Master in Innovation Management

Friday, 12th May 2023, 6 PM (CET)

Module VIII: Internet of Things (IoT). The Interconnection of Intelligent Objects.

- Smart home, smart building, smart city, smart factory and smart environment. The new technological paradigm for the competitiveness of businesses, public administrations and communities.

SPEAKER

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Welcome to the eighth lesson of the Master In Innovation Management of Ascheri Academy.

Curated by Claudia Tarabù, University Researcher
Webinar 12th May 2023

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Module VIII: Internet of Things (IoT). The Interconnection of Intelligent Objects.

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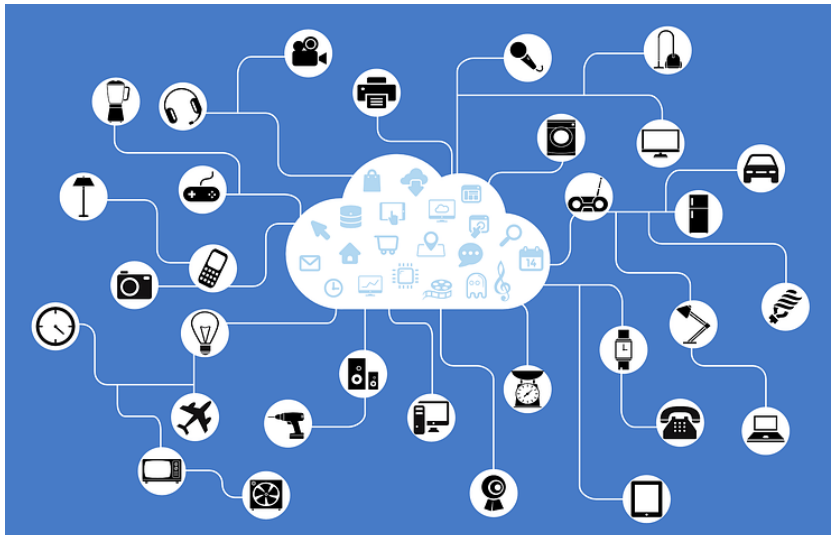
Introduction to the Internet of Things (IoT)

The Internet of Things is transforming our physical world into a complex and dynamic system of connected devices on an unprecedented scale.

Advances in technology are making possible a more widespread adoption of IoT, from pill-shaped micro-cameras that can pinpoint thousands of images within the body, to smart sensors that can assess crop conditions on a farm, to the smart home devices that are becoming increasingly popular.

Over 9 billion ‘Things’ (physical objects) are currently connected to the Internet, as of now. In the near future, this number is expected to rise to a whopping 20 billion.



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A Brief History of IoT

The concept of adding sensors and intelligence to physical objects was first discussed in the 1980s, when some university students decided to modify a Coca-Cola vending machine to track its contents remotely. But the technology was bulky and progress was limited.

The term **'Internet of Things'** was coined in 1999 by the computer scientist Kevin Ashton. While working at Procter & Gamble, Ashton proposed putting radio-frequency identification (RFID) chips on products to track them through a supply chain. He reportedly worked the then-buzzword 'internet' into his proposal to get the executives' attention.

Over the next decade, public interest in IoT technology began to take off, as more and more connected devices came to market.

In 2000, LG announced the first smart refrigerator, in 2007 the first iPhone was launched and by 2008, the number of connected devices exceeded the number of people on the planet. In 2009, Google started testing driverless cars and in 2011, Google's Nest smart thermostat hit the market, which allowed remote control of central heating.

Statista forecasts that around 50B IoT devices will be in use by 2030 across the globe.

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Definitions of IoT

It refers to the **interconnectedness of physical devices, such as appliances and vehicles, that are embedded with software, sensors, and connectivity which enables these objects to connect and exchange data.** This technology allows for the collection and sharing of data from a vast network of devices, creating opportunities for more efficient and automated systems.

Hence, we can say that **Internet of Things (IoT)** is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment.

