V2X TESTBED: TESTING COOPERATIVE DRIVER ASSISTANCE SYSTEMS

Contact

Jürgen Großmann

Project Manager

System Quality Center – SQC

Phone +49 30 3463-7390

juergen.grossmann@fokus.fraunhofer.de

Fraunhofer FOKUS

Kaiserin-Augusta-Allee 31

10589 Berlin

Germany

www.fokus.fraunhofer.de/en/sqc

The new mobility: intelligent, save and convenient

Cooperative traffic systems, especially the vehicle-to-X (V2X) communication, are a crucial element in the development of a safe and flexible transport infrastructure. With the aid of efficient communication technologies, vehicles can communicate either with other vehicles as well as with the transport infrastructure itself. In this communication process, each vehicle conveys anonymised data, for example about its velocity and position as well as about the traffic situation around it. These data are then processed by intelligent driver assistance systems and made available to the driver. Due to the introduction of this technology, vehicle manufacturers and operators of transport infrastructure have to face a number of new challenges, which are unique in its complexity. On the one hand, these new systems vehicles are equipped with have to be safe and work reliably. A systematic Quality Assurance of these complex and highly networked systems sets high demands for the testing environment as well as for the specification of the test cases. On the other hand, it has to be ensured that vehicles of different brands as well as the different infrastructural components are interoperable.

The FOKUS V2X testbed guarantees quality and interoperability

The Fraunhofer FOKUS V2X testbed is a laboratory testbed for systematic and automated testing of networked, cooperative driver assistance systems. It can be used in all stages of the integration of software and hardware and creates a flexible and expandable basis for conformance and interoperability testing. Due to the high degree of test automation, all tests can be used for the automated regression testing.
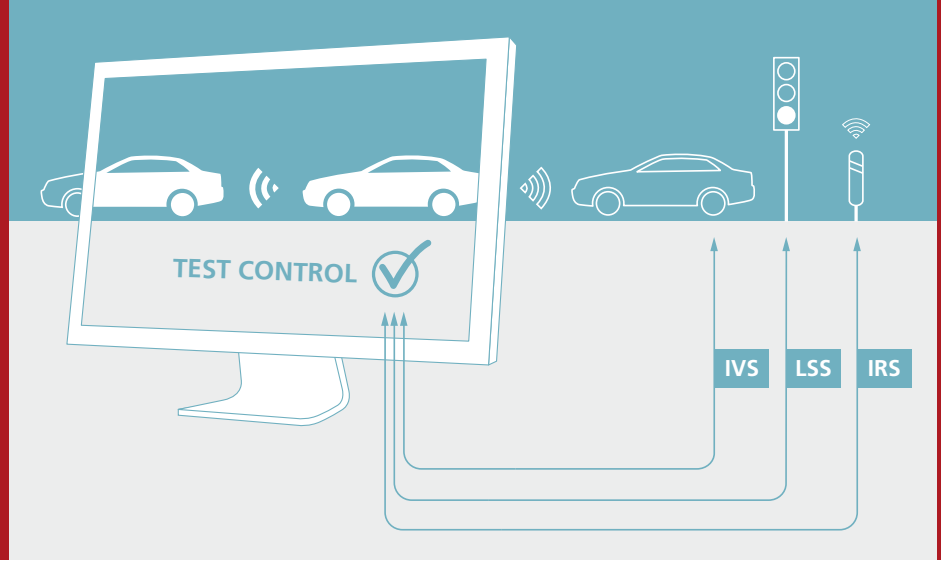
The test cases consist of critical traffic and communication scenarios that are simulated by using predefined motion profiles and applied to the V2X systems that are being tested. In this way, not only merely functional features of single or integrated V2X systems can be tested, but also other crucial features like real-time behaviour, stability, robustness, security and interoperability. In addition to this, the tests can be carried out independently of the communication hardware (virtual testbed) by using adequate virtualisation technologies. The benefit of this system is that testing can already be carried out in the early stages of software development and it is therefore an economical alternative to solutions that are only hardware- or vehicle-based.

Individually adaptable and expandable

The FOKUS V2X testbed can be flexibly adapted to the different test scenarios and environments that can come up in practice. Depending on the goals of the test, it is possible to test single V2X systems or several V2X systems interacting. You can realise configurations of individual vehicle systems (IVS) and individual roadside stations (IRS) as well as the connection to traffic control centres, integrated traffic light systems and traffic simulators. The test control computer generates the data required for simulations, applies the data to the V2X systems to be tested and analyses the reaction of these systems. The process is fully automatic and can be repeated as often as necessary. The customised user interfaces allow the user to see both the technical communication details and the high level view on positions and velocities of the vehicles in the test scenario. Eventually, there are professional visualisation tools for an easy evaluation and an attractive and flexibly adaptable documentation of the test results.

Using standardised technology

The V2X testbed by Fraunhofer FOKUS is based on established and standardised testing technologies. The testing methods and systems as well as the supported V2X data formats comply with the corresponding ETSI standards. The FOKUS V2X testbed therefore creates a testing environment for the automated testing of distributed V2X applications and V2X systems. It supports different communication protocols and communication data formats and can be individually configured for different tests. The standardised test description language TTCN-3 guarantees an easy programming and automation of the testing procedure.

The testbed in overview

– Test automation of complex V2X scenarios and protocols
– Stimulations with dynamic data about the state of the vehicle: velocity, position, lateral and longitudinal acceleration, etc.
– Testing on different levels of integration: software, software/ hardware and system integration
– Support of different types of tests: functional, protocol, robustness, conformance and interoperability testing
– Independence from proprietary interfaces and technologies. Use of abstract interfaces for simulations
– Based on standardised and professional testing technologies: TTCN-3 and Testing Technologies TTWorkbench

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