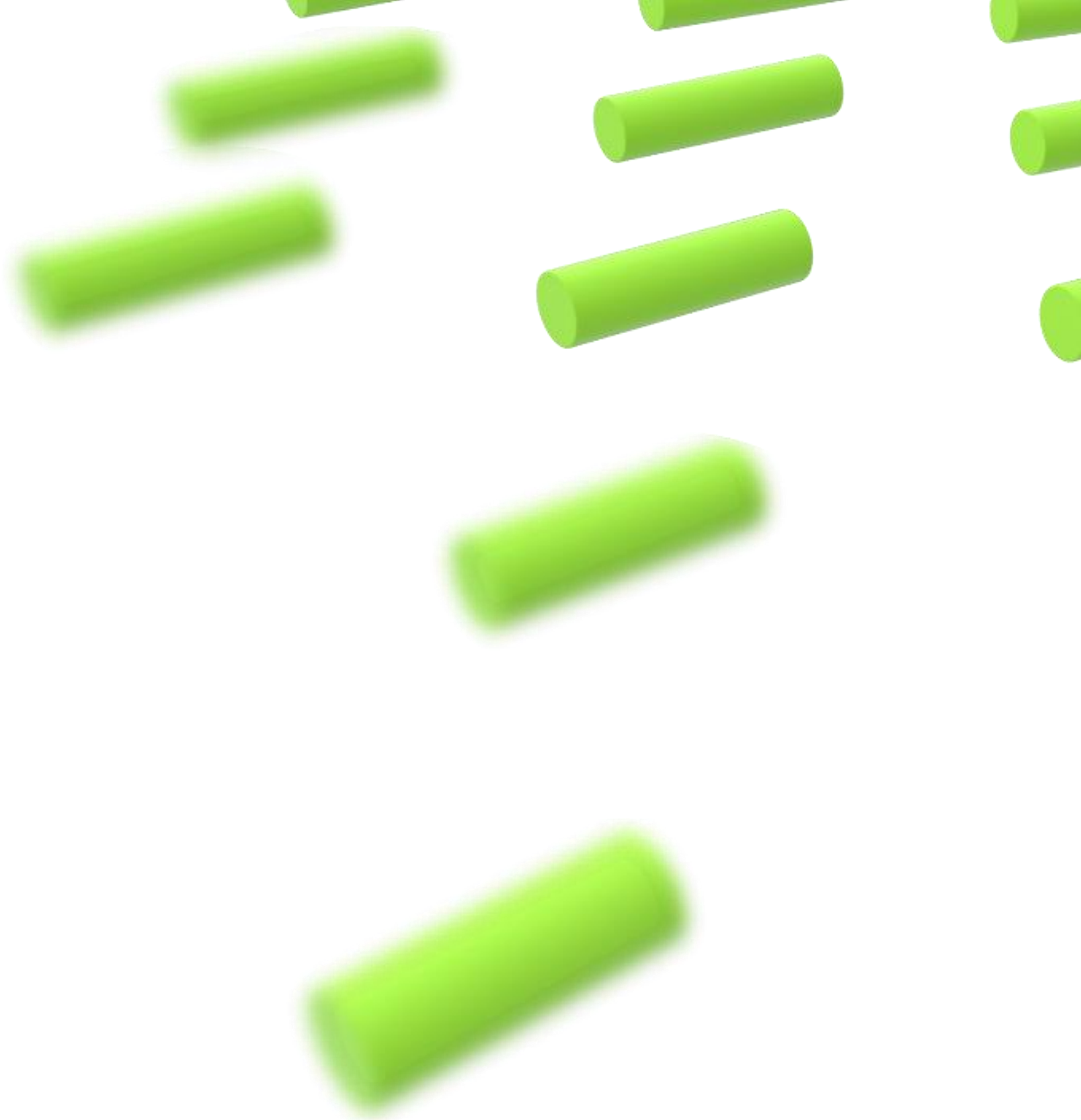


# KPI1



**Module Name**  
Embedded Systems



# Background

We see various devices/products around us, that can be controlled with simple human interfaces e.g., washing machine, microwave oven, cell phones, Point of sale terminals (in shopping centres), robots, Automobiles, Digital signage's etc. The most common controllable element in these devices is computer on chip or microcontroller or CPU. The devices are intelligent devices that sense and respond to external/internal environment.

