V2X (Vehicle to Everything) and CVIS (Cooperative Vehicle Infrastructure System) Industry Report, 2021

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STUDY GOAL AND OBJECTIVES

This report provides the industry executives with strategically significant competitor information, analysis, insight and projection on the competitive pattern and key companies in the industry, crucial to the development and implementation of effective business, marketing and R&D programs.

REPORT OBJECTIVES

- To establish a comprehensive, factual, annually updated and cost-effective information base on market size, competition patterns, market segments, goals and strategies of the leading players in the market, reviews and forecasts.
- To assist potential market entrants in evaluating prospective acquisition and joint venture candidates.
- To complement the organizations' internal competitor information gathering efforts with strategic analysis, data interpretation and insight.
- To suggest for concerned investors in line with the current development of this industry as well as the development tendency.
- To help company to succeed in a competitive market, and

METHODOLOGY

Both primary and secondary research methodologies were used in preparing this study. Initially, a comprehensive and exhaustive search of the literature on this industry was conducted. These sources included related books and journals, trade literature, marketing literature, other product/promotional literature, annual reports, security analyst reports, and other publications. Subsequently, telephone interviews or email correspondence was conducted with marketing executives etc. Other sources included related magazines, academics, and consulting companies.

INFORMATION SOURCES

The primary information sources include Company Reports, and National Bureau of Statistics of China etc.

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Abstract

V2X and CVIS Industry Report: 5G V2X will be a Standard Configuration for Digital Cockpits

After months of debate, in November 2020, the US Federal Communications Commission (FCC) voted for allocation of 75MHz of the spectrum band (5.850-5.925GHz), which had previously been reserved for Dedicated Short-Range Communications (DSRC) services, to Wi-Fi and C-V2X uses, which means the US has given up DSRC and turned to C-V2X.

In 2021, China government has issued the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and the Long-Range Objectives through the Year 2035, and the National Comprehensive Three-dimensional Transportation Network, indicating that in the 15 years to come, China should lead the world in intelligent connected vehicle (intelligent vehicle, autonomous driving, CVIS) by providing full coverage of spatio-temporal information service and transportation perception, and defining China's "CVIS + autonomous driving" technology roadmap.

C-V2X technology is in the first phase of implementation, and OEMs tend to explore application scenarios.

In September 2020, the 5G Automotive Association (5GAA) worked out a C-V2X communication technology roadmap.

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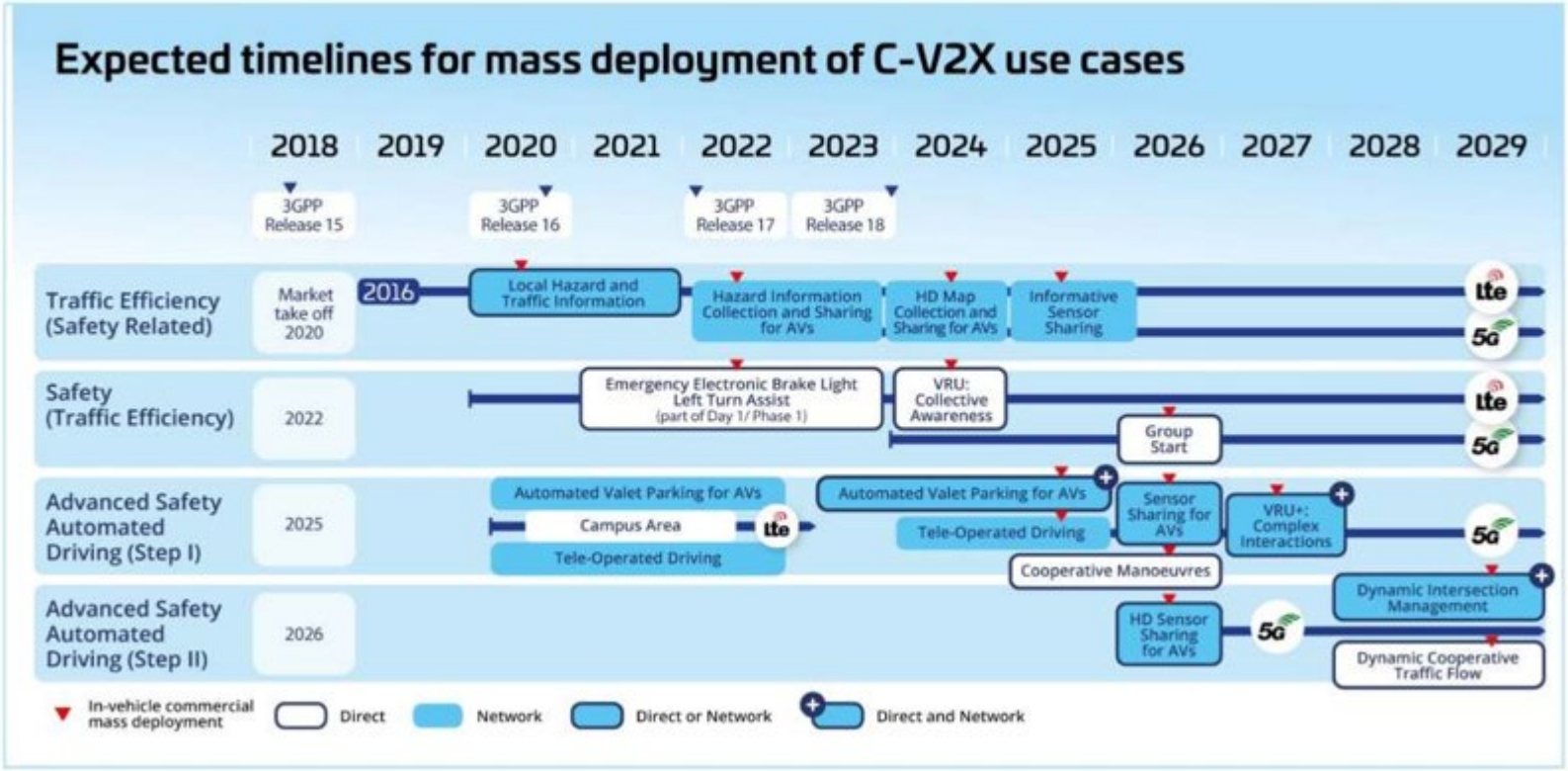
5GAA's Expected Timelines for Mass Deployment of C-V2X Use Cases



