

Fundamentals of Computer Engineering

Module II - Unit 8 New Trends II

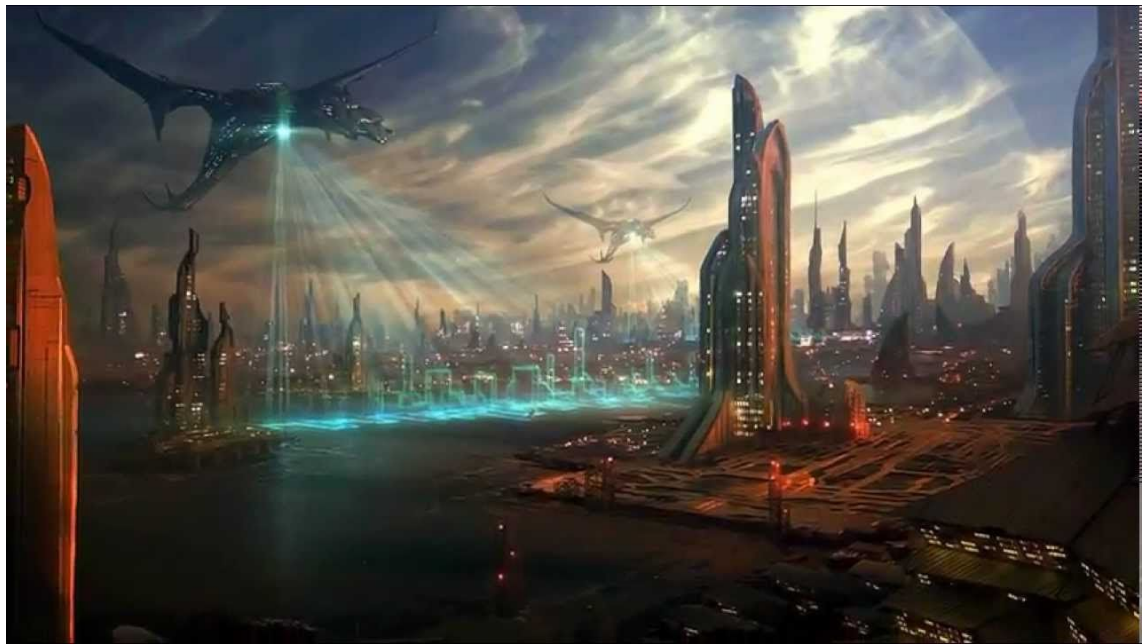
Teachers: Moisés Martínez (1ºA English)

Year: 2022 - 2023

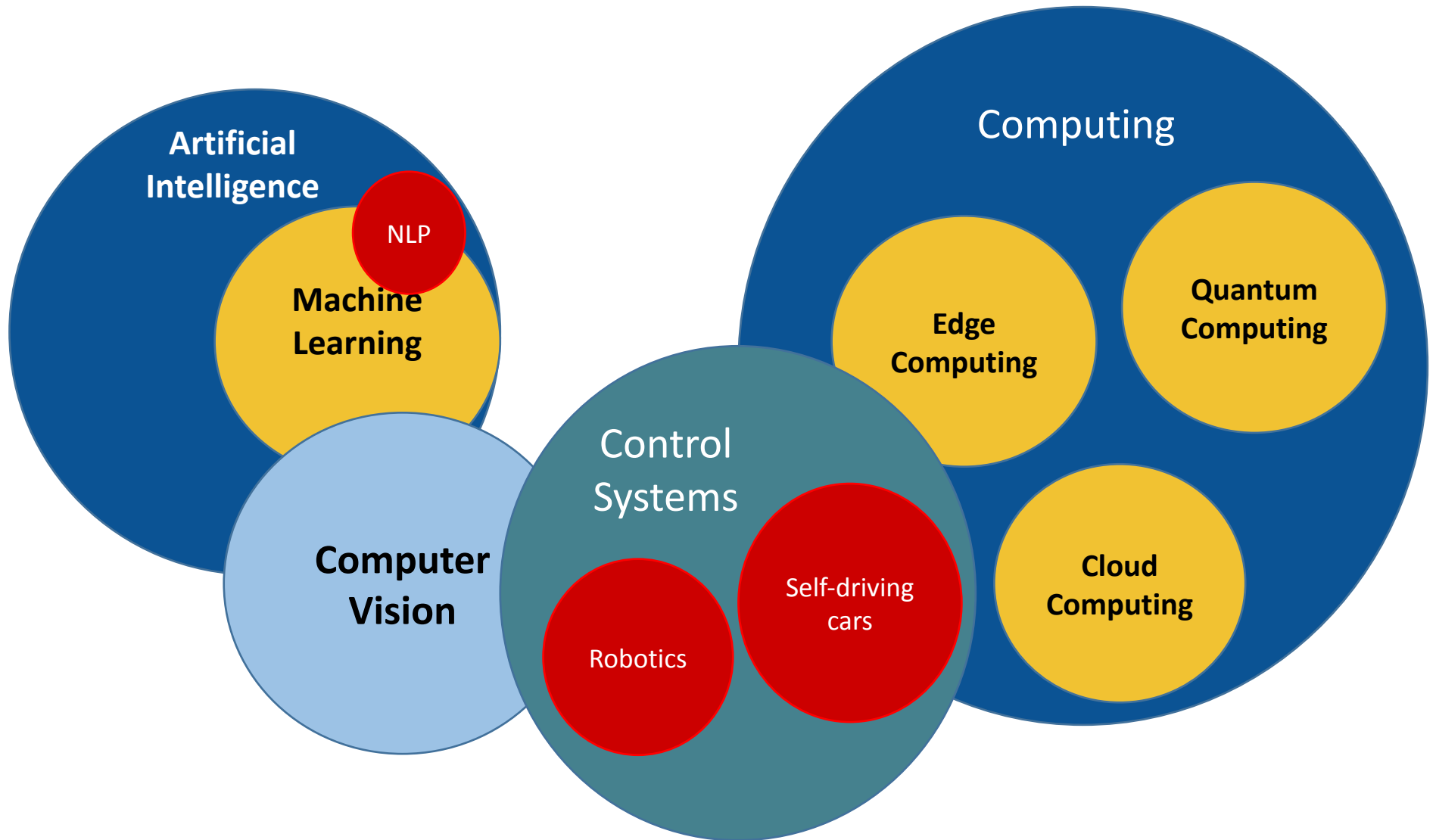
Trend technologies

A **trend** is a change or development towards something new or different.
This means that trend technology will change our future.

- Artificial Intelligence (AI).
- Machine Learning (ML).
- Computer Vision.
- Computation.
- **Control systems.**
- **Internet of Things (IoT).**
- **Blockchain.**
- **5G.**