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Key Components of IoT

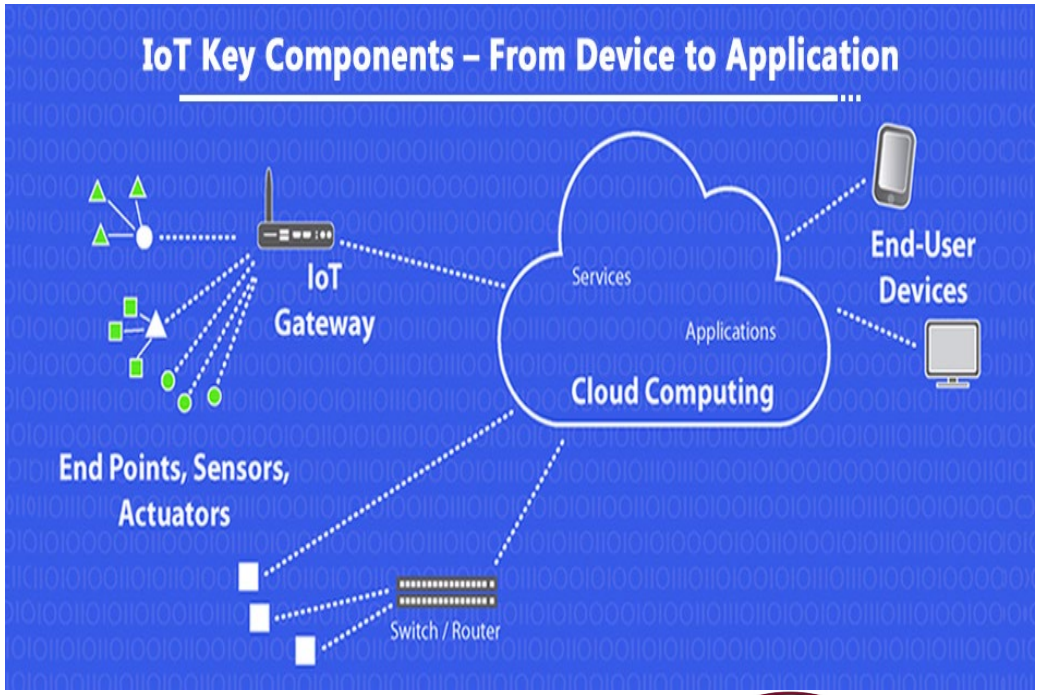
IoT Sensors
The most significant characteristic of sensors is their ability to convert information collected from the IoT network into data for further analysis and processing.

IoT Actuators
Both sensors and actuators are transducers, which means that they can convert signals from one form to another. However, unlike sensors, which track data provided by devices, actuators are responsible for performing actions.

IoT Gateways
An IoT gateway is a device that is used for basic data analysis.

IoT Connectivity
End devices and servers can be connected via cellular or satellite networks, Bluetooth, Wi-Fi, Ethernet (Wired LAN), as well as low-power wide-area networks (LPWAN).

IoT Platforms
An IoT platform is a middleware between hardware-related layers (Perception and Network) on the one hand, and the application layers, on the other. It is a multi-tiered technology that helps in gathering, storing, processing, and visualizing data. It also facilitates the integration of data with other parts of the value chain, like a cloud or end-user app.



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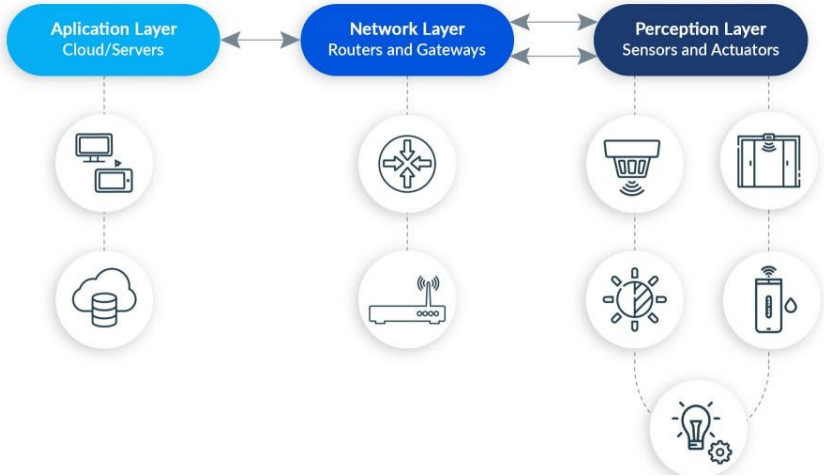
The Fundamental Layers of IoT Architecture

The Perception Layer – The purpose of this layer is to interact with the physical world through IoT devices integrated with sensors and actuators.