Source: 5GAA

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Based on the current 3GPP's 5G technology release speed, global deployment of 5G technology, and automotive communication technology supply chain status, combining 5GAA's prediction and the reality in China, we think the use of C-V2X technology will pass through the following three phases:

2020-2023:

Having become available to mass-produced vehicles, C-V2X now depends on 4G LTE-V2X (R14, R15) technology to offer basic safety functions: LTE-V2X enables higher traffic efficiency and assisted driving safety, and will support other functions such as electronic brake light, left turn assistance, automated valet parking (AVP) in a parking lot, and remote-controlled driving.

In some low- and medium-speed automated driving scenarios (ports, mining areas, parks, etc.), LTE-V2X (R15, composed of 4G core networks + 5G base stations) works for vehicle infrastructure cooperation.

2024-2026:

Based on NR V2X+5G Uu, achieve CVIS-enabled automated driving (R16-released in July 2020), R17-expected to freeze in mid-2022), with available functions including coordinated protection of vulnerable groups in traffic and cooperative automated driving on urban roads;

HD map data (static/semi-static and dynamic) and sensor data (camera, LiDAR, radar, etc.) can be broadcasted to nearby autonomous vehicles for assisted driving decision.

Beyond 2026:

5G NR V2X will be mature enough to be a standard configuration for highly automated vehicles. The combination of NR V2X and 5G eMBB allows for the sharing and collaboration of high-precision perception data between vehicles, and the collaborative interaction between vulnerable traffic participants. By 2029, it will enable collaborative traffic flow management and automated vehicle flow takeover on highways or at intersections.

In China's case, the Cooperative Intelligent Transportation System, Vehicular Communication, Application Layer Specification and Data Exchange Standard (Day II), an association standard, started soliciting opinions in November 2020. Compared with the CVIS DAY I released in 2017, the CVIS Day II underlines the interactions between vehicles, infrastructures and pedestrians and makes the trend to "vehicle-infrastructure cooperation" technology clearer, which means more V2I scenarios will come out and roadside (edge end) capabilities will play a role.

