Introduction of China C-V2X Industry and Standards

Yu Shengbo
China Society of Automotive Engineers(CSAE)
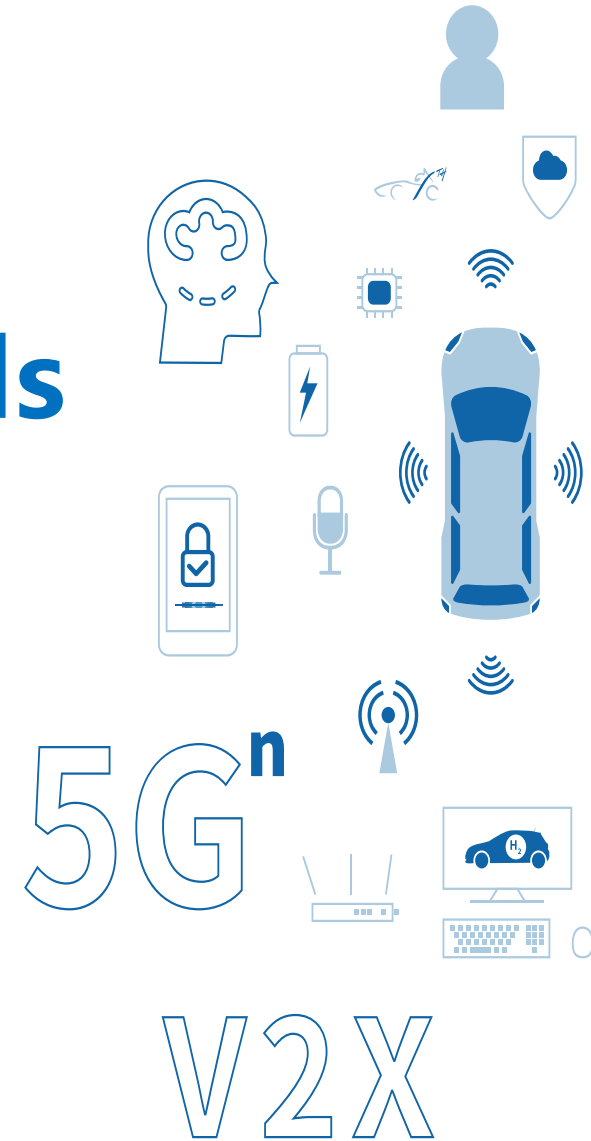**China Industry Innovation Alliance for the Intelligent and Connected Vehicles(CAICV)**

