BITS Pilani presentation

BITS Pilani
Pilani Campus

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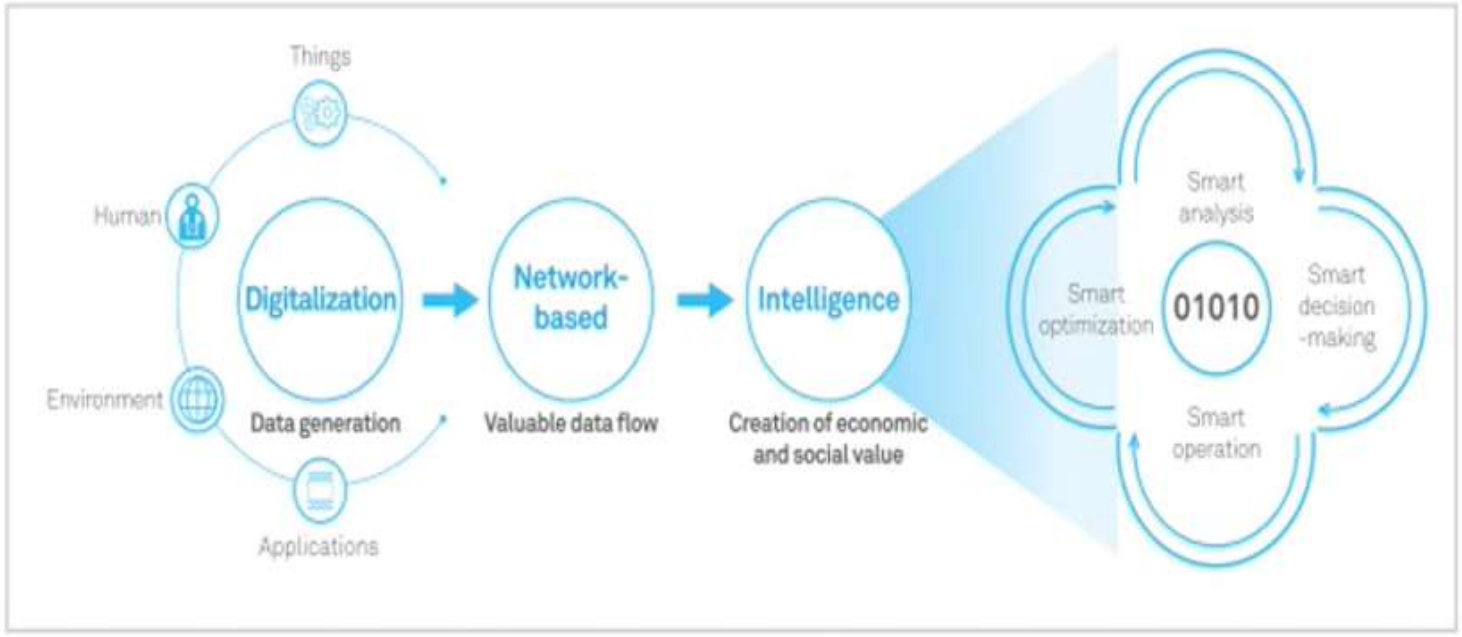
SEZG586/SSZG586, Edge Computing

Lecture No.1

Evolution of Computing

Industry moves to use Intelligence?

Digital transformation of Industries



Digital Transformation

Intelligence Technologies

- Big Data
- Machine learning
- Deep learning

Applications

- Speech recognition – Smart assistance
- Image recognition – AR/VR
- User Profiling
- Wearables
- Connected Cars

Digital Transformation

Industries

- Manufacturing
- Power
- Transportation
- Healthcare
- Agriculture

Intelligence in Industry

Industry intelligence is defined in two phases.

Phase 1: Oriented to the business process

- Market leads
- Marketing
- Purchase
- Logistics
- After-sales

Intelligence in Industry

Technology support for Phase 1

Transformation and Communications Technology (ICT)

- Ubiquitous network connections
- Cloud computing
- Big Data mining and analytics

Intelligence in Industry

Phase II : Oriented to the production processing covering

- Product planning
- Designing
- Manufacturing
- Operation

Intelligence in Industry

Products, production equipment, and manufacturing process have already started to become digitalized and network-based.

This phase aims at:

- Improve agility and collaboration.
- Increase resources sharing and save energy.
- Reduce uncertainties in production and operation.

