# Introduction to IoT

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# IoT and its importance

- What is IoT?

IoT or Internet of things describes physical objects that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks

- Importance?

Live smarter, automate home and business, reduce cost

# Elements & Characteristics of IoT

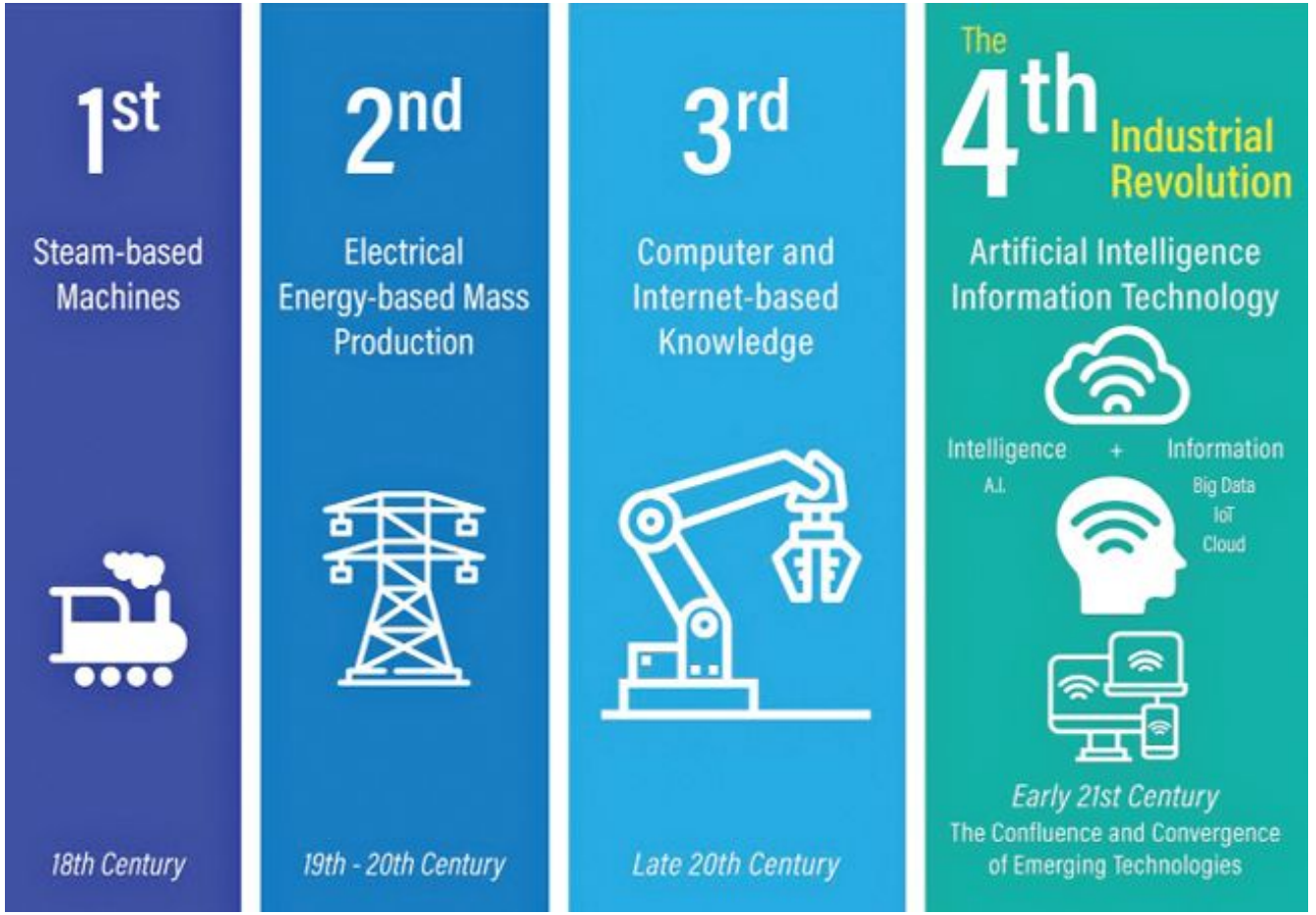
- Elements of IoT

  4 fundamental components of IoT system,
  - Sensors/Device
  - Connectivity
  - Data Processing
  - UI
- Characteristics of IoT