$5G^n$

V2X

Table of Content

Introduction to China-SAE

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

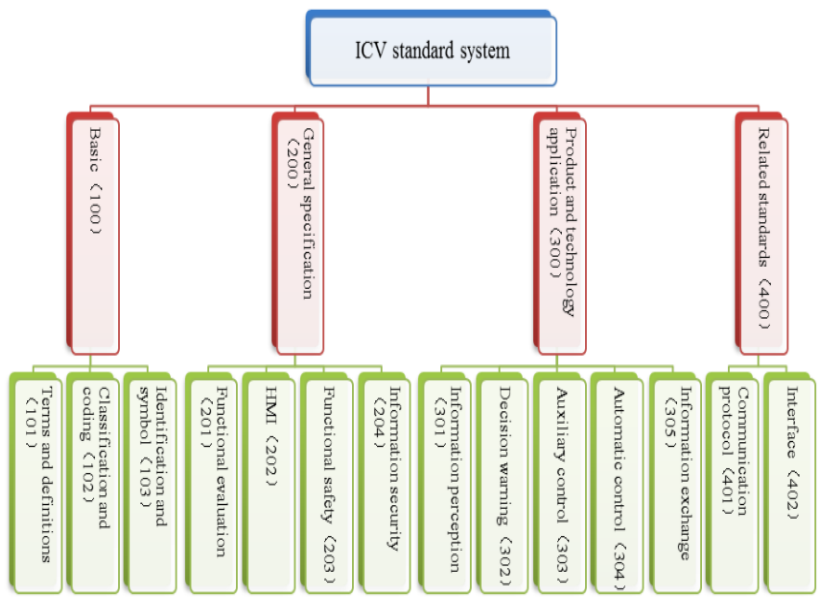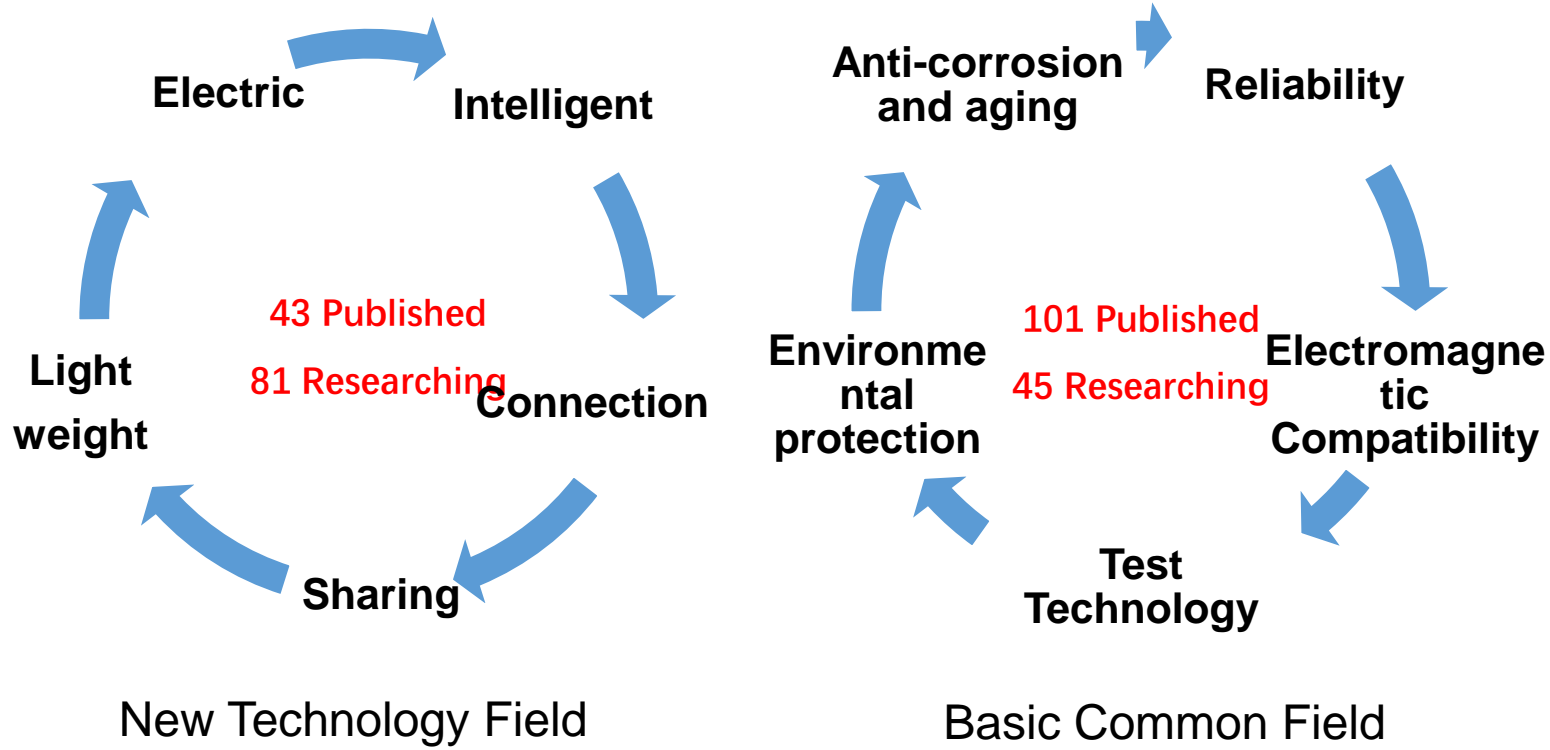| Technical Progress Platform	Industry Research Platform	Industry-Academia-Institute Platform	Popularization Platform
Technical Events	Government Consulting	**Alliances** 1.Light weight 2.Electric Vehicles 3. ICV	Formula Student Contests from high school to post-graduates, incl. ICE, EV, ICV
International Exchange	Industry Research (Publications)	Group Standards	Training & Certification
Scientific Journal	Company Consulting	Collaborative R&D	Awards
Exhibition			

Four Platforms built by China SAE

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.

