

# A VEHICLE-TO-EVERYTHING SOLUTION FOR CONNECTED AND AUTONOMOUS VEHICLES

The Capgemini Engineering V2X ITS software framework

# V2X overview and industry trends

The Capgemini Engineering V2X stack enables faster time to market and rapid development of V2X equipment for safety and non-safety applications. The stack is compliant with specifications in the US, Europe, and China.

Vehicle-to-everything (V2X) communication is the sending of information from a vehicle to any unit that is related to the vehicle, and vice versa. The global V2X market for automotive is projected to reach USD 99.48 billion by 2024, growing at a CAGR of over 17% during 2014-2024 due to

growing technological advancements, increasing demand for safety features in the vehicle, stringent government rules for better traffic management, and the growing trend for connected vehicles<sup>1</sup>.

The target segments include in-vehicle (auto and tier 1 original equipment manufacturers, EV manufacturers, autonomous cars, etc.), roadside units (telecom service providers and smart city solution providers), and mobile devices (handset manufacturers).

1. TechSciResearch, 'Global V2X in Automotive Market By Communication Type (V2C, V2G, V2P, V2I, V2V, V2D), By Connectivity Type (DSRC Connectivity and Cellular Connectivity), By Offering Type (Hardware and Software), By Technology Type (Emergency Vehicle Notification, Automated Driver Assistance, Passenger Information System, Line of Sight and Others), By Propulsion Type (ICE Vehicles and Electric Vehicles), By Region, Competition Forecast & Opportunities, 2026', 2021, available from: <https://www.techsciresearch.com/report/global-v2x-market-for-automotive-market/2292.html>



# Enhance ADAS using V2X

Today's car systems use advanced driver assistance systems (ADAS) to enhance safety in vehicles. ADAS technology leverages vision and camera systems, sensor technology, and car data networks to provide a safer driving experience. With the advent of newer technologies, these systems are improving rapidly, but they still have their own limitations due to the range of their sensors and can be influenced by inclement weather or obstacles such as buildings, towers, etc. Vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) technology, collectively known as V2X, overcome these limitations faced by ADAS and serve as the foundation for intelligent transport systems (ITS).

According to the Intelligent Transportation Society of America (ITS America), V2X will allow next-generation traffic management systems to not only report when and where congestion occurs but can adaptively direct traffic to mitigate congestion<sup>2</sup>. Mobile phones and GPS will include V2X technology that will provide V2X features even for existing vehicles and protect vulnerable road users such as cyclists and pedestrians. V2V has the potential to help drivers avoid or mitigate 70-80% of vehicle crashes involving unimpaired drivers, and could help prevent many thousands of deaths and injuries on roads every year.

## Capgemini Engineering V2X framework overview

Capgemini Engineering offers V2X stack for rapid prototyping and development of V2X equipment for OBU and RSU. The stack is compliant with WAVE, ETSI, and CN standards. Some of the key features of the stack are implementation (talker and listener) and abstractions to OS and hardware.

### **Hardware, network, and OS agnostic**

Capgemini Engineering's V2X software stack is agnostic to radio technology and vendors. It supports C-V2X and DSRC technologies and is pre-ported on leading V2X platforms in the market (such as NXP, Autotalks, and Qualcomm). The stack is auto-grade and available on popular operating systems such as Linux and Android, as well as real-time operating systems.

### **Platform abstraction**

The stack components (V2X core stack and applications) can be run independently across the cores of a processor or different processors. Integration with V2X subsystems such as GPS, CAN, security, IoT sensors, and HMI are provided through well-defined APIs.

### **Rich set of APIs**

A rich set of APIs for application developers to use facility layer APIs provided above the base V2X stack layer to access decoded V2X messages and other information such as position, timing, and vehicle data.

2. Federal Trade Commission, 'Connected Cars: Privacy, Security Issues Related to Connected, Automated Vehicles', 2017, available from: [https://www.ftc.gov/system/files/documents/public\\_comments/2017/07/00055-141127.pdf](https://www.ftc.gov/system/files/documents/public_comments/2017/07/00055-141127.pdf)

### Proven interoperability

Successful participation in V2X interoperability and conformance events, as well as WAVE TCI 2.0 and ETSI TTCN based in-house conformance testing.

