

Master Theses: Adaptive Data Distribution Services, V2X Communication Protocols, Channel Quality Prediction and Optimal Resource Allocation

Background

As part of the research project Providentia++ funded by the federal ministry of transport and digital infrastructure under the initiative “Digital Test Beds for Autonomous Driving”, a group of eminent industry partners and research institutes have come together to conduct research in the field of intelligent transportation systems, and to come up with solutions and recommendations for improving traffic safety, efficiency and comfort. Within the framework of this project, an existing infrastructure for real time localization of traffic participants on the A9 Highway will be extended from the highway into an adjacent urban environment. The infrastructure will include multiple sensor stations equipped with a mix of complementary sensors, edge computing devices and state of the art communication networks in order to be able to create and distribute digital twins of the traffic in real-time, which in turn can widen the perception range for autonomous cars far beyond the capabilities of onboard sensors and vastly improve their situational awareness.

Description

One of the key challenges in handling the digital twin information lies in the creation of suitable data distribution services and communication protocols which take into account the continuously changing network topology, highly varying demand for the digital twin from the consumer vehicles and the need for using minimal network bandwidth. Multiple research topics are available to address the above challenges (not limited to the listed below).

- **Extending Geo-Networking protocols for the exchange of sensor data and object information between the distributed sensor stations and vehicles**
- **Optimal data clustering for multicast and broadcast streaming of digital twin**
- **Traffic prioritization services under heterogeneous networks – Fiber optics, directed Wi-Fi and 5G Mobile**
- **Extending autonomous driving simulators (e.g. CARLA) with network simulation capability**
- **Wireless channel quality prediction**
- **Optimal resource allocation strategies for wireless network resources**

Your Tasks

- Familiarization with the state of the art
- Development of appropriate solutions
- Implementation and evaluation on real-world infrastructure and in simulation environment

Requirements

- Familiarity with communication protocols and concepts - TCP, UDP, IP, Multicast / Broadcast Addressing
- A strong interest in V2X communication networks and optimization methods
- Awareness about network simulation tools and software-defined-radio kits would be an advantage
- Working knowledge and hands-on experience in C++ and Matlab
- Willingness to experiment and learn

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