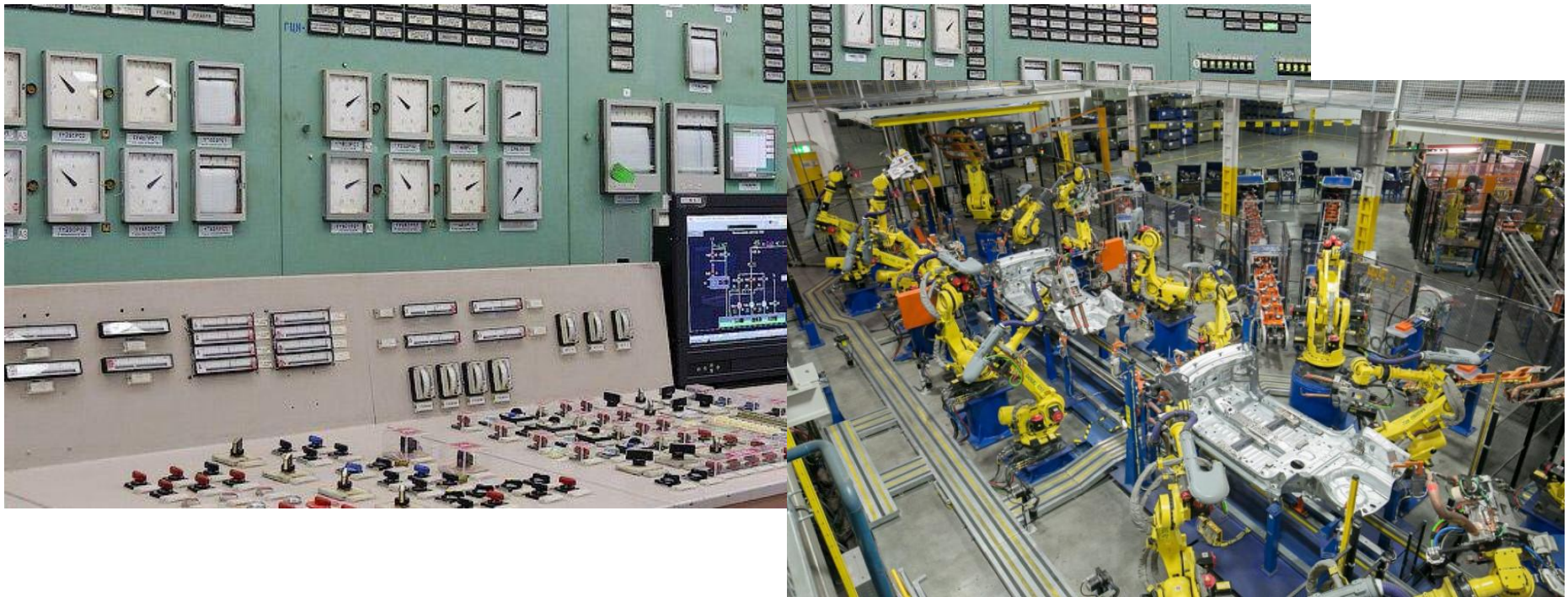


Control System



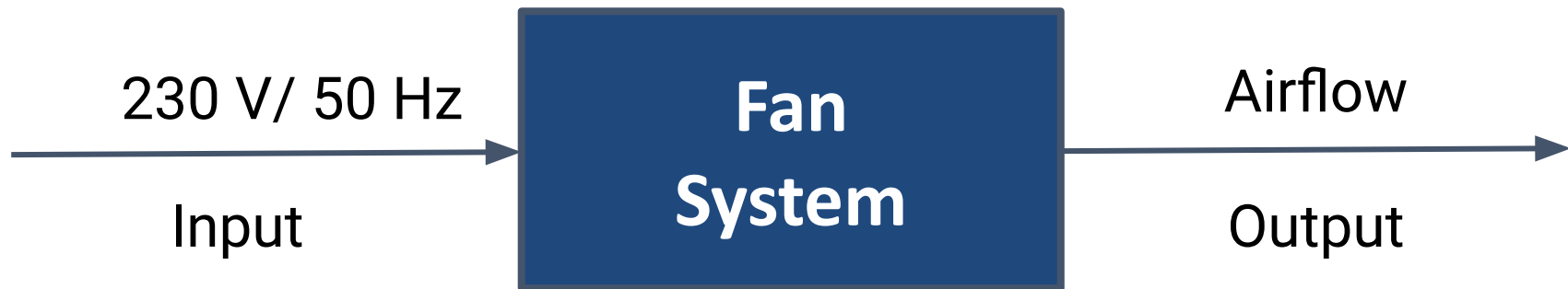
Control Systems - Robotics

Control: It is the process to regulate or command a system in order to reach a desired objective.

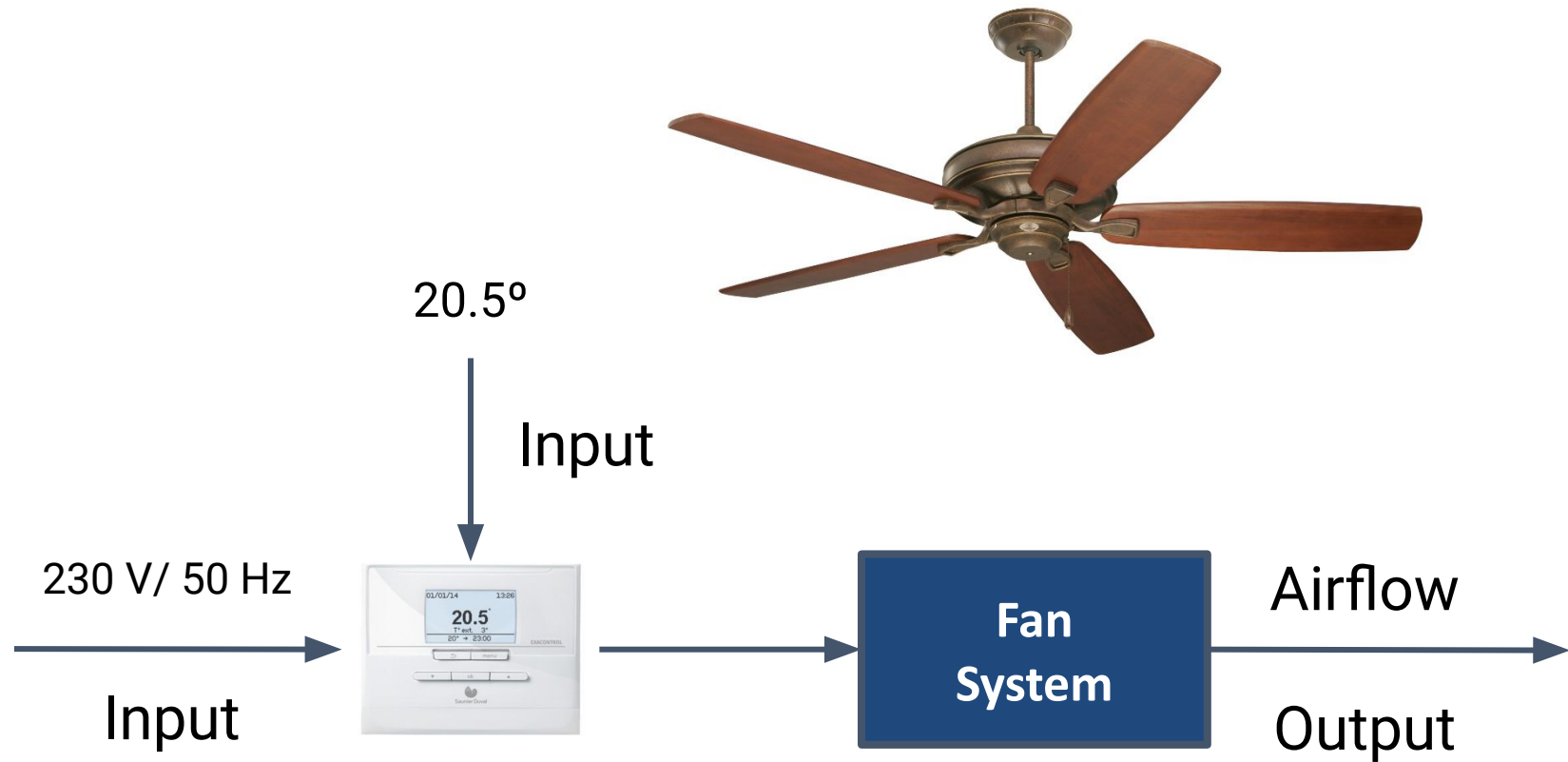


Citroën C3 production line

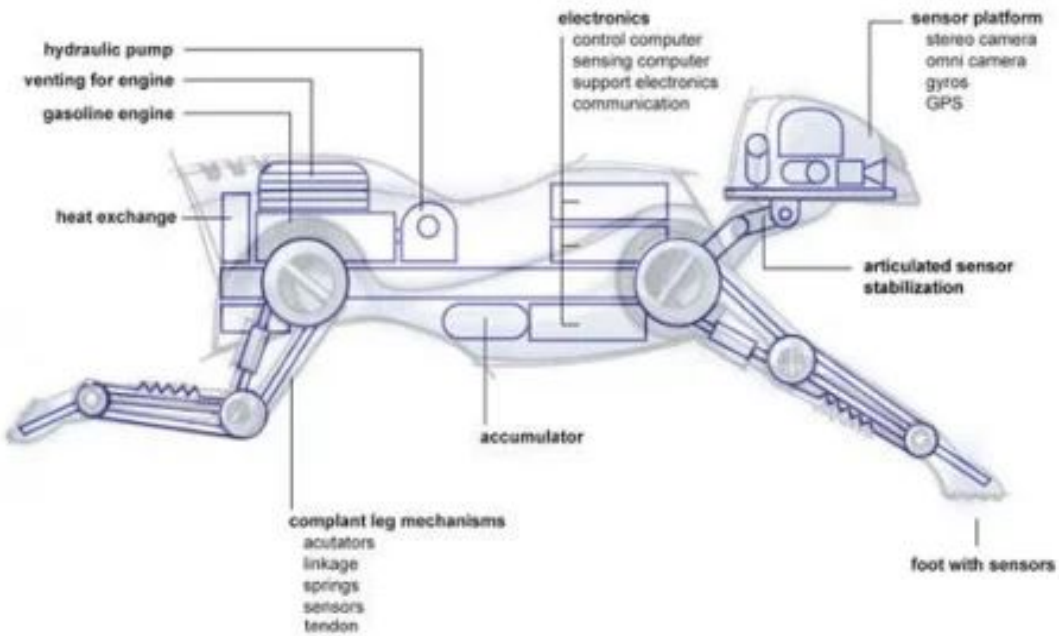
Control Systems - Robotics



Control Systems - Robotics



Control Systems - Robotics



© 2003 Boston Dynamics

Initial design of the robotic dog (Boston Dynamics)



Control Systems - Robotics

A control system is **system** or **subsystem** that is composed of a set of components (sensors, actuators and/or conditioner) that regulate the behavior of a system (or of themselves) to achieve a specific objective.



Control Systems - Robotics

A sensor is a **device** capable of capturing information from the environment through the use of a **transducer**.

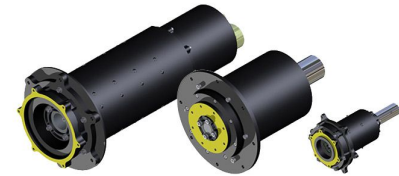
- Proprioceptive sensors: These are sensors which measure internal values to the system. For instance motor speed, wheel load, robot arm joint angles, battery voltage.
- Exteroceptive sensors: These are sensors which measure information from the environment. For instance: Distance (GPS), proximity (sonar, laser, etc), actile (Bumpers, pressure, etc), visual (Cameras, etc) and acoustic (Microphones, etc).



Control Systems - Robotics

An **actuator** is a device capable of transforming some type of energy through the use of a **transducer** in order to produce another type. Actuators are used to produce variations in the environment

- Locomotion (Engines).
- Servomotor.
- Visual (Screens, leds)
- Acoustic (Speakers)



Control Systems - Robotics

A humanoid robot is a robot resembling the human body in shape.

