Advanced Internet of Things Technologies

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Chương 1: Giới thiệu

- 1.1 Đặt vấn đề?

- 1.2 Internet of Things là gì?

- 1.3 Lịch sử phát triển của IoT

- 1.4 Kiến trúc Hệ thống IoT

- 1.5 Các công nghệ liên quan

Đặt vấn đề

- VD1: Tí (một nhân vật ẩn danh của lớp NT532.O21) dự kiến sẽ xây dựng một khu vườn thông minh. Hệ thống vườn thông minh của Tí sẽ tự động tưới nước nếu độ ẩm đất quá thấp, và trời không quá nắng. Tí cũng sẽ xem được tình trạng của khu vườn nhà mình và điều khiển hệ thống này khi ở UIT thông qua "điện thoại khôn" hoặc trên trình duyệt máy tính của mình.

- Bạn hãy trả lời giúp Tí cần đầu tư những gì và phải làm những công việc gì nhé!

Chương 1: Giới thiệu

- **1.1 Định nghĩa Internet of Things**

- 1.2 Lịch sử phát triển

- 1.3 Các thành phần trong Internet of Things

- 1.4 Các tham số dùng để đánh giá hiệu năng Hệ thống mạng?

1.1 Định nghĩa Internet of Things (1/4)

- The Internet of Things, also called The Internet of Objects, refers to a wireless network between objects, usually the network will be wireless and self-configuring, such as household appliances. **(Wikipedia)**

1.1 Định nghĩa Internet of Things (2/4)

- The term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. (**IoT 2008**)
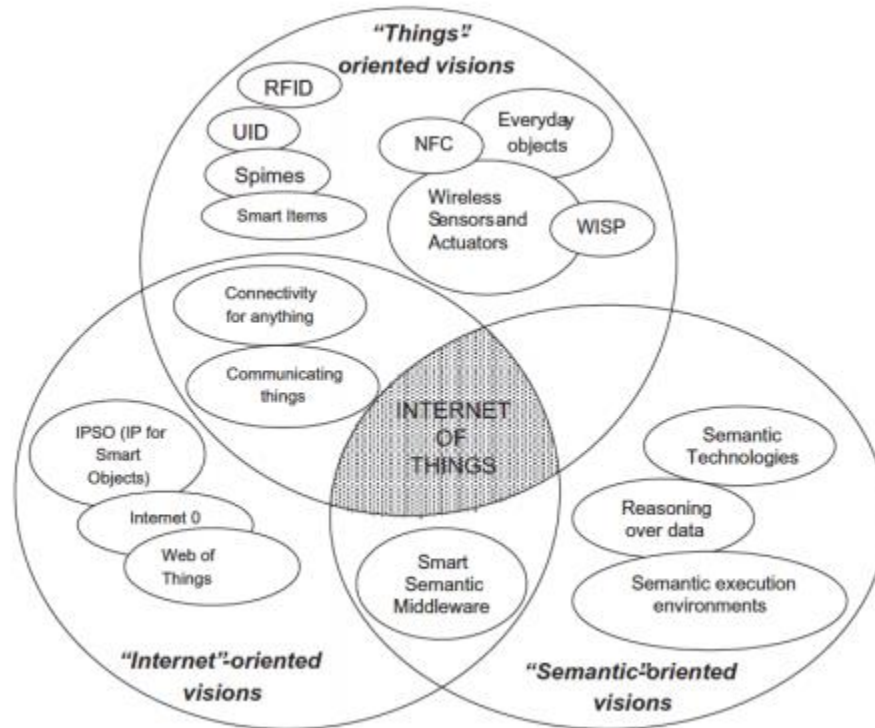
1.1 Định nghĩa Internet of Things (3/4)

- The Internet of Things allows people and things to be connected Anytime, Anyplace, with Anything and Anyone, ideally using Any path/network and Any service (**Perera at al. 2014**)
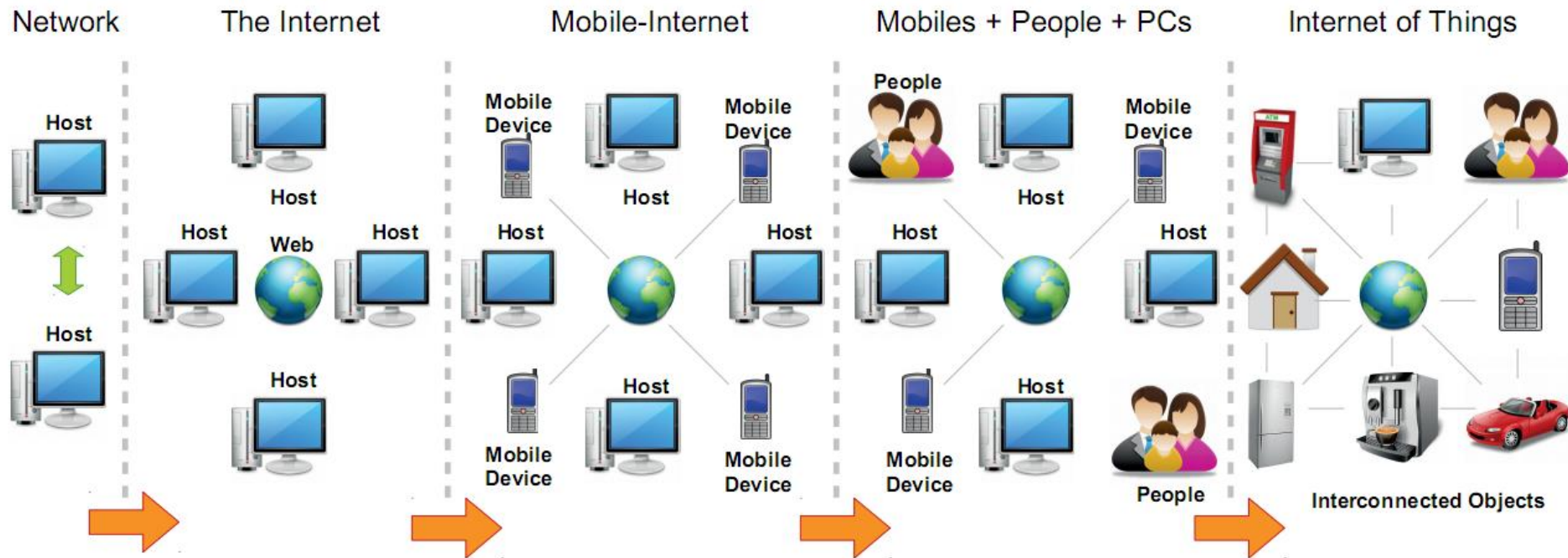
1.1 Định nghĩa Internet of Things (4/4)

