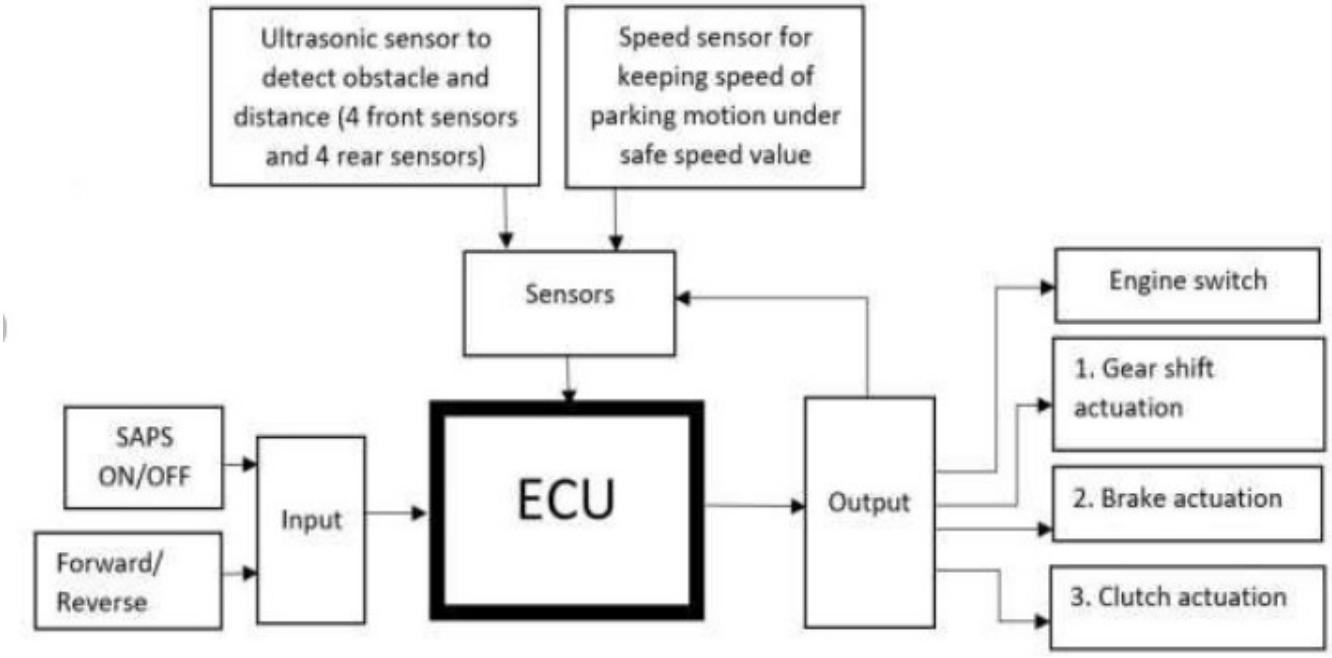
ECU – ELECTRONIC CONTROL UNIT

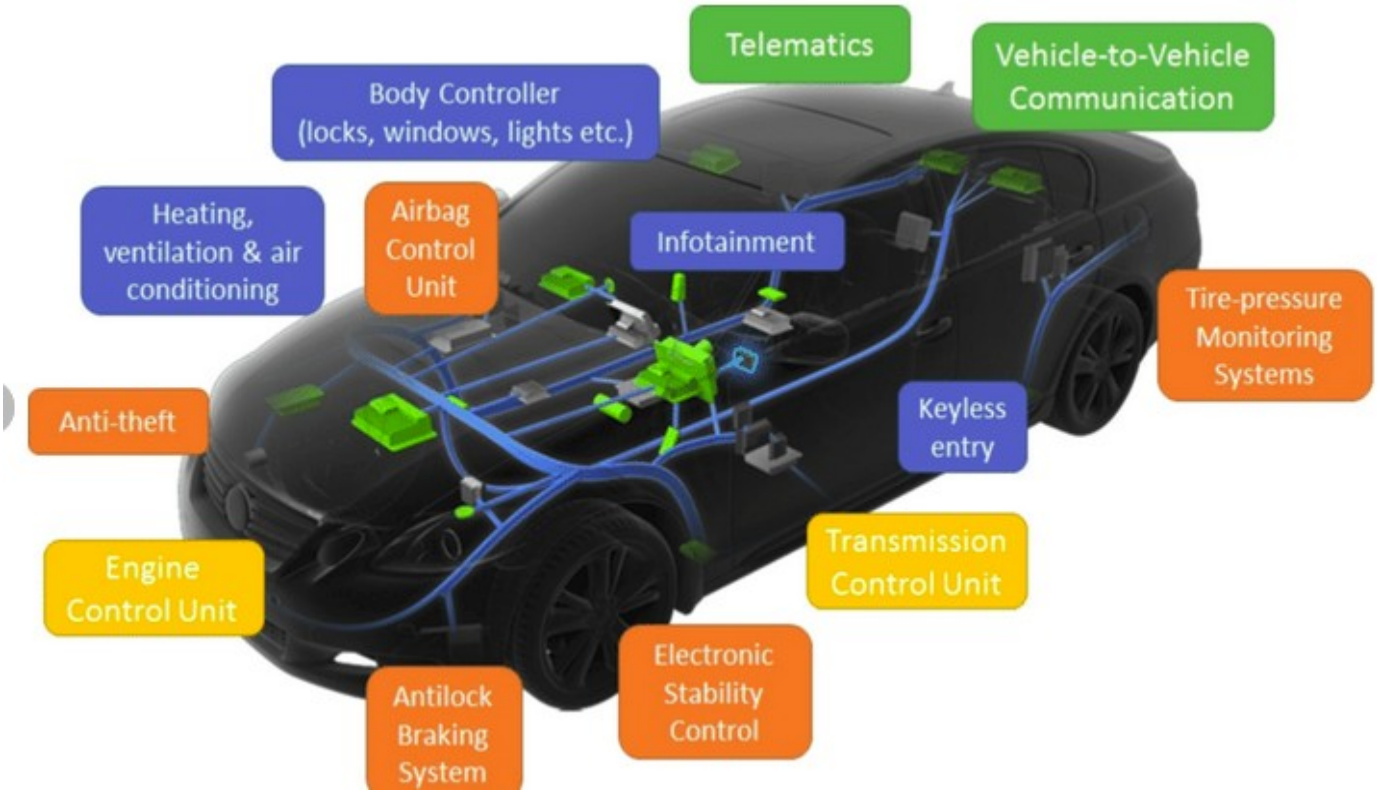
Automotive Electronics – Electronic control unit

An Electronic Control Unit (ECU) is an embedded system that controls electrical subsystems in a transport vehicle. Modern motor vehicles have **up to 80 ECUs**.



Block diagram of the ECU system.

Different types of ECUs in car



For example – a BMW 7-series vehicle is estimated to have **150+ Automotive ECUs** to control and regulate the functions of the car.

different types of ECUs in car

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The various types of ECUs include **Electronic/engine Control Module (ECM), Powertrain Control Module (PCM), Transmission Control Module (TCM), Brake Control Module (BCM or EBCM)**, Central Control Module (CCM), Central Timing Module (CTM), General Electronic Module (GEM), Body Control Module (BCM), Suspension Control ... 17-Jul-2017

