Achieving C-V2X Compliance

The global connected vehicle market generated $54 billion in 2020 despite the Covid-19 pandemic. Automotive industry predictions indicate this figure will increase to $166 billion by 2025 [1]. Automotive manufacturers, innovators of intelligent transportation system (ITS) devices, and those responsible for deploying infrastructures must work collaboratively with certified testing specialists. Communication sharing across all industries ensures the technologies brought to market offer interoperability and meet the evolving standards of 5G and C-V2X.

The global acceptance for the cellular vehicle-to-everything (C-V2X) communication technology takes autonomous driving from a shared vision to mass-market reality. C-V2X uses the 3rd Partner Project (3GPP) standard for 4G and 5G mobile cellular connectivity and operates in the 5.9 GHz frequency band. In most countries, this is the official designated Intelligent Transport System (ITS) frequency band.

This global harmonization is paving the way for automotive manufacturers and infrastructure specialists to create a safe, connected, and unified driving ecosystem that is quickly scalable and cost-effective across geographies.

C-V2X certification is a shifting landscape because of the evolving regional ITS standards while at the same time the regulatory requirements for 5G are a moving target. Manufacturers must accommodate future iterations and legislative changes to be competitive in a rapidly expanding marketplace.

This white paper explores the importance of C-V2X and how to navigate 5G certification when the required standards are evolving.

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1   35 connected vehicle stats to know in 2021. Pareteum. (2021, June 17). Retrieved November 17, 2021, from https://www.pareteum.com/35-connected-vehicle-stats-to-know-in-2021/

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Advantages of C-V2X Technology

C-V2X uses 3GPP standardized 4G or 5G mobile connectivity to send and receive signals from one vehicle to other vehicles, pedestrians, or other fixed objects within range. This technology offers automotive manufacturers a complete communication suite by incorporating vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), vehicle-to-network (V2N), and vehicle-to-cloud (V2C) communication systems.

C-V2X with 3GPP Release 14 provides two transmission modes (Mode 3 and Mode 4) in one technology that covers a broad range of use cases. This technology provides low latency, enhanced communication range, and reliability in the dedicated ITS 5.9 GHz spectrum because it operates independently from a cellular network (PC5 sidelink used for direct communication e.g. V2V, V2I). It also provides vehicle-to-network (V2N) communications using a UTMS air interface (Uu) in the traditional mobile broadband licensed spectrum.

Compared to 802.11p-type technologies, the C-V2X PC5 sidelink communication delivers an increased communication range, enhanced reliability, better non-line-of-sight (NLOS) performance, and significant cost efficiencies. Automotive manufacturers can design vehicles with enhanced safety features without having to rely on a cellular network. The wide acceptance of C-V2X as the chosen technology method for mainstream vehicle communication forms the basis for research and development into the design of advanced safety systems in new vehicles including the fast-growing electric vehicle (EVs) category.

Unlike 4G LTE, 5G has already diversified into a range of vertical industries worldwide, including the transport sector, making it the best platform to build and develop a connected, autonomous transport system.

Industry alliances

Companies in dynamic markets must continuously introduce new products and services to keep up with changing consumer wants and needs. Today's global market provides well-established manufacturing systems with common standards in most countries. Automotive manufacturers will benefit from the economies of scale — applying one technology or producing one model for a global audience rather than bringing to market many different vehicle types for smaller, regional markets.

Economies of scale will ultimately make connected vehicles more affordable for the end user and faster to deploy as demand increases.

Certification Challenges

Compared to previous generations of cellular connectivity, 5G is more susceptible to signal quality issues caused by IQ modulation, phase noise, distortion, signal-to-noise ratio, amplitude, and phase linearity.

Regulations for 5G deployment and performance quality standards are still dynamic as policy makers work to legislate its use. Manufacturers testing against new 5G standards must prepare for the certification target to move as regulations change, such as releasing additional spectrum to take advantage of 5G NR.