The Network Layer – This layer intends to conduct a fundamental analysis of data garnered by sensors using IoT gateways and communicate that data to a server for further processing over communication protocols like MQTT.

The Application Layer – This layer provides an interconnection between the above two hardware-related layers and business applications to render app-specific services to users.



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Let's watch this introductory video 👀

https://www.youtube.com/watch?v=LlhmzVL5bm8
(Source: Edureka)

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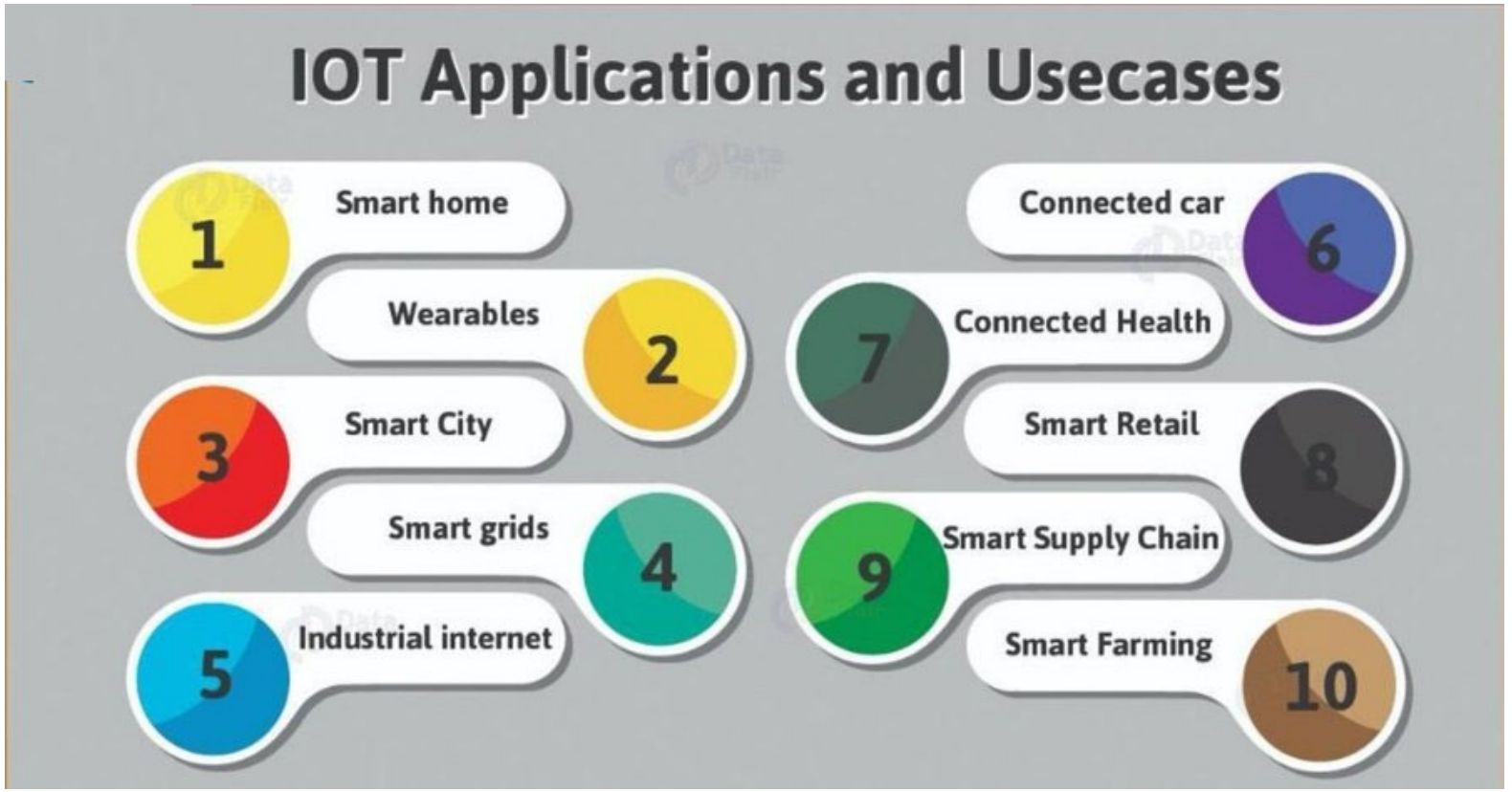