  6 basic characteristics
  - Connectivity
  - Intelligence and Identity
  - Scalability
  - Dynamic and Self-Adapting (Complexity)
  - Architecture
  - Safety

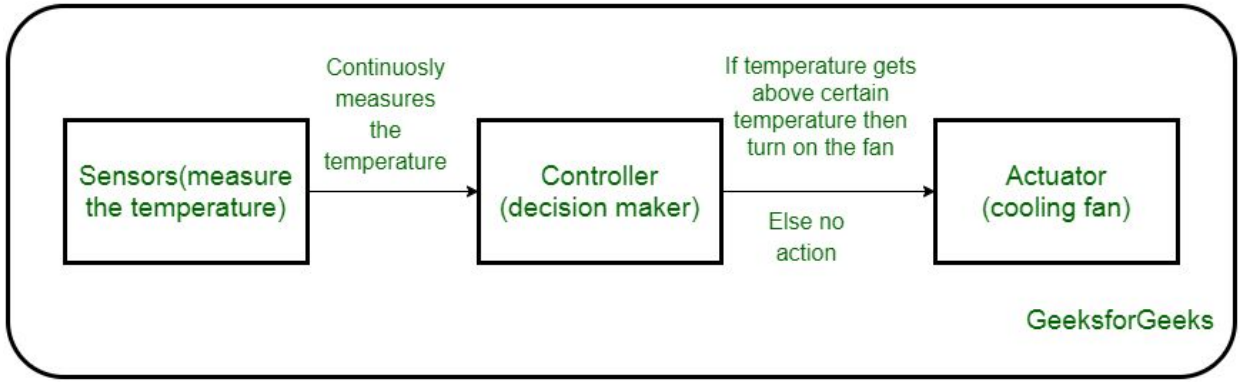
# Influence of in 4th Industrial Revolution

- The Fourth Industrial Revolution is data-driven. And a primary reason for this is the rise of the internet of things (IoT). Connected devices from the consumer level to the industrial are creating—and consuming—more data than ever before.

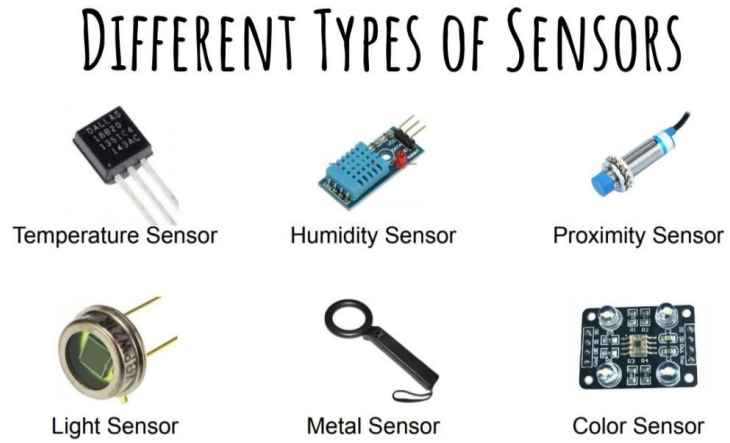


# Sensors, Actuators, Physical Design of IoT

- **A sensor** is **a device that detects and responds to some type of input from the physical environment**. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena.
- **An actuator** is a machine component or system that moves or controls the mechanism or the system.




