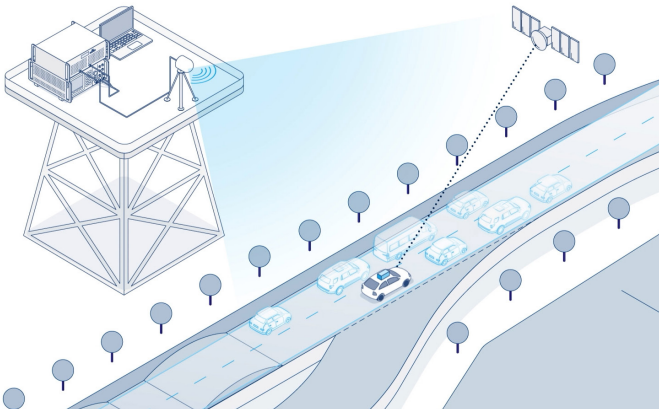
SCENARIO BASED TESTING OF C-V2X APPLICATIONS IN LAB AND FIELD ENVIRONMENTS

Create and simulate detailed traffic situations to verify cellular V2X (C-V2X) connectivity



Your task

For several years, automobile manufacturers and government agencies have sought ways to increase road safety, manage traffic efficiently and, in the future, make it more comfortable. Next generation vehicle-to-everything (V2X) information and communications technology offers low latency vehicle-to-vehicle (V2V), vehicle-to-roadside infrastructure (V2I) and vehicle-to-pedestrian (V2P) communications, adding a new dimension to future driver assistance systems.

3GPP Release 14 cellular V2X (C-V2X) uses LTE technology as the physical communications interface. The standard has two modes. Vehicle-to-network (V2N) mode, where communications take place over the Uu interface and traditional cellular links enable cloud service integration for end-to-end solutions. This can be used for the distribution of local road and traffic information to vehicles. The second mode is direct or side link mode (V2V, V2I, V2P), where communications take place over the PC5 interface. Here, C-V2X does not necessarily require network infrastructure and can operate without an SIM and network assistance by using GNSS as the primary source for time synchronization.

Verifying system functionality and performance with real-world field testing can be time-consuming, costly and very challenging. Function requirements and those for associated assistance functions are constantly changing. Test solutions verify standard compliance during development and introduction phases. PC5 direct communications mode provides highly reliable exchange of time-sensitive and safety-relevant information. A wireless communications tester together with a C-V2X scenario simulation tool can deliver reproducible test scenarios. This is essential to standardizing C-V2X verification processes for reliable and comparable results. It also helps demonstrate the proper end-to-end functionality between two C-V2X instruments from different vendors. Once a prototype model has reached a sufficient state of development, the TCU can be integrated in a host vehicle and evaluated in a C-V2X network environment proving ground.

Rohde&Schwarz solution

The automotive test tool provider Vector and Rohde&Schwarz have developed a new architecture for testing and verifying safety-critical C-V2X applications in lab and field environments. The Rohde&Schwarz test setup consists of the R&S®CMW500 wideband radio communication tester and the R&S®SMBV100B GNSS simulator, combined with the comprehensive Vector CANoe. Car2x simulation tool. The R&S®CMW500 uses a C-V2X software package for physical and MAC layer simulation to transmit and receive data over the PC5 radio interface. Together with the Vector CANoe.Car2x simulation tool, the R&S®CMW500 can also be used for field evaluation. The R&S®SMBV100B acts as a GNSS signal generator in lab

environments. It offers precise synchronization information for out-of-coverage communications in C-V2X mode and provides accurate position information to the device under test (DUT), as required for V2X basic safety messages (BSM). The R&S®CMW-KAX550 LTE V2X test suite for the Vector tool links the instruments to the CANoe.Car2x software environment for V2X application tests. The Vector tool configures and runs traffic scenarios so that telematics control unit (TCU) functions can be thoroughly tested. Users can create and simulate detailed traffic situations to verify C-V2X connectivity including security and certificate management for the intended application. An easy-to-handle graphic scenario editor helps users create traffic scenarios. When a scenario is started, CANoe.Car2x generates the corresponding ITS communications messages based on the configured test scenario using the relevant ITS stack variant for the target market (i.e. North America, Europe or China) in line with specifications. Scenario messages and route information are forwarded to the R&S®CMW500 and the R&S®SMBV100B via the R&S®CMW-KAX550 LTE V2X test suite, providing the radio access layer to the DUT. This makes it possible to stimulate C-V2X enabled TCUs in line with the particular situation and to test implemented functions such as:

