Introduction of China C-V2X Industry and Standards

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China Society of Automotive Engineers(CSAE)
China Industry Innovation Alliance for the Intelligent and Connected Vehicles(CAICV)
1. Introduction of China-SAE and CAICV
2. General Introduction of China C-V2X Industry
3. Standard Status of China C-V2X Industry
Introduction to China-SAE

- Founded in 1963
- 120+ full-time employees
- 28 fellows
- 28,000+ active members
- ~90,000 registered members

Technical Events
International Exchange
Scientific Journal
Exhibition

Government Consulting
Industry Research (Publications)
Company Consulting

Alliances
1. Light weight
2. Electric Vehicles
3. ICV
Group Standards
Collaborative R&D

Formula Student Contests from high school to post-graduates, incl. ICE, EV, ICV
Training & Certification
Awards

Four Platforms built by China SAE

Technical Progress Platform
Industry Research Platform
Industry-Academia-Institute Platform
Popularization Platform
China-SAE Group Standards

- China-SAE has published 144 standards, 128 standards is researching. The new technology field standards focus on electric, intelligent, connection, sharing and lightweight, the basic common field includes anti-corrosion and aging, reliability, electromagnetic compatibility, test technology and environmental protection.

- In ICV field, China-SAE group standards focus on driving assistance and active safety, security, automated driving scenario, V2X, new in-vehicle high speed network, test and evaluation, HD Map and HD Positioning, the V2X related standards are widely used.

New Technology Field

- Electric
- Intelligent
- Anti-corrosion and aging
- Reliability
- Electromagnetic Compatibility
- Test Technology
- Environmental protection

Basic Common Field

- Light weight
- Connection
- Sharing

ICV Standards System
Introduction of CAICV

China Industry Innovation Alliance for the Intelligent and Connected Vehicles

- Established in 2013
- Sponsored by China SAE and CAAM
- Supported by MIIT
- 63 council members and over 500 members

Missions

- Support the governments on policies, strategies and regulations
- Provide public services to the industry incl. standards, tests, etc.
- Build cross-industry innovation platform
- Build new industry ecosystem for ICVs
CAICV works together with SAC/TC114/SC34 to build ICV Group Standards System to supplement the National Standards (GB), as well as organizing research and formulation of China-SAE Group Standards in **foresight, crossover, and blank fields**.
Introduction of China C-V2X Industry

Relevant ministries have issued a number of C-V2X development promotion policies, which have promoted the development of C-V2X industry.

*Intelligent Vehicles Innovation Development Strategy*: Launched by 11 ministries incl. NDRC, MIIT, MOT, etc., Action mission in key technology, standards system, application and service and security.

*National ICV Industry Standards System Construction Guideline*: Whole standards system structure and construction content of ICV industry, guideline for ICV industry standardization.

*Administrative Regulations on the Use of 5905-5925 MHz Frequency Band for Direct Communication of Internet of Vehicles*: Defines the frequency range used for direct communication of the Internet of Vehicles.

*Guiding Opinions on Promoting the Construction of New Infrastructure in the Transportation Field*: By 2035, achieving significant results in the construction of new infrastructure in the transportation field, autonomous vehicles are applied gradually.

A Special Committee for Internet of Vehicles Industry of the Leading Group for the Construction of National Manufacturing Power was established in 2017 and it is responsible for the organizing Internet of Vehicles industry development plan, policy and implement, etc.
General Introduction of China C-V2X Industry

The C-V2X industry chain mainly includes communication chipsets, modules, terminals, v2x protocol stack, vehicles, intelligent roads, infrastructures and so on.

In C-V2X industry, We already have the industrialization capabilities.

**Product R&D**

**Chipsets**
- Huawei, Datang, Qualcomm

**Terminals**
- Huawei, Datang, Desy SV, Neusoft, CTFO, Wanji, Nebula, ZTE, Gosuncn

**Application Software**
- 17 DAY 1 scenarios for safety, efficiency, information (安全类, 效率类和信息类)

**Module**
- Huawei, Datang, Quectel, Gosuncn

**Protocol Stack**
- Neusoft, Nebula, ASTRI

**Security Chipsets**
- HDSC, ISTECC, XDJA
  华大电子、华大信安
General Introduction of China C-V2X Industry

Study on C-V2X Industrialization Path and Timeline in China

By:

2019
- Post-installed V2X devices applied in demonstration zone

2020
- Pre-install C-V2X in new car

2021
- Demonstrate in national IoV demonstration areas, pilot zones, and specific areas. Develop the interface specifications between C-V2X RSU and traffic management facilities

2022
- C-V2X pre-install rate reaches up to 50%
- Expand C-V2X infrastructure coverage in typical cities and highways

2023
- Achieve full coverage of C-V2X in major cities, major regions, and major highways

2024
- Promote 5G-V2X applications

2025
- Carry out 5G-V2X related standard development work. Develop V2X terminals (including 4G/5G+LTE/5G-V2X multimode terminals) that support 5G-V2X, and related verification test work

2019
- Complete LTE-V2X related standard development and large-scale tests

2020
- Massive production for LTE-V2X terminals

2021
- Establish security standard system, and achieve massively produce security chips
- Establish C-V2X security certification management and CA operations

2022
- Continuously improve C-V2X security certification platform and service system

2023
- Develop standards of data platform, and implement demonstration of “region-edge-terminal” three-level platform in demonstration areas and pilot zones

2024
- Continue to carry out standardization work on data platforms, explore cross-industry data platform interconnection, and expand the scope of demonstration pilots
- Standards are completed. Cross-industry data platforms are interconnected. Explorer “central-region-edge-terminal” four-level data platform.

