## Autonomous driving vehicle

### 6.1.1 Description

Autonomous driving refers to the capability of the vehicle to drive from one location to another, without intervention from humans, and in a safe way, without incurring damage to surroundings (pedestrians, buildings, other vehicles) and to its (vehicle’s) passengers.

Different levels of automation are shown in the following figure. From top to bottom we can see increasing levels of automation, with ‘Full automation’ being autonomous driving.



Figure 1: Summary of Automated Driving level - Copyright © 2014 SAE International J3016

For assisted or later for autonomous driving, it is essential to know:

* Who takes action (braking/ accelerating/…)
* Who is monitoring environment
* Who is picking action up when main system fails
* What situations is this applicable to

We assume here lowest level of automated driving, one where the vehicle is driving autonomously, but there is a still human behind the wheel, which can take action upon request – this is level 3 ‘conditional automation’.

### 6.1.1.1 Connected car and surroundings / devices

Modern vehicles are equipped with number of sensors which are increasing comfort, fuel efficiency and safety of vehicles. That is done by using a variety of sensors that measure and collect data about vehicle (ABS sensors, brake switch, MAP sensor, …), vehicle’s current state, but also are equipped with sensors to observe state of the surroundings – using radar, camera, short range distance measurement sensors, light sensor, …

Further, the roads and surrounding infrastructure are becoming more instrumented with sensors and communicating devices. The possibility of interconnecting infrastructure sensors (cameras, traffic light radars, road sensors, magnetic loops, …) and thus exchanging data with driving vehicles may lead to new ways to design automated vehicle systems, thereby reducing cost and increasing robustness and reliability of autonomous driving vehicles.

Many types of connected objects may act as an additional sources of data for autonomous driving vehicle, which will very likely contribute to improve the efficiency and safety of the automated driving functions, while providing driving data redundancy and reduce implementation costs.

System supporting combining all these sources of data will enable pushing the driving automation to the full automation, one where the driver is out of the (control/driving) loop. Furthermore, by making autonomous cars a full entity in the IoT, will enable developers to create IoT/AD services as easy as accessing any entity into the IoT.

### Source

This document.

### Actors

* Vehicle Driver:   
  Driver sits in its normal (driving) position, and is in position to take corrective action (autonomous driving level 3) when prompted by the autonomous driving system..
* IoT platform provider:   
  It operates a IoT platform which is collecting all data from vehicles, other participants (pedestrians, cyclists), from roads and associated infrastructure (traffic lights, cameras,...).
* Communication Network provider / operator:  
  Provides and facilitates connectivity between vehicles, roads and associated infrastructure. This covers both wireless (for example LTE or ITS-G5) and fixed connections. Network MUST support receiving request for data transfers with required latency and with required packet losses. It is not expected or mandated that single network operator provides all of connectivity.
* M2M Device:   
  It is embedded in a vehicles, roads and associated infrastructure. It collects and sends data to IoT platform, and can receive data from platform (and some of devices can act upon it).

### 6.1.4 Pre-conditions

1. The vehicle supports autonomous driving – is capable of transmitting and receiving data from other vehicles, road and other infrastructure, making decision on own actions based on collected data, and act upon those decisions.

### 6.1.5 Triggers

Autonomous driving mode can be activated by vehicle driver, or it can be activated by default (keeping vehicle permanently in autonomous driving mode) – how the HMI (Human Machine Interface) works and which commands are given to the vehicle is out of scope.

When activated, vehicle in automated driving mode is taking passengers from start to end points, in accordance to road signalization, and providing safety for itself, its passengers and all other participants in traffic.

### 6.1.6 Normal Flow

1. The vehicle continuously collects the data from sensors within the vehicle and sends it to the IoT platform. The collected data includes information from Engine and Transmission System, Stability Control System, Air Bag System, Emission System, Antilock Brake System and so on. Further, information is collected on surroundings of the vehicle – from sensors such as radar, lidar, …
2. The IoT platform sends the collected data data to the “LDM (Local Dynamic Map) Application”. This M2M application receives and analyzes the IoT data form all vehicles on particular part of the road / city, and based on it creates model where participants in traffic are (including pedestrians, cyclists).
3. Information from ‘LDM Application’ is sent back to all participants in traffic.
4. Each participant in traffic is responsible for interpretation of received LDM data, and acting upon it.

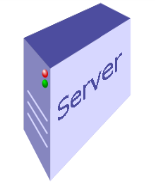
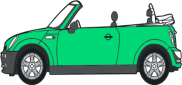
### 6.1.7 Alternative Flow

None

### 6.1.8 Post-conditions

Vehicle can stay in autonomous driving mode or it can be removed from autonomous driving mode by driver.

### 6.1.9 High Level Illustration



IoT platform

Application

Platform

(LDM App)

V2V/V2I communication (LTE-V, ITS-G5)

Cellular communication (LTE, 5G)

Fixed connectivity

Figure 2: IoT data streams and corresponding communication networks

### 6.1.10 Potential Requirements

1. The M2M system shall support the vehicle state information to be transmitted with highest priority, with strict timing (we may need to define a term for this) and packet loss (we may need to define a term for this) requirements, as defined by autonomous driving app. (This may be a “vehicle profile” or something like that since it is an app feeding the system)
2. The M2M system shall support the LDM transmission from the LDM Application to participants in traffic with highest priority, with strict timing and packet loss requirements, as defined by autonomous driving app. (same comments as on Req 1)