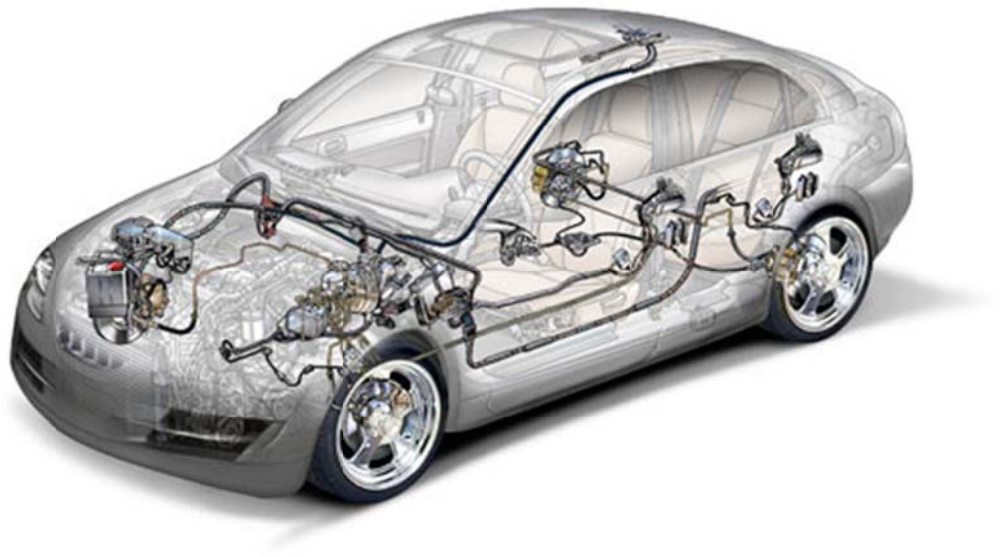
Annex I: Feature Model & Description

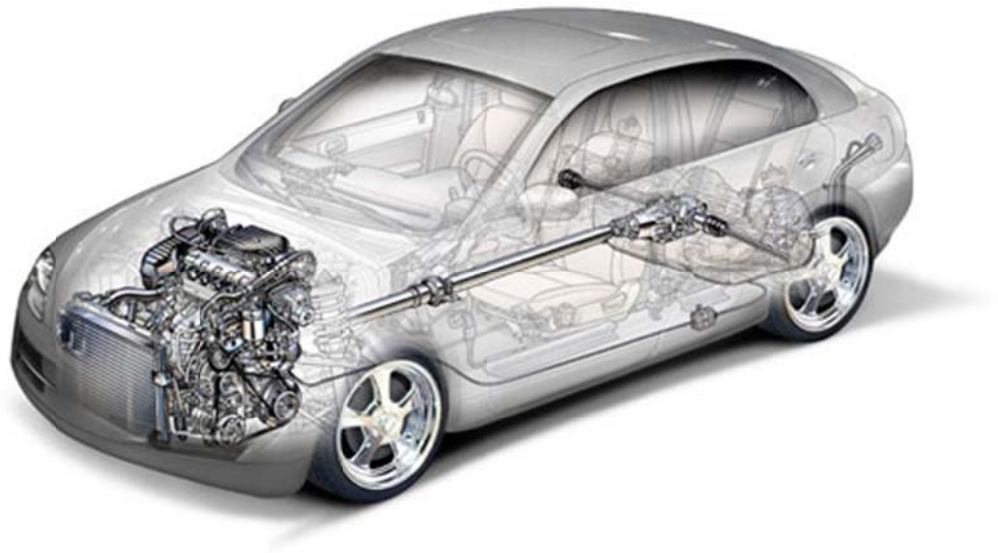
This document describes the different features of the products that integrate the VehicleControlSystem SPL. The Feature model that shows the organization and dependencies among features is shown in Figure 1 (Page 6).

- ***Antilock Braking System (ABS):*** The Goal of the Antilock Braking System (ABS) is to ensure that maximum braking force is transmitted to all four wheels of the vehicle, even under adverse conditions such as skidding on rain, snow or ice. Antilock braking system works by sensing slippage at the wheels during braking, through a wheel rotating sensor, and adjusting brake pressure to ensure maximum contact between tires and road, through the electronic brake actuators. In the most basic version, wheel rotation sensors from all four wheels are used as input and the output is the brake valve on each brake line.



- ***Traction Control System (TCS):*** the Goal of the Traction Control System (TCS) is to avoid wheels to slip while accelerating. TCS deals with the front to back loss of tire to road friction during acceleration. The traction control system uses the data from the rotation sensor of each wheel of the vehicle, compares the rotation data with the speed to detect slipping wheels, and compensates these slipping wheels by reducing the speed. This is achieved either by applying individual braking force to the slipping wheel or by reducing the power of the engine via the throttle control to ensure maximum contact between the road surface and the tires, even under less-than ideal road conditions, such as ice or snow.