The microcontroller makes all these devices intelligent by means of software. Software along with microcontroller helps in decision making and makes them more intelligent.

**Above all devices/products are categorized under Embedded Systems.**

In this module, we will learn about;

Various building blocks of Embedded Systems with sample use cases or applications in automotive, RISC Vs CISC design approach, Role of microcontrollers, Writing software for Automotive Embedded applications, Design and verification techniques of Embedded Software.

# KPIT



## Session-I Embedded Systems Building blocks and applications



# Session outline

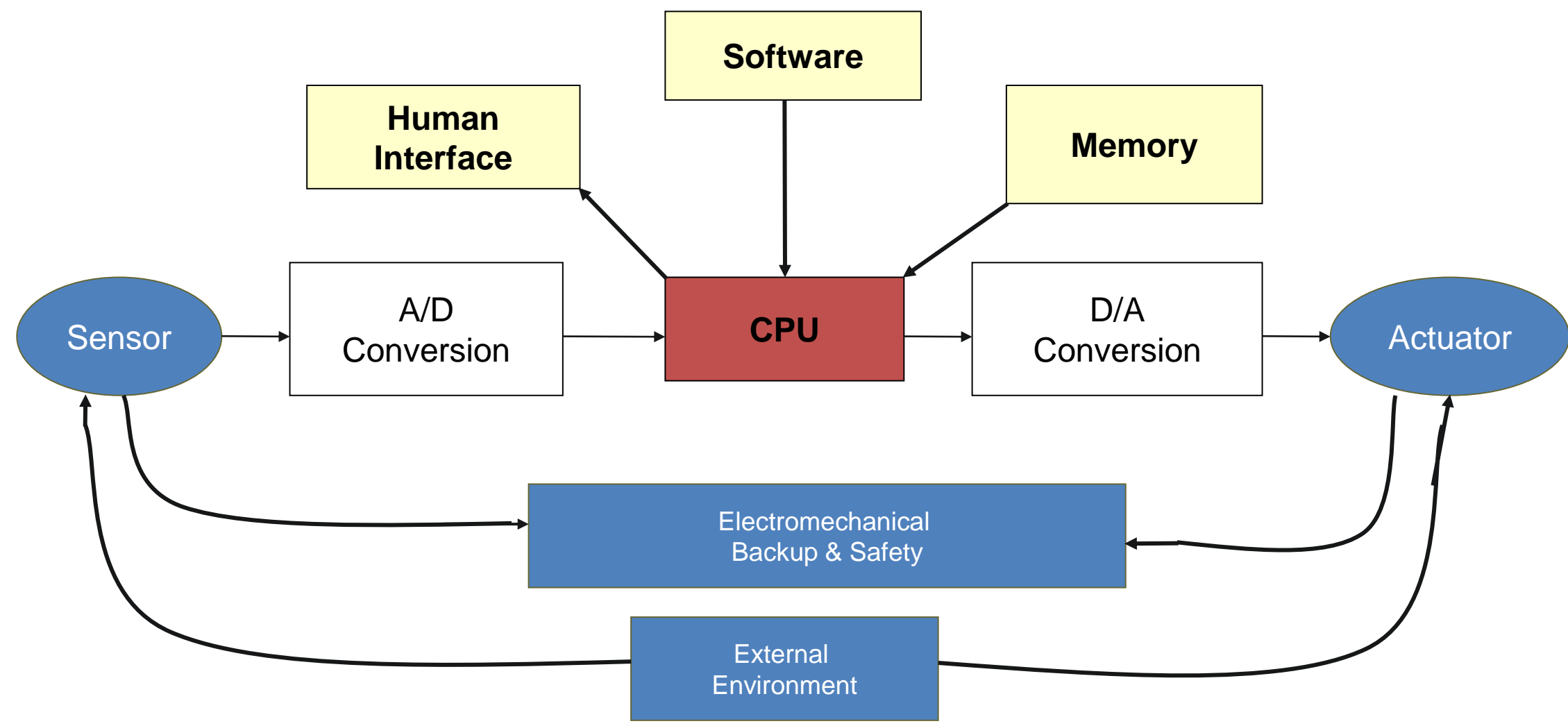
- What are Embedded Systems and its characteristics
- Building blocks of Embedded Systems
- Various applications of Embedded Systems
- Embedded Systems in context to Automotive
- Automotive Embedded System applications