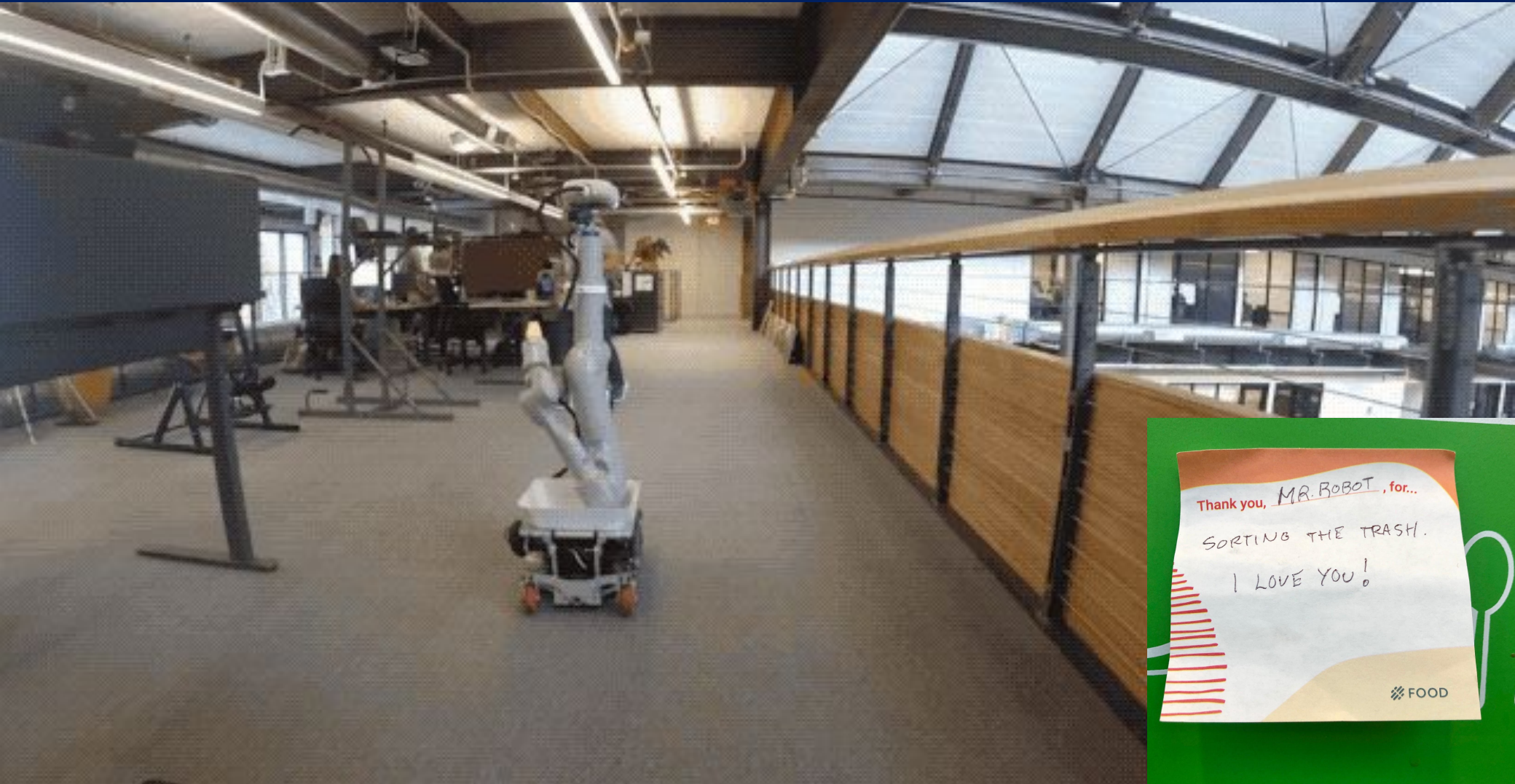


NASA's R5 robot

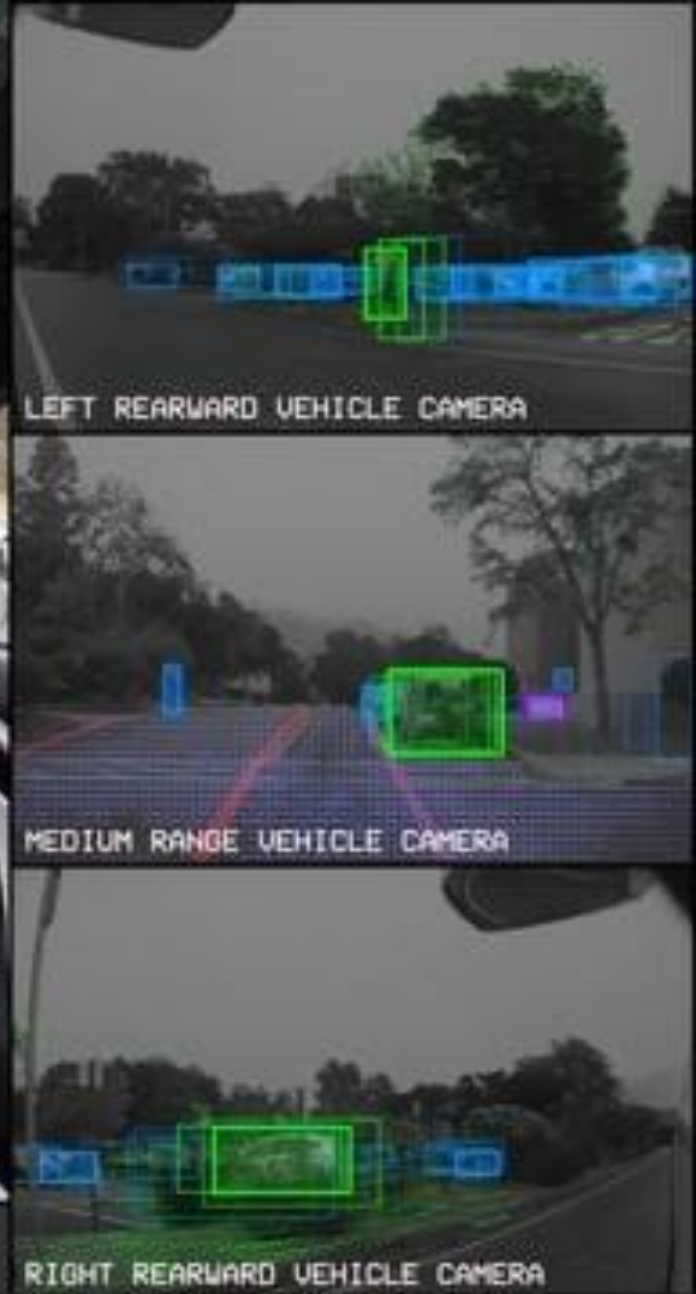


Spot and Atlas (Boston Dynamics)

Control Systems - Robotics



Self-driving cars



LANE LINES LANE LINES ROAD FLOW IN-PATH OBJECTS ROAD LIGHTS OBJECTS ROAD SIGNS

Is this a self-driving car system?

Control Systems - Self-driving cars

Control systems in **self-driving cars** can, usually, be divided into two groups.

- **Driver-in-Control** where the vehicle has sophisticated semi-automated functions for driver assistance, but the driver is still ultimately responsible and in control.
- **Vehicle-in-Control** where the vehicle is fully autonomous and does not require a driver. The vehicle will likely be restricted to certain locations and conditions.

Control Systems - Self-driving cars

SAE Levels of Driving Automation Simplified - Two Matter Most

Level 2: Driver-in-Control and Level 4: Vehicle-in-Control

AUT@PILOT REVIEW



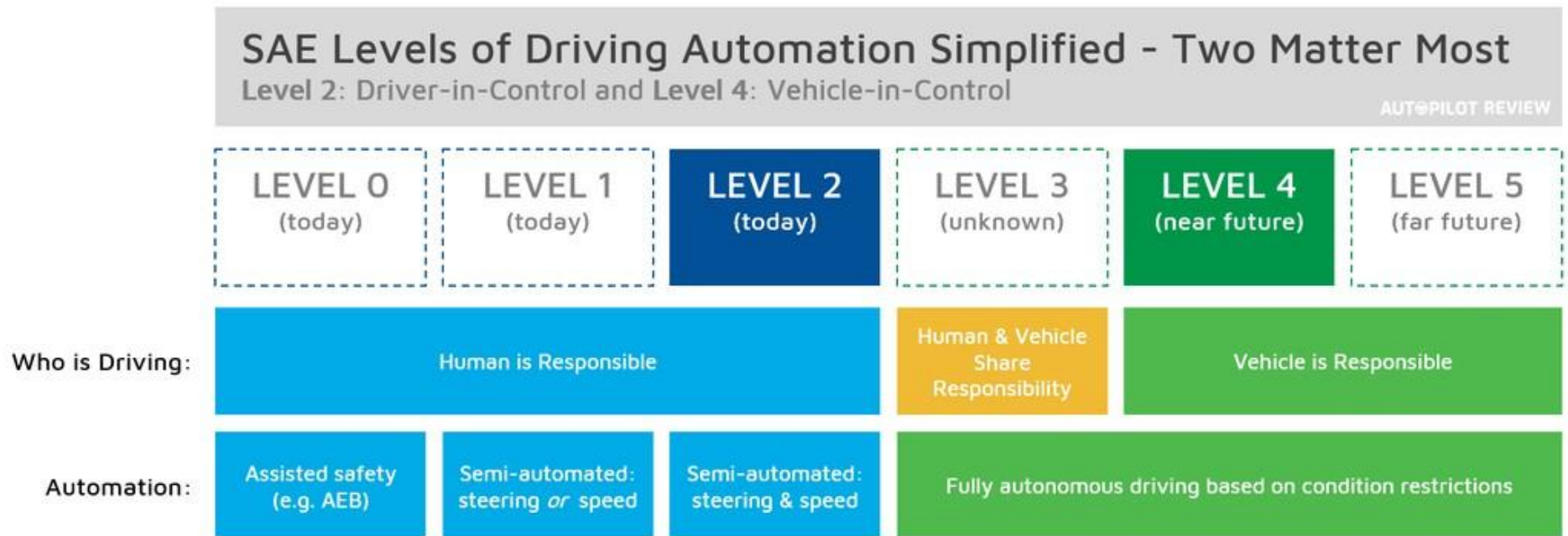
Control Systems - Self-driving cars

Driving mode defines who is responsible of the behaviour of the control system.



