

The V2X (Vehicle-to-Everything) Communications Ecosystem: 2019 – 2030 – Opportunities, Challenges, Strategies & Forecasts

<https://marketpublishers.com/r/V0B1AF02954EN.html>

Date: March 2019

Pages: 871

Price: US\$ 2,500.00 (Single User License)

ID: V0B1AF02954EN

Abstracts

Commonly referred to as V2X, vehicle-to-everything communications technology allows vehicles to directly communicate with each other, roadside infrastructure, and other road users to deliver an array of benefits in the form of road safety, traffic efficiency, smart mobility, environmental sustainability, and driver convenience. In addition, V2X is also helping pave the way for fully autonomous driving through its unique non line-of-sight sensing capability which allows vehicles to detect potential hazards, traffic, and road conditions from longer distances and sooner than other in-vehicle sensors such as cameras, radar, and LiDAR (Light Detection and Ranging).

Although legacy V2I (Vehicle-to-Infrastructure) technologies are currently in operational use worldwide for ETC (Electronic Toll Collection) and relatively simple V2I applications, advanced V2X systems – capable of supporting V2V (Vehicle-to-Vehicle), V2I and other forms of V2X communications – are beginning to gain broad commercial acceptance with two competing technologies vying for the attention of automakers and regulators: the commercially mature IEEE 802.11p/DSRC (Dedicated Short Range Communications) standard, and the relatively new 3GPP-defined C-V2X (Cellular V2X) technology which has a forward evolutionary path towards 5G.

With an initial focus on road safety and traffic efficiency applications, Toyota and GM (General Motors) have already equipped some of their vehicle models with IEEE 802.11p-based V2X technology in Japan and North America. Among other commercial commitments, Volkswagen will begin deploying IEEE 802.11p on volume models in Europe starting from 2019, while Geely and Ford plan to integrate C-V2X in their new vehicles by 2021 and 2022 respectively. It is also worth noting that a number of luxury automakers – including BMW, Daimler, Volkswagen's subsidiary Audi, and Volvo Cars –

already deliver certain V2X-type applications through wide-area cellular connectivity and supporting infrastructure such as appropriately equipped roadwork trailers.

Despite the ongoing 802.11p/DSRC versus C-V2X debate, regulatory uncertainty and other challenges, global spending on V2X communications technology is expected to grow at a CAGR of more than 170% between 2019 and 2022. SNS Telecom & IT predicts that by the end of 2022, V2X will account for a market worth \$1.2 Billion, with an installed base of nearly 6 Million V2X-equipped vehicles worldwide.

The “V2X (Vehicle-to-Everything) Communications Ecosystem: 2019 – 2030 – Opportunities, Challenges, Strategies & Forecasts” report presents an in-depth assessment of the V2X ecosystem including market drivers, challenges, enabling technologies, application scenarios, use cases, business models, key trends, standardization, spectrum availability/allocation, regulatory landscape, V2X deployment case studies, opportunities, future roadmap, value chain, ecosystem player profiles and strategies. The report also presents market size forecasts from 2019 till 2030. The forecasts cover four submarkets, two air interface technologies, 10 application categories and five regions.

The report comes with an associated Excel datasheet suite covering quantitative data from all numeric forecasts presented in the report.

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- 5.18.4 Future Plans to Introduce V2X-Equipped Vehicles in the United States & Other Countries
- 5.19 USDOT Connected Vehicle Pilots: Helping V2X Make the Final Leap into Real-World Deployment
 - 5.19.1 NYC DOT (New York City Department of Transportation) Connected Vehicle Pilot
 - 5.19.1.1 Pilot Deployment Overview
 - 5.19.1.2 Supported V2X Applications
 - 5.19.1.3 Current Status of the Pilot Deployment
 - 5.19.2 THEA (Tampa-Hillsborough Expressway Authority) Connected Vehicle Pilot
 - 5.19.2.1 Pilot Deployment Overview
 - 5.19.2.2 Supported V2X Applications
 - 5.19.2.3 Current Status of the Pilot Deployment
 - 5.19.3 WYDOT (Wyoming Department of Transport) Connected Vehicle Pilot
 - 5.19.3.1 Pilot Deployment Overview
 - 5.19.3.2 Supported V2X Applications
 - 5.19.3.3 Current Status of the Pilot Deployment
 - 5.19.4 Future Plans for Post-Pilot Operations
- 5.20 Vodafone Group: Improving Road Safety & Traffic Efficiency with V2X
 - 5.20.1 Creating a Step-Change in Road Safety & Traffic Efficiency
 - 5.20.2 Initial Field Trials & Demonstrations
 - 5.20.3 Supported V2X Applications
 - 5.20.4 Future Plans for the Rollout of C-V2X Technology
- 5.21 Volkswagen Group: Pioneering the Rollout of V2X-Equipped Vehicles in Europe
 - 5.21.1 WLANp: Group-Wide Implementation of IEEE 802.11p-Based V2X Technology in 2019
 - 5.21.1.1 Supported V2X Applications
 - 5.21.1.2 Efforts to Accelerate the Adoption of V2X Technology
 - 5.21.1.3 Integrating V2X-Capable Roadside Infrastructure & Other Road Users
 - 5.21.2 Audi: Delivering V2I Applications via On-Board LTE Connectivity
 - 5.21.3 Ducati Motor Holding: Developing V2X Interoperability Between Motorcycles, Vehicles & Infrastructure
 - 5.21.4 SEAT: Advancing V2X-Based Assisted Driving Applications
 - 5.21.5 TRATON (Scania & MAN): Piloting Platooning & Commercial Vehicle Applications

5.22 Volvo Group/Volvo Trucks: Enabling Truck Platooning & Commercial Vehicle Applications with V2X

5.22.1 Utilizing V2X to Develop Platooning & Commercial Vehicle Applications

5.22.2 V2X Engagements Worldwide

5.22.3 Supported V2X Applications

5.22.4 Commercial Rollout Plans

5.23 Other Notable V2X Engagements

5.23.1 Automotive OEM Commitments

5.23.2 Mobile Operator-Led C-V2X Projects & Trials

5.23.3 Other Commercial, Pilot & Trial V2X Deployments

6 CHAPTER 6: V2X SPECTRUM AVAILABILITY, ALLOCATION & USAGE

6.1 Frequency Bands for V2X Communications

6.1.1 Legacy V2I Systems

6.1.1.1 915 MHz

6.1.1.2 Other Sub-1 GHz Bands

6.1.1.3 2.4 GHz

6.1.1.4 5.8 GHz

6.1.2 Advanced V2X Technologies

6.1.2.1 760 MHz

6.1.2.2 3.4 – 3.8 GHz

6.1.2.3 5.9 GHz

6.1.2.4 Higher Frequencies

6.2 North America

6.2.1 United States

6.2.2 Canada

6.3 Asia Pacific

6.3.1 Australia

6.3.2 China

6.3.3 Japan

6.3.4 South Korea

6.3.5 Singapore

6.3.6 Taiwan

6.3.7 Thailand

6.3.8 India

6.3.9 Rest of Asia Pacific

6.4 Europe

6.4.1 EU & EFTA Countries

- 6.4.2 Turkey
- 6.4.3 Russia
- 6.4.4 Other Countries
- 6.5 Middle East & Africa
 - 6.5.1 GCC (Gulf Cooperation Council)
 - 6.5.2 Iran
 - 6.5.3 Israel
 - 6.5.4 South Africa
 - 6.5.5 Rest of the Middle East & Africa
- 6.6 Latin & Central America
 - 6.6.1 Brazil
 - 6.6.2 Mexico
 - 6.6.3 Rest of Latin & Central America