- **An IoT device** is made up of a Physical object (“thing”) + Controller (“brain”) + Sensors + Actuators + Networks (Internet)



# Embedded Systems

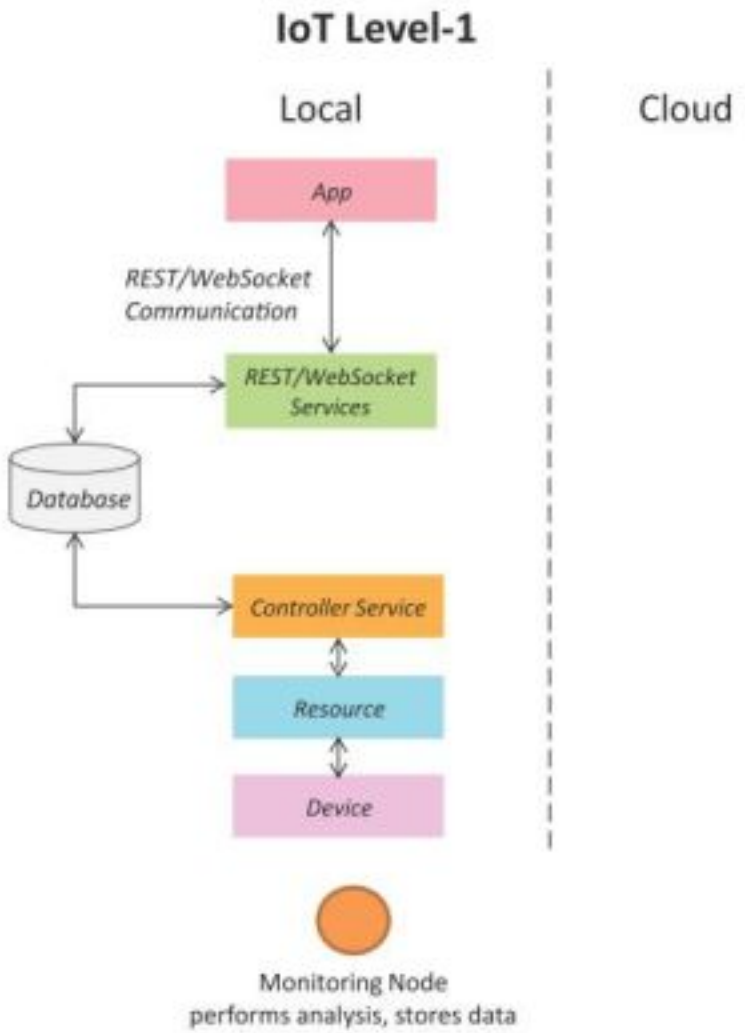
- **An embedded system** is a computer system—a combination of a computer processor, computer memory, and input/output peripheral devices—that has a dedicated function within a larger mechanical or electronic system
- IoT is embedded system that connects to internet. Embedded systems are not updated after they are shipped to customer but IoT may be updated with time.

# IoT Levels & Deployment Templates

- **Database**: Database can be either local or in the cloud and stores the data generated by the IoT device.
- **Web Service**: Web services serve as a link between the IoT device, application, database and analysis components. Web service can be either implemented using HTTP and REST principles (REST service) or using WebSocket protocol (WebSocket service).
- **Analysis Component**: The Analysis Component is responsible for analyzing the IoT data and generate results in a form which are easy for the user to understand.
- **Application**: IoT applications provide an interface that the users can use to control and monitor various aspects of the IoT system. Applications also allow users to view the system status and view the processed data.