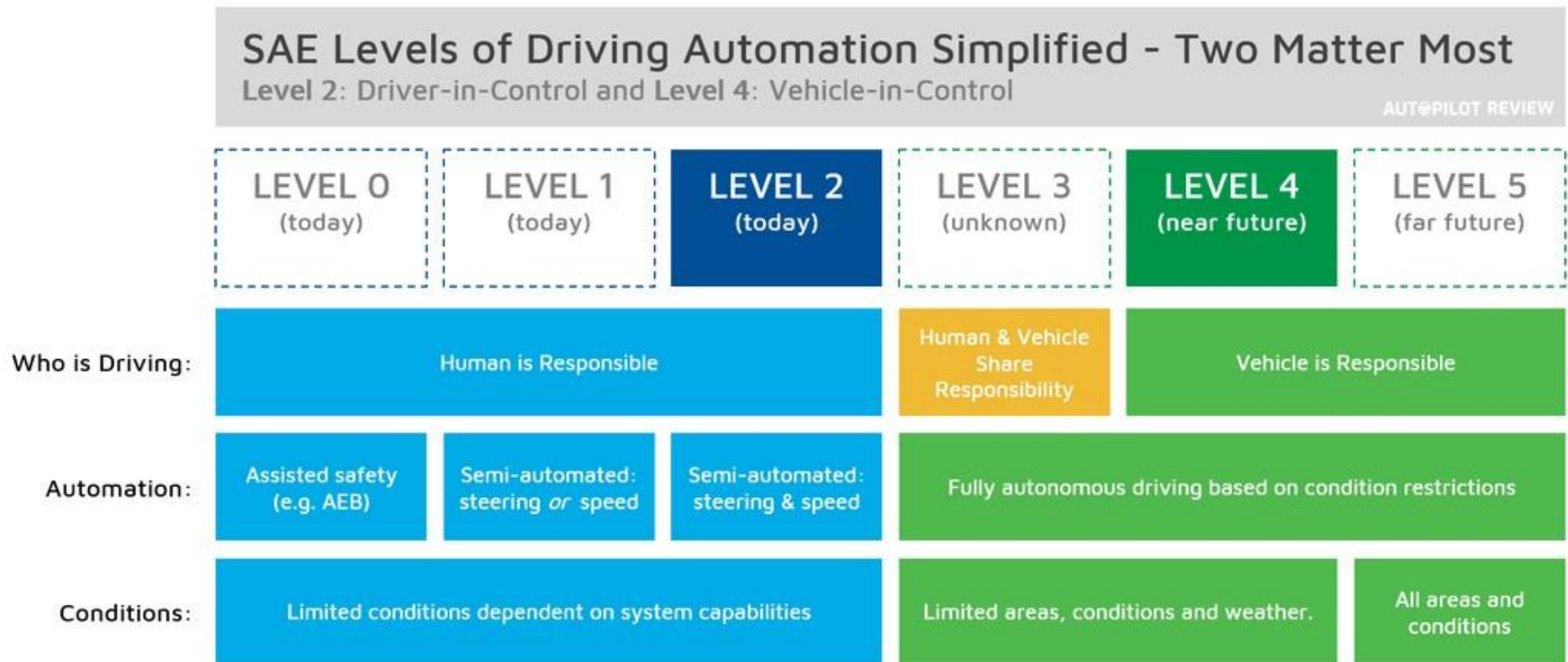
Control Systems - Self-driving cars

Automation defines which are the features of the control system.



Control Systems - Self-driving cars

Conditions defines the environment configuration where the autonomous control system works.

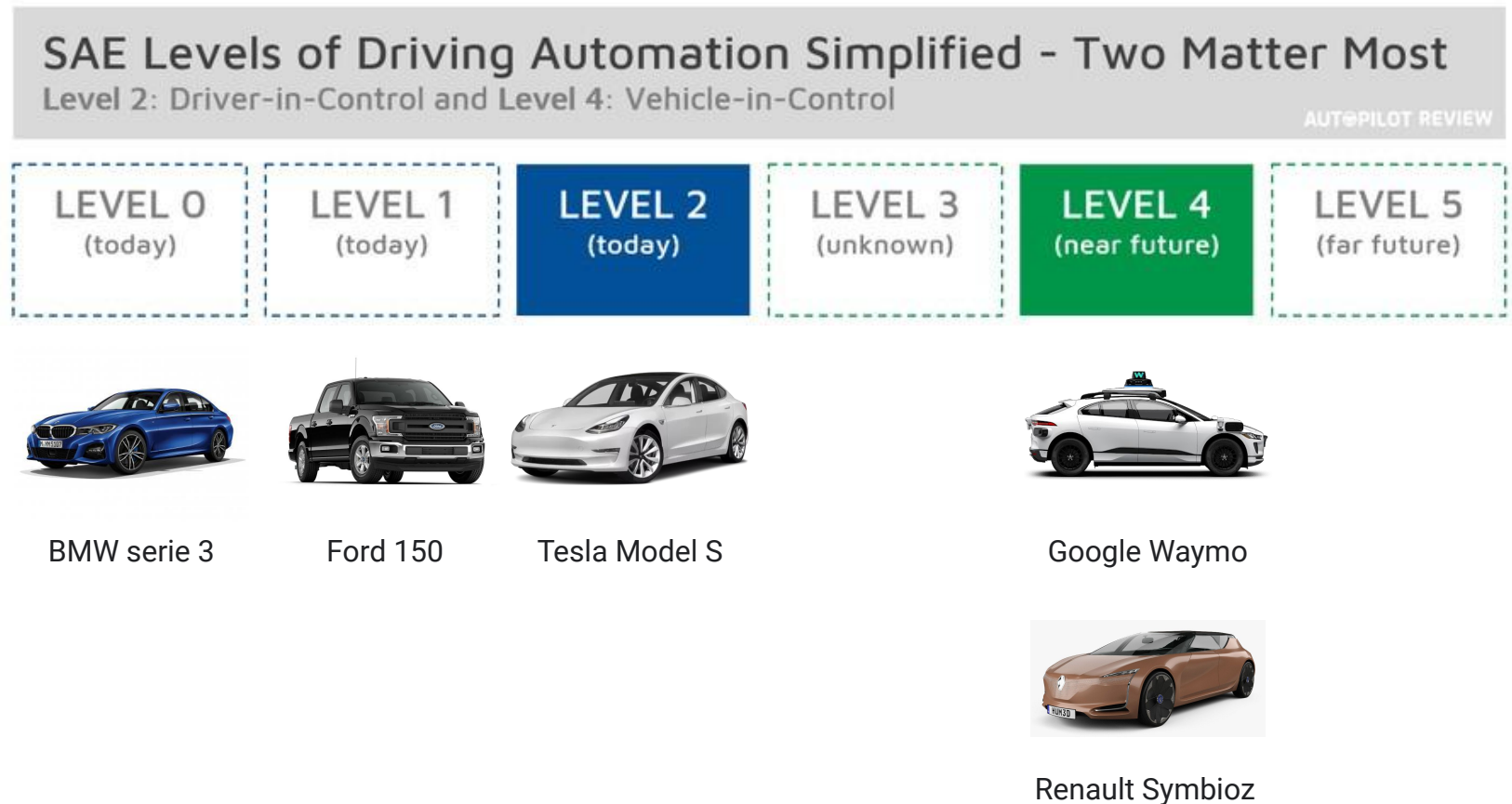


Control Systems - Self-driving cars



Control Systems - Self-driving cars

Which levels are available now?



Self driving cars or autonomous?

Control Systems - Self-driving cars

An **autonomous car** is a vehicle capable of sensing its environment and operating without human involvement. A **human passenger is not required to take control** of the vehicle at any time, nor is a human passenger required to be present in the vehicle at all.

A **self-driving car** is a vehicle capable of sensing its environment and operating in it but **human drivers are required to take control** in dangerous situations.

Control Systems - Self-driving cars

An **autonomous car** is a vehicle capable of sensing its environment and operating without human involvement. A **human passenger is not required to take control** of the vehicle at any time, nor is a human passenger required to be present in the vehicle at all.

Level 4 and Level 5 are autonomous cars.

A **self-driving car** is a vehicle capable of sensing its environment and operating in it but **human drivers are required to take control** in dangerous situations.