7 CHAPTER 7: STANDARDIZATION, REGULATORY & COLLABORATIVE INITIATIVES

- 7.1 3GPP (3rd Generation Partnership Project)
 - 7.1.1 Release 14: LTE-V2X/Phase 1
 - 7.1.2 Release 15: eV2X (Enhanced V2X)/Phase 2
 - 7.1.3 Release 16: 5G NR-V2X/Phase 3
- 7.2 5GAA (5G Automotive Association)
 - 7.2.1 5G/C-V2X Advocacy Efforts
 - 7.2.2 Working Groups
 - 7.2.2.1 WG1: Use Cases & Technical Requirements
 - 7.2.2.2 WG2: System Architecture & Solution Development
 - 7.2.2.3 WG3: Evaluation, Testbeds & Pilots
 - 7.2.2.4 WG4: Standards & Spectrum
 - 7.2.2.5 WG5: Business Models & Go-To-Market Strategies
- 7.3 5G-Connected Mobility Consortium
 - 7.3.1 5G-Based V2X R&D Efforts
- 7.4 AASHTO (American Association of State Highway and Transportation Officials)
 - 7.4.1 Frequency Coordination for V2X Communications
 - 7.4.2 V2X Policy, Deployment Guidance & Related Efforts
 - 7.4.3 Work on Connected Autonomous Driving
- 7.5 ACEA (European Automobile Manufacturers' Association)
 - 7.5.1 Connected & Automated Driving-Related Work
- 7.6 AECC (Automotive Edge Computing Consortium)
 - 7.6.1 Edge Computing System Design for V2I & V2N Applications

7.7 Amsterdam Group

7.7.1 V2X Deployment Roadmap

7.7.2 Corridor Initiatives

7.7.3 Functional Specifications & Other V2X-Related Efforts

7.8 ARIB (Association of Radio Industries and Businesses, Japan)

7.8.1 ARIB STD T75: 5.8 GHz DSRC System for V2I Applications

7.8.2 ARIB STD T88: DSRC Application Sub-Layer

7.8.3 ARIB STD T110: DSRC Basic Application Interface

7.8.4 ARIB STD-T109: 760 MHz Advanced V2X System

7.9 U.S. ARPA-E (Advanced Research Projects Agency – Energy)

7.9.1 NEXTCAR (Next-Generation Energy Technologies for Connected & Automated On-Road Vehicles)

7.9.1.1 Use of V2X Connectivity for Vehicle Control & Powertrain Optimization

7.10 ASECAP (European Association of Operators of Toll Road Infrastructures)

7.10.1 V2X-Related Activities

7.11 Association of Global Automakers

7.11.1 Connected Automation Advocacy

7.12 ASTM International

7.12.1 Legacy DSRC Standards

7.12.2 ASTM E2213-03: 5.9 GHz DSRC MAC & PHY Specifications

7.13 ATA (American Trucking Associations)

7.13.1 V2X-Related Activities

7.14 ATIS (Alliance for Telecommunications Industry Solutions)

7.14.1 V2X Security Guidance & Requirements

7.14.2 Other V2X-Related Work

7.15 Auto Alliance (Alliance of Automobile Manufacturers)

7.15.1 V2X-Related Activities

7.16 AUTOSAR (AUTomotive Open System ARchitecture)

7.16.1 V2X Stack Specifications

7.17 C2C-CC (CAR 2 CAR Communication Consortium)

7.17.1 BSP (Basic System Profile) for V2X Systems in Europe

7.17.2 PKI (Public Key Infrastructure) for V2X Security

7.17.3 Advocacy Efforts to Preserve the 5.9 GHz Band for ITS-G5

7.17.4 Other V2X-Related Efforts

7.18 CAICV (China Industry Innovation Alliance for Intelligent and Connected Vehicles)

7.18.1 V2X Working Group

7.19 CAMP (Crash Avoidance Metrics Partnership)

7.19.1 SCMS (Security Credential Management System) for V2X Communications

7.19.2 Other V2X-Related Efforts

- 7.20 CAT (Cooperative Automated Transportation) Coalition
 - 7.20.1 CAV-ELT (Connected and Automated Vehicle Executive Leadership Team): CAV-Focused Working Groups
 - 7.20.2 V2I DC (Vehicle to Infrastructure Deployment Coalition): V2I Working Groups
- 7.21 CCC (Car Connectivity Consortium)
 - 7.21.1 V2X-Related Projects
- 7.22 CCSA (China Communications Standards Association)
 - 7.22.1 LTE-V2X Standardization
- 7.23 CEDR (Conference of European Directors of Roads)
 - 7.23.1 V2X-Related Activities
- 7.24 ConVeX (Connected Vehicle-to-Everything of Tomorrow) Consortium
 - 7.24.1 C-V2X Field Trials & Demonstrations
- 7.25 CEN (European Committee for Standardization)
 - 7.25.1 CEN TC 278
 - 7.25.1.1 CEN DSRC Family of Standards
 - 7.25.1.2 EFC (Electronic Feed Collection) & V2I Applications
 - 7.25.1.3 Standards for C-ITS/Advanced V2X Systems
- 7.26 CENELEC (European Committee for Electrotechnical Standardization)
 - 7.26.1 ITS-Related Standards
- 7.27 CEPT (European Conference of Postal and Telecommunications Administrations)
 - 7.27.1 ECC (Electronic Communications Committee)
 - 7.27.2 WG SE (Working Group Spectrum Engineering)
 - 7.27.3 Frequency Arrangement for V2X Communications in Europe
- 7.28 C-ITS (China ITS Industry Alliance)
 - 7.28.1 Chinese National Standards for V2X
- 7.29 CLEPA (European Association of Automotive Suppliers)
 - 7.29.1 V2X-Related Activities
- 7.30 CMC (Connected Motorcycle Consortium)
 - 7.30.1 Standardization for Motorcycle-Specific V2X Systems
 - 7.30.2 Feasibility Testing & Prototyping
- 7.31 EATA (European Automotive and Telecom Alliance)
 - 7.31.1 Efforts to Facilitate the Deployment of Connected & Automated Driving
- 7.32 ERTRAC (European Road Transport Research Advisory Council)
 - 7.32.1 Working Group on Connectivity & Automated Driving
- 7.33 ETSI (European Telecommunications Standards Institute)
 - 7.33.1 TC ITS (Technical Committee Intelligent Transport Systems)
 - 7.33.1.1 ETSI TR 101 607: C-ITS (Cooperative ITS) Release 1
 - 7.33.1.2 ETSI EN 302 663: ITS-G5 Access Layer Standard
 - 7.33.1.3 ETSI TS 102 724: Harmonized Channel Specifications for ITS-G5