Edge Computing - definition

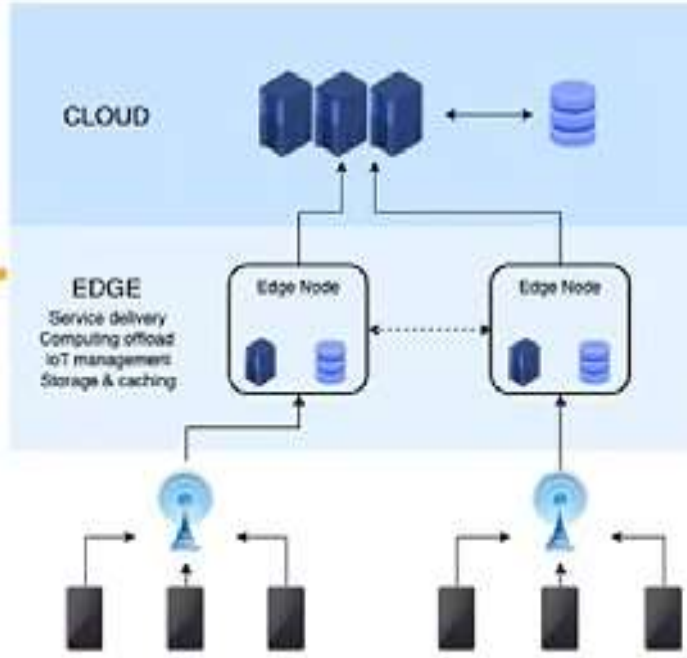
"Edge computing in telecom, often referred to as Mobile Edge Computing, MEC, or Multi-Access Edge Computing, provides execution resources (compute and storage) for applications with networking close to the end users, typically within or at the boundary of operator networks." – **Ericsson**

"Edge computing is a distributed, open IT architecture that features de-centralised processing power, enabling mobile computing and Internet of Things (IoT) technologies. In edge computing, data is processed by the device itself or by a local computer or server, rather than being transmitted to a data centre." – **HP**

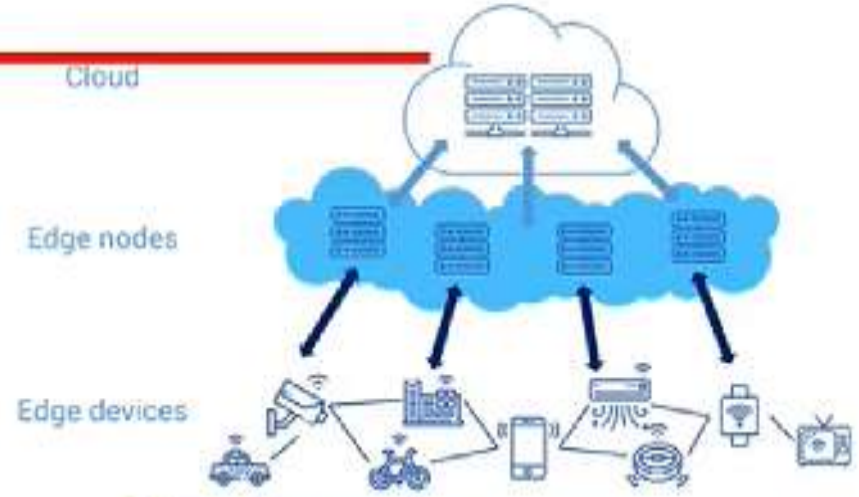
"Edge computing is a distributed computing framework that brings enterprise applications closer to data sources such as IoT devices or local edge servers." – **IBM**

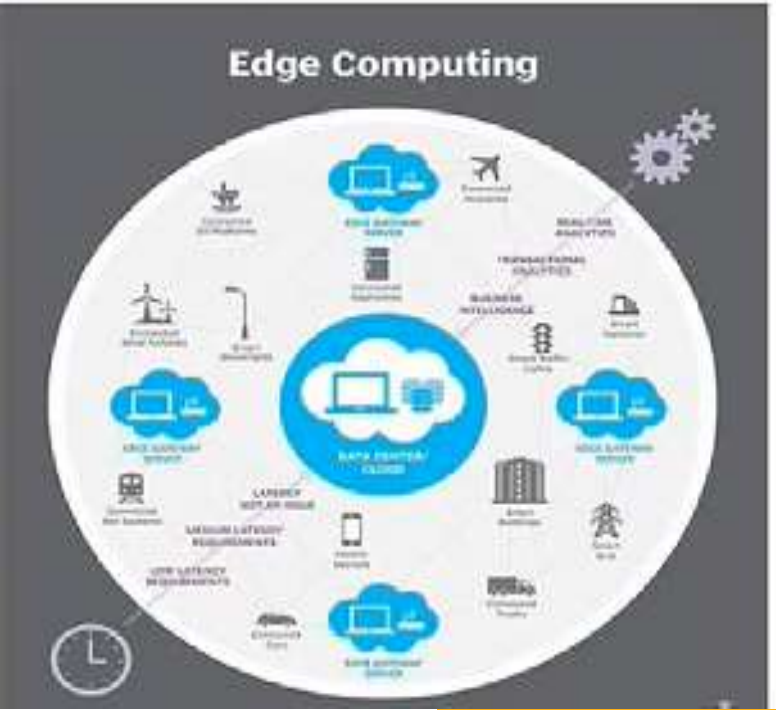
"Edge computing is part of a distributed computing topology where information processing is located close to the edge, where things and people produce or consume that information." – **Gartner**