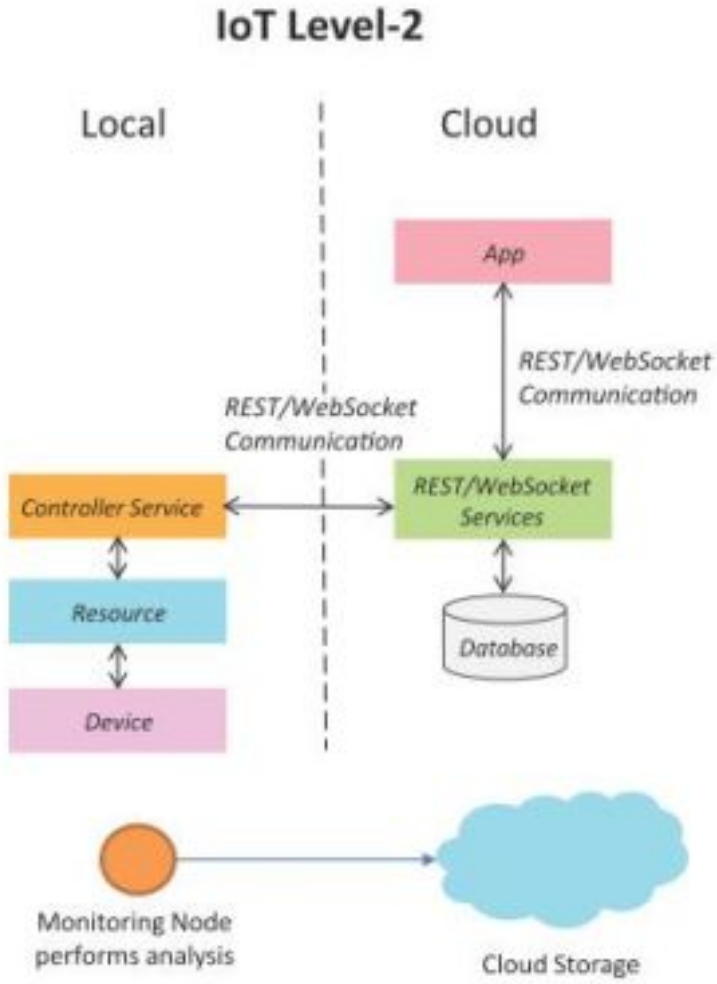
# IoT Level-1

- 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.



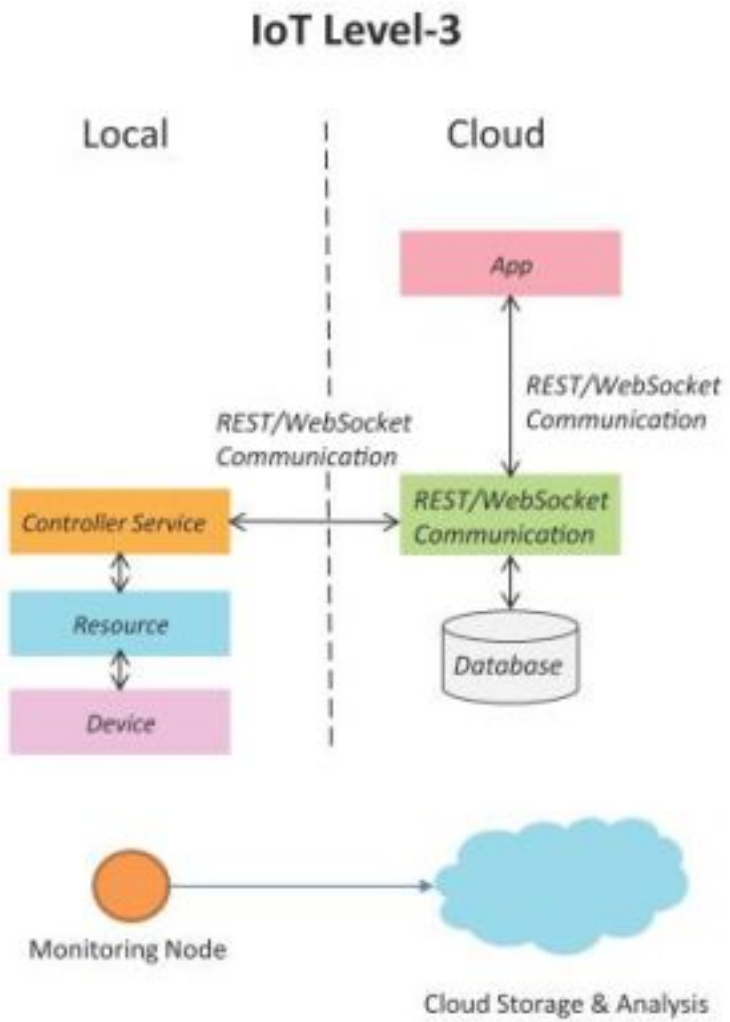
# IoT Level-2

- 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.