- 7.33.1.4 ETSI TS 102 792: Co-Existence Between CEN DSRC & ITS-G5
- 7.33.1.5 ETSI TS 102 687/103 175: DCC (Decentralized Congestion Control)

Mechanisms

- 7.33.1.6 ETSI EN 302 665: ITS Communications Architecture
- 7.33.1.7 ETSI EN 302 637-2: CAMs (Cooperative Awareness Messages)
- 7.33.1.8 ETSI EN 302 637-3: DENMs (Decentralized Environmental Notification

Messages)

- 7.33.1.9 ETSI EN 302 895: LDM (Local Dynamic Map) Specification
- 7.33.1.10 ETSI TS 103 301: Protocols & Communication Requirements for

Infrastructure Services

- 7.33.1.11 ETSI TS 101 539 Series: Safety-Related V2X Applications
- 7.33.1.12 ETSI TS 101 556 Series: V2I Applications
- 7.33.1.13 ETSI TS 102 894-1: Facility Layer Structure, Functional Requirements &

Specifications

- 7.33.1.14 TS 102 890 Series: Additional Facility Layer Specifications
- 7.33.1.15 ETSI TS 102 894-2: Common Data Dictionary
- 7.33.1.16 ETSI EN 302 636 Series: GeoNetworking Protocol
- 7.33.1.17 ETSI TS 102 731, 102 940-943, 103 097: V2X Security Standards
- 7.33.1.18 Other Release 1 Standards
- 7.33.1.19 Work on C-ITS Release 2 & Advanced V2X Applications

7.33.2 ETSI TC ERM (Electromagnetic Compatibility & Radio Spectrum Matters)

- 7.33.2.1 ETSI EN 302 571: Harmonized Standard for ITS-G5 (5.9 GHz) Spectrum
- 7.33.2.2 ETSI EN 302 686: Harmonized Standard for 63 – 64 GHz ITS Spectrum

7.33.3 Other Complementary Standards

7.34 EU Mandates & Directives

- 7.34.1 Action Plan for the Deployment of ITS
- 7.34.2 Mandate M/453 on Cooperative Systems for Intelligent Transport
- 7.34.3 EU ITS Directive 2010/40/EU
- 7.34.4 Supporting Groups for the EU ITS Directive
 - 7.34.4.1 EIC (European ITS Committee)
 - 7.34.4.2 European ITS Advisory Group
- 7.34.5 Mandate M/546 on Urban ITS
- 7.34.6 Declaration of Amsterdam on Connected & Automated Driving
- 7.34.7 COM (2016) 766: EU C-ITS Strategy
- 7.34.8 Letter of Intent on Cooperative, Connected & Automated Mobility
- 7.34.9 Third EU Mobility Package
- 7.34.10 C-ITS Delegated Act Under Directive 2010/40/EU: Specifications for the

Provision of C-ITS

7.35 EU-Funded V2X Deployment Initiatives & Projects

- 7.35.1 C-ITS Deployment Platform
- 7.35.2 C-Roads Platform
- 7.35.3 Cooperative ITS Corridor
- 7.35.4 InterCor (Interoperable Corridors)
- 7.35.5 CONCORDA (Connected Corridor for Driving Automation)
- 7.35.6 C-MoBILE (Accelerating C-ITS Mobility Innovation & Deployment in Europe)
- 7.35.7 NEWBITS (New Business models for ITS)
- 7.35.8 CIMEC (Cooperative ITS for Mobility in European Cities)
- 7.35.9 CODECS (Cooperative ITS Deployment Coordination Support)
- 7.35.10 MAVEN (Managing Automated Vehicles Enhances Network)
- 7.35.11 TransAID (Transition Areas for Infrastructure-Assisted Driving)
- 7.35.12 Auto C-ITS
- 7.35.13 C-V2X Projects
 - 7.35.13.1 5GCAR (Fifth Generation Communication Automotive Research & Innovation)
 - 7.35.13.2 5GCroco (5G Cross Border Control)
 - 7.35.13.3 5G-Carmen (5G for Connected & Automated Road Mobility in the European Union)
 - 7.35.13.4 5G-Mobix (5G for Cooperative & Connected Automated Mobility on X-Border Corridors)
- 7.35.14 Other EU-Funded Projects
- 7.35.15 CAD (Connected Automated Driving) Initiative
 - 7.35.15.1 ARCADE (Aligning Research & Innovation for Connected & Automated Driving in Europe)
 - 7.35.15.2 CARTRE (Coordination of Automated Road Transport Deployment for Europe)
 - 7.35.15.3 SCOUT (Safe & COnnected AUtomatic in Road Transport)
 - 7.35.15.4 EUCAD (European Conference on Connected & Automated Driving)
- 7.35.16 Round Table on CAD (Connected & Automated Driving)
- 7.35.17 Gear 2030 HLG (High Level Group)
- 7.36 EU-US C-ITS Task Force
 - 7.36.1 HWG (Standards Harmonization Working Group) & HTGs (Harmonization Task Groups)
 - 7.36.1.1 HTG 1: ITS Security
 - 7.36.1.2 HTG 2: BSM (Basic Safety Message)/CAM (Cooperative Awareness Message) Harmonization
 - 7.36.1.3 HTG 3: ITS Communications
 - 7.36.1.4 HTG 4/5: Infrastructure Messages
 - 7.36.1.5 HTG 6: C-ITS Security Policy

- 7.36.1.6 HTG 7: Standards Selection, Gap Analysis & Identifiers
- 7.36.1.7 HTG 8 & 9: Candidate Future Work Items
- 7.37 GCF (Global Certification Forum)
 - 7.37.1 C-V2X Certification Program
- 7.38 GENIVI Alliance
 - 7.38.1 V2X-Related Activities
- 7.39 GSMA
 - 7.39.1 C-V2X Advocacy Efforts
- 7.40 IEC (International Electrotechnical Commission)
 - 7.40.1 ISO/IEC JTC 1
 - 7.40.1.1 SC31 WG4: RFID Standards for V2I Applications
 - 7.40.1.2 Other V2X-Related Standardization Activities
- 7.41 IEEE (Institute of Electrical and Electronics Engineers)
 - 7.41.1 IEEE 802.11p/OCB for V2X Communications
 - 7.41.2 IEEE 1609.x Family of Standards for WAVE (Wireless Access in Vehicular Environments)
 - 7.41.3 IEEE 802.11 NGV (Next Generation V2X) Study Group
 - 7.41.3.1 IEEE 802.11bd Amendment Project
 - 7.41.4 IEEE P2040 for Connected, Automated & Intelligent Vehicles
 - 7.41.5 IEEE P2690 for Charging Network Management Protocol in Electric Vehicle Charging Systems
 - 7.41.6 Other Relevant Standards
- 7.42 IETF (Internet Engineering Task Force)
 - 7.42.1 IPWAVE (IP Wireless Access in Vehicular Environments) WG
 - 7.42.1.1 IPv6 over IEEE 802.11-OCB
- 7.43 IMDA (Info-Communications Media Development Authority, Singapore)
 - 7.43.1 TSAC (Telecommunications Standards Advisory Committee)
 - 7.43.1.1 Technical Specification for DSRC
- 7.44 IMT-2020 (5G) Promotion Group
 - 7.44.1 C-V2X Working Group
- 7.45 ISED (Innovation, Science and Economic Development Canada)
 - 7.45.1 Spectrum Allocation for V2X
 - 7.45.2 RSS-252: Certification Requirements for V2X OBU Devices
- 7.46 ISO (International Organization for Standardization)
 - 7.46.1 TC 204
 - 7.46.1.1 V2X Communications
 - 7.46.1.2 V2X Applications & Complementary Technologies
 - 7.46.1.3 V2X Security
- 7.47 ITE (Institute of Transportation Engineers)