- "Things having indentities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts" **(IoT in 2020)**

Source: Atzori et al. 2010

Internet of Things = Things + Internet + Semantic

IoT Evolution

- Source: Perera et al. 2014

Chương 1: Giới thiệu

- 1.1 Định nghĩa Internet of Things

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1.2 Lịch sử phát triển

- 1999

  – We need an internet for things, a standardized way for computers to understand the real world" - **Kevin Ashton** (Auto-ID @ MIT)
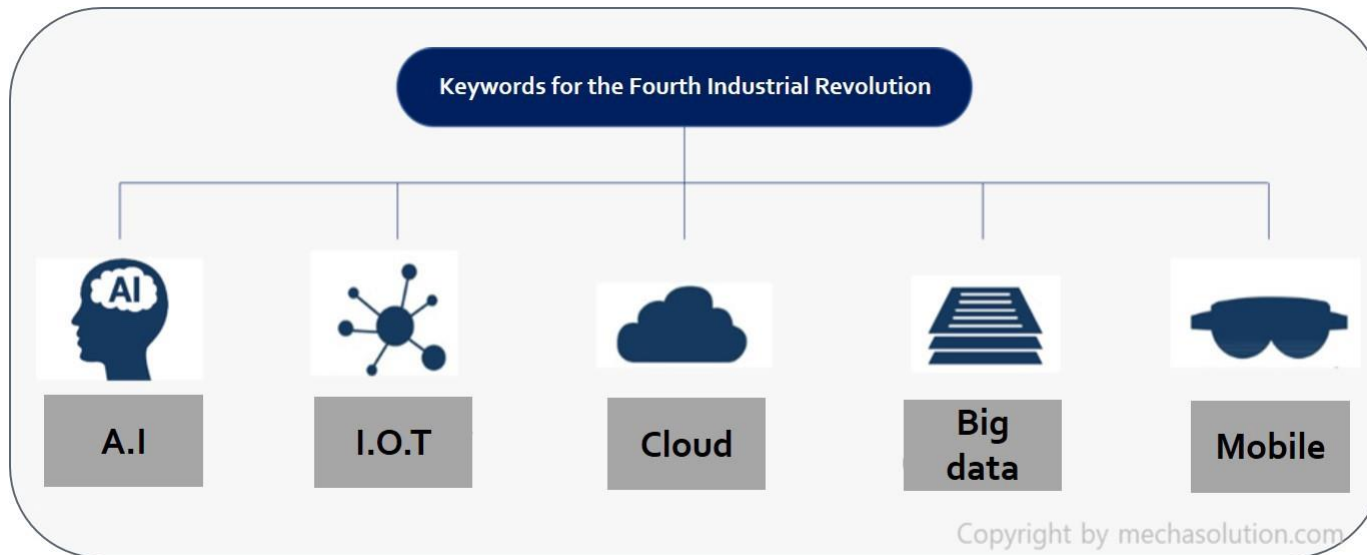
1.2 Lịch sử phát triển

- 2005
  - "always on communications, in which new ubiquitous technologies (such as radio-frequency identification and sensors) promise a world of networked and interconnected devices (e.g. fridge, television, vehicle, garage door, etc.) that provide relevant content and information whatever the location of the user – heralding the dawn of a new era, one in which the internet (of data and people) acquires a new dimension to become an Internet of Things." - **ITU Internet Report: The Internet of Things**