Level 2+ and Level 3 are self-driving cars.

Google self-driving car

Control Systems - Self-driving cars

Long Range Camera + Radar

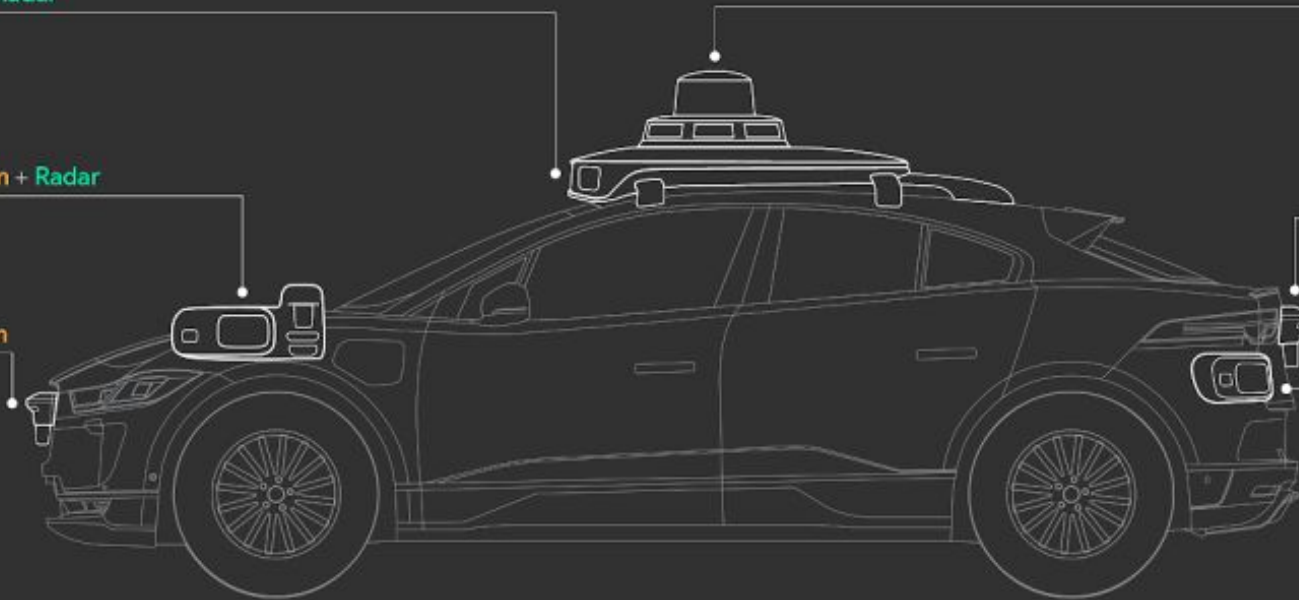
360 Lidar + 360 Vision System

Perimeter Lidar +
Peripheral Vision System + Radar

Perimeter Lidar +
Perimeter Vision System

Perimeter Lidar +
Perimeter Vision System

Perimeter Vision System
+ Radar



Control Systems - Self-driving cars



Look – no driver

Video camera

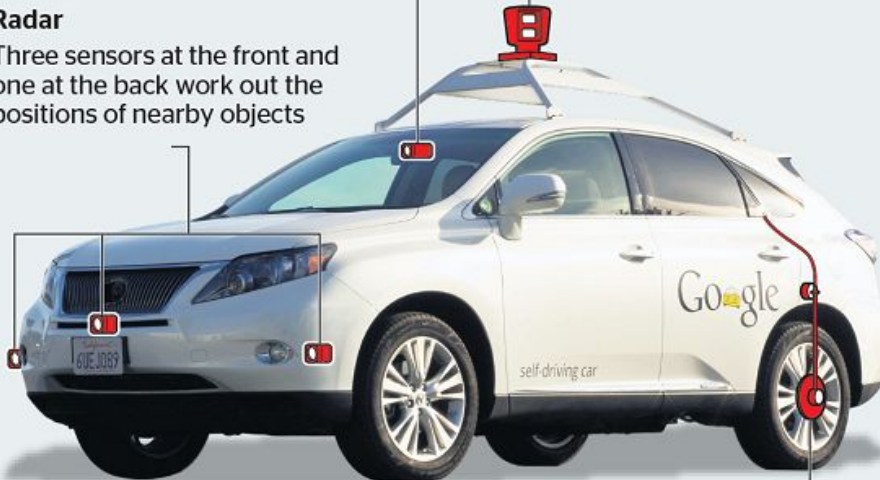
Detects traffic lights, oncoming vehicles and other obstacles

Lidar

A rotating sensor on the roof scans 200ft in all directions to create a 3D map of its surroundings

Radar

Three sensors at the front and one at the back work out the positions of nearby objects