- 7.47.1 Connected Vehicle Initiative
- 7.47.2 Cybersecurity Framework & Tools for Roadway Infrastructure
- 7.47.3 Other V2X-Related Efforts
- 7.48 ITS America (Intelligent Transportation Society of America)
 - 7.48.1 V2X Spectrum Advocacy
 - 7.48.2 V2X Task Force
 - 7.48.3 Other V2X-Related Efforts
- 7.49 ERTICO – ITS Europe
 - 7.49.1 V2X Research, Pilot & Deployment Project Management
 - 7.49.2 Other Efforts Related to Connected & Automated Driving
- 7.50 Other National & Regional ITS Representative Societies
 - 7.50.1 ATEC ITS France
 - 7.50.2 ITS Asia-Pacific
 - 7.50.3 ITS Australia
 - 7.50.4 ITS Canada
 - 7.50.5 ITS China
 - 7.50.6 ITS Japan
 - 7.50.7 ITS Korea
 - 7.50.8 ITS Singapore
 - 7.50.9 ITS Taiwan
 - 7.50.10 ITS UK (United Kingdom)
 - 7.50.11 Others
- 7.51 ITS Connect Promotion Consortium
 - 7.51.1 TD-001: Inter-Vehicle Communication Message Specifications
 - 7.51.2 Other Specifications & Guidelines
- 7.52 ITS Info-Communications Forum
 - 7.52.1 Guidelines for 760 MHz & 5.8 GHz V2X Systems
 - 7.52.2 Work on C-V2X/Technology-Neutral Applications
- 7.53 ITU (International Telecommunication Union)
 - 7.53.1 ITU-R (ITU Radiocommunication Sector)
 - 7.53.1.1 SG5 WP5A, WG 5A-5 (Study Group 5, Working Party 5A, Working Group 5)
 - 7.53.1.2 M.1453: ITS – DSRC at 5.8 GHz
 - 7.53.1.3 M.1890: Guidelines & Objectives for ITS
 - 7.53.1.4 M.2084: Radio Interface Standards of V2X Communications for ITS Applications
 - 7.53.1.5 M.[ITS_FRQ]: Harmonization of Frequency Bands for ITS
 - 7.53.1.6 V2X-Related Study Items & Supplementary Reports
 - 7.53.2 ITU-T (ITU Telecommunication Standardization Sector)
 - 7.53.2.1 SG17: Recommendations for V2X Security

- 7.53.2.2 SG20: Framework & Requirements for C-ITS/Safety-Related Services
- 7.53.2.3 V2X-Related Recommendations in Other SGs
- 7.53.2.4 CITS (Collaboration on ITS Communication Standards)
- 7.54 JEITA (Japan Electronics and Information Technology Industries Association)
 - 7.54.1 V2X-Related Standards
- 7.55 JSAE (Society of Automotive Engineers of Japan)
 - 7.55.1 ITS Standardization Committee
 - 7.55.1.1 V2X-Related Standardization Work
- 7.56 KATS (Korean Agency for Technology and Standards)
 - 7.56.1 V2X-Related Standardization Efforts
- 7.57 KSAE (Korean Society Automotive Engineers)
 - 7.57.1 V2X-Related Activities
- 7.58 Linux Foundation
 - 7.58.1 AGL (Automotive Grade Linux): Open Software Stack for Connected Vehicles
- 7.59 MEMA (Motor & Equipment Manufacturers Association)
 - 7.59.1 V2X-Related Activities
- 7.60 MIIT (Ministry of Industry and Information Technology, China)
 - 7.60.1 CAICT (China Academy of Information and Communications Technology)
 - 7.60.1.1 V2X Development, Testing & Promotion in China
- 7.61 MLIT (Ministry of Land, Infrastructure, Transport and Tourism, Japan)
 - 7.61.1 V2X Deployment & Related Efforts
- 7.62 MOLIT (Ministry of Land, Infrastructure and Transport, South Korea)
 - 7.62.1 C-ITS Pilot Project
 - 7.62.2 Other V2X Related Efforts
- 7.63 U.S. NCHRP (National Cooperative Highway Research Program)
 - 7.63.1 NCHRP 20-102: Impacts of Connected Vehicles & Automated Vehicles on State & Local Transportation Agencies
 - 7.63.2 NCHRP 03-127: Cybersecurity of Traffic Management Systems
 - 7.63.3 NCHRP 20-24(98): Connected/Automated Vehicle Research Roadmap for AASHTO
 - 7.63.4 Other Projects
- 7.64 NEMA (National Electrical Manufacturers Association)
 - 7.64.1 NTCIP (National Transportation Communications for ITS Protocol)
- 7.65 NGMN Alliance
 - 7.65.1 V2X Task Force & White Paper
- 7.66 NICT (National Institute of Information and Communications Technology, Japan)
 - 7.66.1 V2X-Related Activities
- 7.67 U.S. NIST (National Institute of Standards and Technology)
 - 7.67.1 CSF (Cybersecurity Framework)

