Problems related to traffic congestion, safety and environmental challenges could be solved if people, vehicles, infrastructures and businesses were connected into one cooperative ecosystem. The existence of such a system could create a virtuous circle in which each type of user can generate valuable data for others. In project TIMON (enhanced real Time services for optimized multimodal MOBility relying on cooperative Networks and open data) Fraunhofer ESK together with partners from seven other European countries aim to increase safety, sustainability, flexibility and efficiency of road transport systems by leveraging data from a diverse set of sources, i.e. open transport data, infrastructure sensors, data generated by drivers and vulnerable road users (VRUs). This data is aggregated, harmonized, and processed by a cooperative open web based platform and a mobile application, developed with the purpose of delivering information and services to drivers, VRUs and businesses in real time. In addition, the project has the following main objectives:

- Harmonize data from open transport data sources to be used in real-time information services
- Leverage the information gathered from different sources, by applying artificial intelligence techniques to enable traffic congestion prediction and optimized routing
- Provide highly accurate positioning information for vehicles and VRUs through cooperative positioning techniques
- Design and implement an ITS-G5/LTE capable hybrid communication system enabling usage of both technologies in an intelligent, cooperative way
Heterogeneous Networks for Vehicular Communication

Hybrid communication systems within TIMON are mobile nodes which are capable of communicating in both a distributed manner by employing ITS-G5 and a centralized manner by using LTE. ITS-G5 is more appropriate for applications which need to exchange real-time information of local relevance whereas LTE is more suited for distribution of non-real-time information over a large geographical area. The challenge in TIMON is the implementation of a hybrid communication system that enables the cooperation of both radio technologies such that the Quality of Service (QoS) requirements of ITS applications are satisfied and improved. TIMON not only aims to include vehicles and backend systems, but also VRUs such as pedestrians and cyclists into one ITS system.

Radio Access Technology Selection and LTE Capable GeoNetworking

Within TIMON, an adaptive cross-layer approach will be implemented, capable of making local forwarding decisions based on flexible policies to select the optimal communication medium at any time. This is done through continuous monitoring of available communication resources and parameters such as link quality and neighborhood distribution.

Implementation of the centralized approach also requires the introduction of a new network component called the GeoMessagingServer (GMS). The GMS maintains the context of the vehicular network through periodic location updates sent from vehicles which are LTE capable. Since GMS is aware of the mapping between IP addresses and geographical positions, it can distribute messages to vehicles in a geographical target area via cellular links.

Using such a hybrid communication system has the following advantages:

- Information is delivered to endpoints through a coordinated strategy among different technologies so intra- and inter-technology optimizations are possible
- The routing is transparent to the applications allowing the same applications to be used in different systems, contexts and with different technologies
- Thanks to dynamic technology switching, limitations imposed by a standalone distributed or centralized approach are reduced

Simulation and Field Tests

The evaluation of novel hybrid ITS communication solutions will be based on simulation which will serve as an input in the development of a prototyping platform. This hybrid communication unit prototype will comprise an On Board Unit (OBU) with LTE and ITS-G5 communication interfaces and will make use of Fraunhofer ESK’s ezCar2X® software framework which provides a variety of ETSI ITS protocols with the proposed hybrid communication extensions. Throughout the project, field tests shall prove the developed concept as well as provide feedback for the performance and limitation of the deployed system. TIMON services, such as collision alerting for VRUs and road hazard warning, will be tested and validated in test sites in the Netherlands and Slovenia.

TIMON project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 636220.