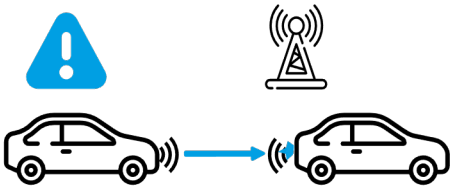
siticom

The challenge of connected cars in C-ITS ecosystems

Services & solutions to master the barriers for a successful implementation of services within the space of „Cooperative Intelligent Transport Systems“

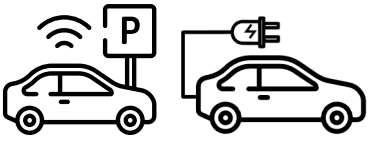
A growing set of use cases

Much more than simple avoidance

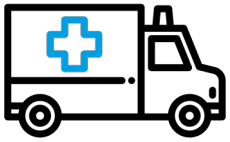


Collision risk warning from a third party

Road hazard warning

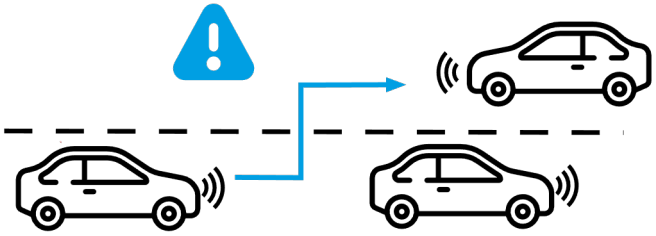


Discover parking and charging

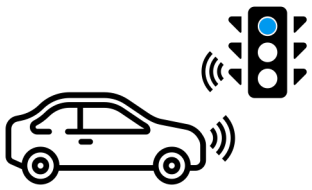


Emergency vehicle alert

Vulnerable Road User alerts

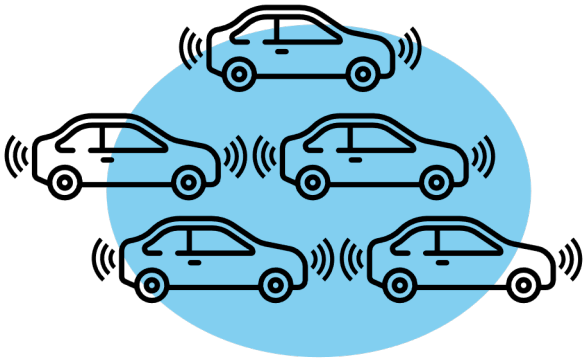


Safety relevant vehicle overtaking warning



Traffic signal priority & speed advisory

Blind Intersection



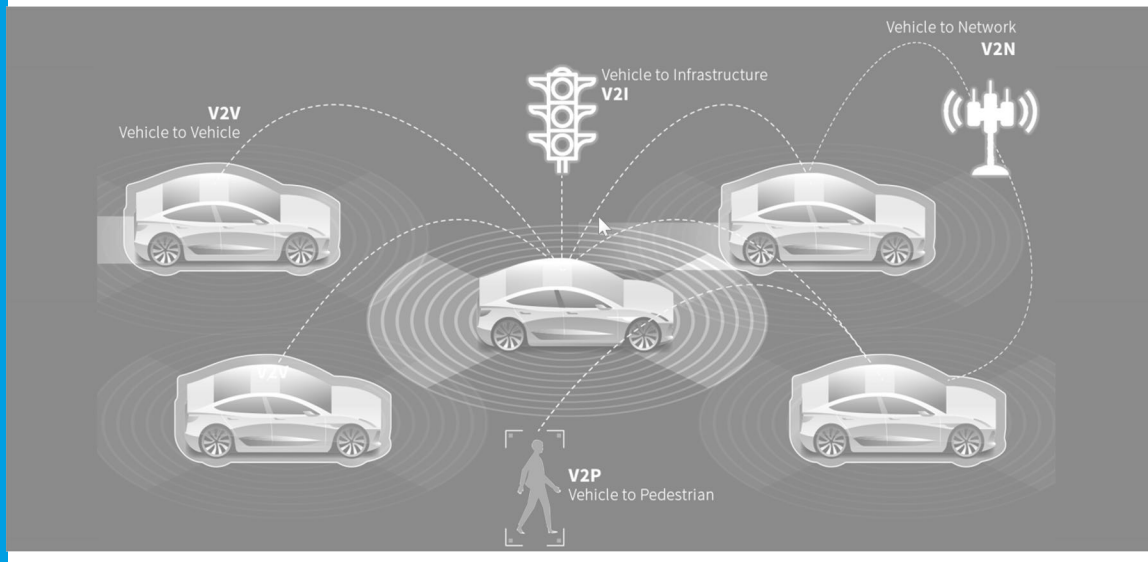
Cooperative adaptive cruise control & platooning