### Automotive grade

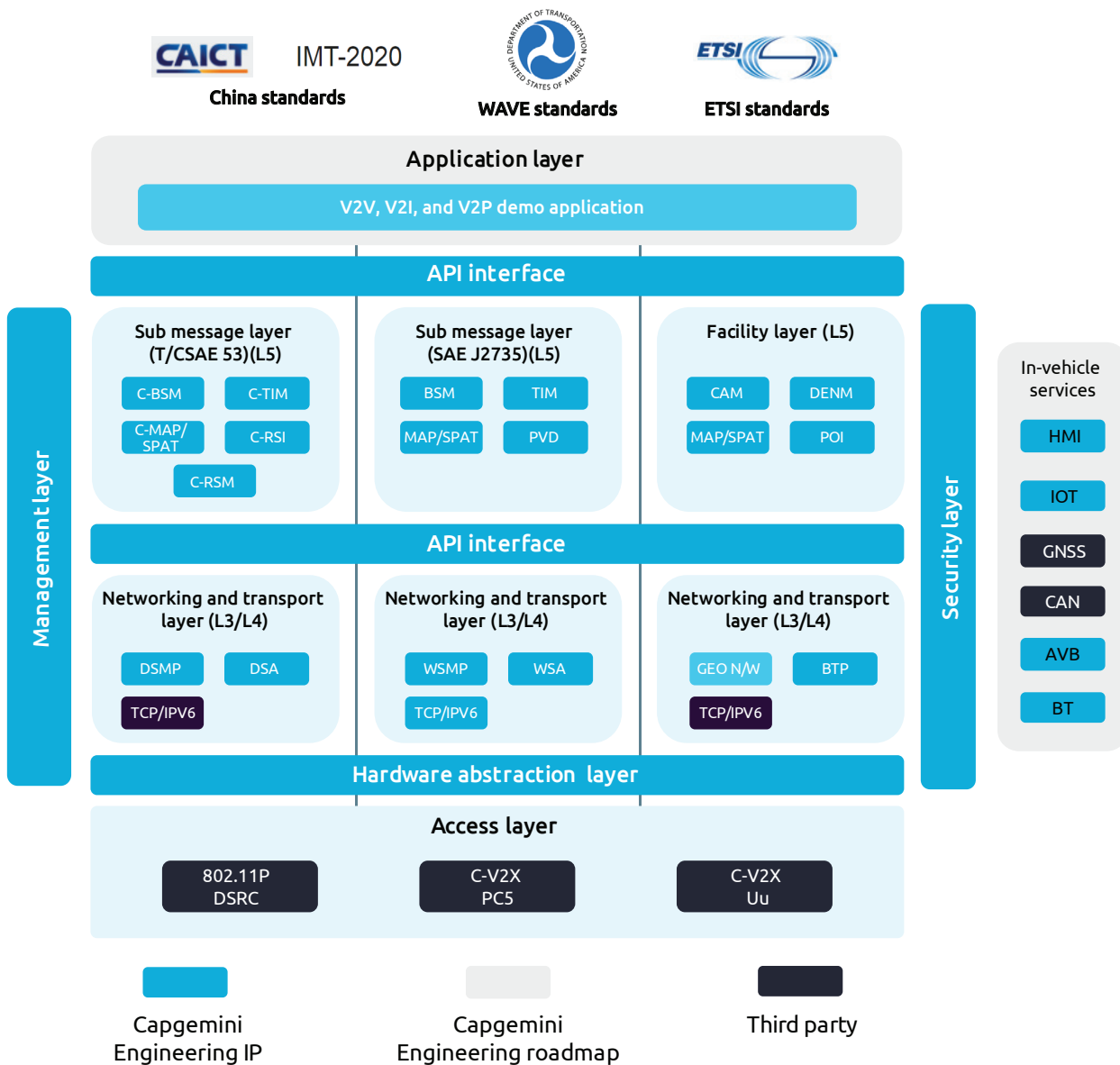
Auto SPICE and MISRA C 2012 compliant

### Security and privacy

Supports self-sign, SCMS client, and integration with third-party SCMS servers. Pre-integrated with hardware security modules (eHSM) or OpenSSL for messages.

### Linux test system

An x86 based Linux system is provided to test V2X stack and test applications without target hardware. Applications can be lab tested before the target hardware.