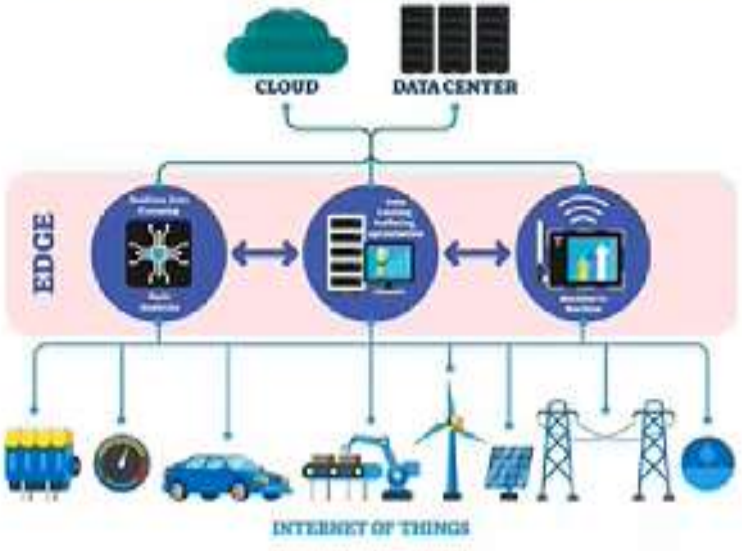
"Edge computing is a distributed computing paradigm that brings computation and data storage closer to the sources of data. This is expected to improve response times and save bandwidth. "A common misconception is that edge and IoT are synonymous"" - Wikipedia


CLOUD
EDGE
Service delivery
Computing offload
IoT management
Storage & caching
Edge Node
Edge Node