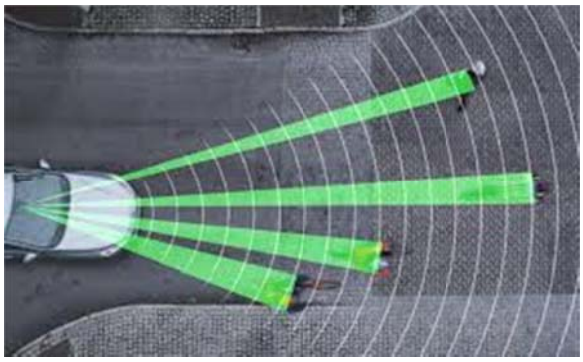
- ***Stability Control System (SCS)***: The goal of the Stability Control System (SCS) is to keep the vehicle going in the direction in which the driver is steering the car. To achieve this, the stability control system applies the brake to one wheel (or passes the torque to the opposite one) to help steer the car in the correct direction. The SCS differs from the TCS in what both systems prevent. A Traction Control System acts on a vehicle's traction wheels to prevent unwanted wheel spin under acceleration. The SCS, on the other hand, goes one step further by detecting when a driver has lost some steering control over the car's trajectory, and then automatically stabilizes the vehicle to help the driver regain the control over the vehicle.



- ***Cruise control system (CC):*** The goal of the cruise control system (CC) is to maintain a constant speed as determined by the driver. The system is in effect between some minimum and maximum speeds (e.g., 40 Km/h to 120 MPH). The cruise control system maintains the vehicle speed at the predetermined value (target value) by storing the speed of the wheel rotation when the speed value is set and attempts to keep the throttle actuator at a position to maintain the vehicle speed at the target value. As the road inclination changes, the vehicle speed changes, and the throttle position should change to maintain the vehicle speed. The control system observes the speed difference between the current speed and the target value and either decreases or increases the throttle actuator position to counteract the speed differential. The algorithm to accomplish this is called the control law. Depending on which other sensors are available (due to the selection of other features) the functionality given by the cruise control may change, we have three possible configurations:
    - Basic Cruise Control: The goal of the Basic Cruise Control is to maintain a constant vehicle velocity as determined by the driver (target speed).
    - Adaptive Cruise Control: The goal of the Adaptive Cruise Control System is to extend the Basic Cruise Control and provide a new function of constant distance cruise control that maintains the distance to a target vehicle traveling in front of the vehicle. In order to ensure constant-distance cruise

control, this system includes obstacle avoidance sensor that yields the following information: the distance from the equipped vehicle to the target vehicle and the relative speed between these two vehicles.

- The goal of the Fully Adaptive Cruise Control System is to extend the Adaptive Cruise Control, by adding a camera that captures the behavior of vehicles and objects in front of the system, and extends the effective range of the radar sensor and is capable to stop the vehicle in case of imminent collision.



- **Park Assistant:** The goal of the Park assistant system is to inform the driver about the presence of an obstacle during the parking maneuvers. The system is monitoring a set of park sensors and obstacle avoidance sensors (on the front and on the rear part of the car) and, when a sensor measures a distance less than a certain threshold, the system assumes the presence of an obstacle and starts emitting a beep and a lighting signal. As the distance with the obstacle decreases, the warnings grow in intensity and frequency.
- **Auto Parking:** The goal of the auto-parking system is to automatically execute the parking maneuvers for the driver. The systems uses a set of proximity sensors and obstacle avoidance sensor so as to measure the environment, and set of cameras for identifying, through artificial vision techniques, a suitable place for parking the car. The system controls the steering, the brakes and the throttle to conduct the parking maneuvers.