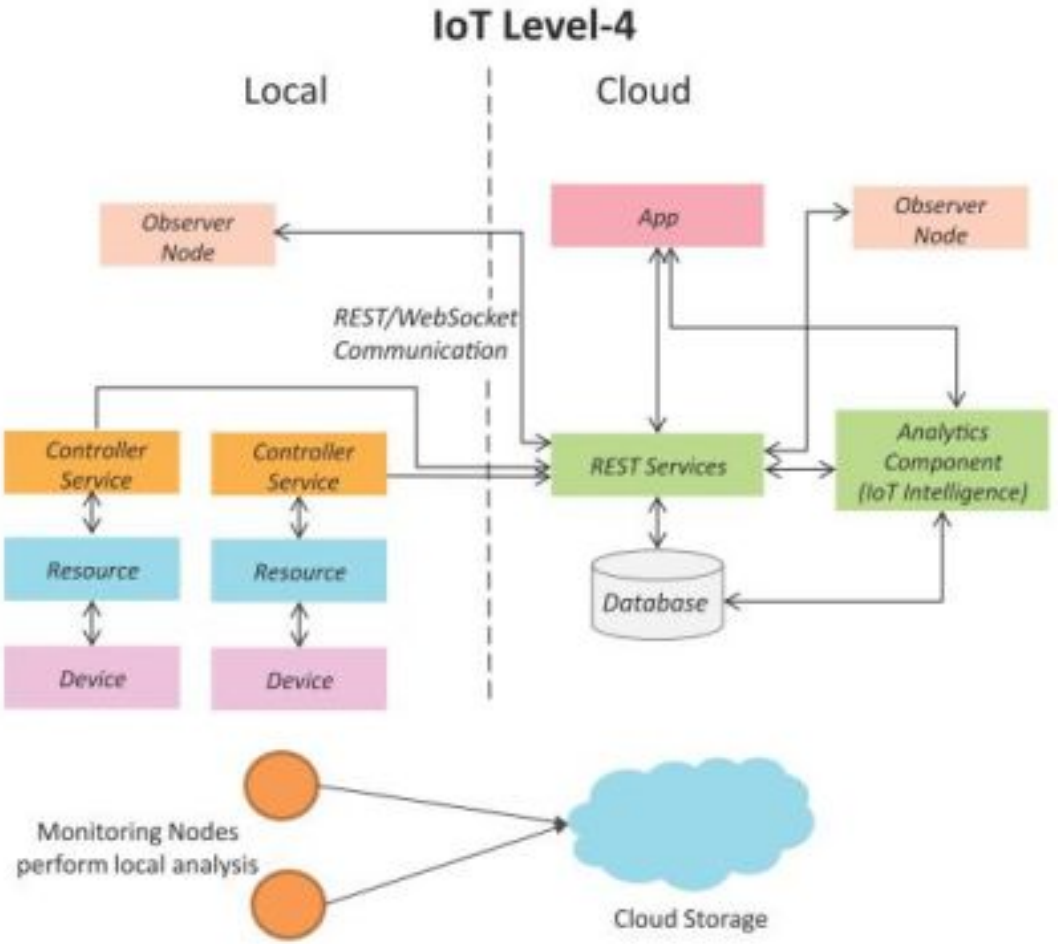
# IoT Level-3

- 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.



