoT system has a single node that performs sensing and/or actuation and local analysis.
- Data is stored in the cloud and application is usually cloud based.
- Level-2 IoT systems are suitable for solutions where the **data involved is big**, however, the primary analysis requirement is **not computationally intensive** and can be done locally itself.



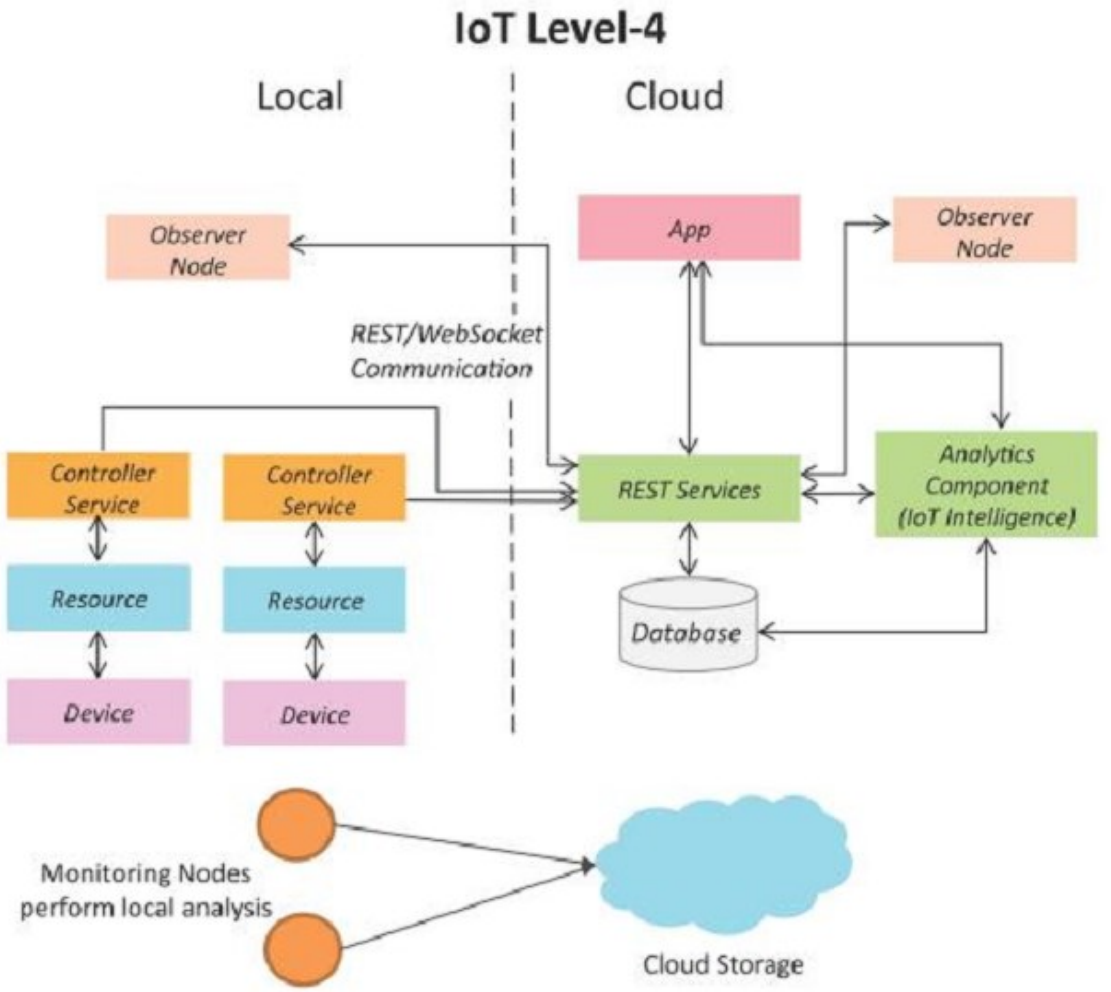
IoT Level-3
Cloud Analysis and Applications

- A level-3 IoT system has a single node. Data is stored and analyzed in the cloud and application is cloud based.
- Level-3 IoT systems are suitable for solutions where the **data involved is big** and the analysis requirements are **computationally intensive**.