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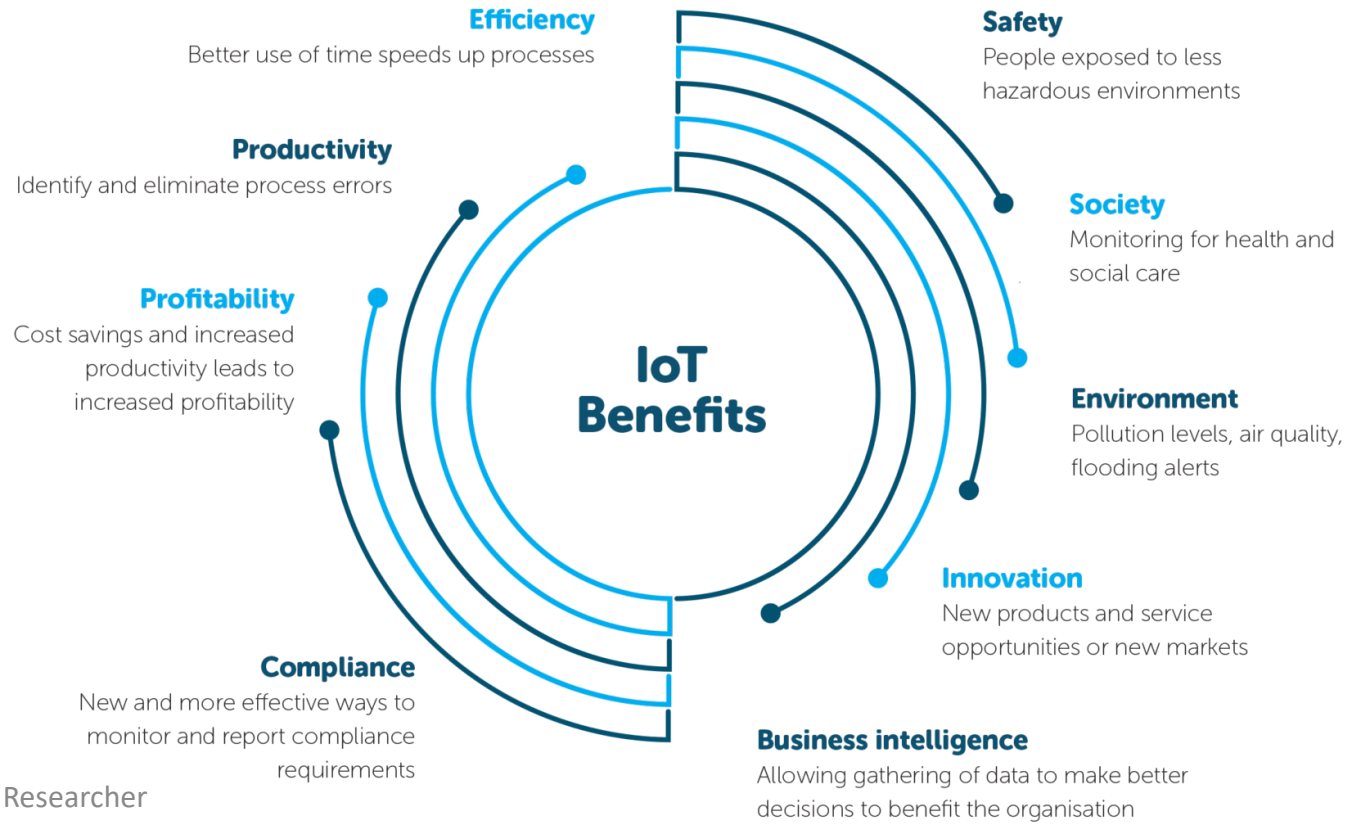
Benefits of IoT