Six barriers to master

C-ITS services with the exchange of status information and sensor and environmental data allow "Cooperative Driving" - the bridge technology for the transition from assisted driving to the long-term goal of highly automated and autonomous driving.

Cooperative vehicular applications for the future transportation ecosystems with complex architecture and hybrid radio access solutions call for new approaches in system testing and verification.

Strict requirements for the system under test regarding high performance, reliability, low latency, interconnection, interoperability, security and safety result in exceptional demands on the test system and affect the entire testing cycle from test design, execution and verification of results.



The barriers to master

- Technical complexity
- Stability & Reliability
- Integrating Heterogenous Systems
- Security
- Time to Market
- Meet Regulation and Standards

Six barriers for successful integrating V2X

The challenges in detail

Technical complexity	Wireless communication with unpredictable and changing RF conditions and parallel connections to moving vehicles of different vendors and implementations is cumbersome. Vehicles are no longer isolated systems but are taking part in an interconnected transportation ecosystem.
Stability & Reliability	The safety of drivers and passengers as the top goal can only be realized with extremely high level of stability and reliability in the underlying systems.
Integrating Heterogenous Systems	The vehicles have to cope with various navigation system standards, competing ITS communication access technologies, onboard and external communication media and technologies and signal processing on sensor data.
Security	Dealing with sensitive and security related data and functions must be protected against hacking and any intrusion and has to guarantee absolute privacy.
Time to Market	Time to market is one of the key factors in a rapidly changing and innovative area having strong and powerful players as competitors.
Meet Regulation and Standards	National authorities issue regulations and standards to ensure the devices to follow regulatory legislation. Vehicles have to fulfil type approvals for bodies located on US, European and Asian Territories.

Services to support you

Four areas where we support

TEST STRATEGY & PLANNING

- The complete testing of complex systems is neither cost effective nor guaranties an "error free" and waterproof system. Flexible test planning and suitable test strategies are imperative.
- With a thorough risk analysis we help you find the right balance between test coverage and effort.

AUTOMATE & PLATFORM

- A sufficient level of automation is necessary to keep the effort within regular regression tests within limits - test automation is even an integral part of the process in continuous development processes.
- We implement test solutions that enable an appropriate level of automation to suit your requirements and deliver the platform if needed.

IMPLEMENTATION

- Whether system or component test, whether test of control units or software functionality, whether UI test or API test - the requirements for test solutions are complex, the possible variants of suitable test solutions are diverse.
- We use our wide range of services and our product portfolio to implement the optimal test solution for you - from the pure software solution to the ready-to-connect control unit test system.