Electric → Intelligent

Light weight

43 Published
81 Researching

Connection

Sharing

New Technology Field

Anti-corrosion and aging → Reliability

Environmental protection

101 Published
45 Researching

Electromagnetic Compatibility

Test Technology

Basic Common Field

ICV standard system

Basic ⟨100⟩ — General specification ⟨200⟩ — Product and technology application ⟨300⟩ — Related standards ⟨400⟩

Terms and definitions ⟨101⟩ | Classification and coding ⟨102⟩ | Identification and symbol ⟨103⟩ | Functional evaluation ⟨201⟩ | HMI ⟨202⟩ | Functional safety ⟨203⟩ | Information security ⟨204⟩ | Information perception ⟨301⟩ | Decision warning ⟨302⟩ | Auxiliary control ⟨303⟩ | Automatic control ⟨304⟩ | Information exchange ⟨305⟩ | Communication protocol ⟨401⟩ | Interface ⟨402⟩

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
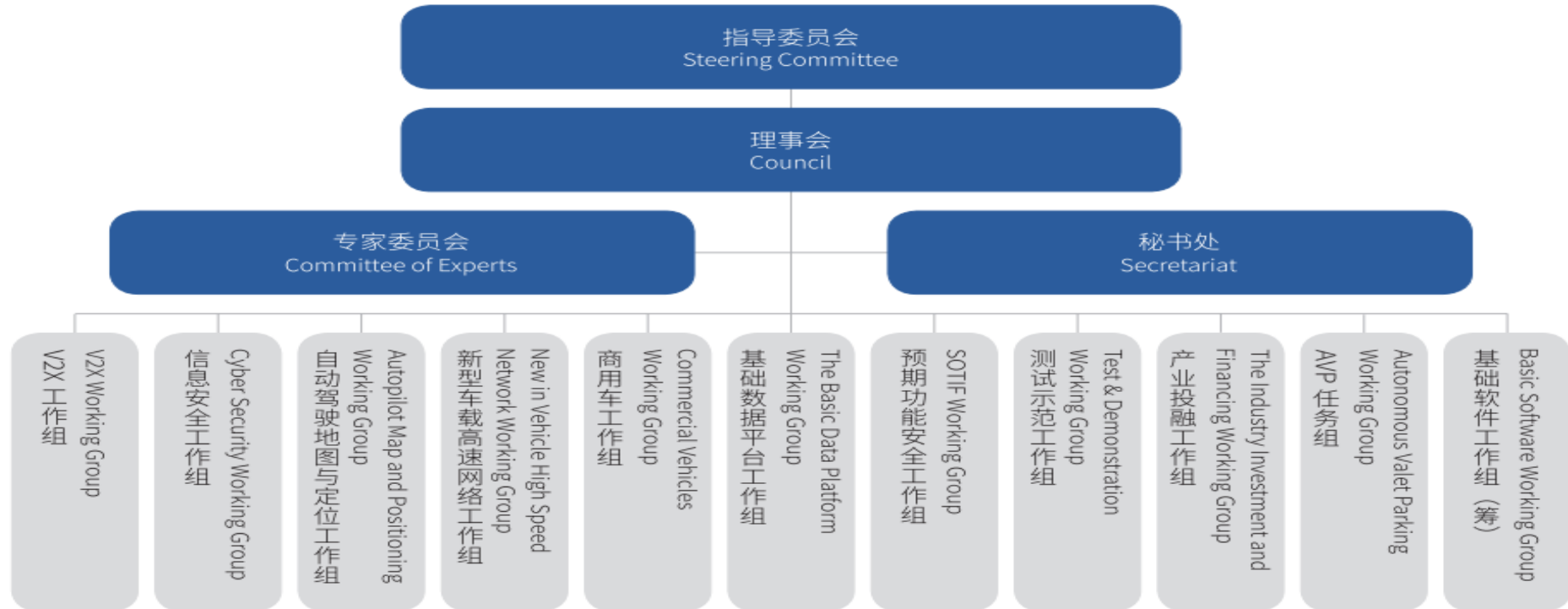- Supported by MIIT
- 63 council members and over 500 members