AIRBAG CONTROL UNIT

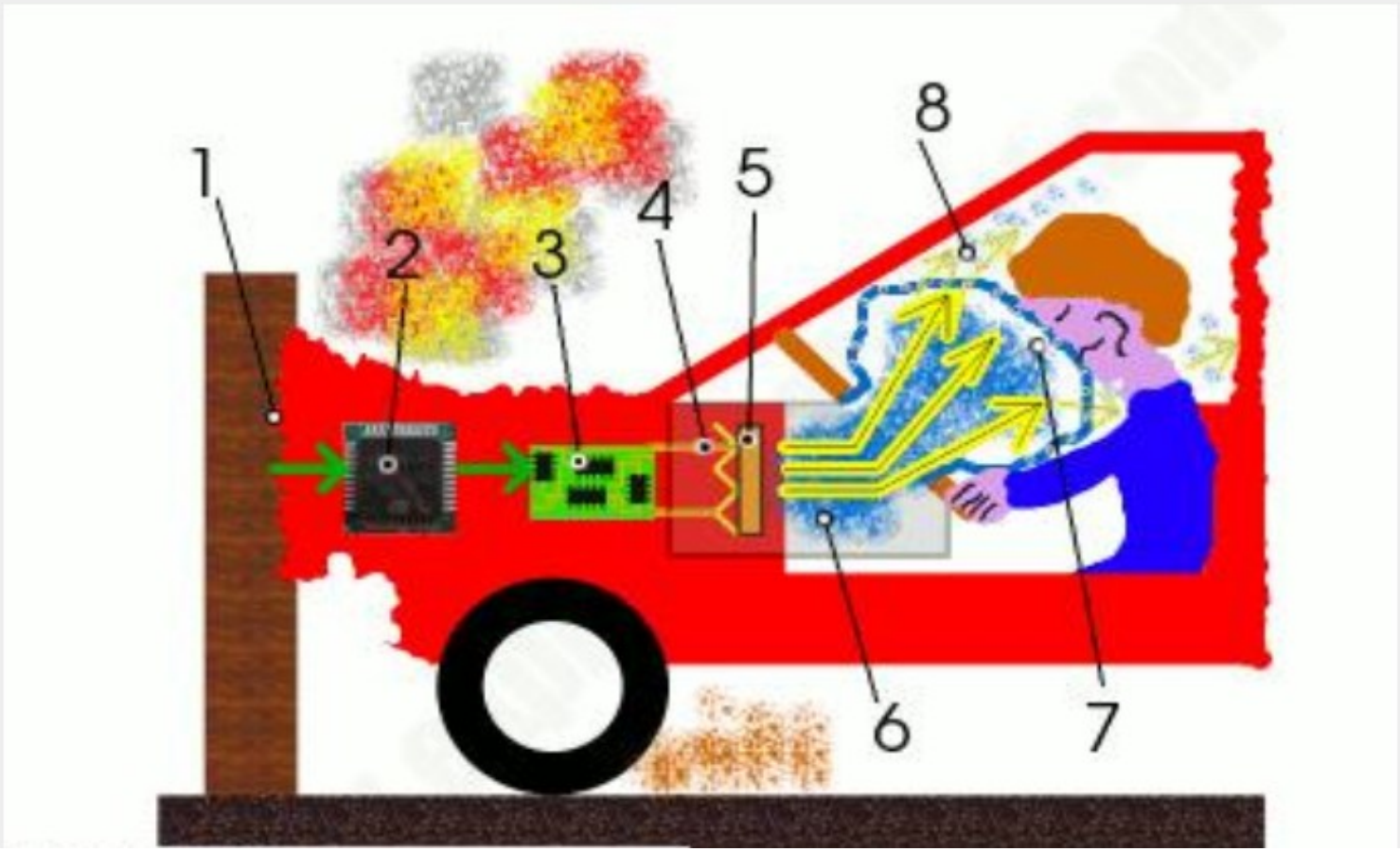
Key components of Airbag Systems

To keep it simple, a modern day automotive airbag system contains the following key components:

- Airbag Sensors - are electro mechanical or MEMS (Micro electro mechanical systems) based chips that are used to provide various kinds of inputs to the airbag control unit
- Airbag Control Unit(ACU) - is like the ECU in the car. It analyzes various inputs from sensors and makes the decision to deploy an airbag
- Airbags - are typically nylon bags that are inflated with an inert gas (typically nitrogen or argon) to protect the occupants from impact

How does an Airbag System work

Here is the simple explanation of how the system is designed to work



- 1. When a car hits something, it starts to decelerate (lose speed) very rapidly
  2. Airbag sensor detects the change of speed
  3. If the deceleration is great enough, the sensor sends a signal to the ACU
  4. The ACU passes an electric current through a heating element
  5. The heating element ignites a chemical explosive. Older airbags used sodium azide as their explosive; newer ones use different chemicals
  6. As the explosive burns, it generates a massive amount of harmless gas that quickly fills up the nylon airbag
  7. As the bag expands, it blows the plastic cover off the steering wheel and inflates in front of the driver. The bag is coated with a chalky substance such as talcum powder to help it unwrap smoothly
  8. The driver (moving forward because of the impact) pushes against the bag. This makes the bag deflate as the gas it contains escapes through small holes around its edges. By the time the car stops, the bag should have completely deflated