innovate
achieve
lead


Cloud
Edge nodes
Edge devices


Edge Computing


Edge Computing
CLOUD
DATA CENTER
EDGE
INTERNET OF THINGS

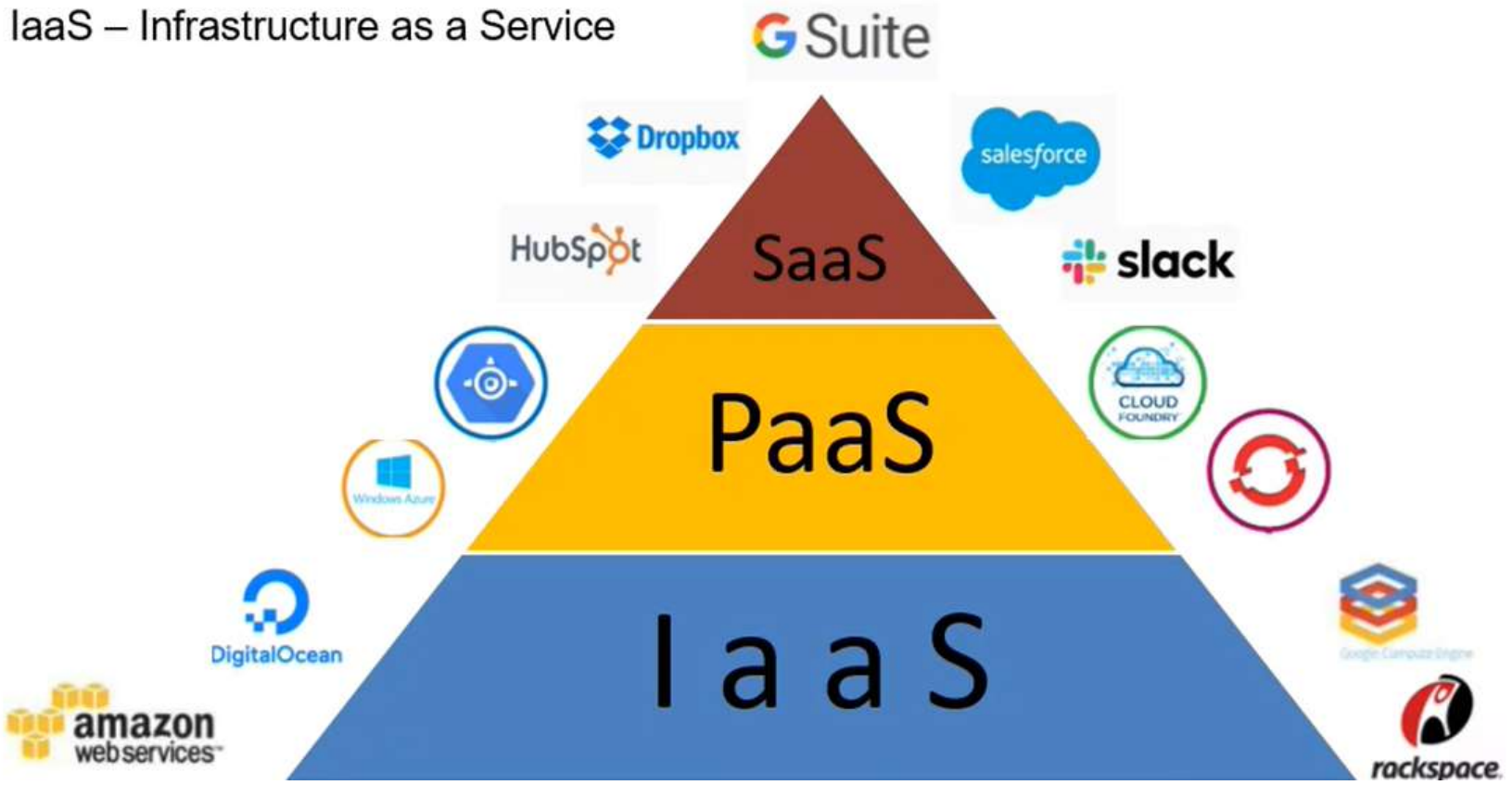
Before EDGE

Cloud Computing:

Cloud computing is relatively new business model in the computing world. According to the official NIST definition, "cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool configurable computing resources (e.g., network servers, storage, application and services) that can be rapidly provisioned and released with minimal management effort of service provider interactions."

Cloud Service Models

SaaS – Software as a Service
PaaS – Platform as a Service
IaaS – Infrastructure as a Service



3-4-5 rule of Cloud Computing

3 – cloud service models or service types

4- deployment models

5 – essential characteristics of cloud computing infrastructure

SaaS and Scalable Services

Software as a Service (SaaS)

- Google Apps, Twitter, Facebook, and Flickr

Scalable infrastructures – processing engines

- Google File System
- MapReduce
- Apache Hadoop
- Apache Spark

Support cloud service

Internet of Things(IoT)

"making a computer sense information without the aid of human intervention"

Adapted by

- Healthcare
- Home
- Environment
- Transportation
- Heavy Industry

Internet of Things(IoT)

Data produced by people, machines, and things

500 zettabytes

Global data center IP traffic

10.4 zettabytes

Things connected to the Internet by 2025

~100 billion and growing

What is IoT?

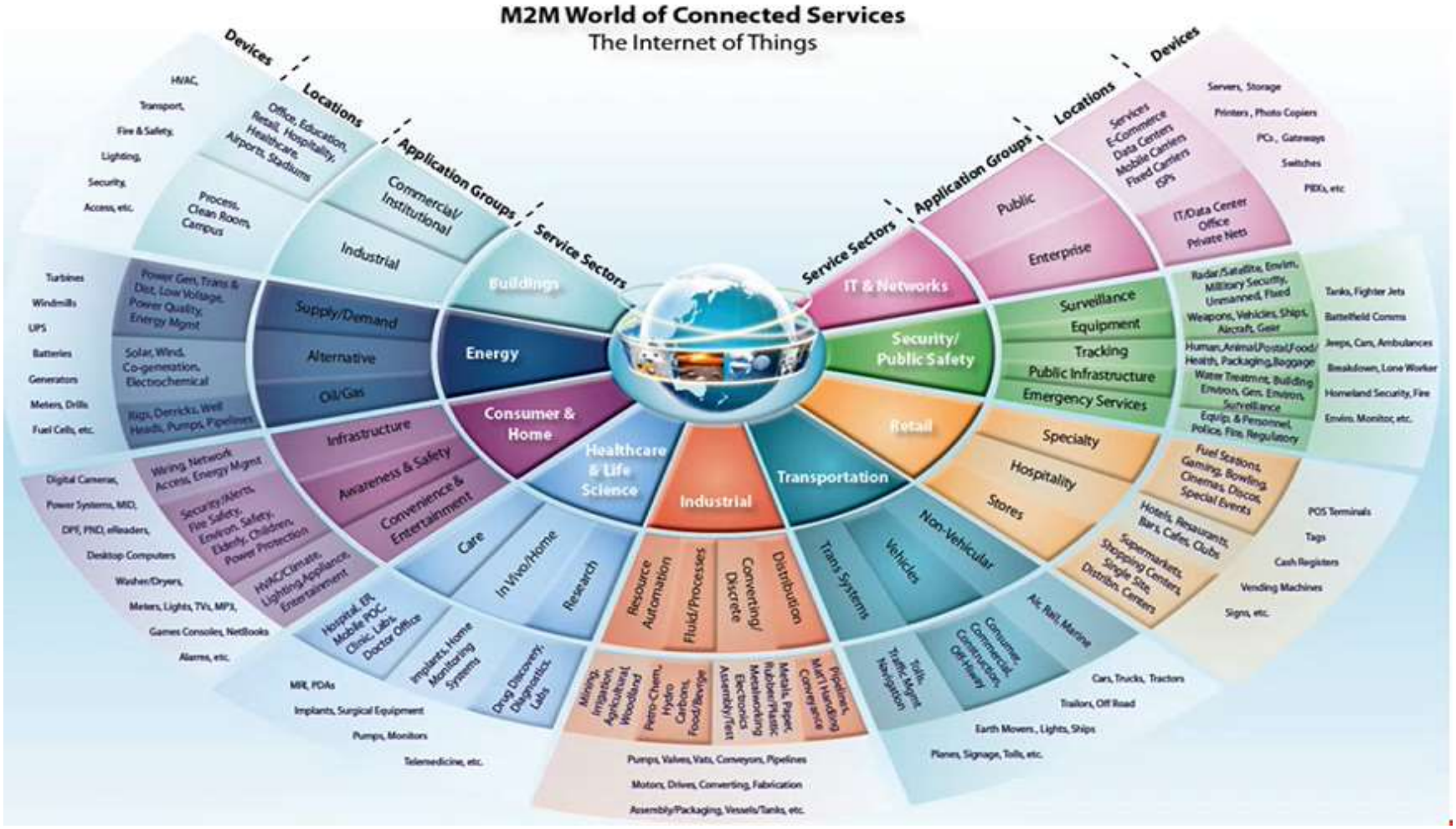
Internet connects people - "Internet of people"