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 eco-system for ICVs

指导委员会
Steering Committee

理事会
Council

专家委员会
Committee of Experts

秘书处
Secretariat

V2X 工作组
V2X Working Group

信息安全工作组
Cyber Security Working Group

自动驾驶地图与定位工作组
Autopilot Map and Positioning Working Group

新型车载高速网络工作组
New in Vehicle High Speed Network Working Group

商用车工作组
Commercial Vehicles Working Group

基础数据平台工作组
The Basic Data Platform Working Group

预期功能安全工作组
SOTIF Working Group

测试示范工作组
Test & Demonstration Working Group

产业投融工作组
The Industry Investment and Financing Working Group

AVP 任务组
AVP Working Group

Autonomous Valet Parking Working Group

基础软件工作组（筹）
Basic Software Working Group

ICV Group Standards System

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**.
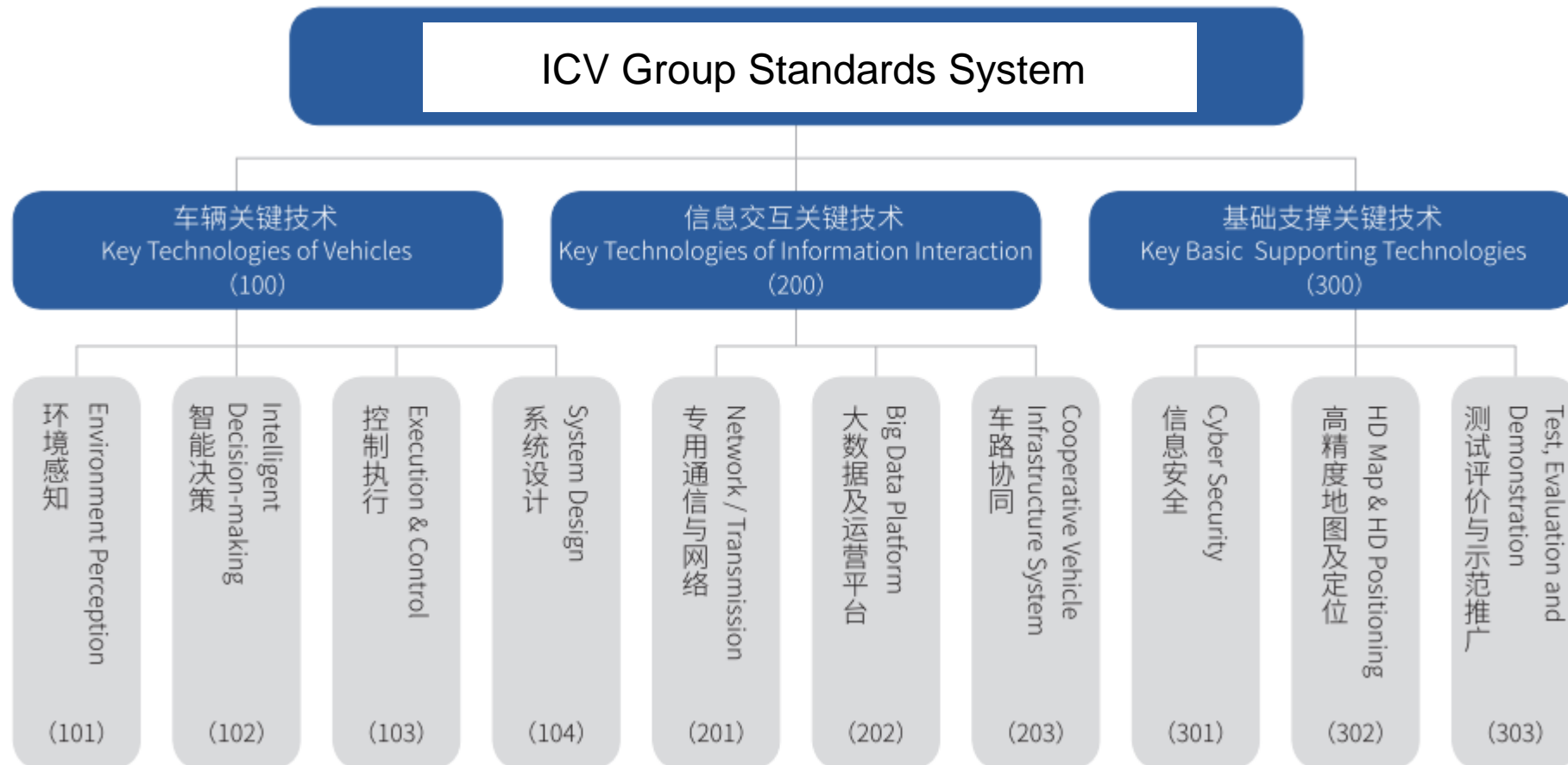
Introduction of China C-V2X Industry