- 7.67.1.1 Application of NIST's CSF to Connected Vehicle Environments
- 7.68 OICA (International Organization of Motor Vehicle Manufacturers)
 - 7.68.1 V2X Standards Harmonization Efforts
- 7.69 OmniAir Consortium
 - 7.69.1 Connected Vehicle Certification Program
 - 7.69.2 Other V2X-Related Activities
- 7.70 oneM2M
 - 7.70.1 V2X-Related Standardization Efforts
- 7.71 PIARC (World Road Association)
 - 7.71.1 Task Force B.1: V2X Technology in Road Design & Infrastructure
 - 7.71.2 Task Force B.2: Automated Vehicles
 - 7.71.3 Other V2X-Related Activities
- 7.72 POLIS (Cities and Regions for Transport Innovation)
 - 7.72.1 V2X-Related Activities
- 7.73 SAE International
 - 7.73.1 DSRC TC (Technical Committee)
 - 7.73.1.1 SAE J2735: DSRC Message Set Dictionary
 - 7.73.1.2 SAE J2945/x Suite of Standards for V2X Applications
 - 7.73.1.3 Other DSRC TC Standards
 - 7.73.2 C-V2X TC (Technical Committee)
 - 7.73.2.1 SAE J3161: On-Board System Requirements for LTE V2X/V2V Safety Communications
 - 7.73.2.2 Standardization Efforts for Advanced V2X Applications
 - 7.73.2.3 SAE J3186: MSCS (Maneuver Sharing & Coordinating Service)
 - 7.73.2.4 Addressing the Needs of Road Operators
 - 7.73.3 Vehicle Cybersecurity Systems Engineering Committee
 - 7.73.3.1 J3061: Cybersecurity Guidebook for Cyber-Physical Automotive Systems
 - 7.73.3.2 Other Vehicle Cybersecurity Standards
 - 7.73.4 Other V2X-Related Standards
- 7.74 SAE-China (Society of Automotive Engineers of China)
 - 7.74.1 T/CSAE 53-2017: V2X Application Layer Standard
 - 7.74.2 Other V2X-Related Efforts
- 7.75 Safety Spectrum Coalition
 - 7.75.1 V2X Spectrum Advocacy
- 7.76 SIP (Japan's Cross-Ministerial Strategic Innovation Promotion Program)
 - 7.76.1 SIP-adus (Automated Driving for Universal Services)
 - 7.76.1.1 V2X-Related R&D Efforts
- 7.77 TAICS (Taiwan Association of Information and Communication Standards)
 - 7.77.1 TC8 (Technical Committee 8): IoV (Internet of Vehicles) & Automated Driving

- 7.78 TCA (Transport Certification Australia)
 - 7.78.1 C-ITS Standardization, Interoperability, Security & Related-Efforts
 - 7.78.2 National Telematics Framework: Facilitating Telematics-Related V2X Applications
- 7.79 TIA (Telecommunications Industry Association)
 - 7.79.1 V2X-Related Advocacy Efforts
- 7.80 TIAA (Telematics Industry Application Alliance)
 - 7.80.1 V2X-Related Standards, Demonstrations & Testing
- 7.81 TISA (Travelers Information Services Association)
 - 7.81.1 V2X-Related Activities
- 7.82 Transport Canada
 - 7.82.1 National Framework & Programs for Automated & Connected Vehicles
 - 7.82.2 Canada-U.S RCC (Regulatory Cooperation Council): Connected Vehicles Work-Plan
- 7.83 TTA (Telecommunications Technology Association, South Korea)
 - 7.83.1 Vehicle Communications System Standards
- 7.84 TTC (Telecommunication Technology Committee, Japan)
 - 7.84.1 V2X-Related Standardization Efforts
- 7.85 UNECE (United Nations Economic Commission for Europe)
 - 7.85.1 WP.29 (Working Party 29): World Forum for the Harmonization of Vehicle Regulations
 - 7.85.2 Working Party on Automated/Autonomous & Connected Vehicles
- 7.86 USDOT (U.S. Department of Transportation)
 - 7.86.1 ITS Joint Program Office
 - 7.86.2 CV (Connected Vehicle) Program
 - 7.86.2.1 CV Pilot Deployments
 - 7.86.2.2 CV Application Prototyping
 - 7.86.3 Connected Autonomous Vehicle Research
 - 7.86.4 ITS Standards Program
 - 7.86.5 ARC-IT (Architecture Reference for Cooperative & Intelligent Transportation)
 - 7.86.6 U.S. NHTSA (National Highway Transportation Safety Administration)
 - 7.86.6.1 FMVSS 150: V2V NPRM (Notice of Proposed Rulemaking) for Light Vehicles
 - 7.86.6.2 Heavy Vehicle V2V Research
 - 7.86.6.3 DOT HS 812 333: Cybersecurity for Modern Vehicles
 - 7.86.7 U.S. FHWA (Federal Highway Administration)
 - 7.86.7.1 V2I Deployment Guidance
 - 7.86.7.2 CARMA (Cooperative Automation Research Mobility Applications) Platform
 - 7.86.8 U.S. FMCSA (Federal Motor Carrier Safety Administration)

- 7.86.8.1 V2X Applications for Commercial Vehicles
- 7.86.9 U.S. FTA (Federal Transit Administration)
 - 7.86.9.1 V2X Applications for Public Transit Systems
- 7.87 VdTUV (Association of Technical Inspection Agencies)
 - 7.87.1 ITS-G5 Advocacy Efforts
- 7.88 VIIC (Vehicle Infrastructure Integration Consortium)
 - 7.88.1 V2X-Related Policy Issues
- 7.89 W3C (World Wide Web Consortium)
 - 7.89.1 Automotive Working Group
 - 7.89.1.1 VISS (Vehicle Information Service Specification)
 - 7.89.1.2 RSI (Restful Service Interface)
 - 7.89.1.3 Previous Work
 - 7.89.2 Automotive & Web Platform Business Group

8 CHAPTER 8: FUTURE ROADMAP & VALUE CHAIN

8.1 Future Roadmap

- 8.1.1 Pre-2020: Early Commitments by Automakers & Other Stakeholders
- 8.1.2 2020 – 2025: Mass-Market Adoption of V2X for Road Safety & Traffic Efficiency
- 8.1.3 2026 – 2030: Towards Connected Autonomous Driving & 5G-Based V2X

Applications

8.2 Value Chain

- 8.2.1 V2X Hardware & Software Suppliers
- 8.2.2 Automotive OEMs
- 8.2.3 Aftermarket Manufacturers
- 8.2.4 System Integrators
- 8.2.5 Application Service Providers
- 8.2.6 Communications Service Providers
- 8.2.7 Road Users & Operators
- 8.2.8 Other Ecosystem Players

9 CHAPTER 9: KEY ECOSYSTEM PLAYERS

- 9.1 A1 Telekom Austria Group
- 9.2 AASA/01LightCom
- 9.3 ADI (Analog Devices Inc.)
- 9.4 Airbiquity
- 9.5 Airgain
- 9.6 Alibaba Group

- 9.7 Alps Alpine (Alps Electric/Alpine Electronics)
- 9.8 Amphenol Corporation
- 9.9 Anritsu Corporation
- 9.10 Apple
- 9.11 Applied Information
- 9.12 Aptiv (Delphi Automotive)
- 9.13 Aricent/Altran
- 9.14 ARM Holdings
- 9.15 Arteris IP
- 9.16 Aston Martin Lagonda
- 9.17 ASTRI (Hong Kong Applied Science and Technology Research Institute)
- 9.18 AT&T
- 9.19 Athena Group
- 9.20 Audi
- 9.21 Autotalks
- 9.22 Aventi Intelligent Communication
- 9.23 BAIC Group/BJEV
- 9.24 Baidu
- 9.25 Battelle
- 9.26 BCE (Bell Canada)
- 9.27 BlackBerry/QNX Software Systems/Certicom
- 9.28 BMW Group
- 9.29 BMW Motorrad
- 9.30 Boreal Bikes
- 9.31 Brilliance Auto (Brilliance China Automotive Holdings)
- 9.32 Broadcom
- 9.33 Bureau Veritas/7Layers
- 9.34 BYD
- 9.35 CalAmp/LoJack
- 9.36 Carsmart (Beijing Carsmart Technology)
- 9.37 CEST Co. (Center for Embedded Software Technology)
- 9.38 CETECOM
- 9.39 CEVA
- 9.40 Changan Automobile
- 9.41 Chemtronics
- 9.42 Chery
- 9.43 China Mobile/CMIoT (China Mobile IoT)
- 9.44 China Telecom
- 9.45 China Transinfo