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12 Application Scenarios Defined in CVIS Day II

No.	DAY-II	Communication mode	Trigger mode	Scenarios	Main messages
1	Perceived data sharing	V2V/V2I	Event	Safety	Msg_ SSM
2	Cooperative lane change	V2V/V2I	Event	Safety	Msg_ VIR
3	Collaborative vehicle cut-in	V2I	Event	Safety/efficiency	Msg_ RSC, Msg_ VIR
4	Collaborative intersection passage	V2I	Event/Period	Safety/efficiency	Msg_ RSC
5	Differentiated data services	V2I	Period	Information Services	Msg_ RTCM
6	Dynamic lane management	V2I	Event/Period	Efficiency/Traffic Management	Msg_ RSC
7	Collaborative priority vehicle passage	V2I	Event	efficiency	Msg_ VIR, Msg_ RSC
8	Route guidance services at parking lots and stations	V2I	Event/Period	Information Services	Msg_ PAM, Msg_ VIR
9	Floating car data collection	V2I	Event/Period	Traffic management	Msg_ BSM, Msg_ VIR, Msg_ SSM
10	Safe passage of vulnerable traffic participants	P2X	Period	Safety	Msg_ PSM
11	Cooperative vehicle fleet management	V2V	Event/Period	Advanced intelligent driving	Msg_ PMM
12	Road toll services	V2I	Event/Period	Efficiency / Information Services	Msg_ VPM

Note: The "main messages" in the table are the main interaction message required by the application scenarios. In practice, different needs and services may require more messages.

Source: China Society of Automotive Engineers

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Through the lens of the mass production of OEMs in China, the 17 typical use cases in the CVIS DAY I can already be seen in vehicles; for the typical Day II use cases, the formulation of recommended standards is underway, and development and commercialization is expected to be phased in in 2021.

For example, Ford China is testing “direct connection” mode-based V2I and V2V capabilities such as electronic emergency brake light (EEBL) and intersection movement assist (IMA), and will further integrate V2X with Co-Pilot 360 ADAS and push them to users over the air (OTA).

Hardware and Functional Configurations of C-V2X-enabled Mass-produced Vehicles in China

Models	V2X hardware	V2X functions
SAIC-GM Buick GL8 and Avenir	Quectel automotive C-V2X module AG15 and automotive LTE module AG35. Optional: V2X Intelligent Transportation Technology. Price: RMB10,000.	EBW, CLW, AVW, ICW, SLW, SVW, HLW, GLOSA
Ford EDGE PLUS	/	EBW, AVW, ICW, HLW, GLOSA, CLW, SVW, SLW
SAIC MARVEL R	The 5G V2X i-BOX of DIAS under SAIC Group. 5G, V2X, high-precision positioning. Optional: RMB30,000 "R-Pilot Smart Driving Growth Package" for V2X and ADAS	17 5G V2X application scenarios such as traffic light information notification, stop/start guidance, and vehicle speed guidance. The road environment and traffic light information can be known in advance. Equipped with intelligent speed control, intelligent intersection assistance, etc.
GAC Trumpchi AION V	Huawei 5G automotive module MH5000. Optional: 5G Pioneer Set for 5G network function configuration. Limited optional package price: RMB9,600	ICW, DNPW, VRUCW, etc.
FAW Hongqi E-HS9	C-V2X smart antenna jointly developed with Neusoft. Quectel AG15 module based on Qualcomm 9150 C-V2X chipset. Quectel LTE automotive module AG35 with built-in Qualcomm MDM9628 chip. The module's own dead-reckoning and high-precision integrated positioning can achieve sub-meter high-precision positioning	FCW, blind spot reminder/lane change, ICW, etc
HiPhi	JOYNEXT's 5G-V2X product. Quectel 5G+C-V2X automotive module AG550Q. JOYNEXT's automotive networked terminal	/
Great Wall Mocha	Based on the "Coffee Intelligence" platform. Qualcomm 8155 chip, automotive 5G+V2X	/
NIO ET7	JOYNEXT, a subsidiary of Joyson Electronics, participates in the NIO5G-V2X platform project. By the end of 2021, 5G-TBOX and 5G-VB0X will be deployed in NIO ET7.	/

Source: ResearchInChina

In future 5G V2X may be a standard configuration for digital cockpits

In the next several years, the stronger computing force of chips will come with much more rapid integration of digital cockpits and a disruption in conventional on-board units like T-BOX; smart cockpits that integrate with more functions including ADAS, V2X and cloud services will hold the trend. Qualcomm's third- and fourth- generation Snapdragon automotive digital cockpit platforms both combine C-V2X. In future, 5G V2X may be a standard configuration for digital cockpits.