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(Source: https://censis.org.uk)

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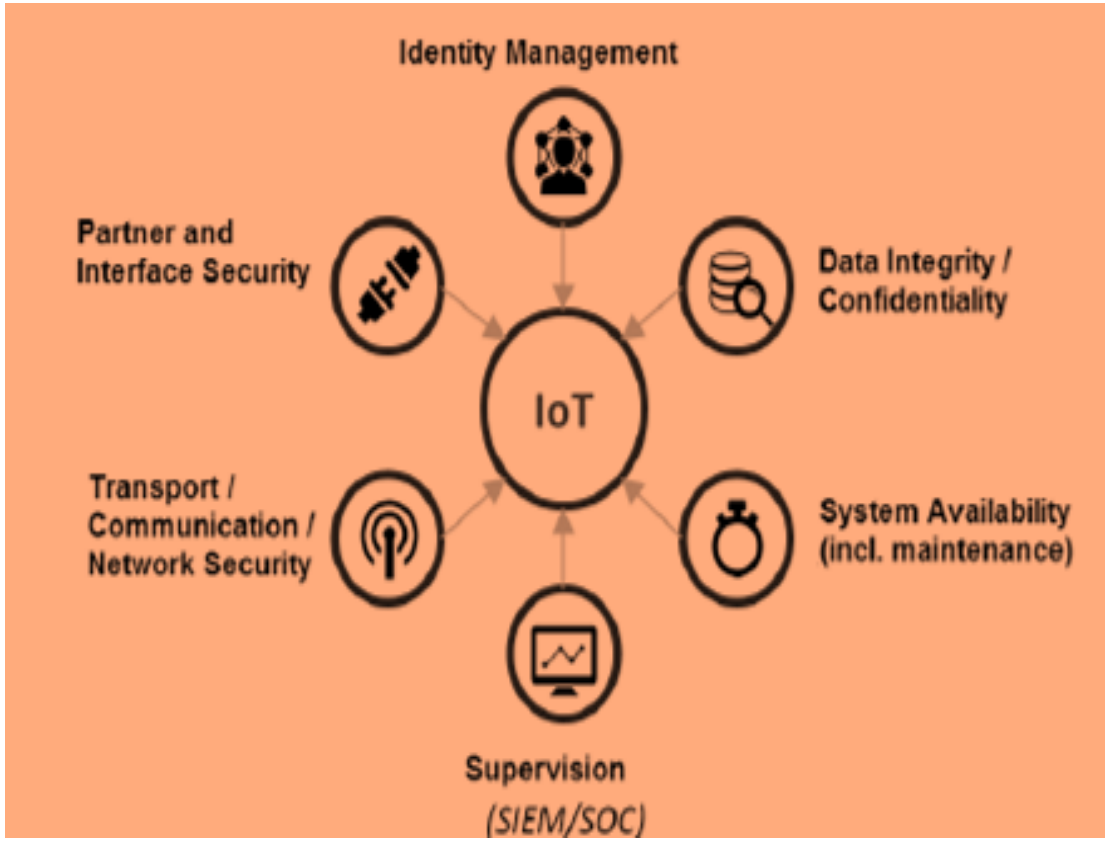
Challenges and Risks of IoT



(Source: Sia Partners)

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Let’s watch this interesting video 👀

https://www.youtube.com/watch?v=x-KBN5cPGww

(Source: Vitria Technology)