- Emergency brake warning (EBW/EEBL)
- Left turn assist (LTA)
- Intersection collision warning (ICW)
- Congestion control with multiple simulated cars

The Rohde&Schwarz test system simulates conditions like non line of sight communications, weak GNSS signals or traffic congestion. The R&S®CMW500 radio communication tester can also transmit virtual vehicle signals over the air. C-V2X applications in various traffic scenarios can be verified. An additional R&S®BBA linear broadband amplifier generates the required field strength. Tests that previously required multiple test vehicles can now be done with a single physical car and multiple virtual vehicles. C-V2X coverage and performance can be monitored in real time with R&S®TSMx PC5 network scanners. Proving ground data can then be used for further development in the lab.

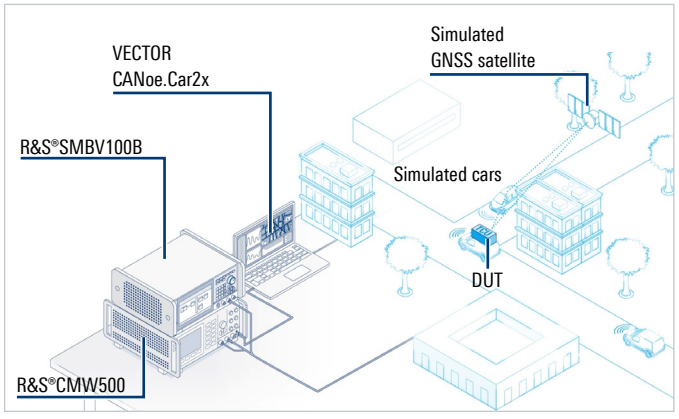
Application

The test solution presented here allows testing safety-critical C-V2X applications in lab and field environments, providing reliable and repeatable results. The Vector CANoe.Car2x software tool in combination with Rohde&Schwarz instruments provides the ability to create complex and reproducible C-V2X scenarios to stimulate C-V2X enabled TCUs in line with the configured situation and to test implemented functions in a targeted manner. The test solution is a future-ready investment with the option to be extended with an R&S®CMX500 radio communication tester to accommodate future C-V2X releases, including 5G New Radio (5G NR).

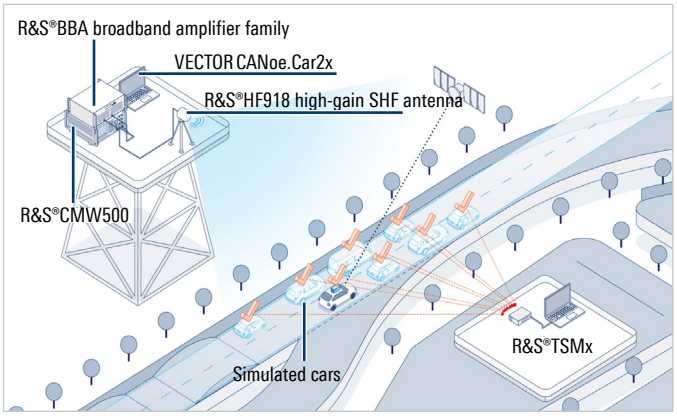
Conclusion

The C-V2X test solutions from Rohde&Schwarz cover the entire development eco system from the physical to the application layer. The test equipment is ideal for use in the lab and in the field, ensuring measurement result repeatability and reduced investment costs.

In the lab



On the proving ground



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