1.2 Lịch sử phát triển

- 2011

  - "The Internet of Everything (IoE) brings together people, processes, data, and things to make networked connections more relevant and valuable than ever before – turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries." **Cisco –Internet of Everything**
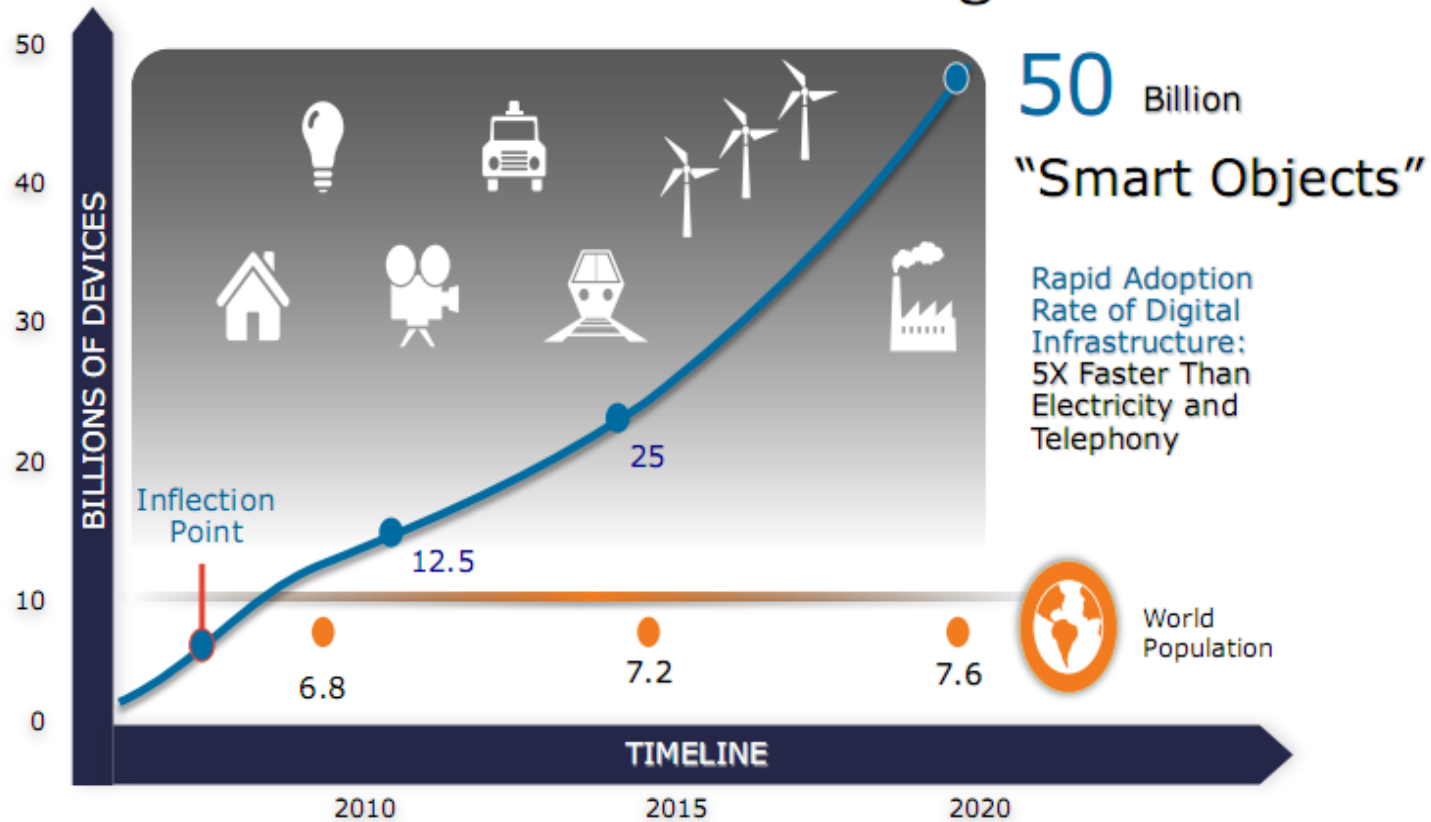
1.2 Lịch sử phát triển

- 2015
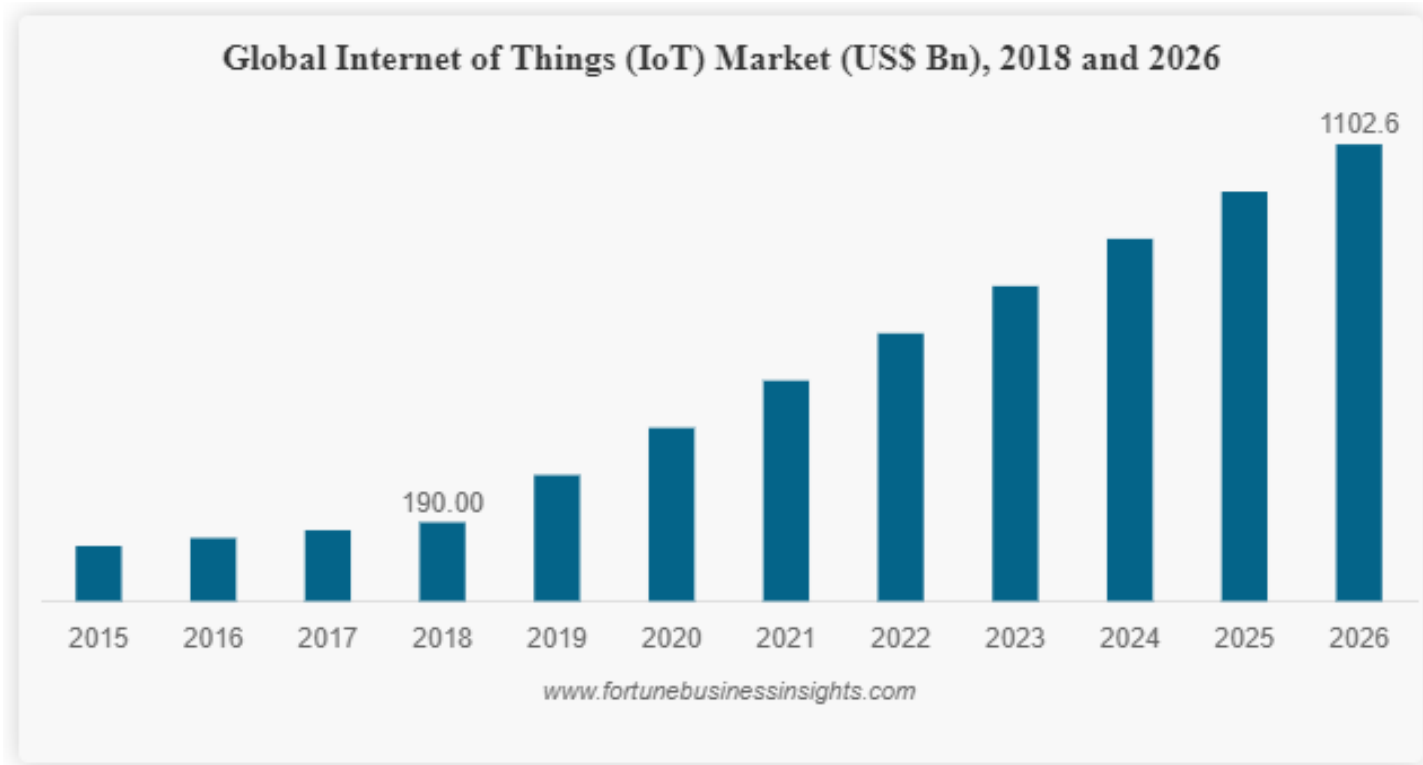 - The Fourth Industrial Revolution - **Ms Angela Merkel – Davos 2015**

1.2 Lịch sử phát triển

- 2020
  - IoT every where
    - Smart Home
    - Smart Farm
    - Smart City
    - … Every Things is smart