IoT connects all things – "Internet of Things"

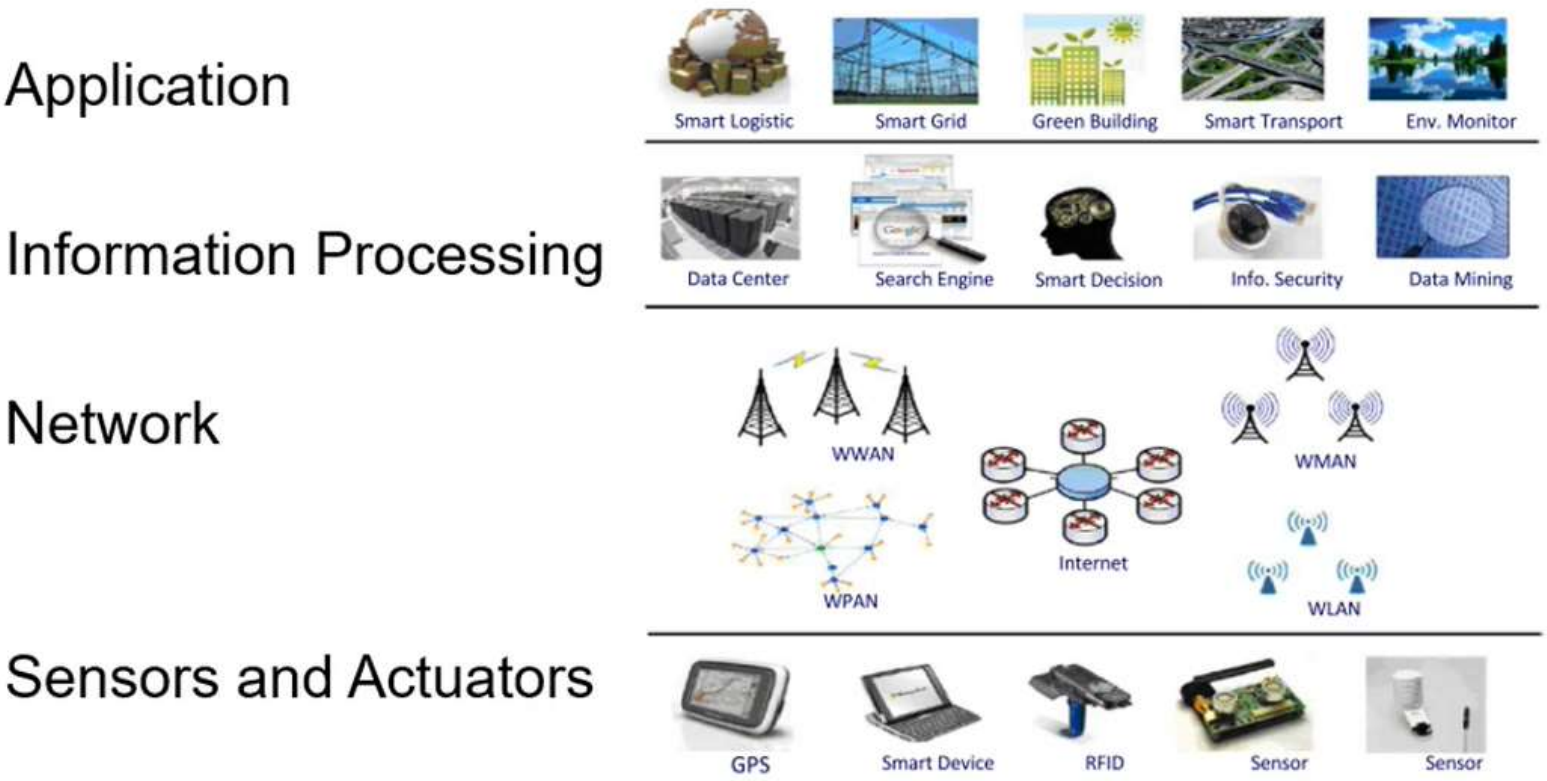
Interconnection of Machines or Devices or Things, and communicate with each other via Internet

Things are embedded with software, sensors, and network connectivity—that enables these objects to collect and exchange data.