- **Multimedia System:** The Multimedia System encapsulates a set of features, described below:
  - ***FM_CD:*** the goal of the FM_CD system is to control the simplest stereo system, which is composed of a FM-Radio and a single-CD unit. The system allows tuning, storing and retrieving radio stations, to select the CD-track to play, to pause and to stop the system.
  - ***FM_CD_Charger:*** the goal of the system is to control the high-end stereo system, which is composed of a FM-Radio and a six cd charger unit. The system allows tuning, storing and retrieving radio stations, tuning, storing and retrieving radio stations sound equalizations, selecting the CD disk and CD-track to play, to pause and to stop the system.
  - ***B_W_OnboardComputer:*** the BW_Onboard_System allows configuring other systems of the vehicle. In addition, it shows statistics about the car performance and about eventual maintenance requirements. It has a Black and White screen and a set of buttons with which the user can interact with the system.
  - ***ColorOnboardComputer:*** the Colour_OnboardComputer allows configuring other systems of the vehicle. In addition, shows statistics about the car performance and about eventual maintenance requirements. It has a full - color high-resolution screen and a set of buttons with which the user can interact with the system. If the VehicleControlSystem is selected, the onboard computer will include the GPS navigation capability.
- **GPS:** The GPS allows t calculate the position, trajectory and speed based on the GPS information. The system integrates a GPS Module with which the system is able to calculate the car's position. The ColourOnboardComputer will show the navigation information in these cases in which the GPS feature is selected.
- **Bluetooth:** The Bluetooth module allows to connect to a mobile phone and to make/receive calls. The system integrates a GPS module and is able to interact with the driver through a set of buttons, a microphone and the sound system (FM_CD or FM_CD_Charger).
- **iSafe:** The iSafe system is a safety system that is able, in case of accident to send the GPS position and to call and communicate with the emergency services. The system is able to read the position from the GPS information and it uses the Bluetooth module to communicate with the emergency services.

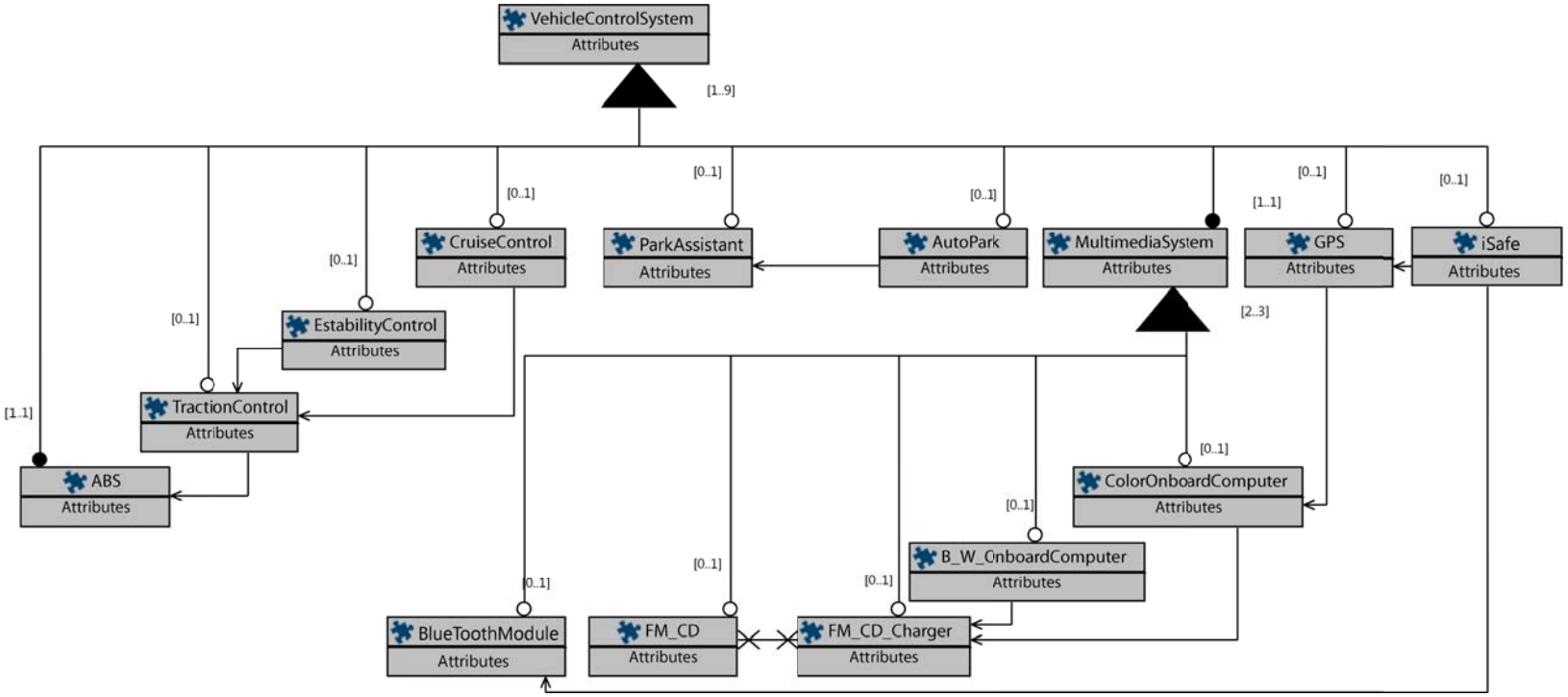


Figure 1 Vehicle Control System SPL Feature Model