    - *Are you Smart???*

IoT Market

Global Internet of Things (IoT) Market (US$ Bn), 2018 and 2026

- Source: https://www.fortunebusinessinsights.com/

IoT Market

Asia Pacific Internet of Things (IoT) Market, 2018

ASIA PACIFIC
USD 74.5 Billion

- Source: https://www.fortunebusinessinsights.com/
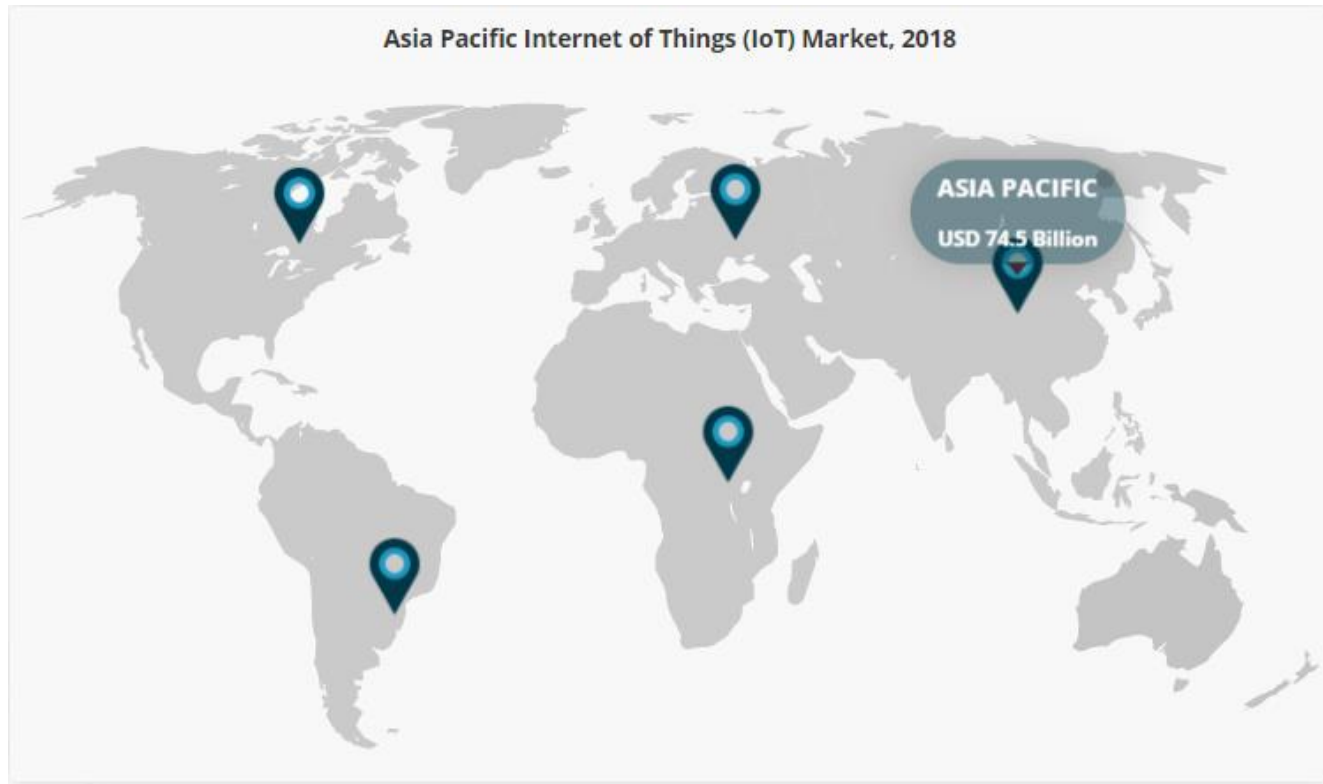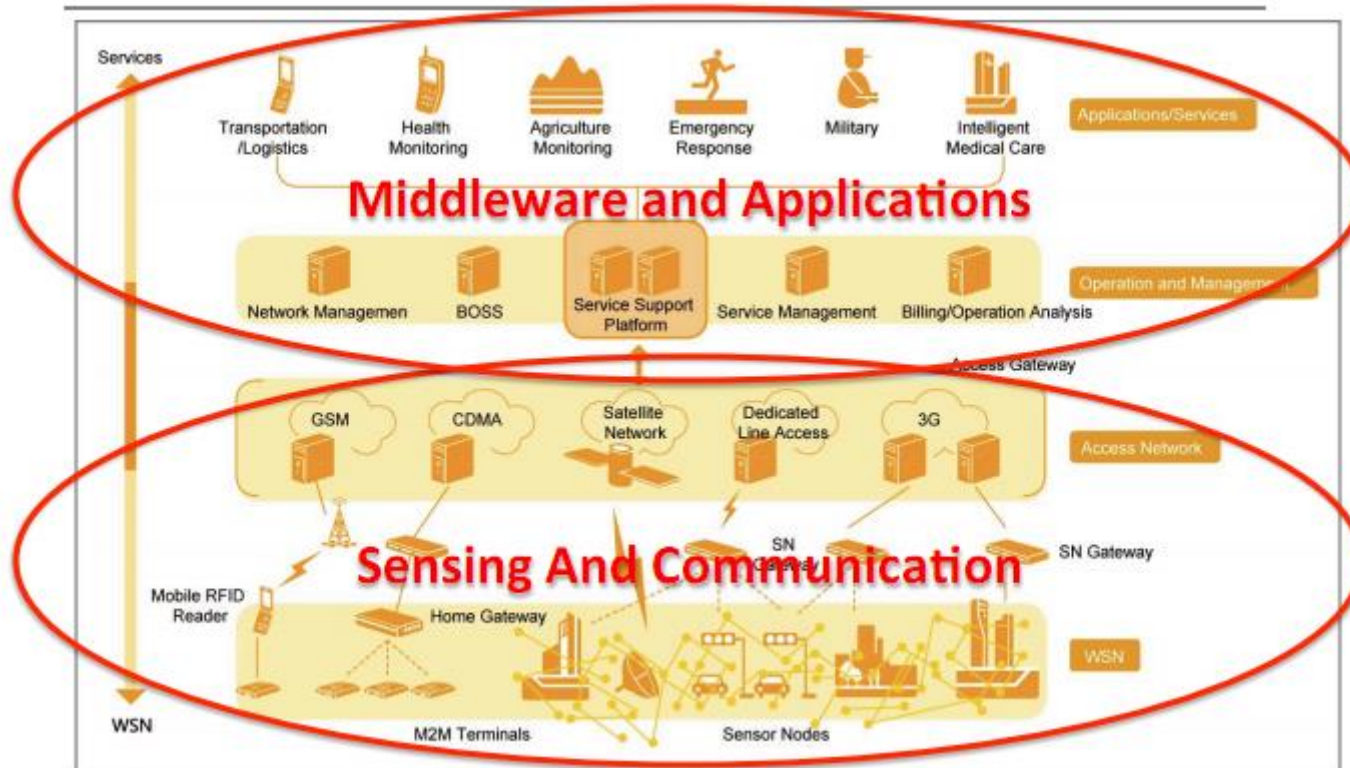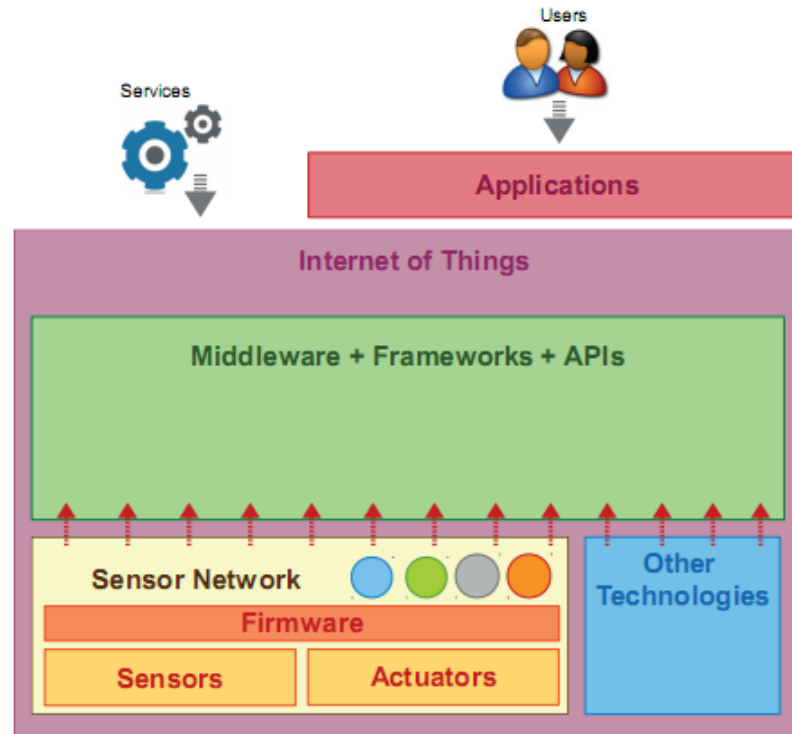
1.4 IoT Layered Architecture