Deconstructing the Airbag Module

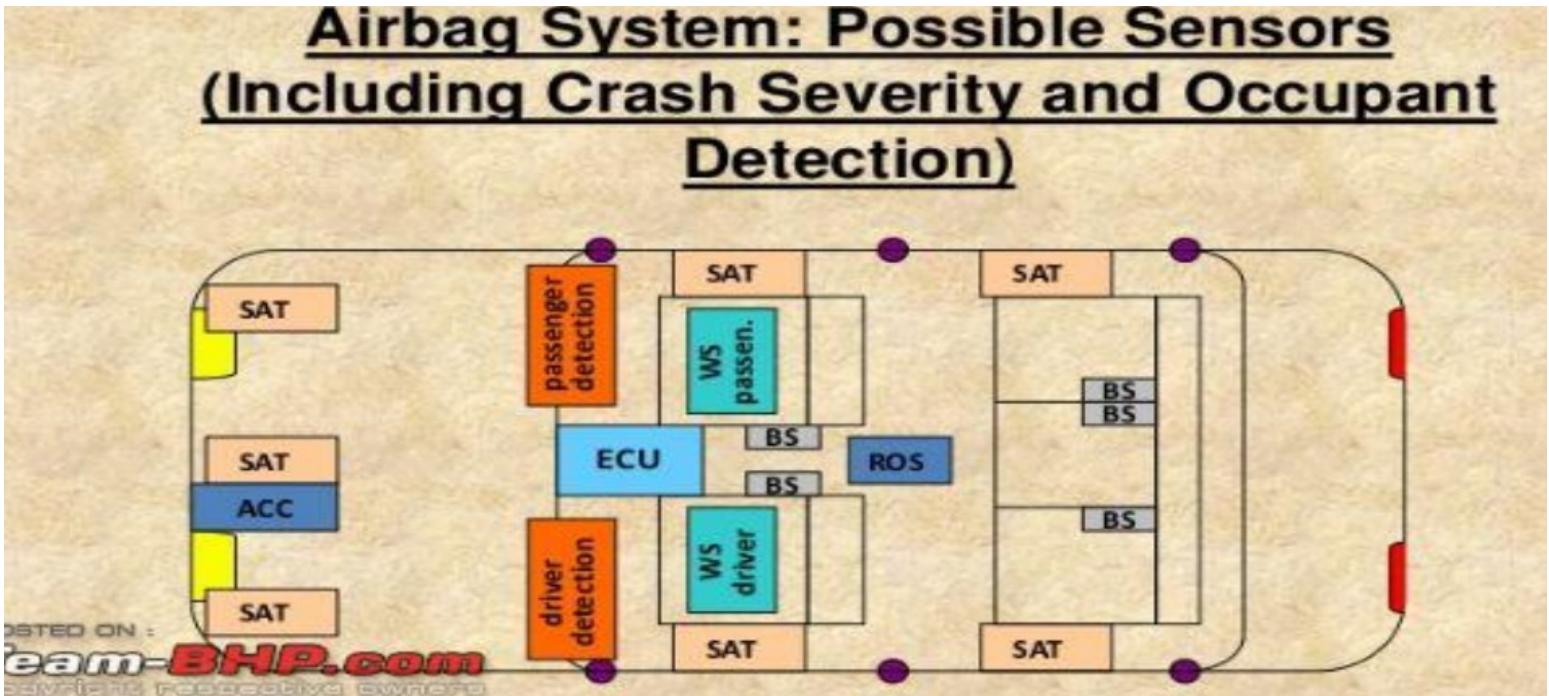
The Airbag module typically consists of 4 main components:

- 1. An inflator that produces sufficient gas to inflate the folded bag. The inflator basically contains the chemicals and the heating element that are required to generate the inert gas that fills up the airbag
  2. A textile cushion made of thin, woven nylon or polyester fabric, which is the actual airbag
  3. A housing for storing the folded bag and the inflator. The housing can be made of steel, plastic or even textile.
  4. A cover that opens as the cushion inflates.

Types of Sensors

Here is where things can get a little complex. Based on my understanding, sensors can be broadly classified into 3 types:

- **Crush zone sensors** - these are sensors that are placed within crush/crumple zones to help measure impact using deceleration/inertial changes
- **Impact sensors** - these are placed just inside the crush/crumple zone to provide the ACU with additional information
- **In cabin sensors** - these mostly sit within the ACU and help provide passenger side inputs to the ACU & help it make the deploy decision



- SAT - Satellite sensors, which are basically various types of sensors that are placed in various sections of the car depending on the number of airbags
- ECU - ACU
- ROS - Roller over sensors
- WS - Weight sensors
- BS - Buckle switches