# Defining Embedded systems

- A general-purpose definition of embedded systems is that they are devices used to control, monitor or assist the operation of equipment, machinery or plant based upon external inputs.
- “Embedded” reflects the fact that they are an integral part of the system.
- In many cases, their “embeddedness” may be such that their presence is far from obvious to the casual observer.



# Building blocks of Embedded Systems



# What is Embedded System?

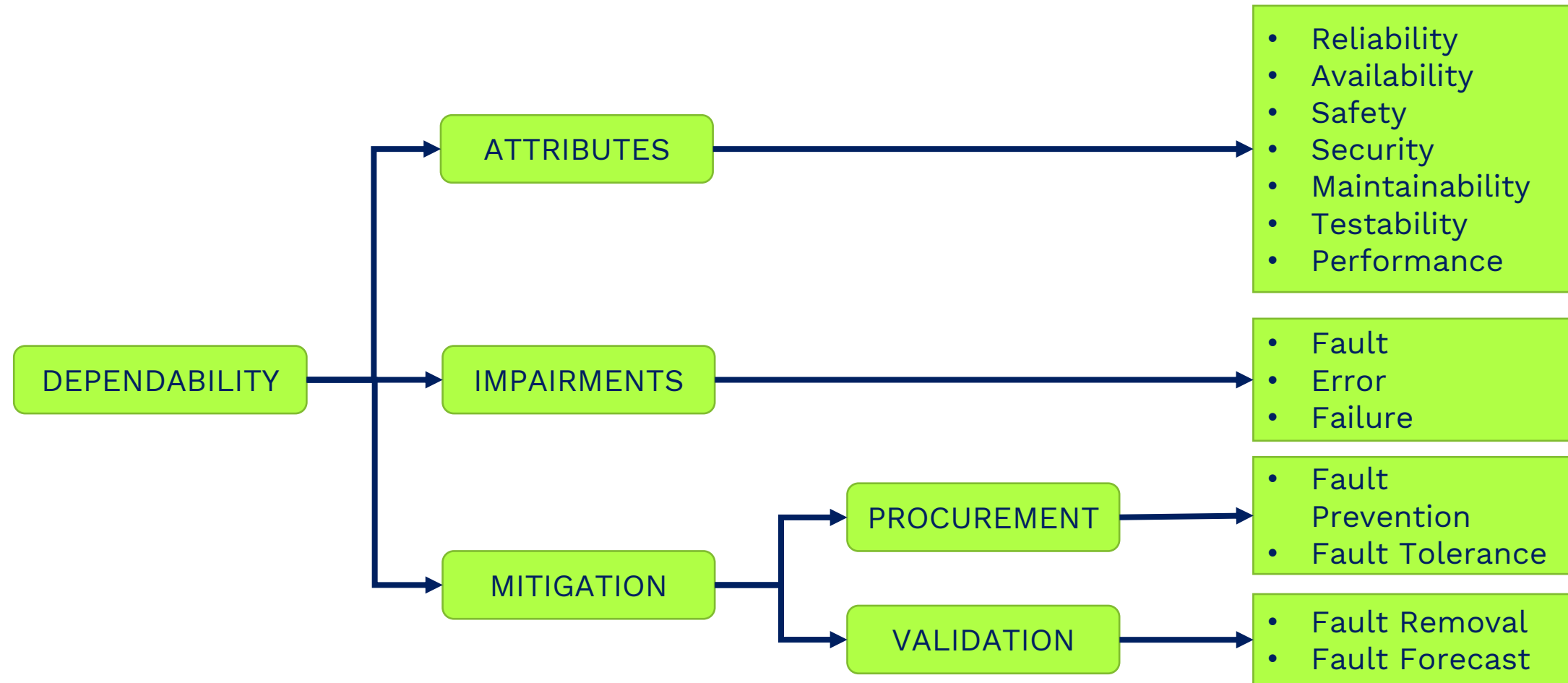
- An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts.
- Embedded systems control many products in common use today.