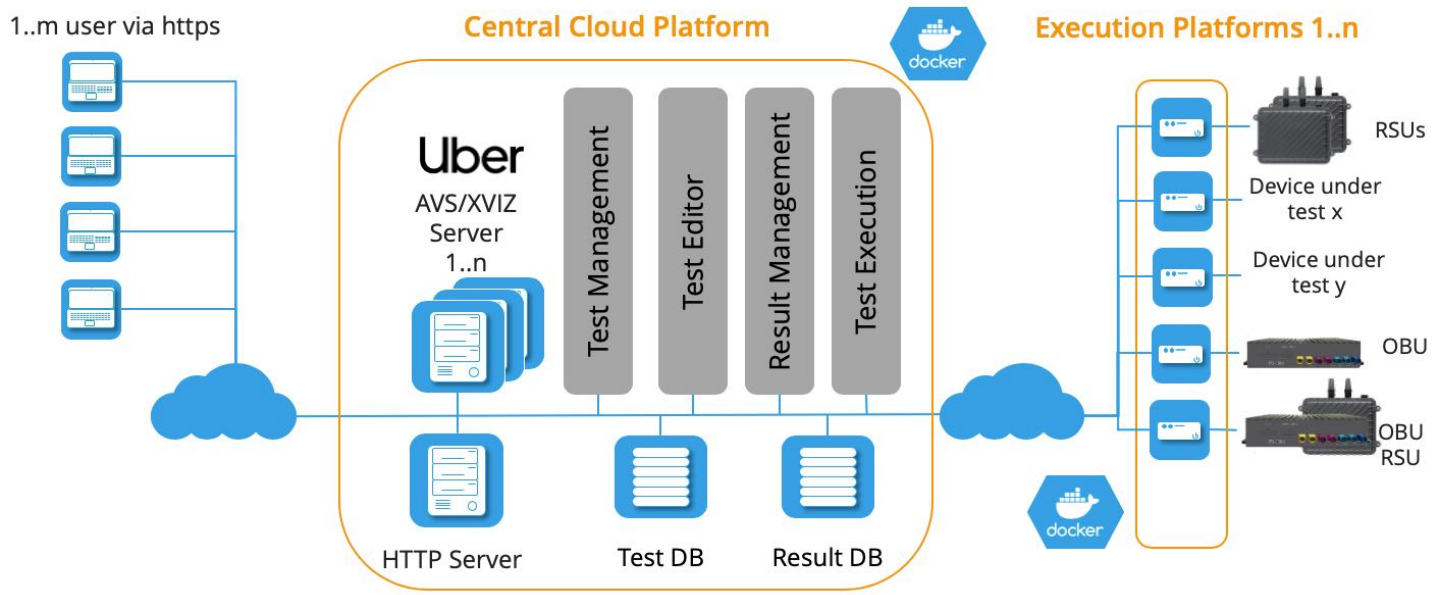
MANAGED SERVICES

- Efficient test and configuration management are a central element of efficient test execution. Nevertheless, testing, including automated testing, remains challenging and demands a lot of effort.
- We take over your test tasks relevant to the validation, from planning through operational implementation to test analysis and reporting.
- The services can be delivered on premises or through a fully managed cloud environment.

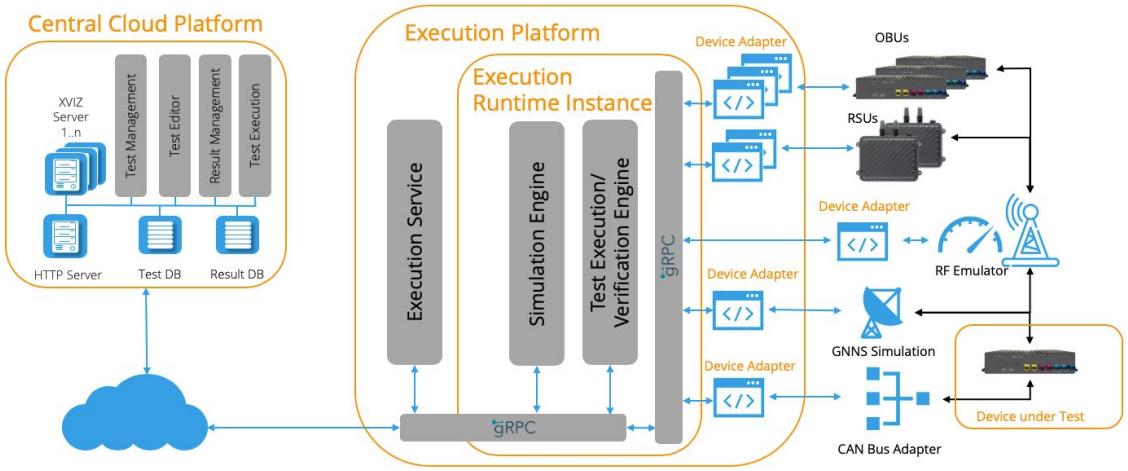
Overview solution - a different approach