IoT Level-4
Multiple Analyzing Nodes

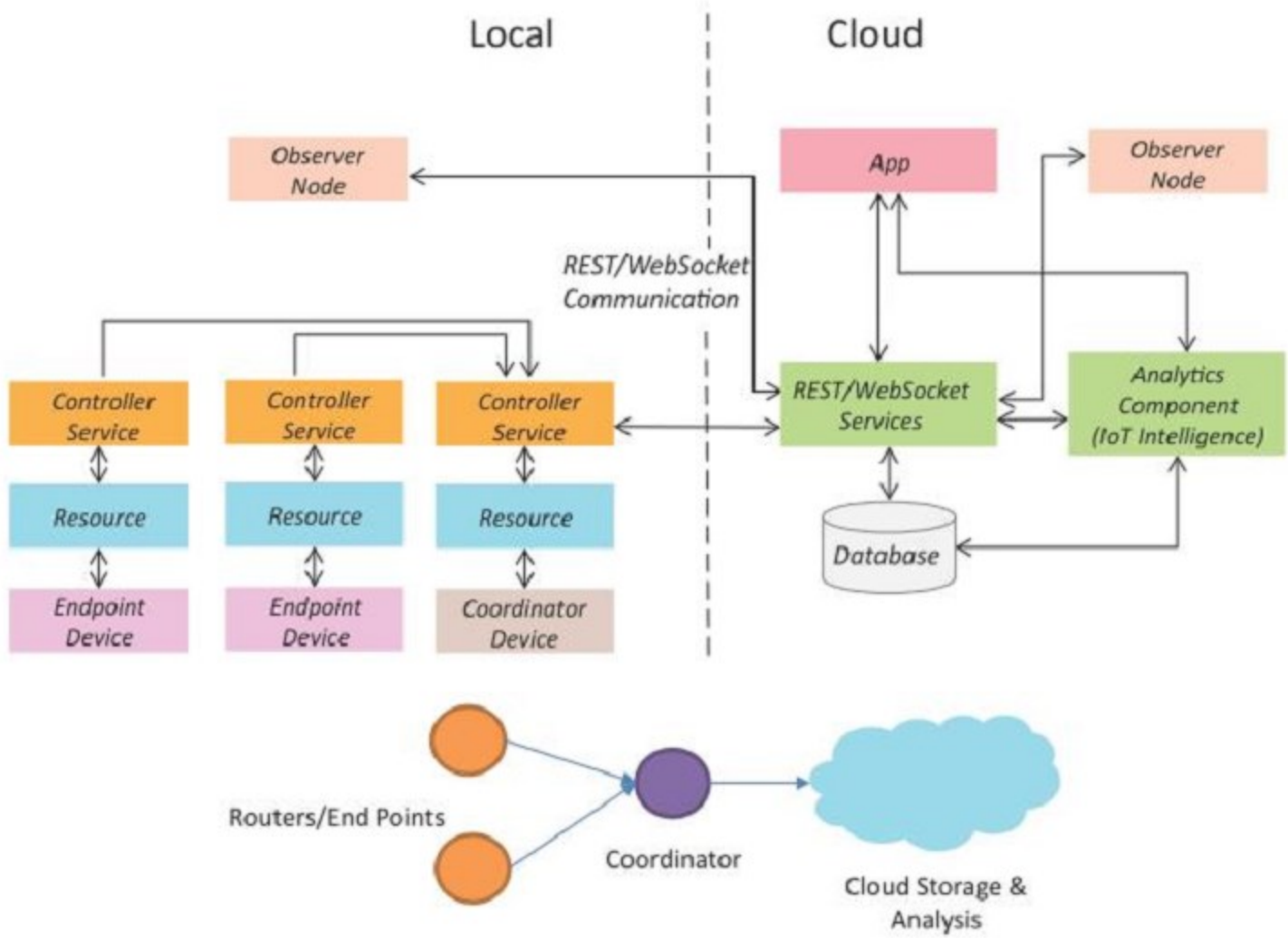
- A level-4 IoT system has multiple nodes that perform local analysis. Data is stored in the cloud and application is cloud-based.
- Level-4 contains local and cloud-based observer nodes which can subscribe to and receive information collected in the cloud from IoT devices.
- Level-4 IoT systems are suitable for solutions where **multiple nodes** are required, the **data involved is big** and the analysis requirements are **not computationally intensive**.



IoT Level-5 **Coordinator Node**

- A level-5 IoT system has **multiple end nodes** and **one coordinator node**.
- The end nodes that perform sensing and/or actuation.
- Coordinator node collects data from the end nodes and sends to the cloud.
- Data is stored and analyzed in the cloud and application is cloud-based.
- Level-5 IoT systems are suitable for solutions based on wireless sensor networks, in which the **data involved is big** and the analysis requirements are **computationally intensive**.