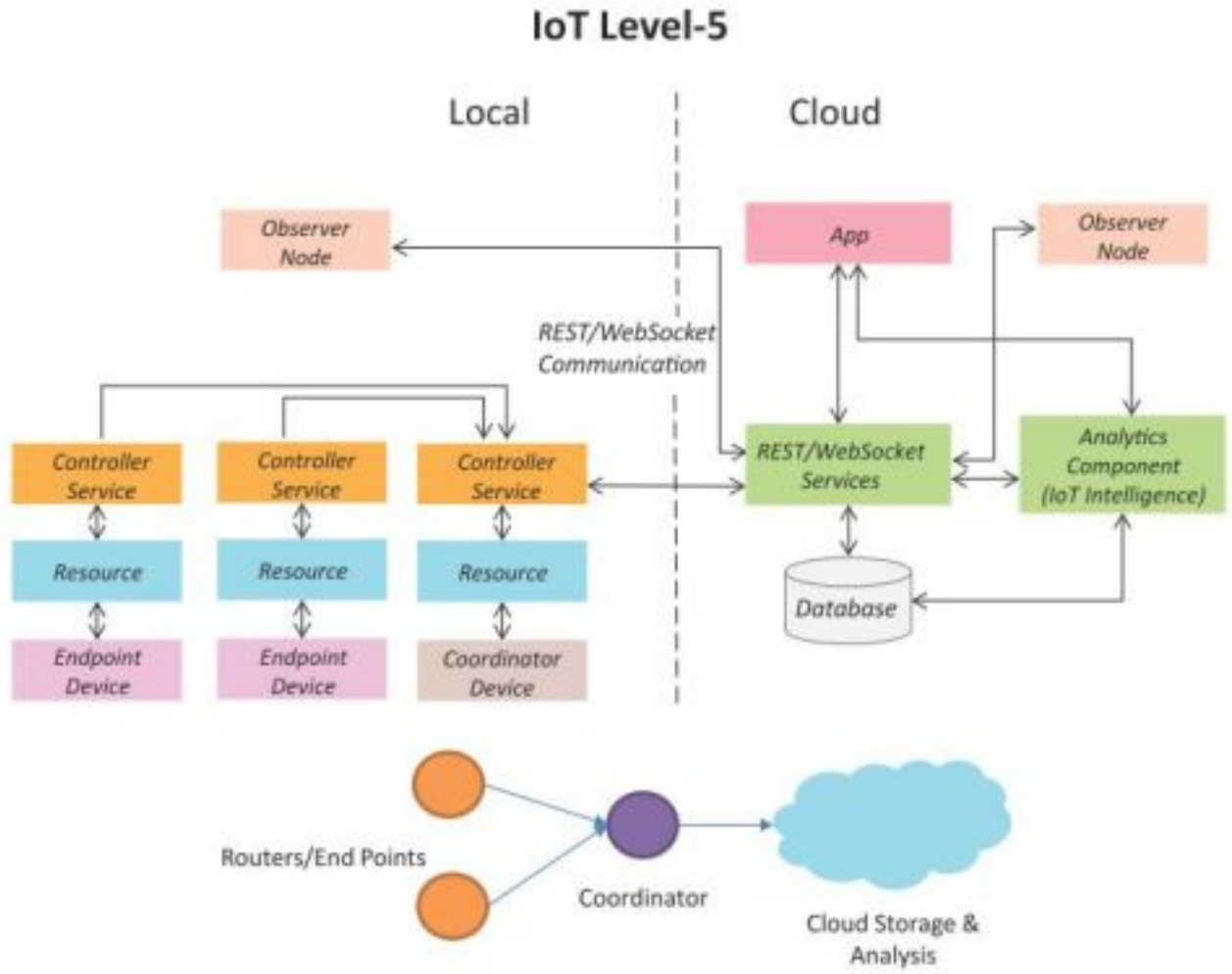
# IoT Level-4

- 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 computationally intensive.