# Characteristics of Embedded Systems

## 1. Must be Dependable:

Dependability is defined as the trustworthiness of a computer system such that reliance can justifiably be placed on the service it delivers





# Characteristics of Embedded Systems

## 2. Must be efficient :

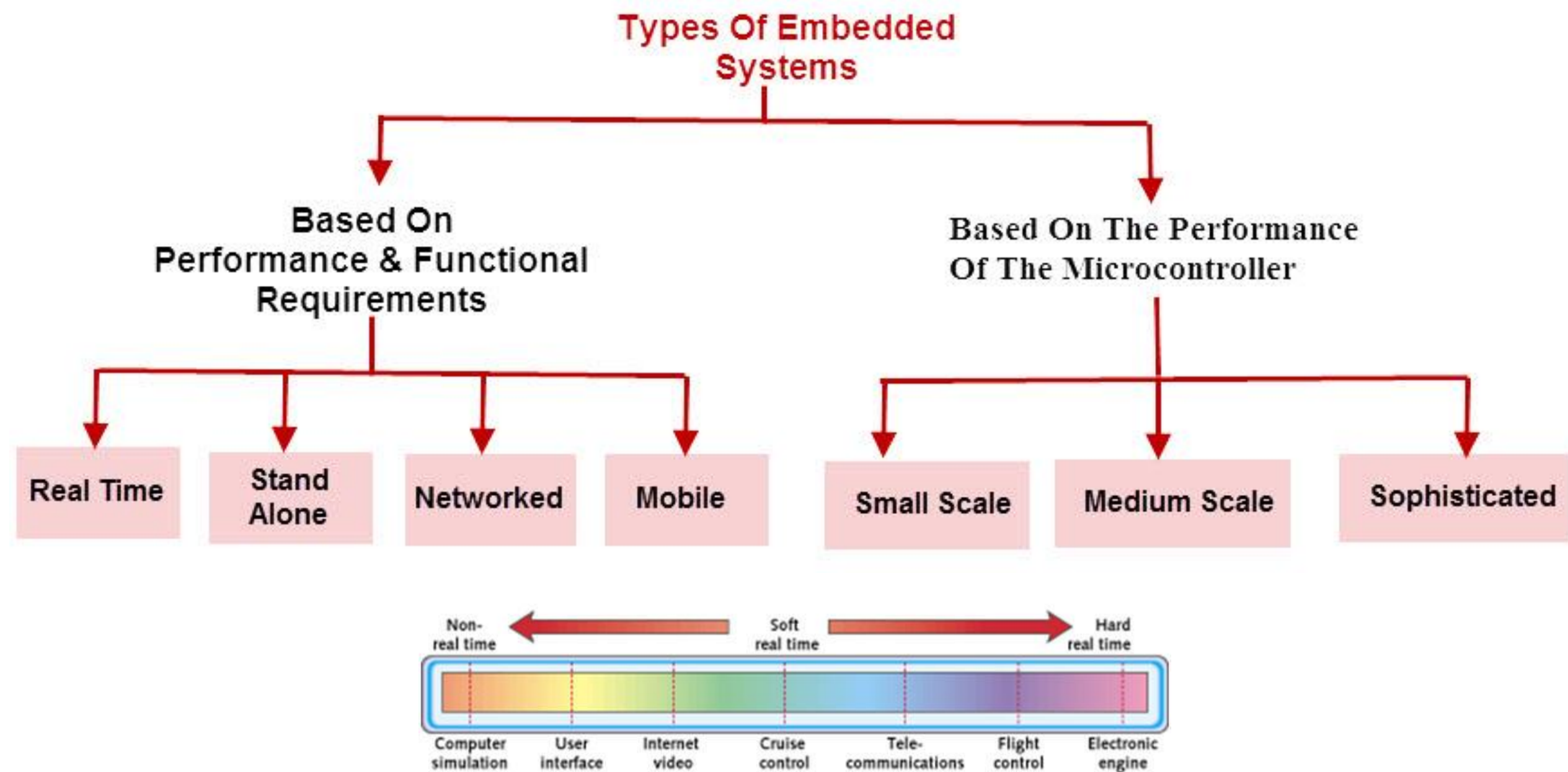
- **Energy** : Power efficient (Specially for standalone embedded systems)
- **Code-Size**: Smaller memory footprint (Can't have hard disk on mobile)
- **Run-time**: Can run for ever and perform multitasking
- **Weight**: More the weight – more power required to move it
- **Cost**: Optimal cost

## 3. Dedicated: Dedicated towards a certain application. Knowledge about behavior at design time can be used to minimize resources and to maximize robustness.