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, infructures and so on.

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

Chipsets通信芯片
Huawei, Datang, Qualcomm

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

Application SoftwareV2X应用软件
17 DAY 1 scenarios for safety, efficiency, information（安全类、效率类和信息类）

Module通信模组
Huawei、Datang、Quectel、Gosuncn
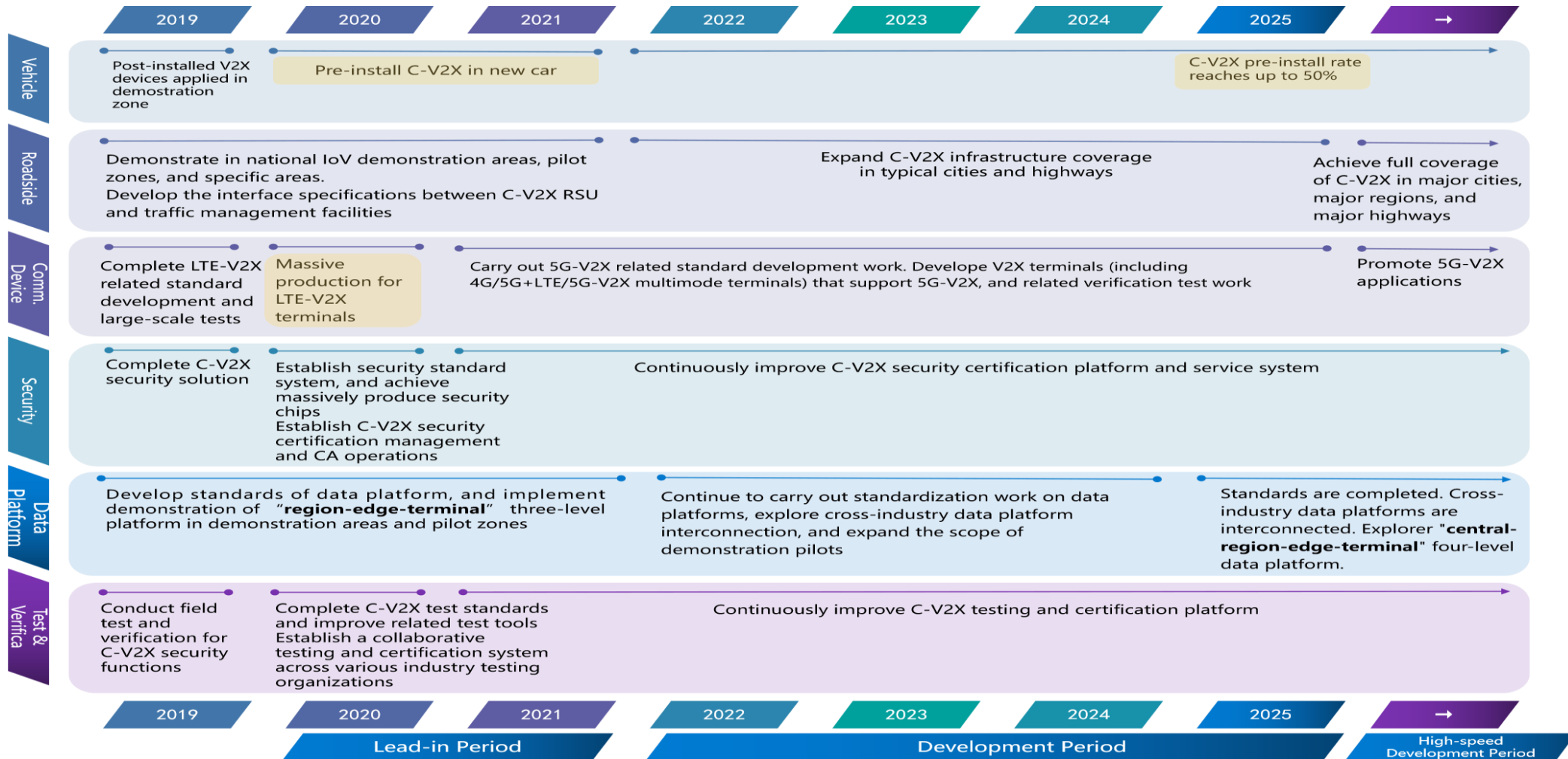
Protocol Stack协议栈
Neusoft、Nebula、ASTRI