- Source: ZTE

Sensor Networks and IoT

- Source: Perera at al. 2014

Middleware

- Middleware is a software layer that stands between the networked operating system and the application and provides well known reusable solutions to frequently encountered problems like heterogeneity, interoperability, security, dependability **[Issarny, 2008]**

- IoT requires stable and scalable middleware solutions to process the data coming from the networking layers

Libelium Smart World

Air Pollution
Control of CO_2 emissions of factories, pollution emitted by cars and toxic gases generated in farms.

Forest Fire Detection
Monitoring of combustion gases and preemptive fire conditions to define alert zones.

Wine Quality Enhancing
Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

Offspring Care
Control of growing conditions of the offspring in animal farms to ensure its survival and health.

Sportsmen Care
Vital signs monitoring in high performance centers and fields.

Structural Health
Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

Smartphones Detection
Detect iPhone and Android devices and in general any device which works with Wifi or Bluetooth interfaces.

Perimeter Access Control
Access control to restricted areas and detection of people in non-authorized areas.

Radiation Levels
Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

Electromagnetic Levels
Measurement of the energy radiated by cell stations and WiFi routers.

Traffic Congestion
Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.

Smart Roads
Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Lighting
Intelligent and weather adaptive lighting in street lights.

Intelligent Shopping
Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

Noise Urban Maps
Sound monitoring in bar areas and centric zones in real time.

Water Leakages
Detection of liquid presence outside tanks and pressure variations along pipes.

Vehicle Auto-diagnosis
Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

Item Location
Search of individual items in big surfaces like warehouses or harbours.

Quality of Shipment Conditions
Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

Water Quality
Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.

Golf Courses
Selective irrigation in dry zones to reduce the water resources required in the green.

Waste Management
Detection of rubbish levels in containers to optimize the trash collection routes.