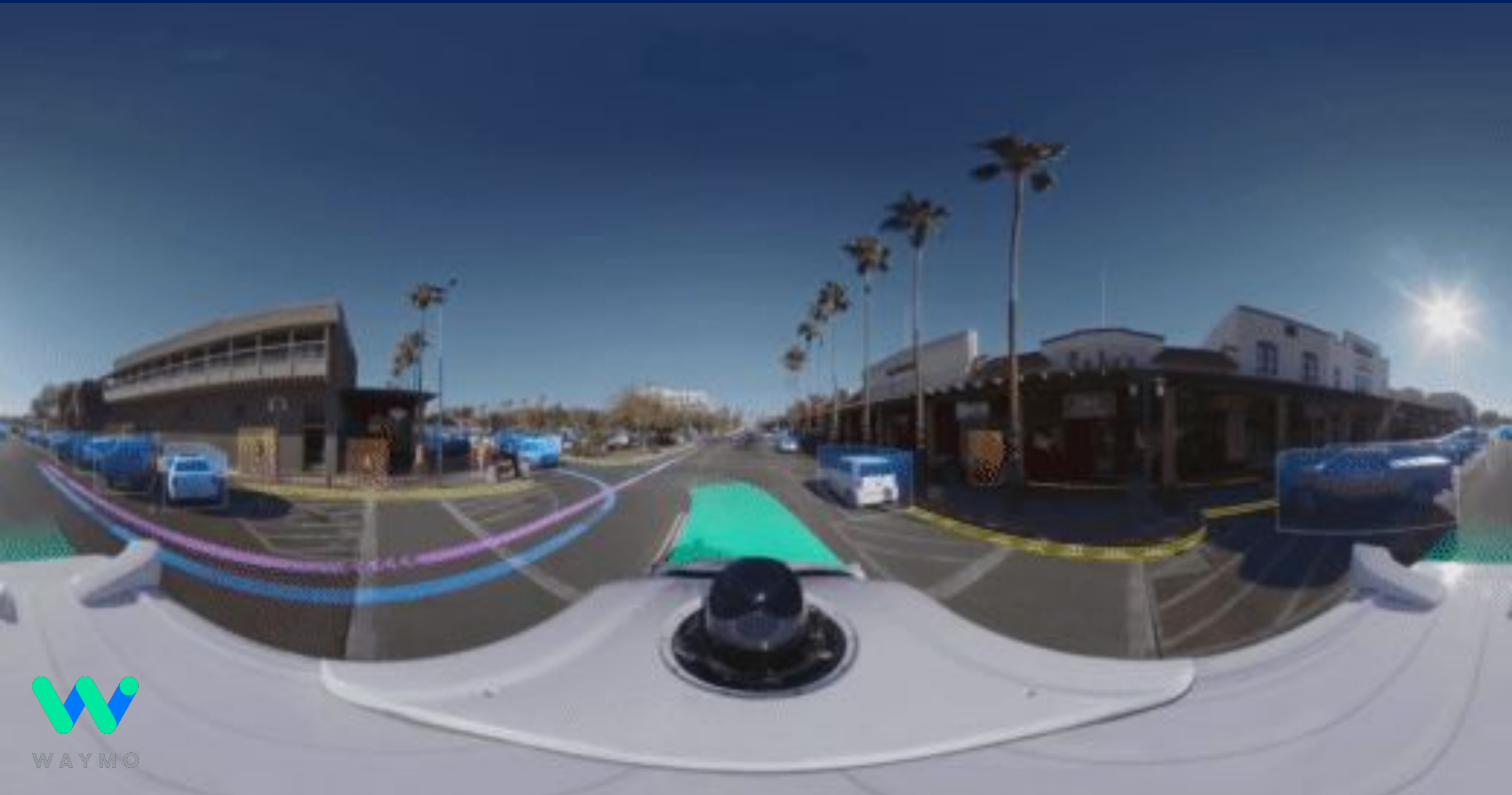


Position estimator

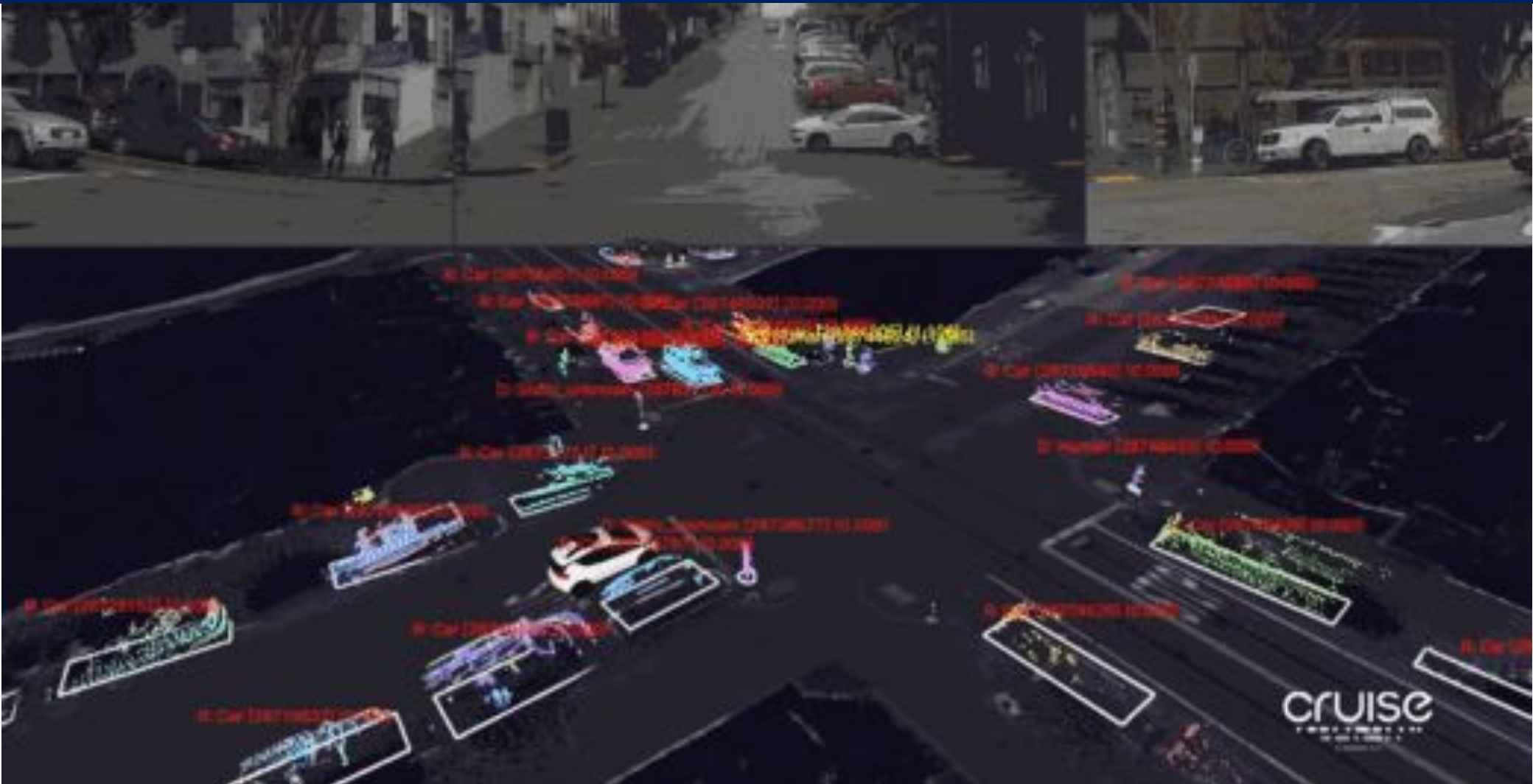
A sensor on the left rear wheel measures the car's movements so that its position can be mapped with accuracy

- The lidar system sits atop the car, always spinning like R2D2, catching objects and helping the AI to figure out where things are.
- Radar sensors around the car detect objects so that the car can avoid them.
- Video camera on the human level to detect traffic lights, signals or objects.
- Position estimators to measure car movements.

Control Systems - Robotics



Control Systems - Robotics



Control Systems - Self-driving cars

The e-stop button: This is a panic stop and it allows to stop the self-driving system.

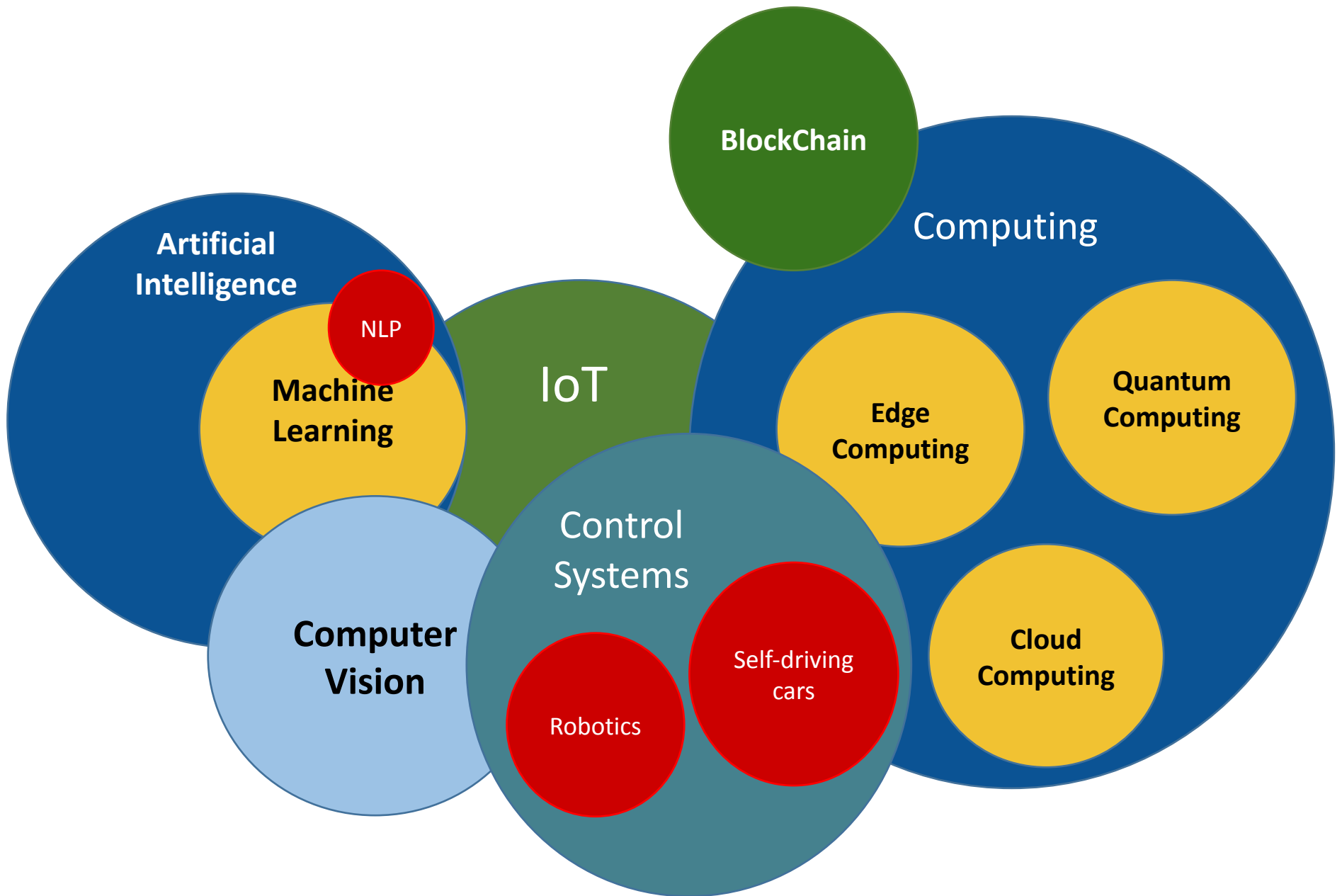


Control Systems - Self-driving cars

Otto was a San Francisco startup that makes software and hardware kits for self-driving vehicles. It was acquired by Uber.



Internet of Things



IoT - Internet of Things

The Internet of Things (IoT) describes the network of physical objects – **things** – that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.



IoT - Internet of Things

IoT technologies are divided in two types:

- Consumer IoT (CloT) is focus on convenience for individual customers, whereas IIoT is strongly focused on the industry sector, improving the efficiency, security.
- Industrial IoT (IIoT) is focus on offer services to organization (smart factory) or between organizations (retailer supply chain) to improve Efficiency, operations, save energy or include AI to the devices.

IIoT is the most established and mature type of IoT.

IoT - Internet of Things

Consumer IoT (CloT) is used to create applications like:

- Gadgets are consumer devices, for example, mobile, refrigerator, glasses, etc.
- Data quantity and rates are comparatively low.
- Applications are not very critical, for example, failure of fitness gadgets will not harm you.



CloT applications are considered **consumer-centric**.