## 4. Must meet real-time constraints:

- A real-time system must react to stimuli from the controlled object (or the operator) within the time interval dictated by the environment.
- For real-time systems, right answers arriving too late are wrong

# Classification of Embedded Systems



# Embedded applications: some examples and types

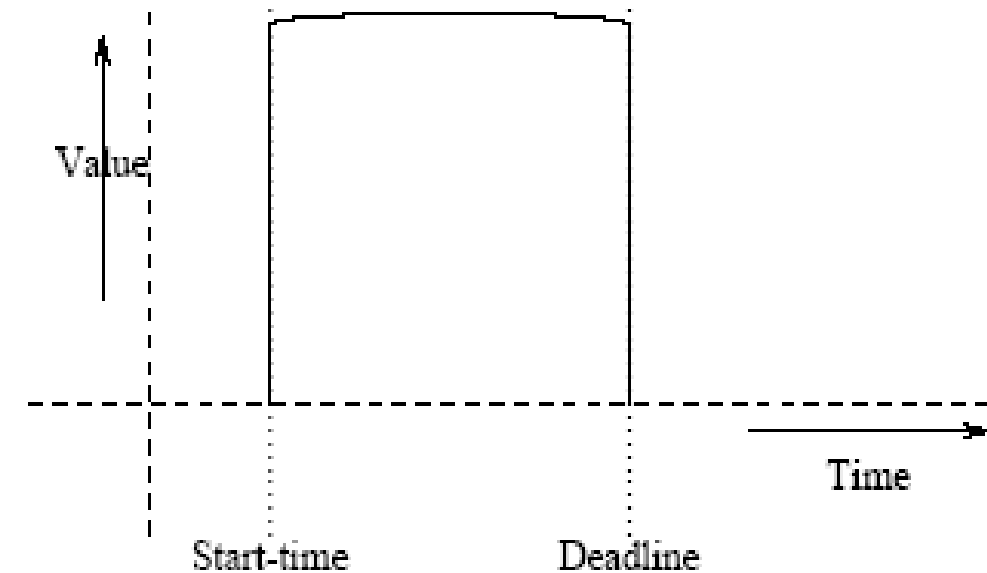
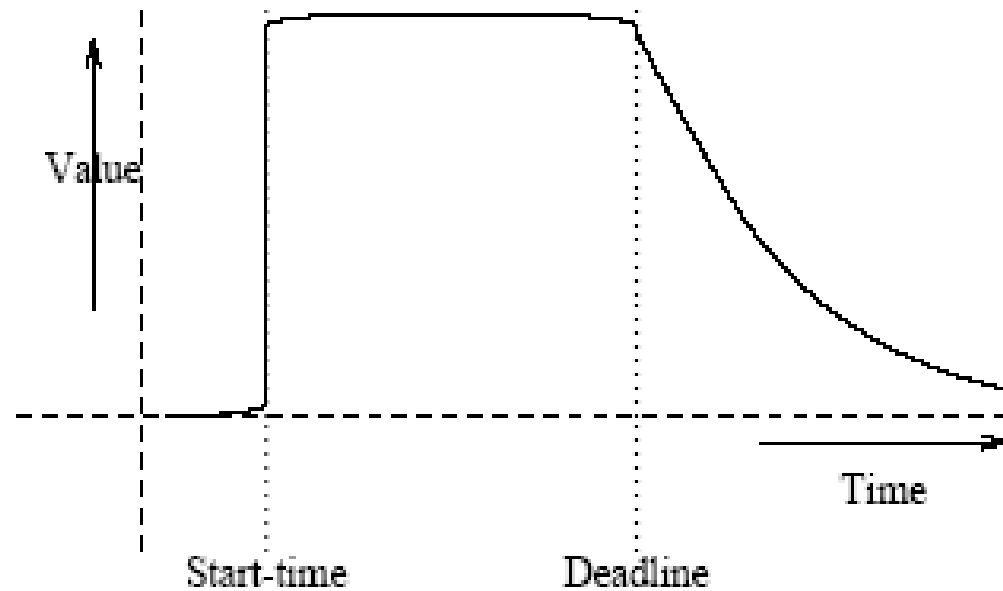
## Non – Real time applications