Security Chipsets安全芯片
HDSC、ISTECC、XDJA
华大电子、华大信安

Study on C-V2X Industrialization Path and Timeline in China

By:

| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | → |

Vehicle

Post-installed V2X devices applied in demostration zone

Pre-install C-V2X in new car

C-V2X pre-install rate reaches up to 50%

Roadside

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

Expand C-V2X infrastructure coverage in typical cities and highways

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

Comm. Device

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

Massive production for LTE-V2X terminals

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

Promote 5G-V2X applications

Security

Complete C-V2X security solution

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

Continuously improve C-V2X security certification platform and service system

Data Platform

Develop standards of data platform, and implement demonstration of "**region-edge-terminal**" three-level platform in demonstration areas and pilot zones

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.

Test & Verifica

Conduct field test and verification for C-V2X security functions

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

Continuously improve C-V2X testing and certification platform

| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | → |

| Lead-in Period | Development Period | High-speed Development Period |

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

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.
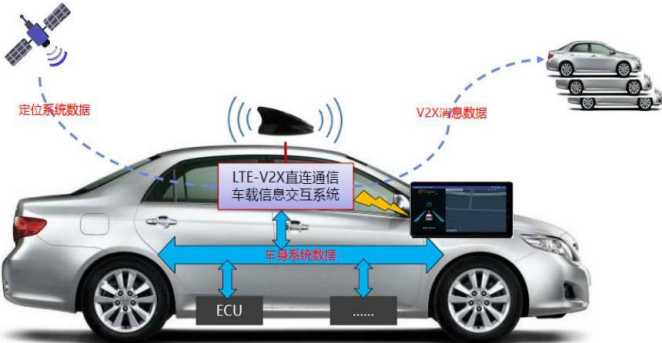

全国汽车标准化技术委员会　全国智能运输系统标准化技术委员会
全国通信标准化技术委员会　全国道路交通管理标准化技术委员会

关于加强汽车、智能交通、通信及
交通管理C-V2X标准合作的框架协议
签约仪式
2018年11月17日 河北雄安新区

Nov 17th, 2018, National Technical Committee in **Automotive, Intelligent Transportation System, Communication and Traffic Management** sign *Framework Agreement on Enhancing Cooperation on C-V2X Standards for Automotive, Intelligent Transportation, Communications and Traffic Management*

Standards Category	Standards	Standards Level	Standards Organization
Access Protocol	基于LTE网络的车联网无线通信系统总体技术要求	行标/国标	CCSA/TC485
	基于LTE的车联网无线通信技术空中接口技术要求	行标/国标	CCSA/TC485
Network Protocol	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	团标	C-SAE/C-ITS
	基于LTE的车联网无线通信技术 网络层技术要求	行标	CCSA
	基于LTE的车联网无线通信技术 网络层测试方法	行标	CCSA
Message Protocol	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	团标	C-SAE/C-ITS
	基于LTE的车联网无线通信技术 消息层技术要求	行标	CCSA
	基于LTE的车联网无线通信技术 消息层测试方法	行标	CCSA
Security Protocol	基于LTE的车联网通信 安全技术要求	行标	CCSA
	基于LTE的车联网无线通信技术 安全认证技术要求	行标	CCSA
	基于LTE的车联网无线通信技术 安全认证测试方法	行标	CCSA
Technical Reequipment Regulation	基于LTE的车联网无线通信技术 支持直连通信的车载终端设备技术要求	行标	CCSA
	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测试方法	行标	CCSA
	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	行标	CCSA
	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	行标	CCSA
	基于LTE的车联网无线通信技术 基站设备技术要求	行标	CCSA
	基于LTE的车联网无线通信技术 基站设备测试方法	行标	CCSA
	基于LTE的车联网无线通信技术 核心网设备技术要求	行标	CCSA
	基于LTE的车联网无线通信技术 核心网设备测试方法	行标	CCSA
	基于LTE的车联网无线通信技术 直接通信系统技术要求	团标	C-SAE/C-ITS
	基于LTE-V2X直连通信的车载信息交互系统技术要求	国标	NTCAS