IoT - Internet of Things

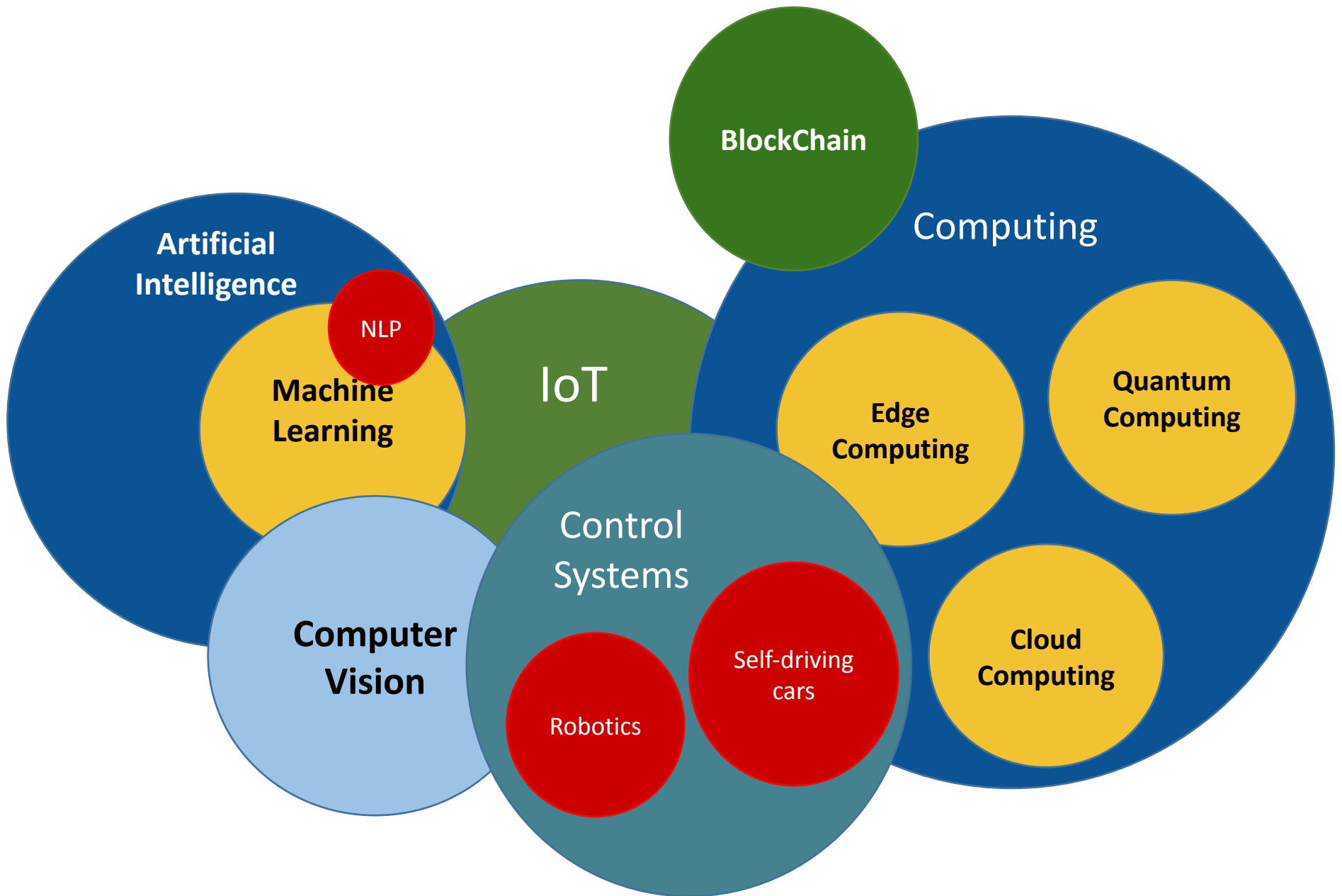
Industrial IoT (IIoT) is used to create applications like:

- Devices are gadgets functioning in industrial, transportation, energy, or medical environment.
- Data quantity and rates tend to vary from sustained to relatively high.
- Applications are safety-critical, for example, the misbehaving of a smart traffic system can threaten drivers.



IIoT applications are considered **system-centric**.

Blockchain



Blockchain

It is an open, distributed **ledger** that can record transactions between two parties efficiently and in a verifiable and permanent way.



- Open
- Distributed
- Ledger
- P2P
- Secure

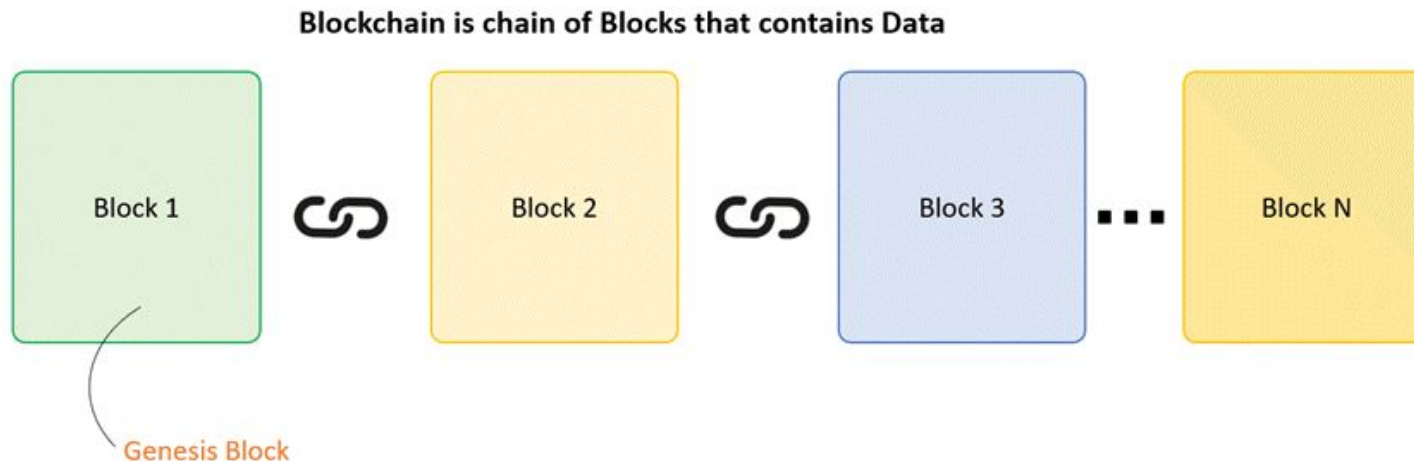
A really important thing



- Blockchain is not Bitcoin, but it is the technology behind Bitcoin.
- Bitcoin is the digital token and blockchain is the ledger to keep track of who owns the digital tokens.
- You cannot have Bitcoin without blockchain, but you can have blockchain without Bitcoin.

Blockchain

Blockchain is a chain of blocks which contain information. The data stored inside a block depends on the type of blockchain.



- The first block in the chain is called the Genesis block.
- Each new block in the chain is linked to the previous block.

Blockchain



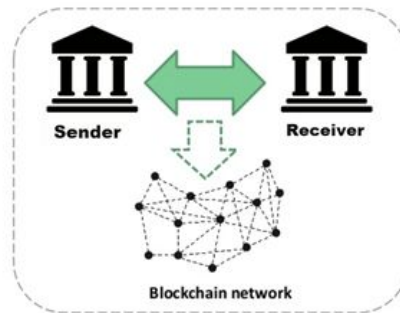
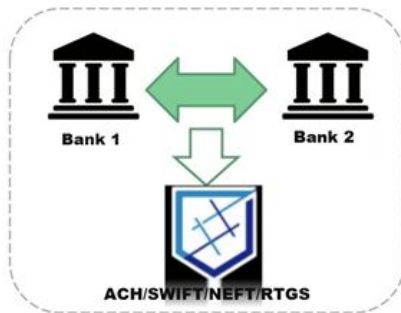
Bitcoin Block Example

For Example, A Bitcoin Block contains information about the:

- Sender (From)
- Receiver (To)
- Number of bitcoins to be transferred (Amount)

Blockchain

A **cryptocurrency** is one medium of exchange like traditional currencies such as EURO, but it is designed to exchange the digital information through a process made possible by certain principles of cryptography. A cryptocurrency is a digital currency and is classified as a subset of alternative currencies and virtual currencies.