User interface  
internet video  
computer simulation

## Real –Time applications

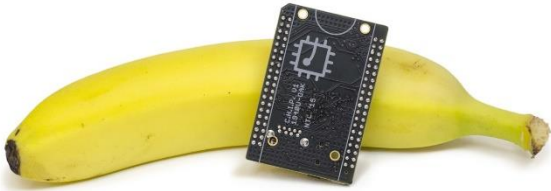
Cruise control  
Flight control  
Electronic Engine control  
Tele - communication

## How to differentiate ?

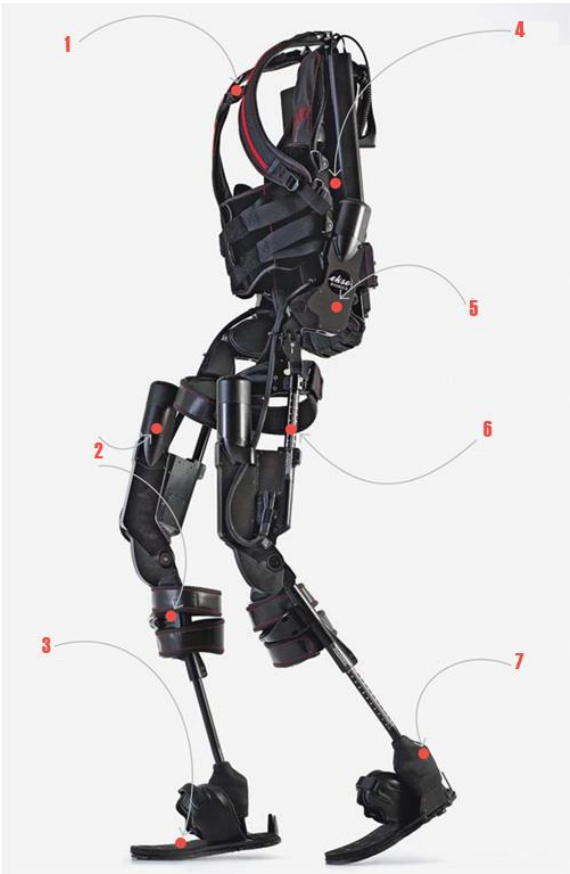
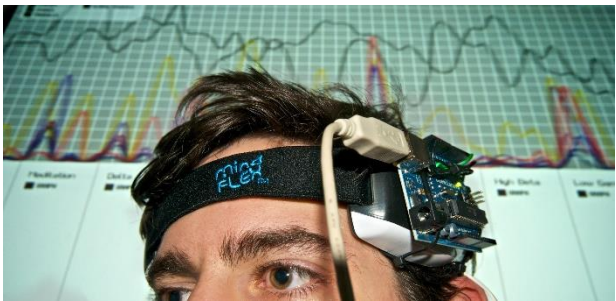