Smart Parking
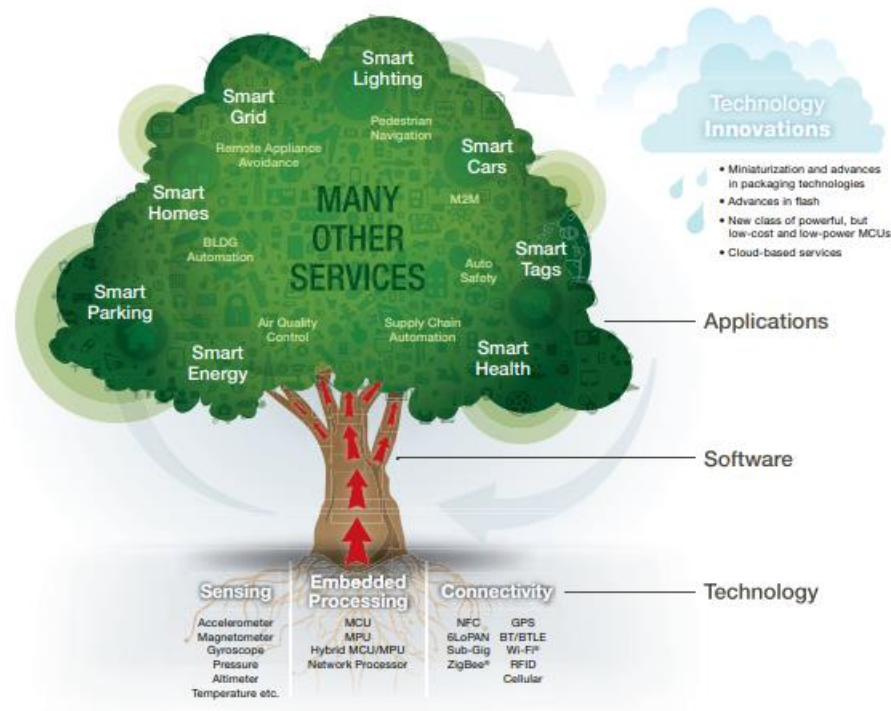Monitoring of parking spaces availability in the city.

libelium
www.libelium.com

IoT – Overall Picture

- Source: "What the Internet of Things (IoT) Needs to Become a Reality," White Paper, by K. Karimi and G. Atkinson

IoT Characteristics

- Intelligence

- Architecture

- Complex system

- Scalability

- Time considerations

- Space considerations
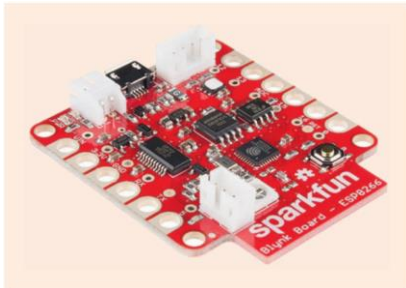
- Everything-as-a-service

IoT Benefits

- Efficiency
- Transparency
- Automation and control
- Accuracy
- Monitoring

- Information
- Time
- Safety and comfort
- Security
- Cost/money

IoT Challenges

- Scale
- Heterogeneity
- Privacy
- Data ownership
- Cybersecurity
- Legal liability

- Sensors
- Networks
- Big data
- Analysis
- Interoperability
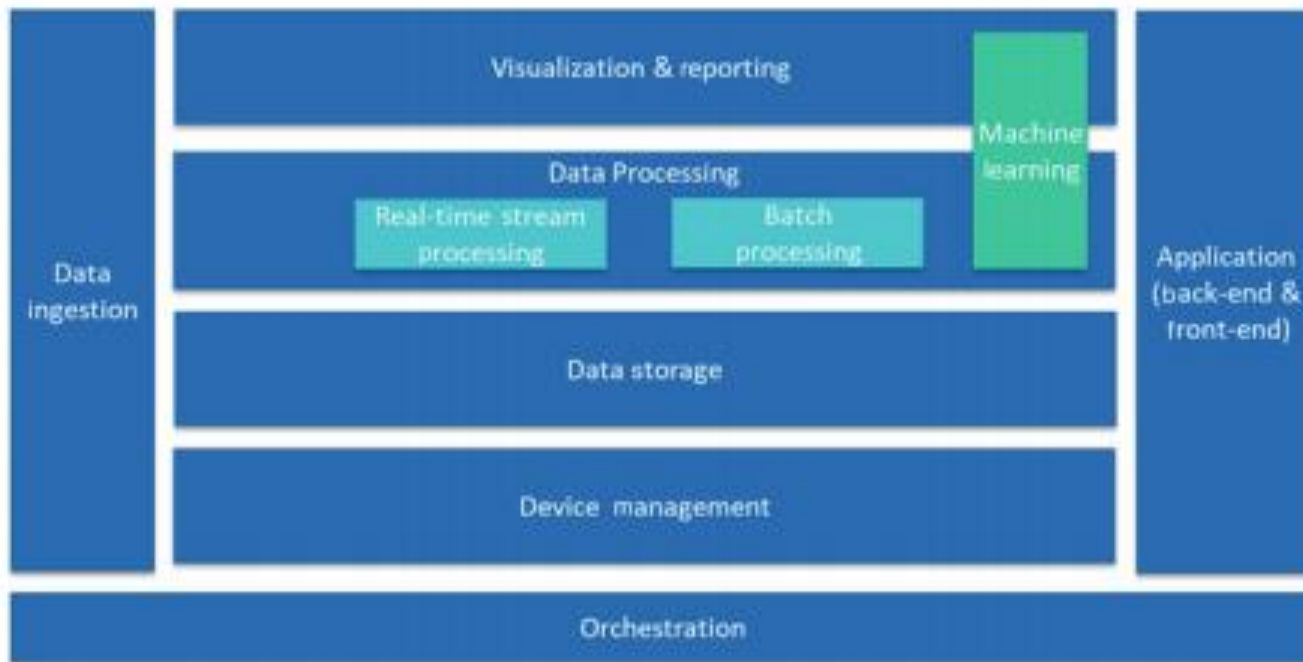
IoT Hardware Technologies
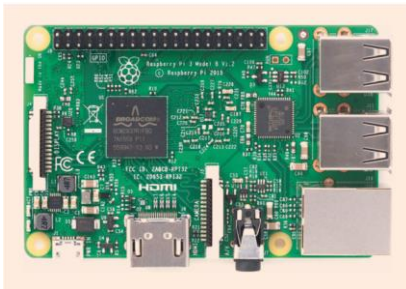
IoT Software Technologies