Internet of Things



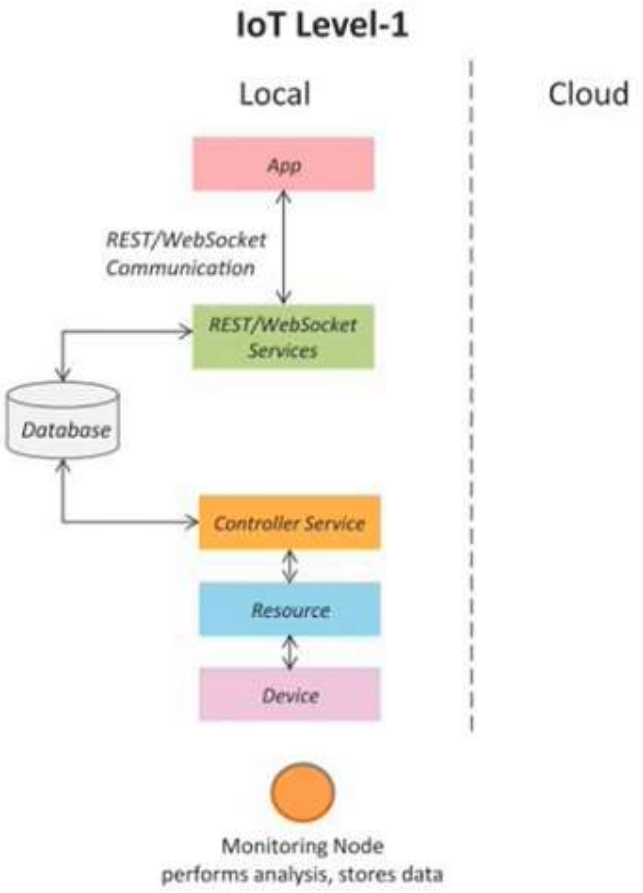
IoT: 4 Layer model



IoT Level 1

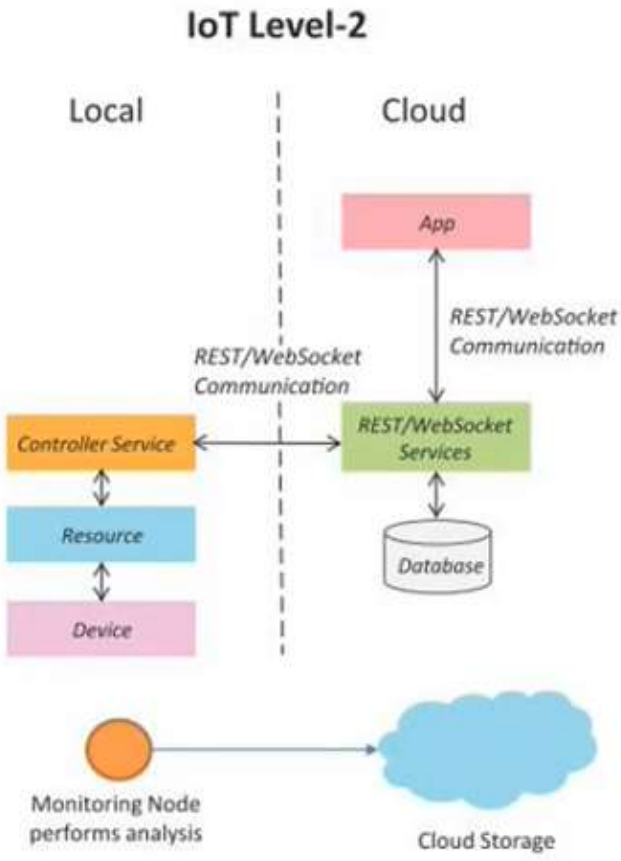
- A level-1 IoT system has a single node/device that performs sensing and/or actuation, stores data, performs analysis and hosts the application

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.