# Examples

## CHIP



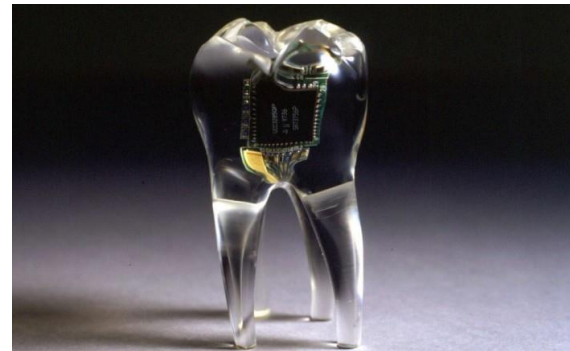
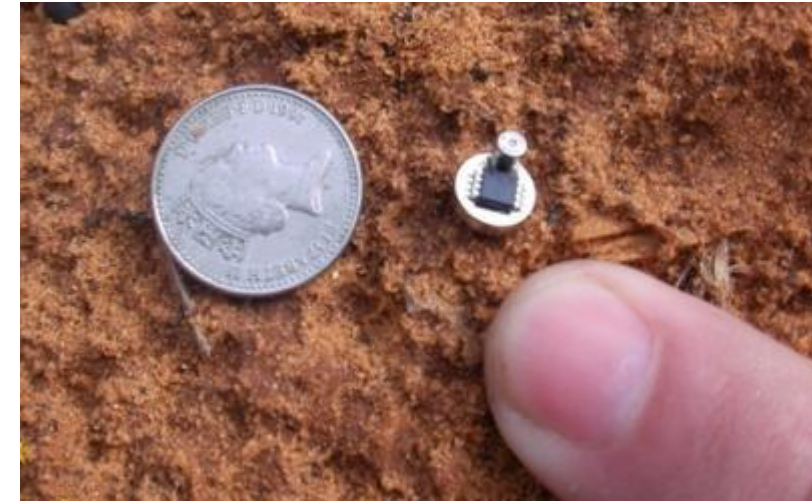
The World's First \$9 Computer



## KPI1



# Examples



# Automotive Embedded Systems

- more than 100 ECUs embedded in the car
- about 100+Million lines of software embedded.

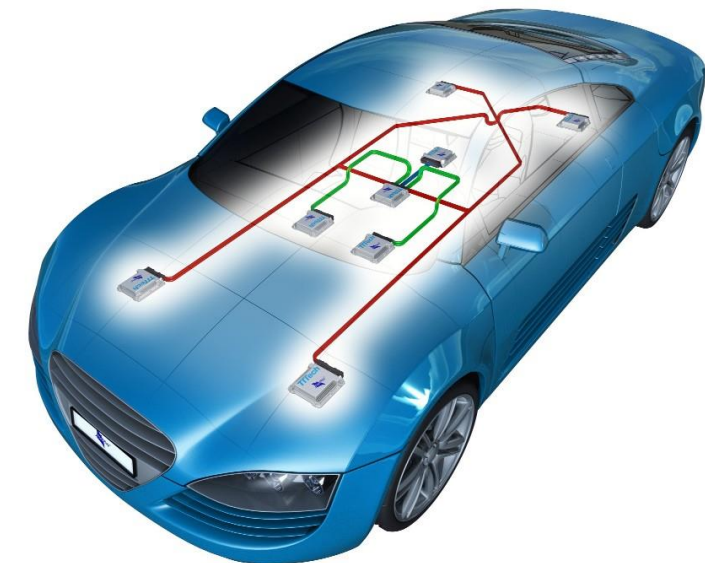
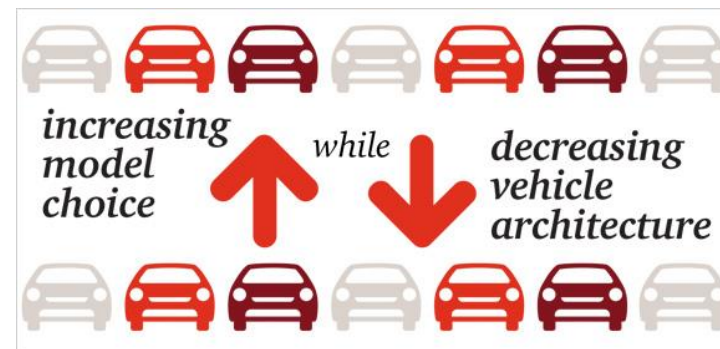


My Car runs on Code?

- **Automotive Embedded Systems:** A computer system that is embedded into a car to control it.
- An embedded computer unit is called an ECU (Electronic Control Unit).