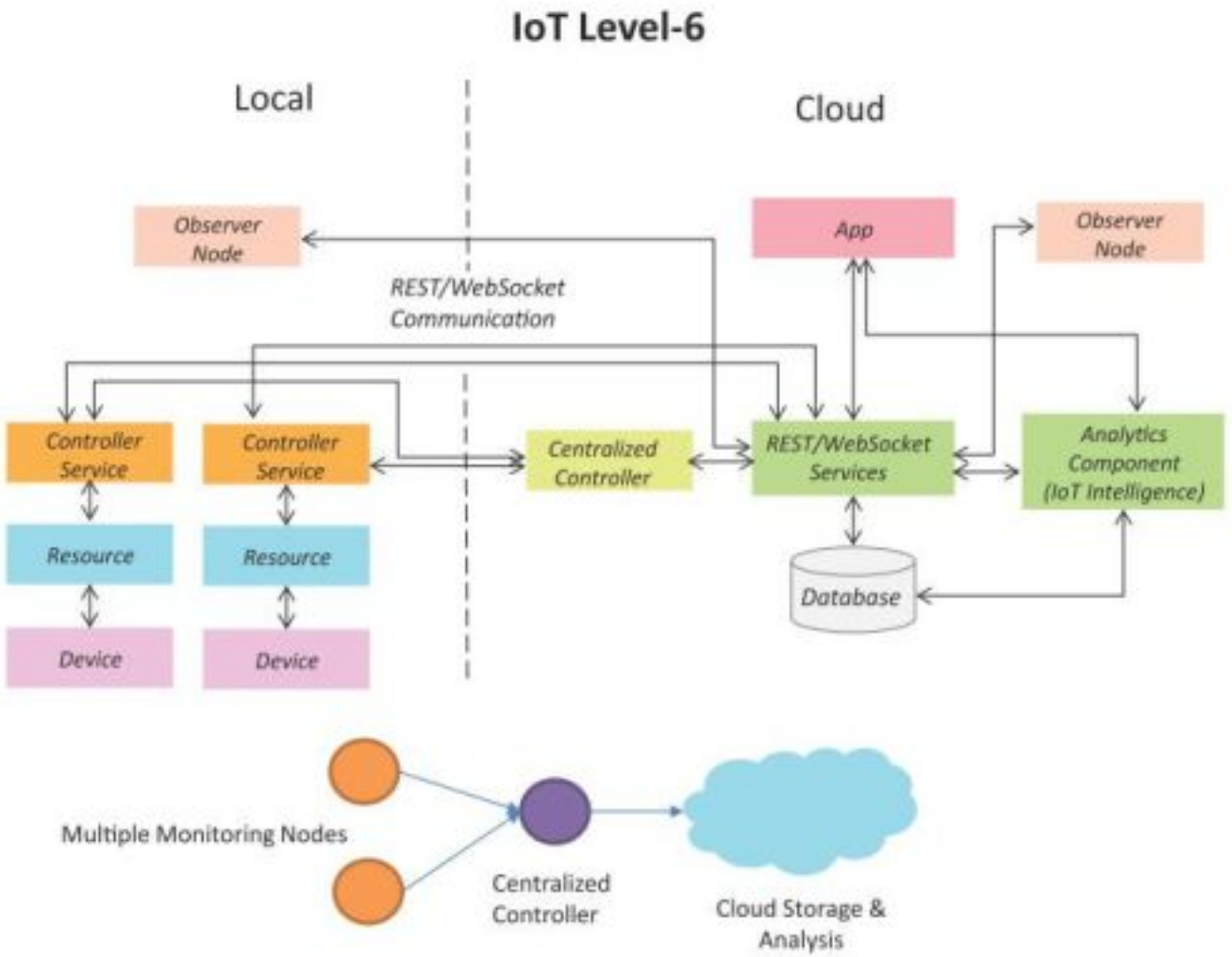
# IoT Level-5

- 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-6

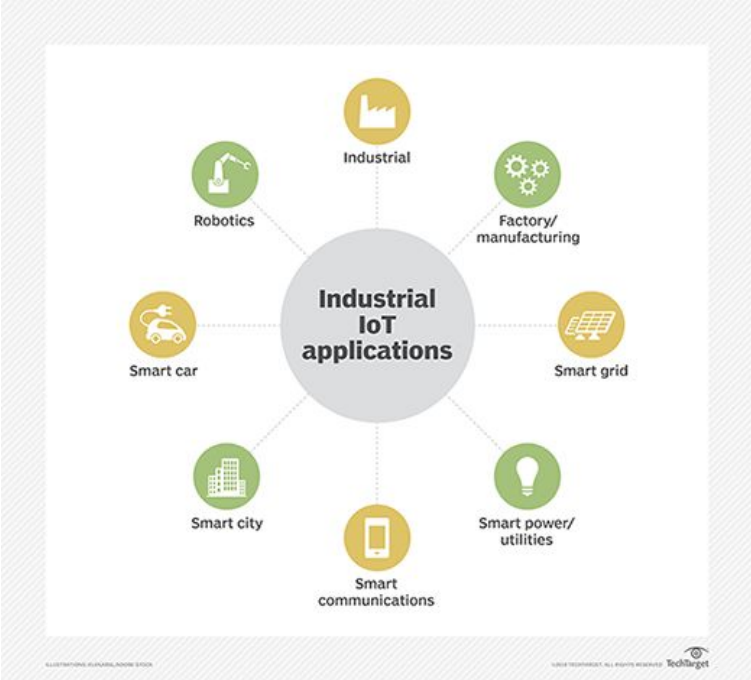
- A level-6 IoT system has multiple independent end nodes that perform sensing and/or actuation and send data to the cloud.
- Data is stored in the cloud and application is cloud-based.
- The analytics component analyzes the data and stores the results in the cloud database.
- The results are visualized 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.



# Domain Specific IoTs: Home automation


IoT home automation is **the ability to control domestic appliances by electronically controlled, internet-connected systems.**

# Domain Specific IoTs: Industrial application




The industrial internet of things refers to interconnected sensors, instruments, and other devices networked together with computers' industrial applications, including manufacturing and energy management.

# Domain Specific IoTs: Agriculture

On farms, IOT **allows devices across a farm to measure all kinds of data remotely and provide this information to the farmer in real time**. IOT devices can gather information like soil moisture, chemical application, dam levels and livestock health - as well as monitor fences vehicles and weather.

# Domain Specific IoTs: Surveillance


Video surveillance capabilities are enhanced by IoT technology. Smart cameras and connected applications can process visual information without human intervention, opening the door for the adoption of many automated processes.

# Future Factory Concepts

- **Industrial Internet of Things(IIoT) in manufacturing & Smart Factories**

