Abstract

This research focused on designing a large-scale distributed traffic management system (TMS). It aims at developing a TMS to support the slot-based driving approach and to control vehicles remotely.

At present, autonomous driving is one of the most promising areas in the automotive domain. This technology consists of sensing, perception, planning and operation to improve road safety by avoiding human mistakes. The European Commission states that the nature of human driving is competitive. In reality, drivers tend to drive faster on the motorway, and they prefer to drive on faster lanes instead of slower lanes. Such phenomenon has a negative impact on road safety, efficiency and traffic congestion. Thus, prior work of slot-based driving, as an example of remote control, underpins this project as a way to reduce traffic congestion, coordinate vehicles and guarantee journey times. To support the slot-based driving approach, a large-scale TMS is proposed in this research. This TMS aims to help traffic management, enable autonomous vehicles, give guidance and control them.

This large-scale distributed traffic management system is proposed to handle large user capacity and it requires high scalability, availability, reliability and low latency. This TMS consists of App, load balancer, TMS centers (TMC), map service, road servers, road-side units (RSU), on-board units (OBU), the overall database and local databases. Users can input their requests through the App which will then reroute requests to the load balancer. Load balancers will distribute loads to TMC that will query the map service to get routes based on users' requests. This is followed by TMC querying road servers to check the road availability. The overall database will provide road servers with slot information which will then be sent back to TMC. When vehicles are travelling on the motorway, OBUs will keep broadcasting vehicle information to RSUs which will constantly update the overall database and local databases to store real-time information. This TMS is designed to be able to book the journey for vehicles and to ensure vehicles to follow the pre-defined trajectories while travelling.

A prototype of the overall design was achieved by using simulator SUMO to simulate the traffic environment. This prototype consists of OBU, RSU and slot information. RSUs will read the slot information and send it to OBUs before vehicles joining the motorway. Vehicles will be allocated a route defined by slots in OBUs. Control commands will be sent to vehicles from OBUs while they are travelling on the motorway. This implemented prototype shows the interaction between RSUs and OBUs. It also allows vehicles to be scheduled before travelling and to be controlled during the journey.