IoT Level-5

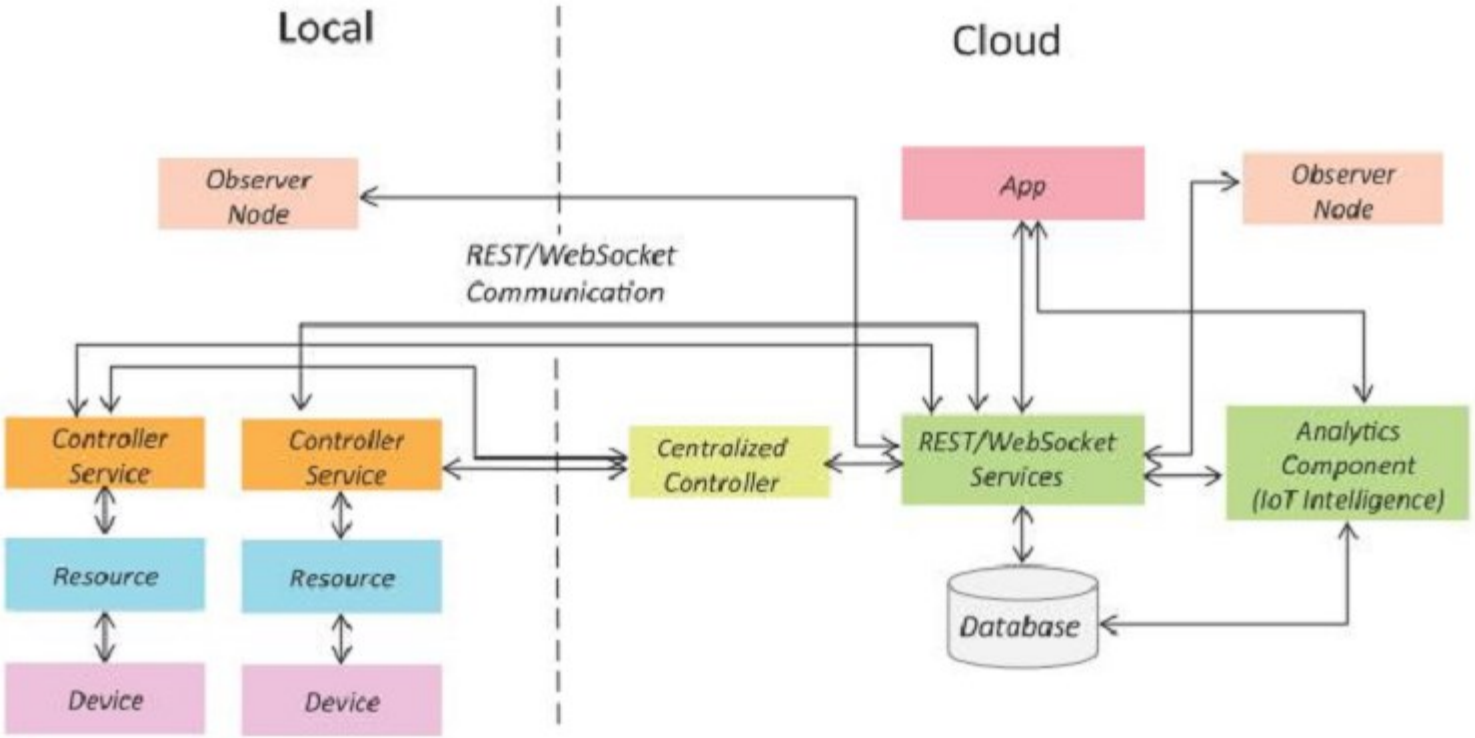

Local
Cloud
Observer Node
App
Observer Node
REST/WebSocket Communication
Controller Service
Controller Service
Controller Service
REST/WebSocket Services
Analytics Component (IoT Intelligence)
Resource
Resource
Resource
Database
Endpoint Device
Endpoint Device
Coordinator Device
Routers/End Points
Coordinator
Cloud Storage & Analysis

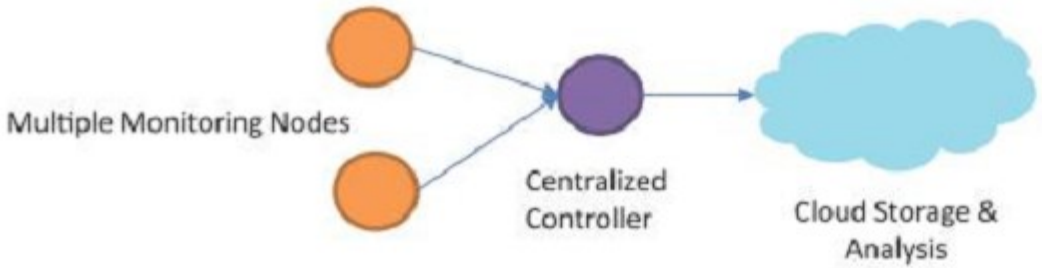
IoT Level-6

Independent Nodes with Cloud Communication

- A level-6 IoT system has multiple independent end nodes that perform sensing and/or actuation and send data to the cloud.
- Data is stored in the cloud and application is cloud-based.
- The **analytics component** analyzes the data and stores the results in the cloud database.
- The results are visualized with the **cloud-based application**.
- The centralized controller is aware of the status of all the end nodes and sends control commands to the nodes.

IoT Level-6


Local
Cloud
Observer Node
App
Observer Node
REST/WebSocket Communication
Controller Service
Controller Service
Centralized Controller
REST/WebSocket Services
Analytics Component (IoT Intelligence)
Resource
Resource
Database
Device
Device


Multiple Monitoring Nodes
Centralized Controller
Cloud Storage & Analysis


Thank
you!