Widely applied in sourcing and production, assembly and packaging, warehousing and supply chain management, IIoT solutions enable a fully-connected factory where information and operational commands can be directly sent to suppliers, manufacturers and distributors. Smart factories can achieve improved manufacturing efficiency and quality, enhanced human activity support and reduced energy consumption and costs. Many industrial and tech companies are venturing into IIoT product development, aiming to bring innovative IIoT solutions to smart manufacturing.

# Green vs Brown Field of IoT

- **Greenfield IoT development :** In software development, greenfield refers to software that is created from scratch in a totally new environment. No constraints are imposed by legacy code, no requirements to integrate with other systems.

- **Brownfield IoT development :**Again, to take the cue from software development, brownfield development refers to any form of software that created on top of legacy systems or with the aim of coexisting with other software that are already in use. This will impose some constraints and requirements that will limit design and implementation decisions to the developers. The development process can become challenging and arduous and require meticulous analysis, design and testing, things that many upstart developers don’t have the patience for.

# Smart Objects

- The concept of smart in IoT is used for physical objects that are active, digital, networked, can operate to some extent autonomously, reconfigurable and has local control of the resources. The smart objects need energy, data storage, etc.
- A smart object carries blocks of application logic that make sense for their local situation and interact with human users. A smart object sense, log, and interpret the occurrence within themselves and the environment, and intercommunicate with each other and exchange information with people.
- Example: Smartphone, Tablet, Smart TV, SmartMat etc.

Thank you