Although standards for C-V2X certification are still evolving, there are global and regionally defined standards for the physical, protocol and application layers. In addition to the 3GPP Radio Access standards, input from a wide range of global legislative organizations for these preliminary standards come from the Institute of Electrical and Electronics Engineers (IEEE), Society of Automotive Engineers (SAE), Institute of Transportation Engineers (ITE), National Electrical Manufacturers Association (NEMA), European Telecommunications Standards Institute (ETSI), China Communications Standards Association (CCSA), China Society of Automotive Engineers (SAE-C) to name a few.

ITS organizations and road operator regulators need to meet the performance criteria set by the respective standards development organizations, telecom and automotive industry governing bodies.

Test and validate

Typically, a C-V2X device requires GCF RF / protocol certification according to global cellular standards. Depending on the region the device will operate, it will likely need to be tested against ITS upper layer standards such as IEEE 1609.2/3/4, SAE J2945 for North America and/or the other applicable regional standards in Eu and China. In addition, devices will likely need to pass region specific test cases currently being developed for the ITS Application Layer.

For many manufacturers, purchasing test equipment that is capable of testing future expansions of 5G NR is too great an investment; however, this should not be an obstacle to success. Fully audited test houses worldwide provide technical expertise and the most state-of-the-art testing technologies. Using an outside resource ensures each device under test (DUT) meets the evolving standards of C-V2X. All at a more affordable operating expense.

Given that testing standards are sometimes a moving target, using an independent test house can help you understand the latest guidelines to ensure your product meets the requirements.

Whether you choose to invest in test equipment for an in-house laboratory, or partner with a leading independent test house, choosing to test with fully audited test equipment for current and future 5G / C-V2X standards are essential. Doing so delivers accurate, repeatable results with the latest guidelines — keeping test time to a minimum and accelerating time to market.

Ensure conformance

Using a testing and certification body such as OmniAir Consortium can be the most time- and cost-effective method for gaining the required certification for a C-V2X device, whether you test in-house or through an independent third-party laboratory.

Using an audited state-of-the-art facility to bench, field, and security test ensures conformance with the latest test standards. Once the lab reports are complete, the governing body approves the findings, and the device receives a certification mark to prove conformance.

OmniAir certification testing provides the following benefits:

- Comprehensive certification process that requires less time and financial resources than alternative methods.
- Inclusive conformance testing for RF and MAC according to relevant standards, upper layer message structure testing, and network and security services.
- Extensive certification framework to ensure the device under test (DUT) adheres to all relevant standards.
- Best practices to confirm interoperability, so tier one suppliers and original equipment manufacturers (OEMs) can readily identify compatible devices to ensure certification.

C-V2X Test Solutions

Keysight's cost-effective test processes are helping automotive manufacturers meet C-V2X certification. We have cutting-edge technology to support a range of test types that will support future releases of 5G new radio (NR) C-V2X. These test capabilities enable you to:

- Characterize transmitter performance for power, error vector magnitude (EVM), frequency accuracy, in-band emissions, adjacent channel leakage ratio (ACLR).
- Perform detailed receiver testing for sensitivity, maximum input level, adjacent-channel selectivity.
- Test protocols with comprehensive coverage of C-V2X, LTE test cases for Global Certification Forum (GCF), and PTCRB device certification testing.
- Use application layer testing that incorporates and integrates C-V2X scenarios with hardware-in-the-loop (HIL) systems.

The Keysight SA8700A C-V2X test solution is a comprehensive system that enables functional protocol and RF measurements on R14 C-V2X compliant devices. The platform's design is from the new Keysight UXM 5G platform and the MXG for GNSS emulation.

At present, the SA8700A C-V2X is the only test solution to support the evolving 5G / C-V2X RF, protocol, and application layer testing. You can protect your initial investment safe with a fully accredited test system, knowing that it will not become outdated as testing standards evolve.

Figure 1. SA8700A C-V2X Test Solution.

Summary

C-V2X is built on evolving 3GPP standards and test requirements are changing over time. Keysight is committed to align with the latest 3GPP standards and assures customers can be test their devices with confidences according to the latest protocols and future 5G NR-V2X release. For more information, please visit the SA8700A C-V2X Test Solution.

Learn More

- Keysight Test as a Service
- Keysight SA8700A C-V2X Test Solution – Solution Brief

Learn more at: www.keysight.com

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