Ethereum

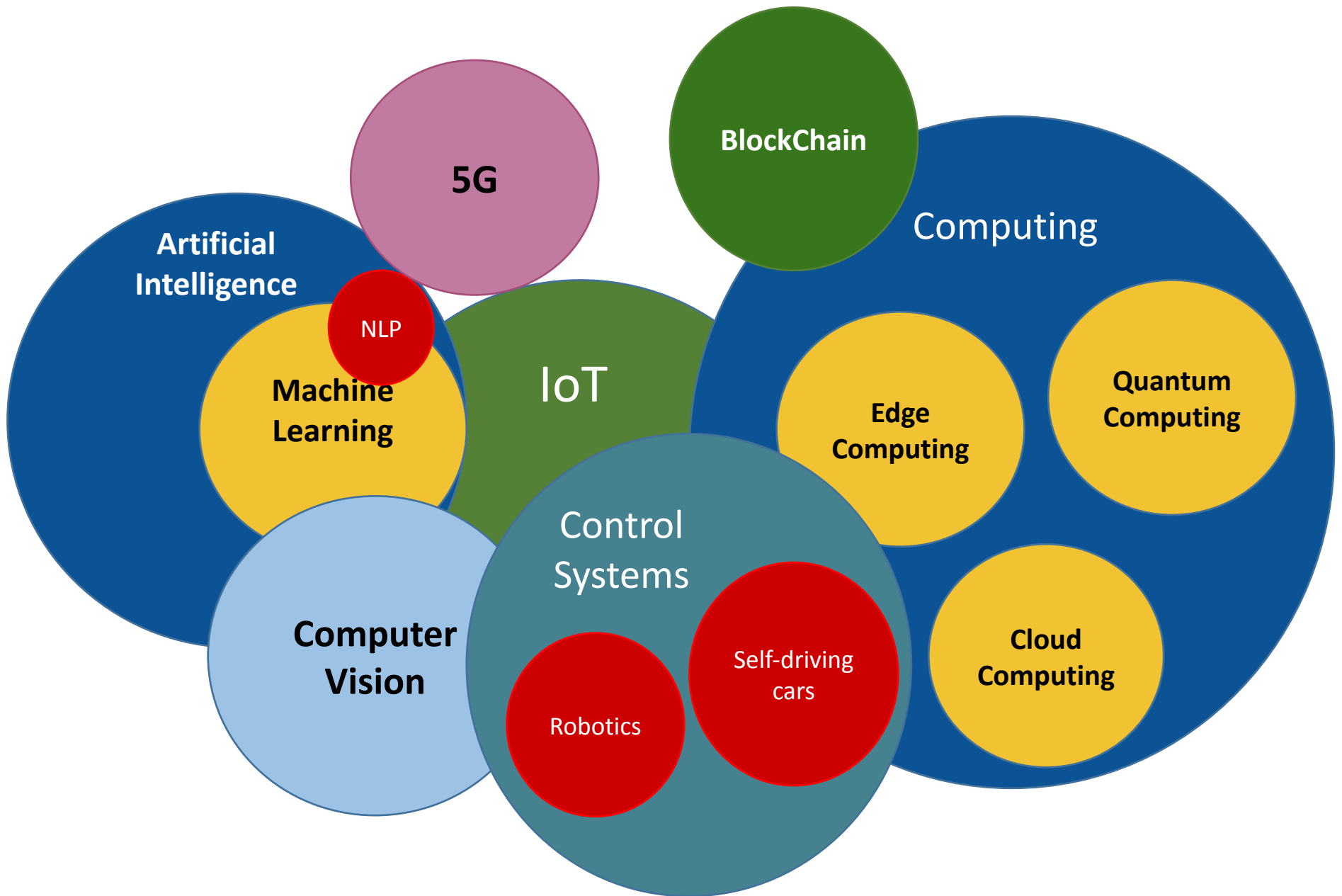
Bitcoin



Litecoin

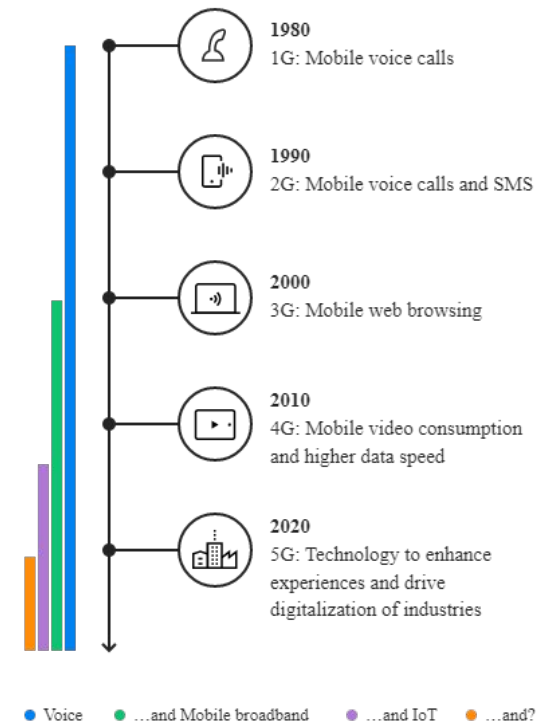
Ripple

5G

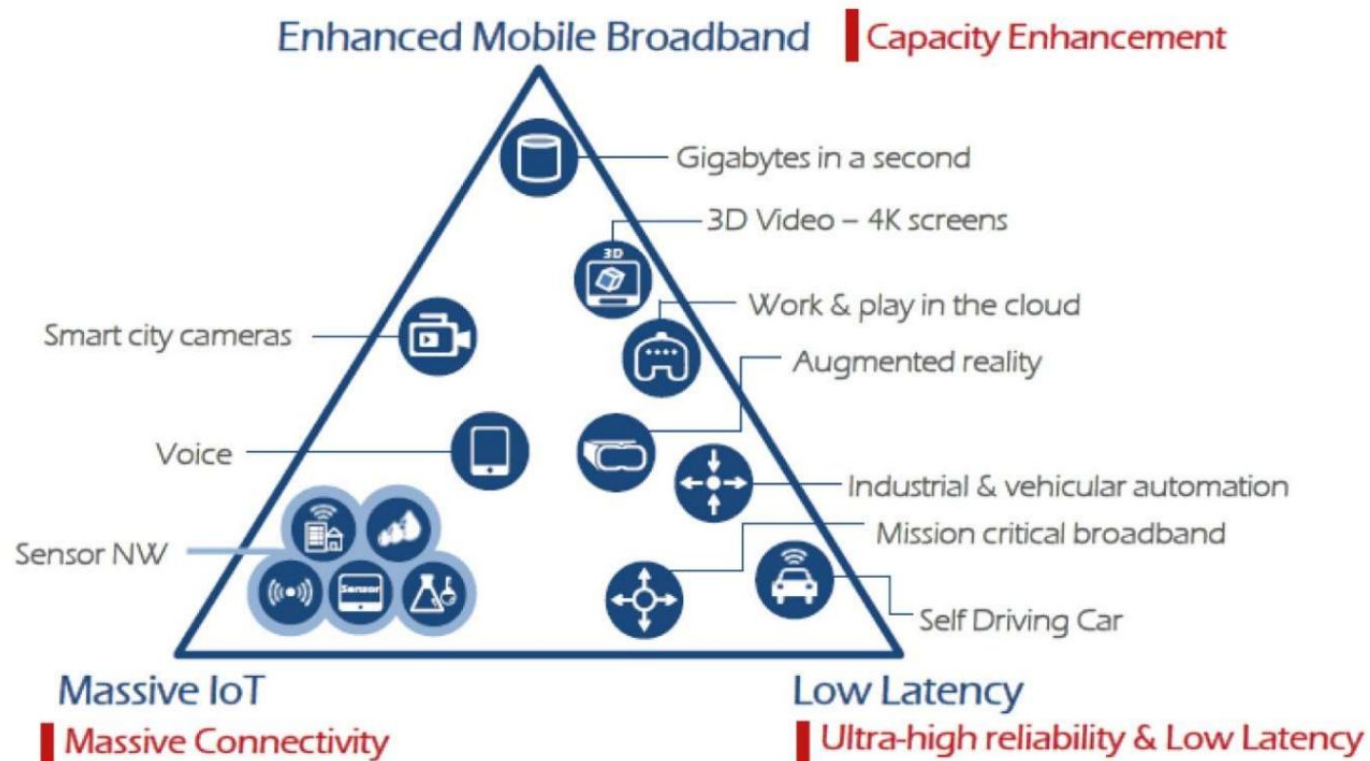


5G is the fifth generation of phone networks which is 100 times faster than 4G. This means 5G download speeds can reach 10 gigabits per second. 5G applications in the near future:

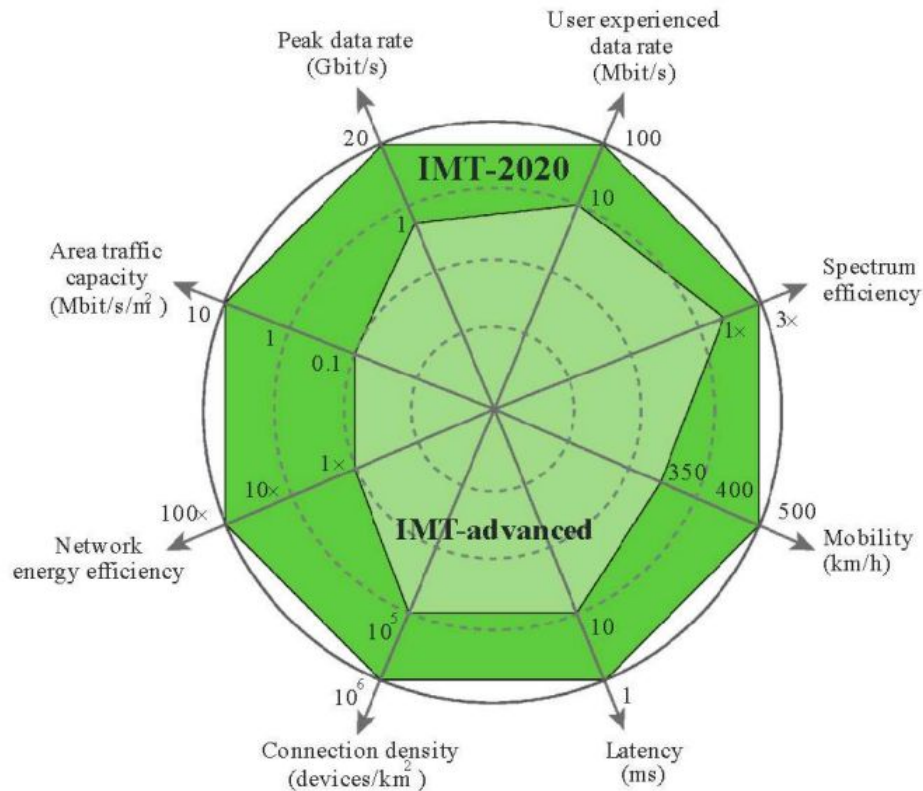
- Autonomous Vehicles.
- Complex Artificial Intelligence.
- Virtual Reality (VR) and Augmented Reality (AR).
- Complex IoT like drones.
- Mobile Services Resembling Broadband Perspectives.
- Dedicated network slicing.



5G is based on 3 important features.



5G - Performance Goals International Telecommunication Union (ITU)



The International Telecommunication Union is a specialized agency of the United Nations responsible for many matters related to information and communication technologies.



There are more