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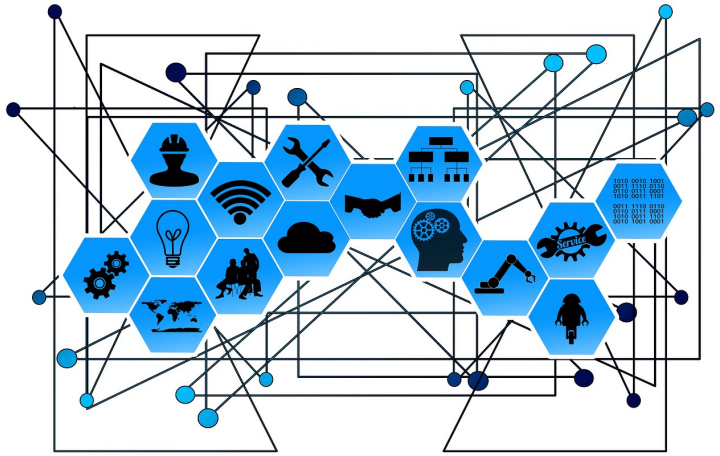
IoT and Data Collection

3 Types of Data Collection

- Equipment Data: this is the type of data that concerns the status of the IoT devices. Equipment data is collected in real time to facilitate activities of predictive maintenance. As a result, it saves the system lots of energy costs while enhancing machine productivity and longevity;

- Submeter Data: Submetering allows property owners to automate the measurement of individual utility usage in multi-user settings. Submeter data can be collected in buildings where multiple tenants use resources like water, electricity, gas, or cable. Digital submetring devices reduce measurement costs, errors, and improve timeliness during the billing process;

- Environmental Data: IoT sensors can measure and monitor environmental data such as humidity, temperature, movement, air quality. These streams of data serve as a basis to track physical work conditions to avoid calamities like floods and air toxicity.



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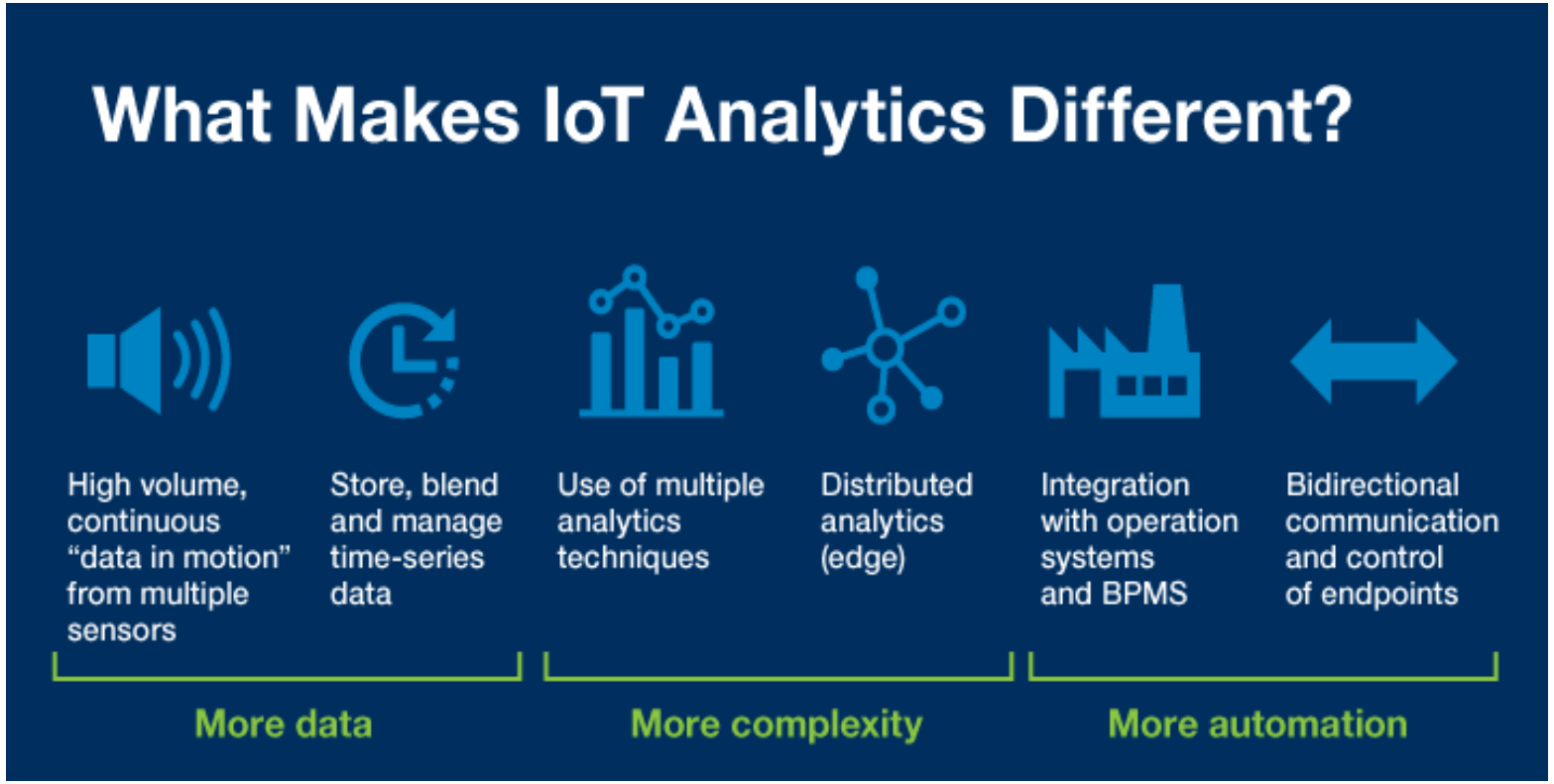
IoT and Data Analytics