Compared with the traditional way, ACDT has following different attributes

- Distributed environment
- Multi user cloud access
- 24/7 utilization and global access
- Centralized maintenance
- Central archive log and test data - exportable to any data format (csv, Excel, etc.)
- Automation by design from day 1
- Open source usage
- Open architecture for other use cases
- Supporting CI/CD pipeline

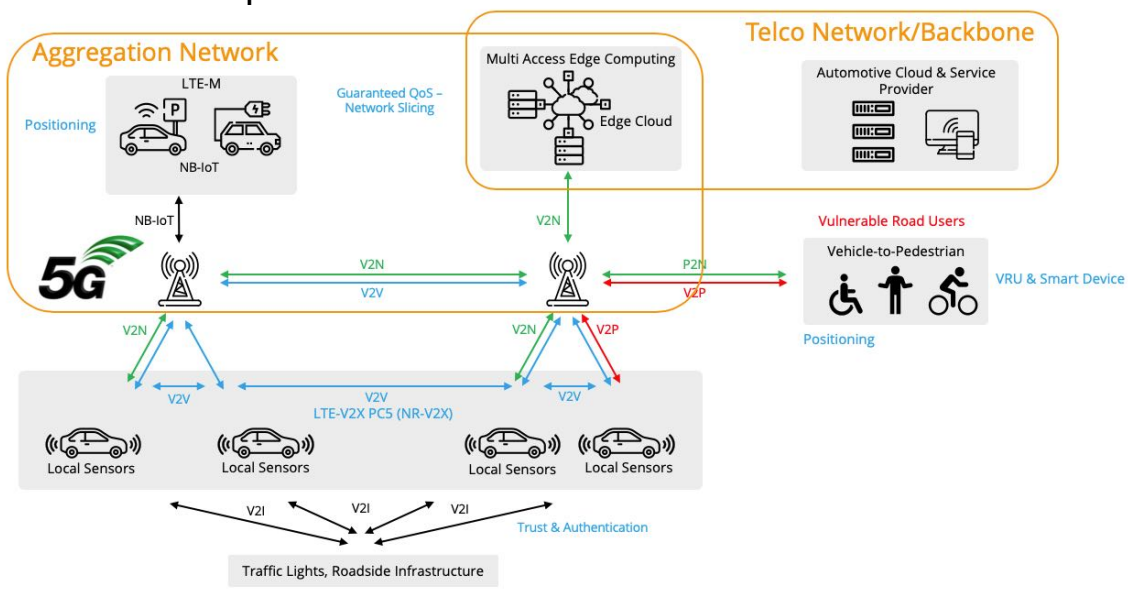


ACDT - execution platform



5G Automotive usage areas

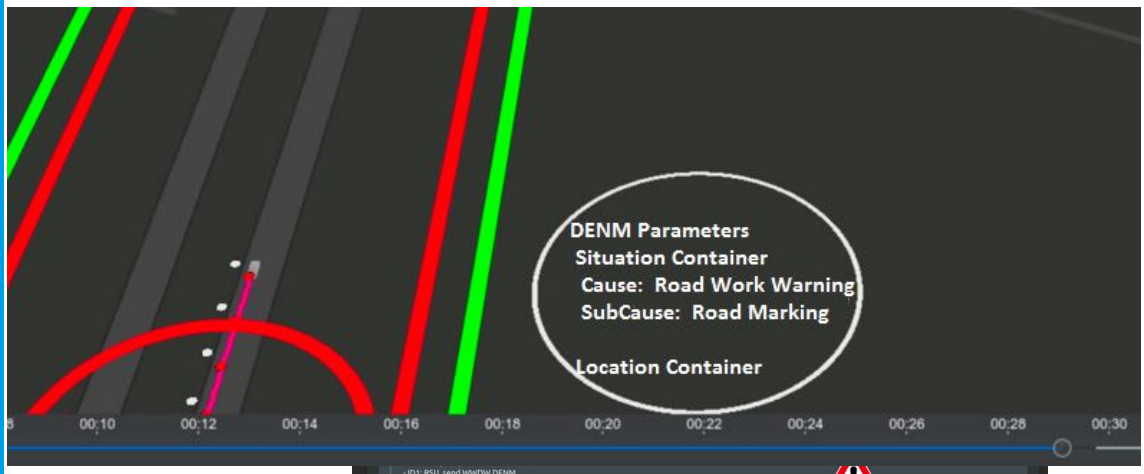
To expand the test services to 5G scenarios including applications in the Mobil Edge Cloud including the Aggregation and Telco Backbone Network is possible.



Use areas

- **Smart traffic management**
  - Sensor data filtering
  - Real time analytics
  - Sensor data aggregation
- **Drive assistance**
  - Situation shown in real time
- **Infotainment**
  - Content adjusted for radio situation

Device under Test – OBU (On Board Unit)



The reference – V2X Test & Simulation

Context

Based of the ETSI specifications for Cooperative Intelligent Transport Systems (C-ITS), a test system was developed that uses various scenarios to check the communication between the different stations and determine various performance parameters. In an end-to-end simulation environment, the message flow and timing in the different protocol layers are recorded and compared with the expected behaviour. In this way, the protocol conformity of the implementation can be verified, thus ensuring the correct functioning of the overall system.

The system was developed for the ZALA Zone project. See more under https://zalazone.hu/en/

Work done by siticom

Implementation of a Decentralized Environmental Notification (DEN)° use case Road Hazard Warning (RHW) based on

- V2V Direct Link (Sidelink) based on Rel-14 / Rel-15 C-V2X alternatively 802.11p (Dual Mode Stations)