2025
- Conduct field test and verification for C-V2X security functions

2026
- Complete C-V2X test standards and improve related test tools. Establish a collaborative testing and certification system across various industry testing organizations

2027
- Continuously improve C-V2X testing and certification platform

2028
- High-speed Development Period
General Introduction of China C-V2X Industry

Development Outlook

➢ Strengthen the top-level design to form an overall coordination mechanism between relevant ministries
➢ Focusing on the development direction of China standard ICV, improve the relevant regulations and standards system
➢ Break through multiple key technologies related to 5G-V2X and form a complete industry chain ecosystem
➢ Roadside infrastructure and on-board terminals should coordinated to form a clear development route
➢ Organize large-scale test demonstration activities to explore the mature business model of the Internet of Vehicles
China C-V2X Standard System Status

A relatively complete LTE-V2X standards system has been built in China.

The LTE-V2X standards system covering **access layer, network layer, message layer and security layer** has been set up. A cross-industry standards coordination mechanism has been set up as well.

### Standards

<table>
<thead>
<tr>
<th>Standards Category</th>
<th>Standards</th>
<th>Standards Level</th>
<th>Standards Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access Protocol</strong></td>
<td>基于LTE网络的车联网无线通信系统总体技术要求</td>
<td>行标/国标</td>
<td>CCSA/TC485</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术空中接口技术要求</td>
<td>行标/国标</td>
<td>CCSA/TC485</td>
</tr>
<tr>
<td><strong>Network Protocol</strong></td>
<td>合作式智能运输系统 车用通信系统应用层及应用数据交互标准</td>
<td>团标</td>
<td>C-SAE/C-ITS</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 网络层技术要求</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 网络层测试方法</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td><strong>Message Protocol</strong></td>
<td>合作式智能运输系统 车用通信系统应用层及应用数据交互标准</td>
<td>团标</td>
<td>C-SAE/C-ITS</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 消息层技术要求</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 消息层测试方法</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td><strong>Security Protocol</strong></td>
<td>基于LTE的车联网通信 安全技术要求</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 安全认证技术要求</td>
<td>行标</td>
<td>CCSA</td>
</tr>
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<td></td>
<td>基于LTE的车联网无线通信技术 安全认证测试方法</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td><strong>Technical Reequipment Regulation</strong></td>
<td>基于LTE的车联网无线通信技术 支持直接通信的车载终端设备技术要求</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 支持直接通信的车载设备技术要求</td>
<td>行标</td>
<td>CCSA</td>
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<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 支持直接通信的路侧设备技术要求</td>
<td>行标</td>
<td>CCSA</td>
</tr>
<tr>
<td></td>
<td>基于LTE的车联网无线通信技术 支持直接通信的路侧设备测试方法</td>
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<td>团标</td>
<td>C-SAE/C-ITS</td>
</tr>
<tr>
<td></td>
<td>基于LTE-V2X直连通信的车载信息交互系统技术要求</td>
<td>国标</td>
<td>NTCAS</td>
</tr>
</tbody>
</table>

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This standard stipulate environment evaluation requirement, system function requirement, system communication performance requirement, positioning and timing and test method in vehicle information interaction system based on LTE-V2X direct communication.

| 5 General requirements | 5.1 Operating voltage range  
5.2 Environmental adaptability requirements  
5.3 Electrical performance requirements  
5.4 Reliability test  
5.5 EMC requirements |
|------------------------|--------------------------------------------------------------------------------|
| 6 System functional requirements | 6.1 Access layer requirements  
6.2 Network layer requirements  
6.3 Application layer requirements  
6.4 Communication security requirements |
| 7 System communication performance requirements | 7.1 RF performance requirements  
7.2 Antenna performance requirements  
7.3 Performance requirements for vehicle equivalent radiated power and receiving sensitivity |
| 8 Positioning timing requirements | 8.1 Positioning requirements  
8.2 Location enhancement requirements  
8.3 Coordinate system and positioning reference point requirements  
8.4 System timing requirements |
| 9 Test | 9.1 General requirements test  
9.2 Function test  
9.3 System communication performance test  
9.4 Location test |
# C-V2X Related Group Standards