V2X can fuse with on-board smart terminals like IVI system and T-BOX, as well as ADAS or autonomous driving platform. Tier1s and OEMs have been developing corresponding products. Specifically, C-V2X hardware products have the following forms:

1.C-V2X+T-BOX on-board terminals can integrate with such technologies and products as 4G/5G module, C-V2X module, CAN controller and GNSS. PATEO's 5G C-V2X T-BOX packs Huawei MH5000 module. PATEO has partnered with Huawei closely in communication modules since 2009, with their cooperation extending from Huawei MU203 module at first to 4G, 4.5G C-V2X and 5G C-V2X; at the 2020 C-V2X Cross-industry & Large-scale Pilot Plugfest, the fleet co-built by PATEO, Huawei and BAIC completed dozens of scenario demonstrations like V2I (vehicle to infrastructure) and V2V (vehicle to vehicle) and showed applications, for instance, AR navigation, ADAS and lane-level HD navigation map.

2.The further integration of UWB / WIFI / Bluetooth keyless entry and other functional modules into all-in-one intelligent antennas already highly integrated with such as GNSS positioning module, 4G/5G and V2X may be taken into account. Honqqi E-HS9 launched in late 2020 carries the C-V2X intelligent antenna that is jointly developed with Neusoft.

3."ETC+T-BOX+C-V2X" all-in-one terminals. An example is China TransInfo Technology Co., Ltd. which integrates automotive-grade ETC and C-V2X PC5 modules into the existing passenger car 4G/5G T-Box platform to connect ETC and V2X to vehicle navigation system and ADAS.

4.AR navigation and AR HUD technology will further enhance the fusion of ADAS, V2V and V2I communication technologies, becoming an important display interface for V2X. Mocha, a mass-produced model under Great Wall WEY, has carried Qualcomm 8155 cockpit chip, 5G+V2X and AR-HUD.

5. Autonomous driving DCU that fuse with C-V2X can serve as redundant sensors for autonomous driving. Qualcomm Snapdragon Ride hardware stack incorporates planning, positioning (Qualcomm Vision Enhanced) and perception (camera, radar, LiDAR, sensor fusion, C-V2X). V2X software supports ITS protocol stacks subject to SAE and ETSI standards, as well as third-party ITS protocol stacks.

In general, most of the current models spawned by OEMs adopt the technical solutions integrated with V2X module and T-BOX. At present, 5G+LTE-V2X+WiFi+GNSS functions can be integrated into one module priced at RMB2,000 or so.

In future, the price will have a further drop to RMB1,000 to RMB1,500, and those based on R16/R17 5G NR will be a bit more expensive. Optimists predict that China's passenger car C-V2X OEM terminal market will be worth more than RMB10 billion in 2025.

Passenger Car C-V2X Integrated Terminal OEM Market Size in China, 2020-2025E

Source: ResearchInChina

In addition, in an age of software-defined vehicles, Tier1s can provide OEMs with road scenario tests, middleware (ITS protocol stack) and application layer development services and charge them development and license fees, while the value of pure protocol stack providers will be highlighted.

Foreign protocol stack providers are led by Cohda Wireless, Commsignia, Savari, MARBEN and Veniam; in China, typical players are Baidu Apollo, Neusoft VeTalk, Nebula Link and iSmartWays.

Samsung Harman's buyout of the V2X software provider Savari in March 2021 and its early investment in Autotalks enable Samsung to offer complete V2X TCU software and hardware solutions in an age of 5G. Samsung 5G V2X TCU is to be mounted on BMW iX SUV at the end of 2021.

In China, Nebula Link, an ITS software stack provider rolls out V2X stack software protocols for conventional Tier1s, for example, offering communication protocol stacks and upper application algorithm software to vehicle V2X products of JOYNEXT, a subsidiary of Joyson Electronics, which have been applied to the mass-produced model platform of one OEM in China.

In addition, V2X modules of Morningcore Technology Co., Ltd. under China Information and Communication Technology Group Co., Ltd. (CICT) integrate with CWAVE II, Nebula Link's C-V2X national standards-compliant protocol stack. 2 million sets of CX7101N, a full-stack software and hardware integrated solution for mass-produced vehicles jointly introduced by Nebula Link and Morningcore Technology, are projected to be used in the next five years.

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Room 2-626, 6th Floor, No.1, Shanyuan Street, Haidian District, Beijing, 100080

Phone: +86 10 82600828 ● Fax: +86 10 82601570 ● www.researchinchina.com ● report@researchinchina.com

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