name	architecture	scheduler	programming model	targeted device class*	supported MCU families or vendors	programming languages	license	network stacks
Contiki	monolithic	cooperative	event-driven, Protothreads	Class 0 + 1	AVR, MSP430, ARM7, ARM Cortex-M, PIC32, 6502	C*	BSD	uIP, RIME
RIOT	microkernel RTOS	preemptive, tickless	multi-threading	Class 1 + 2	AVR, MSP430, ARM7, ARM Cortex-M, x86	C, C++	LGPLv2	gnrc, OpenWSN, ccn-lite
FreeRTOS	microkernel RTOS	preemptive, optional tickless	multi-threading	Class 1 + 2	AVR, MSP430, ARM, x86, 8052, Renesas*	C	modified GPL*	None
TinyOS	monolithic	cooperative	event-driven	Class 0	AVR, MSP430, px27ax	nesC	BSD	BLIP
OpenWSN	monolithic	cooperative*	event-driven	Class 0 – 2	MSP430, ARM Cortex-M	C	BSD	OpenWSN
nuttX	monolithic or microkernel	preemptive (priority-based or round robin)	multi-threading	Class 1 + 2	AVR, MSP430, ARM7, ARM9, ARM Cortex-M, MIPS32, x86, 8052, Renesas	C	BSD	native
eCos	monolithic RTOS	preemptive	multi-threading	Class 1 + 2	ARM, IA-32, Motorola, MIPS …	C	eCos License*	lwIP, BSD
uClinux	monolithic	preemptive	multi-threading	>Class 2	Motorola, ARM7, ARM Cortex-M, Atari	C	GPLv2	Linux
ChibiOS/RT	microkernel	preemptive	multi-threading	Class 1 + 2	AVR, MSP430, ARM Cortex-M	C	Triple License*	None
CoOS	microkernel RTOS	preemptive	multi-threading	Class 2	ARM Cortex-M	C	BSD	None
nanoRK	monlothic (resource kernel)	preemptive	multi-threading	Class 0	AVR, MSP430,	C	Dual License	None
NutOS	monolithic	cooperative	multi-threading	Class 0 + 1	AVR, ARM	C	BSD	native

IoT Wireless Technologies

Advanced Internet of Things Technologies Course
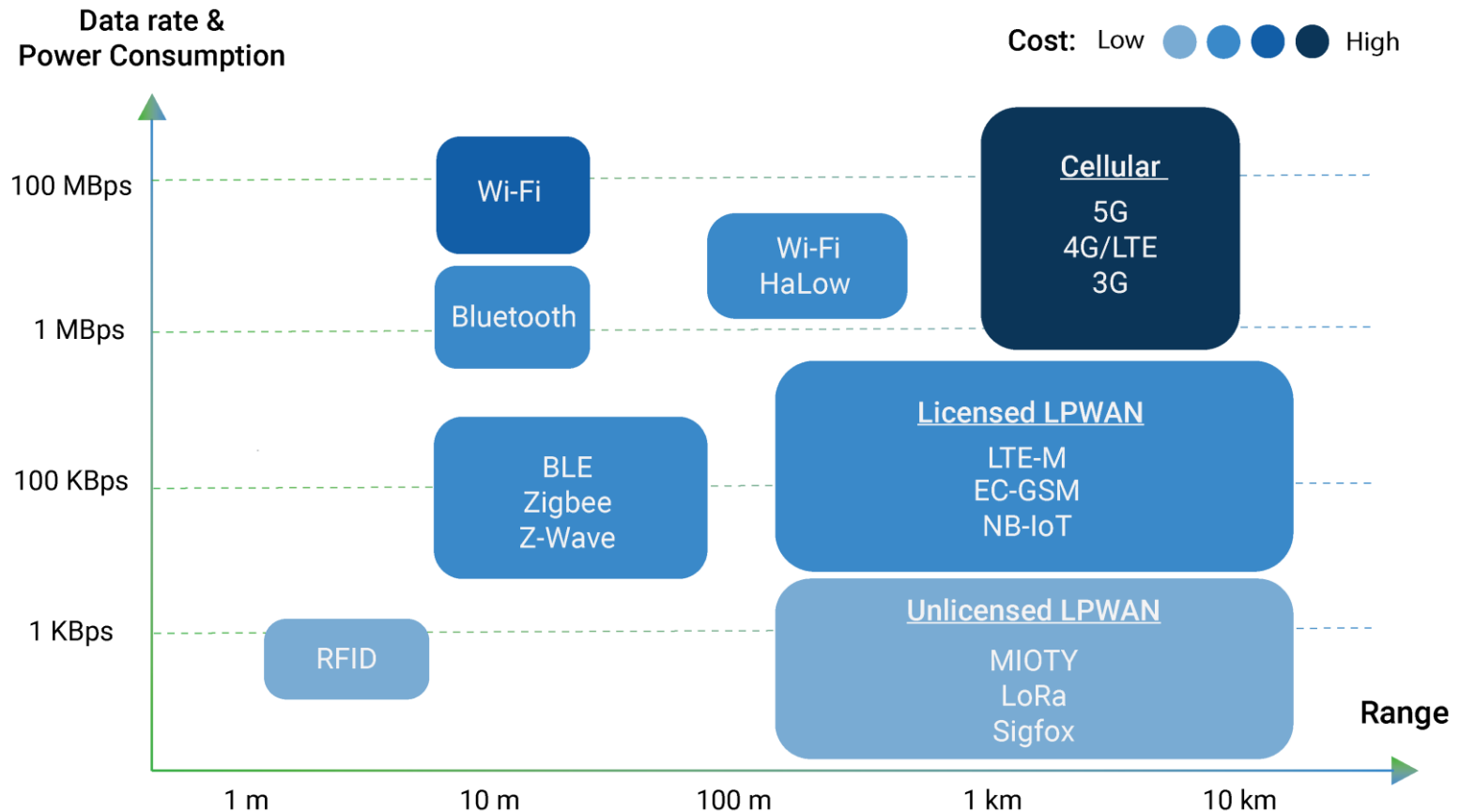
IoT Cloud Architecture