(Source: Gartner Inc.)

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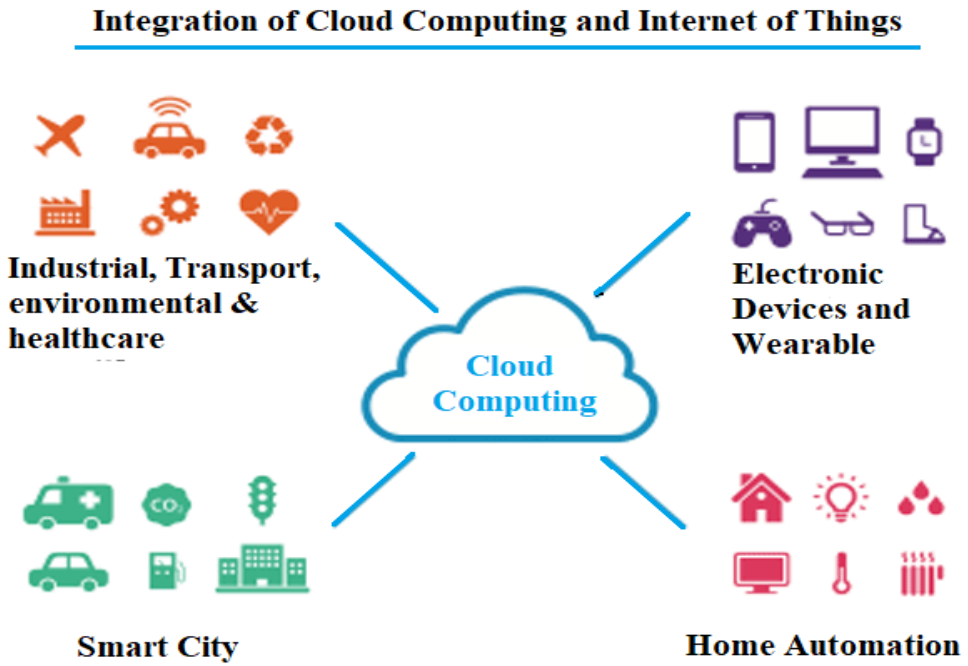
IoT and Cloud Computing



Cloud computing offers a wide range of services to IoT such as data storage, processing, and analysing. Cloud computing also allows IoT device users to carry out common computing tasks using services that are entirely provided over the internet. **Integrating IoT and cloud computing, especially in an enterprise environment, is very cost-effective. The enterprise does not have to own all the devices, platforms and services but can hire them from the cloud service providers.**

The mobile IoT devices such as smartwatches collect data at different locations and may need to access these data at any time. The cloud enables the devices to store data and access it from any location.