<table>
<thead>
<tr>
<th>Group Standards</th>
<th>Status</th>
<th>Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative intelligent transportation system; vehicular communication; application layer specification and data exchange standard</td>
<td>Finished</td>
<td>This standard specifies the terms and definitions of the application layer of the cooperative intelligent transportation system vehicular communication system, as well as <strong>data sets, data exchange standard and interface specifications</strong>.</td>
</tr>
<tr>
<td>Cooperative intelligent transportation system; vehicular communication; application layer specification and data exchange standard Phase II</td>
<td>WIP</td>
<td>This standard specifies enhanced application scenario and <strong>corresponding data set</strong> in cooperative intelligent transportation system vehicular communication application layer Phase II.</td>
</tr>
<tr>
<td>Direct Communication System Roadside Technical Requirements of LTE-based Vehicular Communication</td>
<td>WIP</td>
<td>This standard specifies <strong>V2I communication system requirement</strong> based on LTE-V2X pc5 mode 4.</td>
</tr>
<tr>
<td>Data exchange standard for high level automated driving vehicle based on vehicle infrastructure cooperative system</td>
<td>WIP</td>
<td>This standard specifies <strong>L4/L5</strong> high level automated driving data exchange content based on vehicle infrastructure cooperative system, focus on <strong>data set in message layer</strong>.</td>
</tr>
</tbody>
</table>
C-V2X Related Group Standards

The application layer standards Phase I and Phase II define different scenarios, including basic application scenarios and enhanced application scenarios in the following two tables. The scenarios can be divided into four types, like safety, efficiency, information service and traffic management.

<table>
<thead>
<tr>
<th>Type</th>
<th>Communication Type</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V2V/V2I</td>
<td>Sensor Data Sharing</td>
</tr>
<tr>
<td>2</td>
<td>V2V/V2I</td>
<td>Cooperative Lane Change</td>
</tr>
<tr>
<td>3</td>
<td>V2I</td>
<td>Cooperative Vehicle Merge</td>
</tr>
<tr>
<td>4</td>
<td>V2I</td>
<td>Cooperative Intersection Passing</td>
</tr>
<tr>
<td>5</td>
<td>V2I</td>
<td>Differential Data Service</td>
</tr>
<tr>
<td>6</td>
<td>V2I</td>
<td>Dynamic Lane Management</td>
</tr>
<tr>
<td>7</td>
<td>V2I</td>
<td>Cooperative High Priority Vehicle Passing</td>
</tr>
<tr>
<td>8</td>
<td>V2I</td>
<td>Guidance Service in Parking Area</td>
</tr>
<tr>
<td>9</td>
<td>V2I</td>
<td>Probe Data Collection</td>
</tr>
<tr>
<td>10</td>
<td>P2X</td>
<td>Vulnerable Road User Safe Passing</td>
</tr>
<tr>
<td>11</td>
<td>V2V</td>
<td>Cooperative Platooning Management</td>
</tr>
<tr>
<td>12</td>
<td>V2I</td>
<td>Road Tolling Service</td>
</tr>
</tbody>
</table>

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<th>Type</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>V2V</td>
<td>Forward Collision Warning</td>
</tr>
<tr>
<td>2</td>
<td>V2V/V2I</td>
<td>Intersection Collision Warning</td>
</tr>
<tr>
<td>3</td>
<td>V2V/V2I</td>
<td>Left Turn Assist</td>
</tr>
<tr>
<td>4</td>
<td>V2V</td>
<td>Blind Spot Warning</td>
</tr>
<tr>
<td>5</td>
<td>V2V</td>
<td>Do Not Pass Warning</td>
</tr>
<tr>
<td>6</td>
<td>V2V-Event</td>
<td>Emergency Brake Warning</td>
</tr>
<tr>
<td>7</td>
<td>V2V-Event</td>
<td>Abnormal Vehicle Warning</td>
</tr>
<tr>
<td>8</td>
<td>V2V-Event</td>
<td>Control Loss Warning</td>
</tr>
<tr>
<td>9</td>
<td>V2I</td>
<td>Hazardous Location Warning</td>
</tr>
<tr>
<td>10</td>
<td>V2I</td>
<td>Speed Limit Warning</td>
</tr>
<tr>
<td>11</td>
<td>V2I</td>
<td>Red Light Violation Warning</td>
</tr>
<tr>
<td>12</td>
<td>V2P/V2I</td>
<td>Vulnerable Road User Collision Warning</td>
</tr>
<tr>
<td>13</td>
<td>V2I</td>
<td>Green Light Optimal Speed Advisor</td>
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<tr>
<td>14</td>
<td>V2I</td>
<td>In-vehicle Signage</td>
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<tr>
<td>15</td>
<td>V2I</td>
<td>Traffic Jam Warning</td>
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<tr>
<td>16</td>
<td>V2V</td>
<td>Emergency Vehicle Warning</td>
</tr>
<tr>
<td>17</td>
<td>V2I</td>
<td>Vehicle Near-field Payment</td>
</tr>
</tbody>
</table>
Application Demonstration Activities

Building a cross-industry collaborative testing and verification platform based on the needs of C-V2X industrialization

2018 Three Layers
- Modules
- Terminals
- OEMs

2019 Four Layers
- Modules
- Terminals
- OEMs
- Certificate Authority
- Open Road

2020 New Four Layers
- Four Layers
- HD Map & Positioning
- Cloud Control Platform
- Industrialization and enhanced scenario
- Closer to the actual travel scenario
Many Thanks for Your Attention