IoT Edge/Fog

- https://www.lanner-america.com/
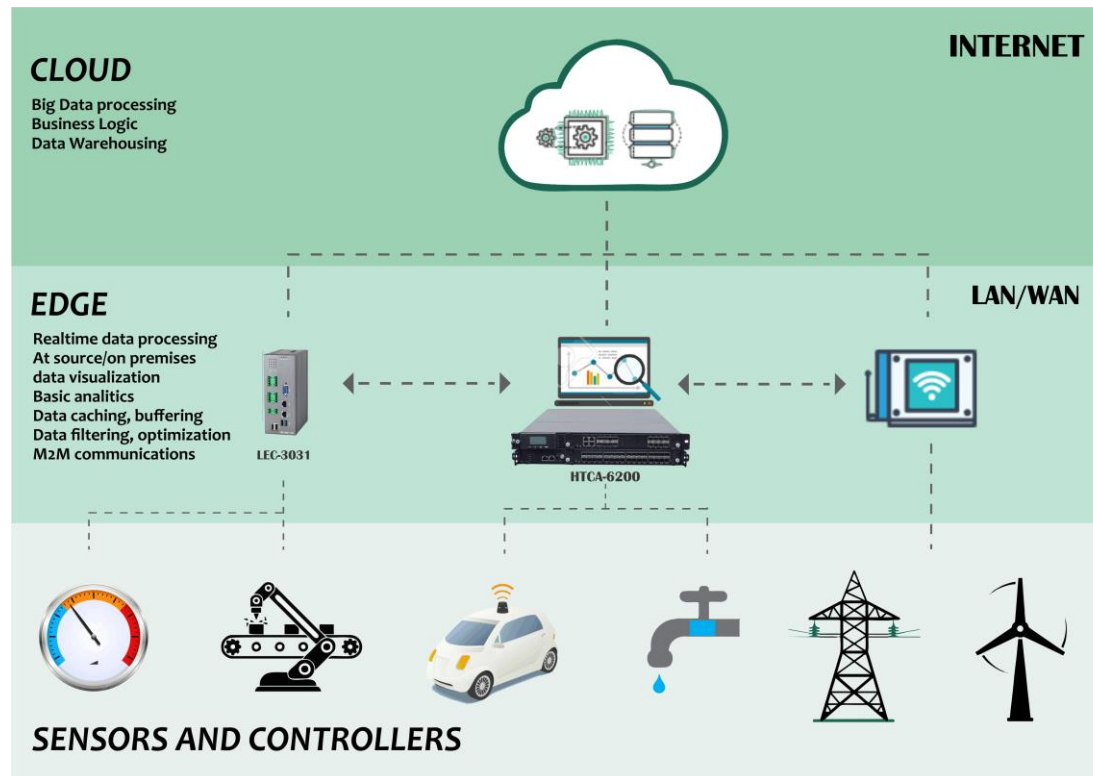
Intelligent in IoT

- Source: https://www.stoodnt.com/
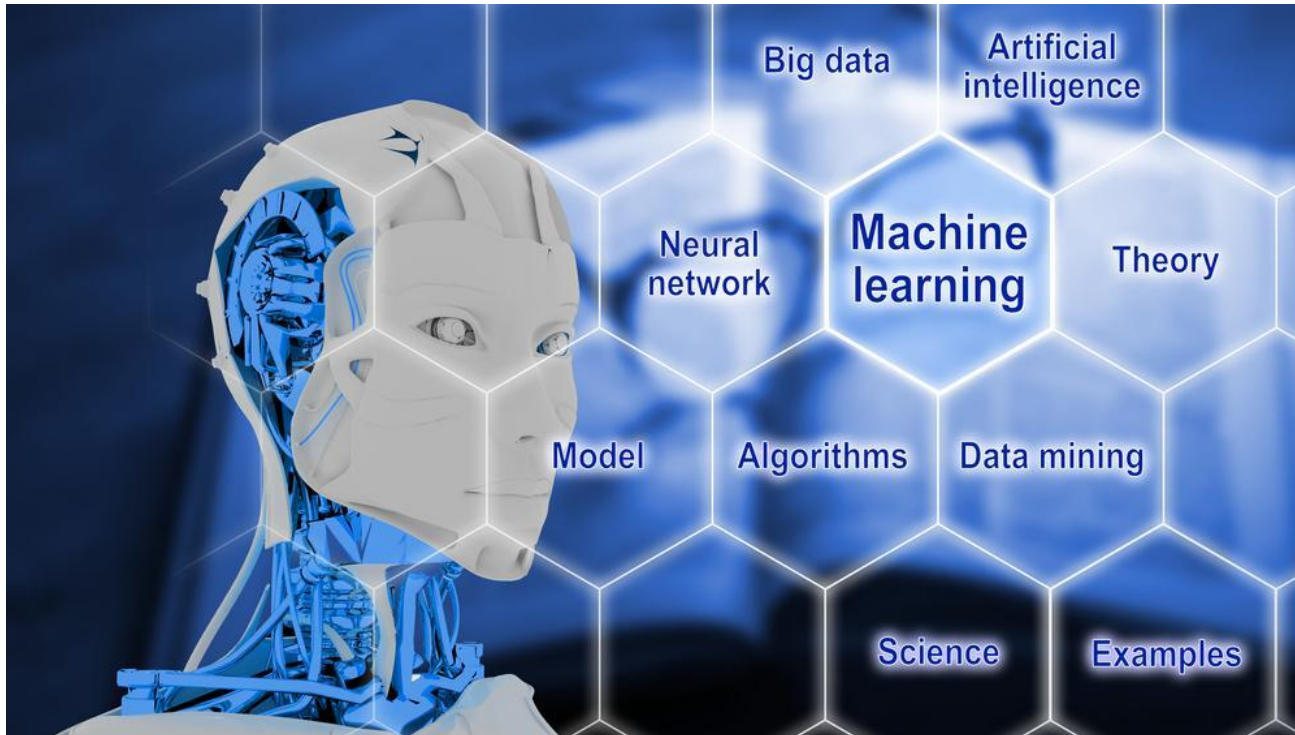
Tổng kết

- Ở chương này, bạn đã học được:
  - Internet of Things là gì?
  - Lịch sử phát triển của IoT
  - Các công nghệ liên quan đến Internet of Things
  - Kiến trúc một hệ thống IoT
  - Các thách thức trong IoT