## Standard compliance

IEEE 802.11p (DSRC), 3GPP Rel 14 (C-V2X)  
IEEE 1609.2 (Security), IEEE 1609.3 (WSMP, WSA), IEEE 1609.4  
SAE J2735 (BSM, MAP, SPaT, TIM, RSA, EVA, ICA, ...)  
SAE 2945/1  
SCMS CAMP LLC

GN EN 302 636-4-1  
BTP TS 103 248  
CAM EN 302 637-2  
DENM EN 302 637-3  
Security TS 103 097  
GB/T 31024.3  
CSAE 53-2017

## V2X radios support

- Autotalks CRATON2
- Autotalks SECTON
- NXP RoadLINK
- Qualcomm Atheros

## OS support

- Linux
- Android
- RTOS

## Application processor support

- ST Telemaco3P
- i.MX series
- Renesas RZ/G1E
- Most ARM-based host processors supported

## Key use cases supported

### V2V

- Forward collision warning
- Dangerous goods warning
- Stationary vehicle warning
- Emergency braking

### V2I

- Curve speed warning
- Road works warning
- Road hazard warning
- Dangerous goods warning
- Time to green
- Point of interest (electric vehicle charging station)
- BEEPS (blockchain enabled enterprise platooning services)

### V2P

- Human presence on road

### V2X demo

- Demonstration of V2V, V2I, and V2P use cases on Capgemini Engineering's visualization software
- Capgemini Engineering's visualization software is made up in easy HTML5/CSS with Websocket interface
- Dynamic map support using Google Maps



# Why Capgemini Engineering

Our software frameworks offer best-in-class solutions that significantly reduce the total cost of ownership and time to market. We are a trusted partner with over 25 years of experience in technology and engineering. We are proud of our up to-the-minute expertise in the domain with regular participation and conformance verification at Plugfest events.

We also deliver unique in-car user experiences by leveraging a strong pedigree in communications (short and long range), multimedia, and embedded domains, and by partnering with leading automotive forums and platform providers. With a strong culture of innovation, we offer continuous experimentation with newer technologies and collaboration with leading standards, bodies, and forums, along with a global delivery model for optimized cost and timely delivery.

## Key V2X differentiators

- Rich-set of APIs written in C and are available across all layers and portable across platforms
- Integration with IoT sensors
- Customization services based on request
- Low latency and high reliability event and message delivery
- Message priority support
- AVB, Bluetooth, and LTE complimentary offering to support next generation V2X
- Flexible business models – binary or source code licensing options

## Key automotive differentiators

- A combined expertise in wireless communications and automotive which accelerate development, integration, and deployment of products and services, from car to cloud across market segments
  - #1 in cellular and Wi-Fi
  - #1 in automotive product engineering services
- Well positioned in three strategic domains – autonomous driving and connectivity, sustainable mobility, and complete vehicle development
- Global player serving leading automotive players: technological expertise and deep understanding of product engineering and manufacturing processes for OEMs and tier 1
- End-to-end high-value offering for next generation cars around autonomous driving (ADAS), artificial intelligence, connectivity, HMI, digital services, and electric and electronic systems or architectures

## Example of a use case with 2getthere

- Since 2009, our engineers worked alongside experts from 2getthere, a leading developer of mobility solutions, to design, produce, and deliver driverless electric vehicles. The driverless vehicles, each with a capacity of 24 passengers, were fully engineered and produced by our teams
- 2getthere delivers autonomous vehicle systems for smart cities with 25+ years of experience with autonomous vehicles in various demanding environments

## About Capgemini Engineering

Capgemini Engineering combines, under one brand, a unique set of strengths from across the Capgemini Group: the world leading engineering and R&D services of Altran – acquired by Capgemini in 2020 - and Capgemini's digital manufacturing expertise. With broad industry knowledge and cutting-edge technologies in digital and software, Capgemini Engineering supports the convergence of the physical and digital worlds. We help clients unleash the potential of R&D, a key component of accelerating their journey towards Intelligent Industry. Capgemini Engineering has more than 52,000 engineer and scientist team members in over 30 countries across sectors including aeronautics, space and defense, automotive, railway, communications, energy, life sciences, semiconductors, software, and internet and consumer products.

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