- RSU (Road Side Unit)
- OBU (onboard unit)

Opport unities

- Implementation of further scenarios
- Extension to V2N application examples
- Simulation of 5G application examples for V2N (up / downlink infrastructure)

Results and client benefits

Securing the implementation with regard to

- Conformance
- Interoperability
- Performance

The different approach

ACDT provides a flexible platform for various V2x scenarios

The ACDT-way

- Distributed Environment
- Multi user cloud
- 24/7 utilisation global access
- Centralised maintenance
- Central archive log and test data
- Automation by design from day 1
- Open Source usage
- Open architecture for other use cases
- Supporting CI/CD pipeline

Traditional

- Test workstations
- Single user per WS
- Low utilisation due to local access
- Each WS maintained individually
- Manual/local Log archive
- Automation cumbersome

Coming next

- Generic Protocol Framework
  - gRPC replacement
- Failure injection
- GNSS simulation features
- Channel emulation extensions
- Map server OSM
- Traffic simulation
- Bus Systems
  - CAN
  - Automotive Ethernet

Additional information's

The ACDT project

- was developed with a focus on code quality
- includes unit tests for C++ (google test), Python (unit test), JavaScript (jest, jasmine) and the Web UI (cypress)
- uses GitLab CI to run the tests
- uses docker containers for testing and deployment
- uses static code analysers for C++ (clang-tidy), Python (pylint), JavaScript (eslint)
- uses code formatting tools for C++ (clang-format), Python (black), JavaScript (prettier)
- supports developers by providing the development environment in the form of (VirtualBox based) development VMs or development docker containers (using packer, vagrant, gitlab docker container registry)

Contact

Stefan Höltken
+49 171 5288884
stefan.hoeltken@siticom.de
Landaubogen 10
81373 Munich/Germany