- 9.46 China Unicom
- 9.47 Chunghwa Telecom
- 9.48 CiDi (Changsha Intelligent Driving Institute)
- 9.49 Cisco Systems
- 9.50 Clarion
- 9.51 Cohda Wireless
- 9.52 Commsignia
- 9.53 Confidex
- 9.54 Connected Signals
- 9.55 Continental
- 9.56 Cubic Corporation
- 9.57 Cubic Telecom
- 9.58 Cybercom Group
- 9.59 Cypress Semiconductor Corporation
- 9.60 Daimler
- 9.61 Daimler Trucks
- 9.62 Danlaw
- 9.63 Datang Telecom Technology & Industry Group/CICT (China Information and Communication Technology Group)
- 9.64 DEKRA
- 9.65 Delphi Technologies
- 9.66 Denso Corporation
- 9.67 Derq
- 9.68 Desay SV Automotive
- 9.69 DFM (Dongfeng Motor Corporation)
- 9.70 DT (Deutsche Telekom)
- 9.71 DT&C
- 9.72 Ducati Motor Holding
- 9.73 Econolite
- 9.74 EFKON
- 9.75 Ericsson
- 9.76 ESCRYPT/ETAS
- 9.77 eSSys
- 9.78 ETRI (Electronics & Telecommunications Research Institute, South Korea)
- 9.79 Faraday Future
- 9.80 FAW Group
- 9.81 FCA (Fiat Chrysler Automobiles)
- 9.82 Ferrari
- 9.83 FET (Far EasTone Telecommunications)

- 9.84 FEV Group
- 9.85 Ficosa
- 9.86 Firefly LiFi (Firefly Wireless Networks)
- 9.87 Flex
- 9.88 FLIR Systems
- 9.89 Fluidmesh Networks
- 9.90 Ford Motor Company
- 9.91 Foresight Autonomous Holdings
- 9.92 Forward Electronics
- 9.93 Fraunhofer FOKUS (Institute for Open Communication Systems)
- 9.94 Fraunhofer HHI (Heinrich Hertz Institute)
- 9.95 Fraunhofer IIS (Institute for Integrated Circuits)
- 9.96 Fraunhofer SIT (Institute for Secure Information Technology)
- 9.97 Fujitsu
- 9.98 GAC Group (Guangzhou Automobile Group)
- 9.99 Geely Holding/Geely Auto
- 9.100 Gemalto
- 9.101 Genvict
- 9.102 GM (General Motors)
- 9.103 Goodyear Tire & Rubber Company
- 9.104 Gosuncn Technology Group
- 9.105 Great Wall Motor Company
- 9.106 Green Hills Software/ISS (INTEGRITY Security Services)
- 9.107 Griip
- 9.108 Groupe PSA
- 9.109 Groupe Renault
- 9.110 HAAS Alert
- 9.111 Hancorn MDS
- 9.112 Harada Industry
- 9.113 Helix Technologies
- 9.114 HELLA
- 9.115 HERE Technologies
- 9.116 Hino Motors
- 9.117 Hitachi
- 9.118 HKT/PCCW
- 9.119 HNTB Corporation
- 9.120 Honda Motor Corporation
- 9.121 HORIBA MIRA
- 9.122 HSAE/Hangsheng Technology

- 9.123 Huali/iSmartWays Technology
- 9.124 Huawei/HiSilicon
- 9.125 Hyundai Mobis
- 9.126 Hyundai Motor Group (Hyundai Motor Company/ Kia Motors Corporation)
- 9.127 IAV
- 9.128 IBM Corporation
- 9.129 IDnomic
- 9.130 Infineon Technologies
- 9.131 INRIX
- 9.132 Intel Corporation/Mobileye
- 9.133 InterDigital
- 9.134 Intertek
- 9.135 Invengo
- 9.136 Isuzu Motors
- 9.137 Iteris
- 9.138 ITRI (Industrial Technology Research Institute, Taiwan)
- 9.139 iTRONICS
- 9.140 ITT (IT Telecom)
- 9.141 Iveco/CNH Industrial
- 9.142 Jin Woo Industrial
- 9.143 JLR (Jaguar Land Rover)/Tata Motors
- 9.144 JRC (Japan Radio Company)
- 9.145 Juniper Networks
- 9.146 JVCKENWOOD Corporation
- 9.147 Kapsch TrafficCom
- 9.148 Karamba Security
- 9.149 Kawasaki Heavy Industries
- 9.150 KDDI Corporation
- 9.151 Keysight Technologies
- 9.152 KOSTAL Group (Leopold Kostal)
- 9.153 KPN
- 9.154 KT Corporation
- 9.155 KTM
- 9.156 Kymeta Corporation
- 9.157 Kyocera Corporation
- 9.158 LACROIX City/LACROIX Neavia
- 9.159 Lear Corporation
- 9.160 Leidos
- 9.161 Lenovo/Motorola Mobility

- 9.162 Leonardo
- 9.163 Lesswire/Prettl Group
- 9.164 LG Electronics/LG Innotek
- 9.165 LITE-ON Technology Corporation
- 9.166 LMT (Latvijas Mobilais Telefons)
- 9.167 Lucid Motors
- 9.168 Luxoft/Objective Software/DXC Technology
- 9.169 Lyft
- 9.170 Magna International
- 9.171 Magneti Marelli
- 9.172 Mando Corporation/Halla Group
- 9.173 Marben
- 9.174 Marvell
- 9.175 Mazda Motor Corporation
- 9.176 McLaren Automotive
- 9.177 Mediatek
- 9.178 MET Labs (MET Laboratories)/Eurofins Scientific
- 9.179 Michelin
- 9.180 Microchip Technology/Microsemi Corporation
- 9.181 Microsoft Corporation
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- 9.183 Mitsuba Corporation
- 9.184 Mitsubishi Electric Corporation
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- 9.188 Murata Manufacturing
- 9.189 NavInfo
- 9.190 Navistar
- 9.191 Navya
- 9.192 Nebula Link
- 9.193 NEC Corporation
- 9.194 Neology/SMARTRAC
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- 9.196 Neusoft Reach
- 9.197 NEVS (National Electric Vehicle Sweden)
- 9.198 Nexar
- 9.199 Nexus Group
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- 9.203 NJR (New Japan Radio)
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- 9.229 Qualcomm
- 9.230 Quectel Wireless Solutions
- 9.231 RANIX
- 9.232 Redpine Signals
- 9.233 Renesas Electronics Corporation
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- 9.235 Rohde & Schwarz
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- 9.240 Saleen Automotive
- 9.241 Samsung Electronics/HARMAN International
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- 9.255 SK Telecom
- 9.256 Skoda Auto
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- 9.258 Smart Mobile Labs
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- 9.262 Spirent Communications
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- 9.264 STAR Systems International
- 9.265 STMicroelectronics
- 9.266 sTraffic
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- 9.269 Sunsea AIoT/SIMCom Wireless Solutions/Longsung Technology
- 9.270 Suzuki Motor Corporation
- 9.271 Swarco/McCain
- 9.272 Synopsys
- 9.273 Taiwan Mobile
- 9.274 Taoglas
- 9.275 TAPCO (Traffic and Parking Control Company)
- 9.276 Tata AutoComp Systems
- 9.277 Tata Elxsi
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LIST OF COMPANIES MENTIONED