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IoT and Artificial Intelligence

Realizing the future and full potential of IoT devices will require an investment in new technologies. **The convergence of AI (Artificial Intelligence) and IoT can redefine the way industries, business, and economies function. AI enables IoT in creating intelligent machines that simulate smart behavior and support in decision making with little or no human interference.**

The common person and specialists alike can benefit from the combination of the two technologies. While IoT deals with devices interacting using the internet, AI makes the devices learn from their data and experience.

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IoT and Cybersecurity

One of the primary challenges to securing the IoT is a lack of comprehensive standards. This is due in large part to the **complex ecosystem consisting of a wide range of devices from a large number of companies and manufacturers**. It is complicated by the fact that securing the IoT, by definition requires **securing standard, scalable, interoperable systems.**

The situational awareness of IoT industrial applications and devices must provide three key capabilities:

- **Detect:** the ability to know what IoT devices and components are connected to a given network or system;
- **Authenticate:** the ability to verify the provenance of IoT components and prevent and detect spoofing;
- **Update:** IoT security programs must include the ability to securely maintain and upgrade these components.

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IoT and Smart Homes

A smart home is a household with internet-connected appliances you can remotely control using a tablet or smartphone. It uses smart devices such as smart TVs, smart thermostats, air conditioners, and even a robot vacuum. **They are then connected together in a single network, through either hardwired or wireless systems like Zigbee, Wi-Fi, Bluetooth, and NFC, among others.**

Using the Internet of Things (IoT) technology, your smart appliances can communicate and share real time data with each other. This allows the devices to perform scheduled and automated tasks.

IoT home gadgets bounce data back and forth with the use of sensors, learning and processing your patterns to automatically adjust themselves to your comfort. Some smart home Internet of Things applications are automatic light switches, burglar alarms, and voice-activated sound systems.

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IoT and Smart Cities

Smart cities use IoT devices such as connected sensors, lights, and meters to collect and analyze data. The cities then use this data to improve infrastructure, public utilities and services, and more.

Smart cities provide a more efficient and higher quality lifestyle for their residents; moreover, they use more secure methods for reaching these goals. Smart city devices work to make everyday tasks easier and more effective, while relieving pain points related to public safety, traffic, and environmental issues. Here are some of the most popular smart city technologies:

- smart utility meters;
- smart grids;
- smart waste management solutions;
- smart air quality monitors.

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IoT and Smart Transportation

“Smart transportation” refers to the integrated application of modern technology and management strategies into transportation systems.
Smart transportation can simply mean the basic management systems we’re already accustomed to, such as:

1. Car navigation: this uses satellite navigation to get position data which is then correlated to a vehicle's position on a road. When directions are needed routes can be then calculated;

2. Traffic signal control systems: newer traffic control systems have been adapted to work in a smart way. They’ve been developed to respond to their surroundings and adjust to traffic conditions;

3. Automatic number plate recognition: this uses character recognition on images to detect and read vehicle registration plates. The mechanism creates vehicle location data, used for law enforcement, electronic toll collection and pay-per-road systems;

4. Speed cameras: using detectors embedded in the road or radar technology to detect vehicles going above the legal speed limit. A digital picture is then taken and sent to the driver. This is a prevention method, used to encourage safer driving.

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Let’s reflect by watching this explanatory video 👀

https://www.youtube.com/watch?v=nt00cm7irVE
(Source: FutureYan)

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Wrap-up

Module VIII:

- Introduction to The Internet of Things (IoT);
- A Brief History of IoT;
- Definitions of IoT;
- Key Components of IoT;
- The Fundamental Layers of IoT Architecture;
- IoT Applications and Usecases;
- Benefits of Iot;
- Challenges and Risks of IoT;
- IoT and Data Collection;
- IoT and Data Analytics;
- IoT and Cloud Computing;
- IoT and Artificial Intelligence;
- IoT and Cybersecurity;
- IoT and Smart Homes;
- IoT and Smart Cities;
- IoT and Smart Transportation.

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IoT Worm - https://iotworm.com/

IoT Council - https://www.theinternetofthings.eu/

IoT Security Foundation - https://iotsecurityfoundation.org/

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Many thanks for your attention. See you at the next lesson ☺

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