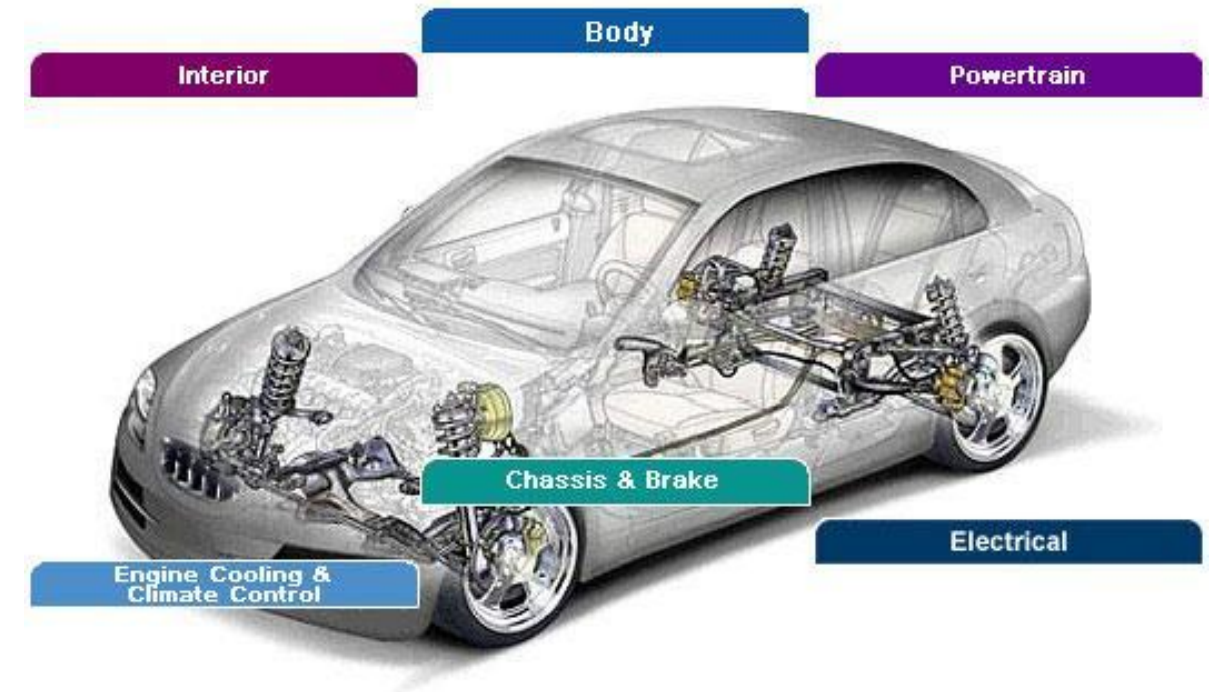
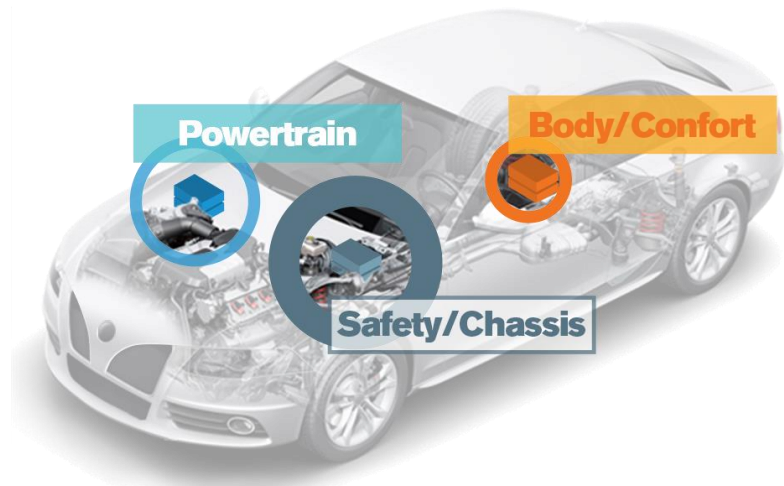
# Automotive Embedded Systems - Difference

- Automotive embedded systems must be designed with many additional aspects in mind:
  - Safety
  - Communication
  - Processes
  - Portability
  - Reuse
  - Standards
  - Cross functional activities
  - Diagnostics
  - Emission
  - Comfort
  - Fuel Economy
  - Education and awareness
  - Security





# Various Automotive sub-verticals





# Applications - Automotive Embedded Systems