01LightCom

3GPP (3rd Generation Partnership Project)

5GAA (5G Automotive Association)

5G-Connected Mobility Consortium

7Layers

A1 Telekom Austria Group

AASA

AASHTO (American Association of State Highway and Transportation Officials)

Abu Dhabi Department of Transport

ACEA (European Automobile Manufacturers' Association)

ADI (Analog Devices Inc.)

AECC (Automotive Edge Computing Consortium)

Airbiquity

Airgain

Alibaba Group

Allgon

Alphabet

Alps Alpine (Alps Electric/Alpine Electronics)

Altran

Amphenol Corporation

Amsterdam Group

Anritsu Corporation

Apple

Applied Information

Aptiv (Delphi Automotive)

ARIB (Association of Radio Industries and Businesses, Japan)

Aricent

ARM Holdings

Arteris IP

ASECAP (European Association of Operators of Toll Road Infrastructures)

Association of Global Automakers

ASTM International

Aston Martin Lagonda

ASTRI (Hong Kong Applied Science and Technology Research Institute)

AT&T

ATA (American Trucking Associations)

ATEC ITS France

Athena Group

ATIS (Alliance for Telecommunications Industry Solutions)

Audi

Auto Alliance (Alliance of Automobile Manufacturers)

Autoliv

Automatic Labs

Autotalks
Aventi Intelligent Communication
BAIC Group
Baidu
Battelle
BCE (Bell Canada)
Beijing BDSStar Navigation
BJEV
BlackBerry
BMW Group
BMW Motorrad
Boreal Bikes
Brilliance Auto (Brilliance China Automotive Holdings)
Broadcom
Bureau Veritas
BYD
C2C-CC (CAR 2 CAR Communication Consortium)
CAICT (China Academy of Information and Communications Technology)
CAICV (China Industry Innovation Alliance for Intelligent and Connected Vehicles)
CalAmp
CAMP (Crash Avoidance Metrics Partnership)
Carsmart (Beijing Carsmart Technology)
CAT (Cooperative Automated Transportation) Coalition
CCC (Car Connectivity Consortium)
CCSA (China Communications Standards Association)
CDOT (Colorado Department of Transportation)
CEDR (Conference of European Directors of Roads)
CEN (European Committee for Standardization)
CENELEC (European Committee for Electrotechnical Standardization)
CEPT (European Conference of Postal and Telecommunications Administrations)
Certicom
CEST Co. (Center for Embedded Software Technology)
CETECOM
CEVA
Changan Automobile
Chemtronics
Chery
China Mobile
China Telecom

China Transinfo
China Unicom
Chunghwa Telecom
CICT (China Information and Communication Technology Group)
CiDi (Changsha Intelligent Driving Institute)
Cisco Systems
C-ITS (China ITS Industry Alliance)
Clarion
CLEPA (European Association of Automotive Suppliers)
CMC (Connected Motorcycle Consortium)
CMIoT (China Mobile IoT)
CNH Industrial
Cohda Wireless
Commsignia
Confidex
Connected Signals
Continental
ConVeX (Connected Vehicle-to-Everything of Tomorrow) Consortium
CSTI (Council for Science, Technology and Innovation, Japan)
Cubic Corporation
Cubic Telecom
Cybercom Group
Cypress Semiconductor Corporation
DAF Trucks
Daimler
Daimler Trucks
Danlaw
Datang Telecom Technology & Industry Group
DEKRA
Delphi Technologies
Denso Corporation
Derq
Desay SV Automotive
DFM (Dongfeng Motor Corporation)
DT (Deutsche Telekom)
DT&C
Ducati Motor Holding
DXC Technology
EATA (European Automotive and Telecom Alliance)

Econolite
EFKON
Ericsson
ERTICO – ITS Europe
ERTRAC (European Road Transport Research Advisory Council)
ESCRYPT
eSSys
ETAS
ETRI (Electronics & Telecommunications Research Institute, South Korea)
ETSI (European Telecommunications Standards Institute)
Eurofins Scientific
European Commission
Faraday Future
FAW Group
FCA (Fiat Chrysler Automobiles)
Ferrari
FET (Far EastOne Telecommunications)
FEV Group
Ficosa
Firefly LiFi (Firefly Wireless Networks)
Flex
FLIR Systems
Fluidmesh Networks
Ford Motor Company
Foresight Autonomous Holdings
Forward Electronics
Fraunhofer FOKUS (Institute for Open Communication Systems)
Fraunhofer HHI (Heinrich Hertz Institute)
Fraunhofer IIS (Institute for Integrated Circuits)
Fraunhofer SIT (Institute for Secure Information Technology)
Fujitsu
GAC Group (Guangzhou Automobile Group)
GCF (Global Certification Forum)
Geely Auto
Geely Holding
Gemalto
GENIVI Alliance
Genvict
GM (General Motors)

Goodyear Tire & Rubber Company
Google
Gosuncn Technology Group
Great Wall Motor Company
Green Hills Software
Griip
Groupe PSA
Groupe Renault
GSMA
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Huali/iSmartWays Technology
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Hyundai Mobis
Hyundai Motor Company
Hyundai Motor Group
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IBM Corporation
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IEEE (Institute of Electrical and Electronics Engineers)
IETF (Internet Engineering Task Force)
IMDA (Info-Communications Media Development Authority, Singapore)
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Infineon Technologies
INRIX
Intel Corporation
InterDigital
Intertek
Invengo
IPC (Increment P Corporation)
ISED (Innovation, Science and Economic Development Canada)
ISO (International Organization for Standardization)
ISS (INTEGRITY Security Services)
Isuzu Motors
ITE (Institute of Transportation Engineers)
Iteris
ITRI (Industrial Technology Research Institute, Taiwan)
iTRONICS
ITS America (Intelligent Transportation Society of America)
ITS Asia-Pacific
ITS Australia
ITS Canada
ITS China
ITS Connect Promotion Consortium
ITS Info-Communications Forum
ITS Japan
ITS Korea
ITS Singapore
ITS Taiwan
ITS UK (United Kingdom)
ITT (IT Telecom)
ITU (International Telecommunication Union)
Iveco
JEITA (Japan Electronics and Information Technology Industries Association)
Jin Woo Industrial
JISC (Japanese Industrial Standards Committee)
JLR (Jaguar Land Rover)
JRC (Japan Radio Company)
JSAE (Society of Automotive Engineers of Japan)
Juniper Networks
JVCKENWOOD Corporation
Kapsch TrafficCom