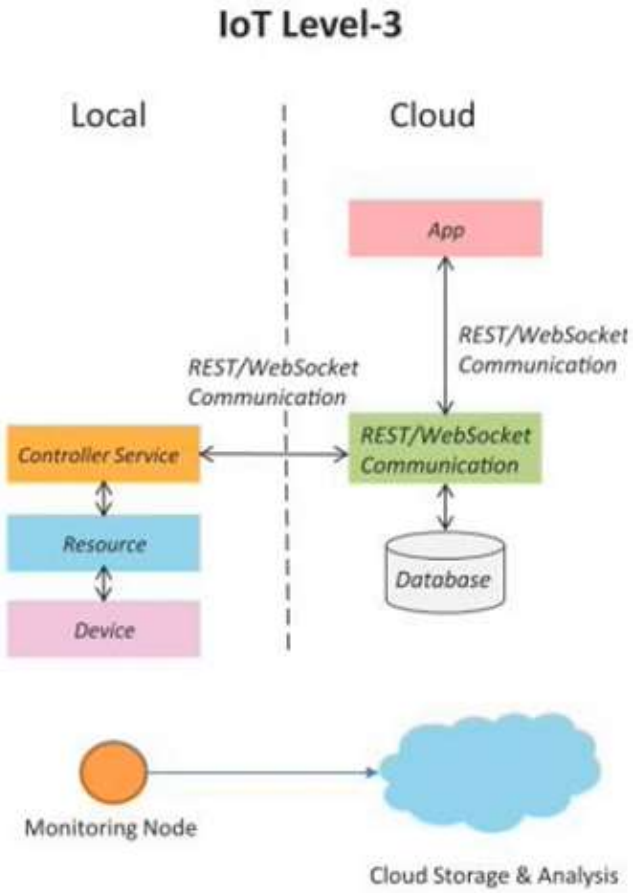
IoT Level 2

- 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**.



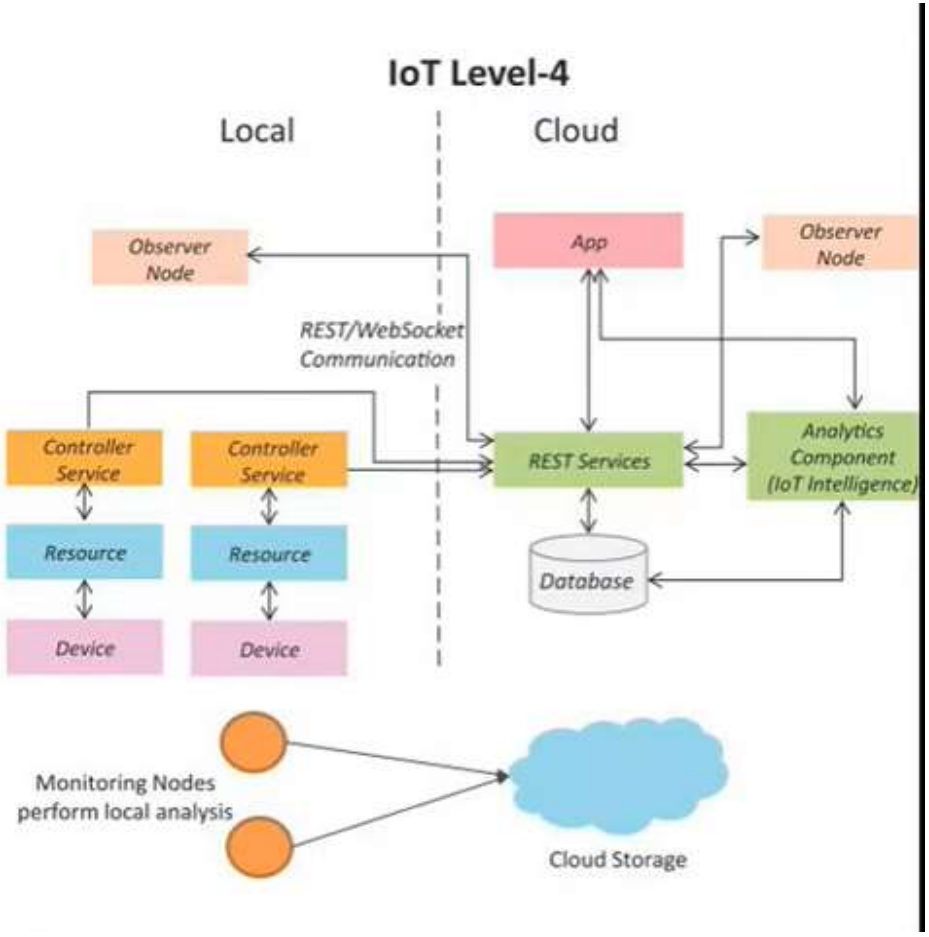
IoT Level 3

- A level-3 IoT system has a single node. Data is stored and analyzed i 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**.



