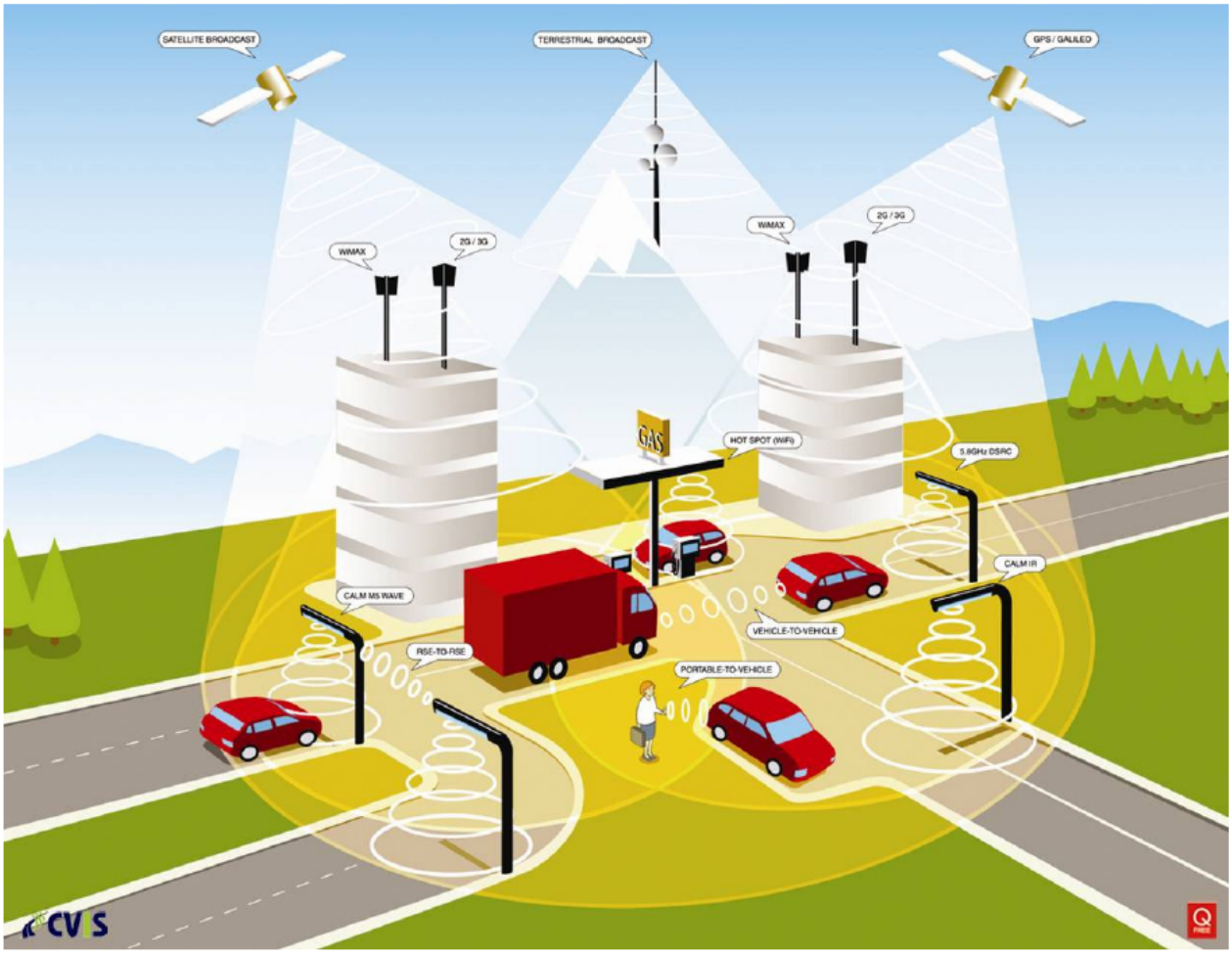
Master Projects – Vehicular Networking

Nowadays, cars are essentially computers on wheels. Whereas up till now cars have always relied on information they could autonomously gather, it is expected that the emergence of communicating vehicles will allow safer, more efficient, more comfortable methods of transport in the future. Think of a speedometer, a gyroscope or a sensor which counts the revolutions of every wheel. These sensors are present in modern vehicles and serve as input for features such as ABS, ESP, Cruise Control and display to the driver on the dashboard.

If a car could have access - by means of wireless communication with other vehicles - to sensor data such as speed and position of vehicles around it, it is able to build a situational awareness and a vast amount of new applications could be developed.

If a car could have access - by means of wireless communication with infrastructure - to whatever data is available on the internet, the driver (or the vehicle itself) could make decisions such as routing to nearest gas station based on actual gas price, remaining fuel and traffic conditions.

These exciting new applications are part of Intelligent Transportation Systems - ITS. Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications are an enabling technology.



Assignments

We offer a flexible implementation of your final project – ranging from simulator experiments, protocol design to implementation of real-world systems and analytical modelling. Below we some possible topics to do an assignment on. If you find any of the topics interesting contact one of the supervisors.

Flooding in VANETs

Flooding is a necessary functionality in any wireless network, flooding in regular mobile ad-hoc networks (MANETs) has therefore received quite some attention in past years. Flooding in vehicular ad-hoc networks (VANETs) is a different problem however, as VANETs have a number of specific characteristics, e.g., cars have regular mobility patterns and they do not suffer from limited battery power. Some specific problems related to flooding in VANETs are the timeslot boundary synchronisation problem and how one should deal with partitioning of the network

Geographical networking

In geographical networking, routing is performed based on the *location* of nodes (source, destination and forwarders) rather than on their network/IP address. Georouting is an essential part of vehicular networking and makes applications possible in which you for instance can warn drivers behind you of an accident, an upcoming traffic jam or bad road conditions. Georouting is still subject to research however and there are plenty of issues to address.

Integrated simulation of traffic and networking

When simulating vehicular networking services it is necessary to couple traffic simulation (which is performed in steps of, e.g., 0.1s) with network simulation (which operates at the level of microseconds or even smaller timesteps). Obviously this difference in timescales has its problems when you want to combine both types of simulation, especially if you consider that the probability of a successful transmission depends on the behaviour of the traffic, while at the same time traffic behaviour depends on information being communicated.

Vehicle-to-infrastructure (V2I) applications

Specific ideas have been proposed for V2I applications, such as intelligent traffic lights, intelligent traffic signs, automatic toll systems and what not. These are often relatively simple applications (w.r.t communication that is) in which a single infrastructure device (such as the mentioned intelligent traffic light) communicates often directly with one or more vehicles. Due to the small scale of these systems they are suitable for more concrete development, e.g., by means of building a prototype.

Channel switching and medium access

IEEE 1609 mandates use of a Control Channel and Service Channels. In a setup with a single radio, a node periodically visits the Control Channel to exchange „safety critical“ information, and can arbitrarily use other channels in the meantime. On a channel, the CSMA/CA mechanism defined by IEEE 802.11 is used. These schemes and their interaction on eachother and with a wide variety of applications is still subject of research.

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