Enhanced Traffic Safety with LTE and Mobile Edge Computing

Highly automated vehicles and connected driving are foreseen to be the next big steps toward improved traffic safety, efficiency and comfort. New mobility services are required to meet the increased demand from further urbanization and growing megacities. In a connected world, communication between road users, traffic infrastructure and data centers plays a key role to enable intelligent systems which cooperate and think ahead.

Several different communication technologies and architectures are currently investigated in research projects and field trials. Local information exchange based on IEEE 802.11p (US) or ETSI ITS-G5 (Europe) is paving the way towards market deployment within the next years, thanks to a wide set of common standards for networking and message contents. This provides low latency for communication ranges up to a few kilometers without the need for existing infrastructure. On the other hand, cellular services such as 3GPP Long Term Evolution (LTE) gain increased attention due to their growing network coverage, cheap device availability and continuous connectivity to cloud and backend services.

In the project Car2MEC, Fraunhofer ESK is working together with Continental Automotive, Deutsche Telekom, Mieschke Hofmann & Partner and Nokia to develop concepts to improve connectivity especially for delay-sensitive traffic safety applications by using two complementary approaches:

- Local message distribution and processing based on Mobile Edge Computing (MEC) to improve communication latency for short range information exchange via cellular communication
- Adaptive utilization of different technologies to combine the strengths of ad hoc and infrastructure-based networks depending on availability, congestion and application requirements
Low Latency Information Distribution with MEC and GeoService

Mobile Edge Computing (MEC) is a standardized concept to provide flexible computational resources close to the mobile users by extending cellular base stations (eNBs) with IT infrastructure, so-called cloudlets. In addition to the traditional split of applications between in-vehicle and centralized cloud, functions can be implemented on the distributed cloudlets in direct vicinity of the user. This leads to reduced communication latency and enables new applications based on aggregation and correlation of local data sources. While current cellular networks and cloud services cause delays of 100ms and above, Fraunhofer ESK and the project partners have already demonstrated traffic safety use cases based on standardized ETSI ITS protocols and a commercial LTE network with end-to-end latencies below 20ms. Within Car2MEC, this basic concept will be extended to a scalable, distributed Geographic Messaging Service (GeoService) which provides local message distribution and information aggregation with minimal latency, while interfacing with existing cloud and backend services, enabling automatic detection of incidents and timely notification of the affected road users.

Adaptive Heterogeneous Connectivity

Current cellular network implementations are not designed to support millions of vehicles which exchange small messages at a high frequency. Furthermore, without infrastructure support communication is not possible. To address these issues, ad hoc communication via 802.11p or ITS-G5 is foreseen to complement cellular services in scenarios with high traffic density, or if higher update frequencies are required by applications such as automated platooning. The selection of the best technology not only depends on the application requirements, but also on the availability of the required infrastructure, potential communication partners in range and the current congestion level of the wireless channels. Fraunhofer ESK researches algorithms to select the optimal dissemination path for individual messages taking all those factors into account. Instead of the common “always best connected” paradigm known for internet based services such as video streaming, an “always best informed” approach is envisioned to meet the demands of cooperative mobility services.

From the Lab to the Field

The concepts developed in the project will be validated with real prototypes in a commercial cellular network located at the German A9 highway. Thus, besides extensive analysis based on simulation studies, feasibility of the concepts will be demonstrated in real traffic. Several field tests throughout the project lead to solid hands on experience and its feedback is used to improve accuracy of the simulation models. For simulation and prototyping, Fraunhofer ESK is using its software framework ezCar2X®. The latter provides a variety of standardized ETSI ITS protocols and custom extensions. This in fact allows for an easy transition between simulation and prototype by using the same implementation in both environments.

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