Karamba Security
KATS (Korean Agency for Technology and Standards)
Kawasaki Heavy Industries
KDDI Corporation
Keysight Technologies
Kia Motors Corporation
KOSTAL Group (Leopold Kostal)
KPN
KSAE (Korean Society Automotive Engineers)
KT Corporation
KTM
Kymeta Corporation
Kyocera Corporation
LACROIX City/LACROIX Neavia
Laird
Lear Corporation
Leidos
Lenovo
Leonardo
Lesswire
LG Electronics
LG Innotek
Linux Foundation
LITE-ON Technology Corporation
LMT (Latvijas Mobilais Telefons)
LoJack
Longsung Technology
Lucid Motors
Luxoft
Lyft
Magna International
Magnetis Marelli
Mahindra & Mahindra
MAN
Mando Corporation
Marben
Marvell
Mazda Motor Corporation
McCain

McLaren Automotive
Mediatek
MEMA (Motor & Equipment Manufacturers Association)
Mentor
MET Labs (MET Laboratories)
Michelin
Microchip Technology
Microsemi Corporation
Microsoft Corporation
MIIT (Ministry of Industry and Information Technology, China)
MinebeaMitsumi Group
MINI
Mitsuba Corporation
Mitsubishi Electric Corporation
Mitsubishi Motors Corporation
MLIT (Ministry of Land, Infrastructure, Transport and Tourism, Japan)
Mobile Mark
Mobileye
Molex
MOLIT (Ministry of Land, Infrastructure and Transport, South Korea)
Motorola Mobility
Murata Manufacturing
NavInfo
Navistar
Navya
Nebula Link
NEC Corporation
NEMA (National Electrical Manufacturers Association)
Neology
Neoway Technology
Neusoft Reach
NEVS (National Electric Vehicle Sweden)
Nexar
Nexus Group
NGMN Alliance
NI (National Instruments)
NICT (National Institute of Information and Communications Technology, Japan)
NIO
Nissan Motor Corporation

NJR (New Japan Radio)
Nokia
Nordsys
Noris Network
NTT DoCoMo
NXP Semiconductors
NYC DOT (New York City Department of Transportation)
Objective Software
OICA (International Organization of Motor Vehicle Manufacturers)
Oki Electric Industry
Oledcomm
OmniAir Consortium
OnBoard Security
oneM2M
OnStar
OPPO
Orange
P3 Group
PACCAR
Panasonic Corporation
Parsons Corporation
PCCW
Peloton Technology
Penta Security Systems
Phantom Auto
PIARC (World Road Association)
Pioneer Corporation
POLIS (Cities and Regions for Transport Innovation)
Prettl Group
Proximus Group
Pulse Electronics
pureLiFi
Q-Free
Qianxun SI (Spatial Intelligence)
QNX Software Systems
Qorvo
Qosmotec Software Solutions
Qualcomm
Quectel Wireless Solutions

Queensland TMR (Department of Transport and Main Roads)
RANIX
Redpine Signals
Renesas Electronics Corporation
Robert Bosch
Rohde & Schwarz
ROHM Semiconductor
Rolls-Royce Motor Cars
RoyalTek
S.E.A. Datentechnik
SAE International
SAE-China (Society of Automotive Engineers of China)
Safety Spectrum Coalition
SAIC Motor Corporation
Saleen Automotive
Samsung Electronics
Sanjole
Sanyo Techno Solutions Tottori
Savari
Scania
SEAT
Security Innovation
Sensefields
Sequans Communications
SGS
Shanghai Gotell Communication Technology Holdings (roam2free)
Siemens
Sierra Wireless
SIMCom Wireless Solutions
Sinclair Broadcast Group
SiriusXM
SK C&C
SK Telecom
Skoda Auto
Skyworks Solutions
Smart Mobile Labs
Smarteq Wireless
SMARTRAC
Socionext

SoftBank Group
Spirent Communications
SsangYong Motor Company
STAR Systems International
STMicroelectronics
sTraffic
Subaru Corporation
Sumitomo Electric Industries
Sunsea AIoT
Suzuki Motor Corporation
Swarco
Synopsys
TAICS (Taiwan Association of Information and Communication Standards)
Taiwan Mobile
Taoglas
TAPCO (Traffic and Parking Control Company)
TASS International
Tata AutoComp Systems
Tata Elxsi
Tata Motors
TCA (Transport Certification Australia)
TE Connectivity
Telefonica Group
Telenor Connexion
Telenor Group
Telit Communications
Telstra
Telus Corporation
Tencent
Terranet
Tesla
THEA (Tampa-Hillsborough Expressway Authority)
TIA (Telecommunications Industry Association)
TIAA (Telematics Industry Application Alliance)
TIM (Telecom Italia Mobile)
TISA (Travelers Information Services Association)
Tome Software
TomTom
Toshiba Corporation

TowerJazz
Toyota Motor Corporation
TransCore
Transport Canada
TRATON
Trek Bicycle Corporation
TTA (Telecommunications Technology Association, South Korea)
TTC (Telecommunication Technology Committee, Japan)
TTS (Traffic Technology Services)
TUV Rheinland
TUV SUD
U.S. ARPA-E (Advanced Research Projects Agency – Energy)
U.S. FCC (Federal Communications Commission)
U.S. FHWA (Federal Highway Administration)
U.S. FMCSA (Federal Motor Carrier Safety Administration)
U.S. FTA (Federal Transit Administration)
U.S. NHTSA (National Highway Transportation Safety Administration)
U.S. NIST (National Institute of Standards and Technology)
Uber Technologies
U-Blox
UL
UMTRI (University of Michigan Transportation Research Institute)
UNECE (United Nations Economic Commission for Europe)
Unex Technology Corporation
Unicore Communications
Unisoc
USDOT (U.S. Department of Transportation)
Valens
Valeo
VdTUV (Association of Technical Inspection Agencies)
Vector Informatik
Veniam
Veoneer
Verizon Communications
Verizon Connect
Viavi Solutions
VIIC (Vehicle Infrastructure Integration Consortium)
Vinli
Visteon Corporation

VLNComm
Vodafone Group
Volkswagen Group
Volvo Cars
Volvo Group/Volvo Trucks
VT iDirect
VTT Technical Research Centre of Finland
W3C (World Wide Web Consortium)
Wanji Technology
Waymo
Wayties
Wieson Technologies
WiSeKey
WNC (Wistron NeWeb Corporation)
WSP Global
WYDOT (Wyoming Department of Transport)
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