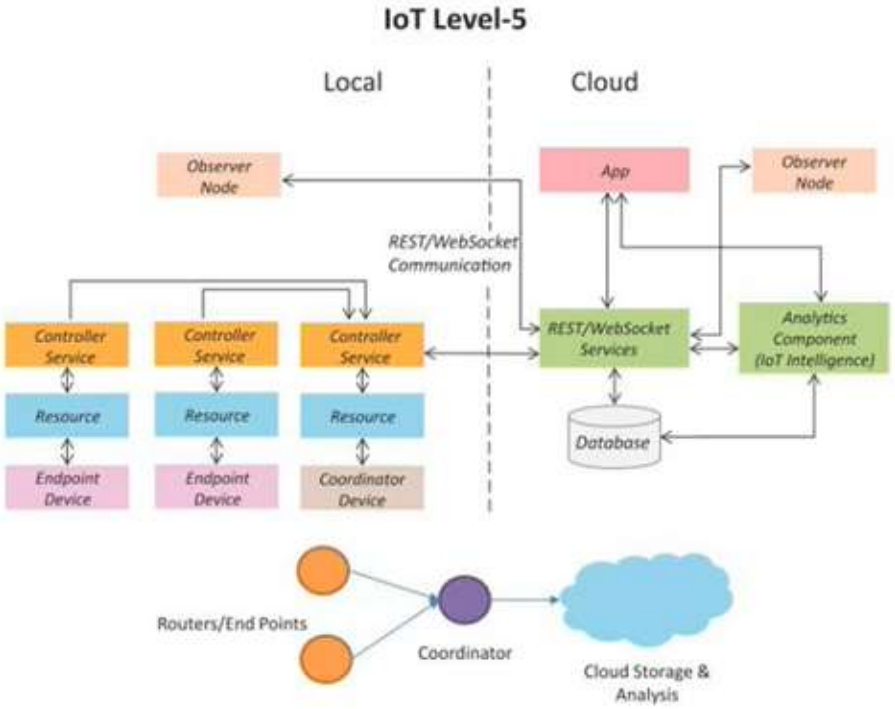
IoT Level 4

- 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

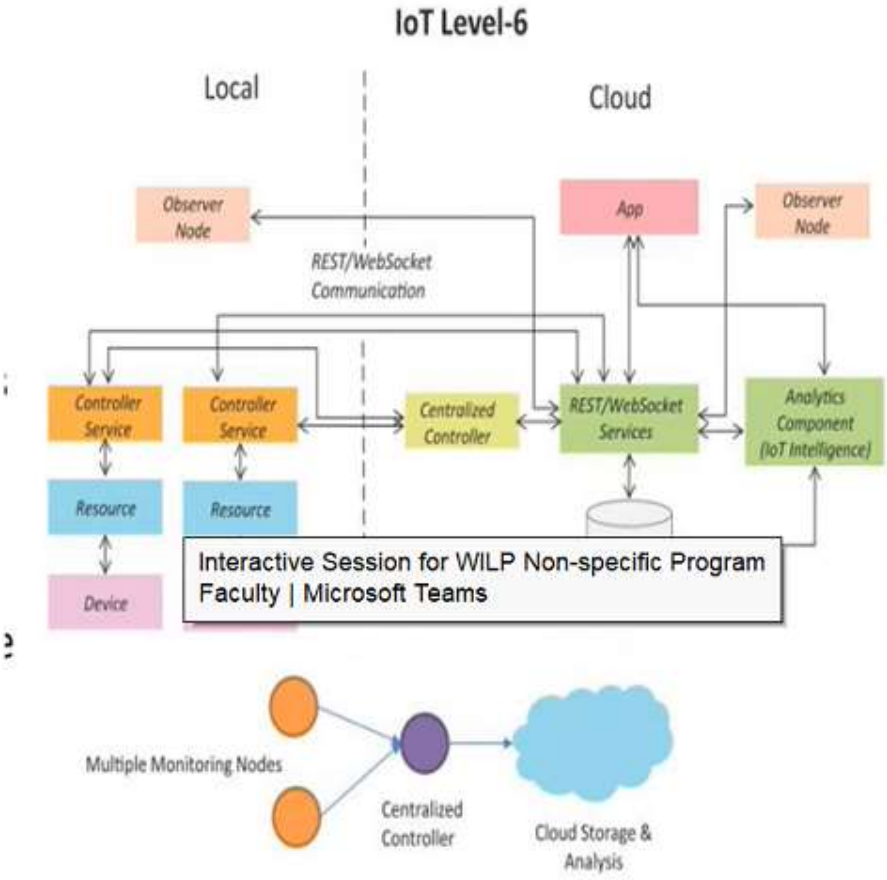
- A level-5 IoT system has multiple end nodes and one coordinator node.
- The end nodes that perform sensing and/or actuation.
- Coordinator node collects data from the end nodes and sends to the cloud.
- Data is stored and analyzed in the cloud and application is cloud-based.
- Level-5 IoT systems are 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.



Use Cases

- Farming and agriculture
  - Agribots
  - Farm automation
  - Disaster protection
- Healthcare
  - Patient monitoring that leverages medical devices such as insulin pumps, smart lenses and pacemakers
  - Rural Medicine
  - Wearables and connected apps that track various health metrics
  - A closed-loop system in an ICU that uses smart sensors

Use Cases

Boeing 787 – Generate 5GB of data every second

Autonomous Vehicles – Generate 1 GB of data by every car every second

Smart grid - Sensors and IoT devices in factories, plants and offices are being used to monitor energy use and analyze their consumption in real-time

In-hospital patient monitoring - monitoring devices (e.g. glucose monitors, health tools and other sensors) generate large amounts of unprocessed data from devices would need to be stored on a 3rd party cloud – Security concern

Content delivery - By caching content – e.g. music, video stream, web pages. Need reduced latency

Video surveillance - need strict real-time analytics to mine video content