GB/T *Technical Requirements of Vehicular Communication System based on LTE-V2X Direct* Communication

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
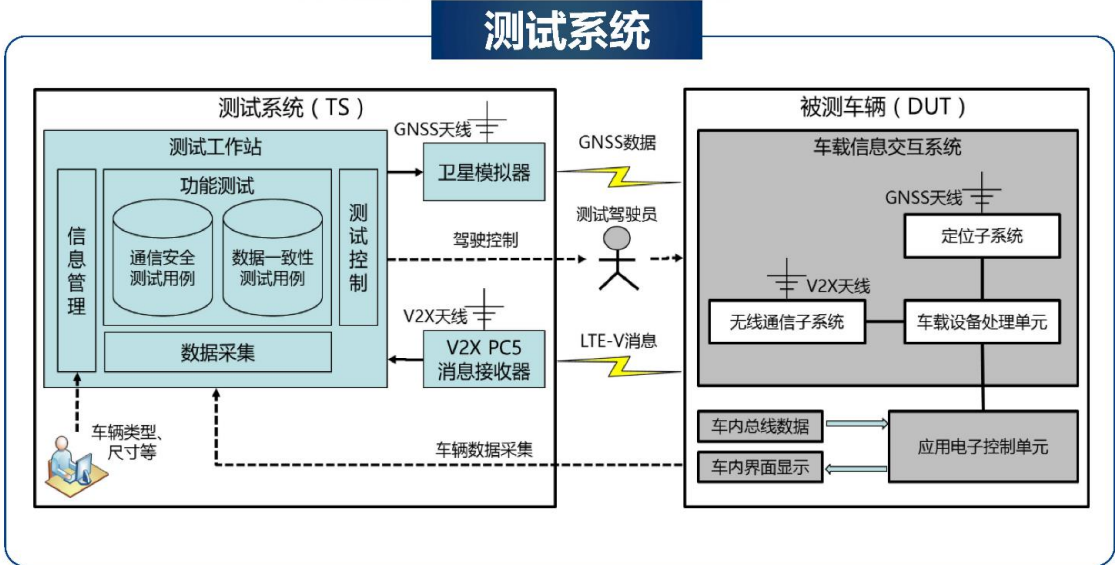
C-V2X Related Group Standards

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

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**.

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

	Type	Communication Type	Application
1	Safety	V2V/V2I	Sensor Data Sharing
2		V2V/V2I	Cooperative Lane Change
3	Safety/ Efficiency	V2I	Cooperative Vehicle Merge
4		V2I	Cooperative Intersection Passing
5	Information Service	V2I	Differential Data Service
6	Efficiency/Traffic Management	V2I	Dynamic Lane Management
7	Efficiency	V2I	Cooperative High Priority Vehicle Passing
8	Information Service	V2I	Guidance Service in Parking Area
9	Traffic Management	V2I	Probe Data Collection
10	Safety	P2X	Vulnerable Road User Safe Passing
11	High Intelligent Driving	V2V	Cooperative Platooning Management
12	Efficiency/Information Service	V2I	Road Tolling Service

Application Demonstration Activities

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

2020 New Four Layers
Four Layers
HD Map & Positioning
Cloud Control Platform
Industrialization and enhanced scenario
Closer to the actual travel scenario

2019 Four Layers
Modules
Terminals
OEMs
Certificate Authority
Open Road

2018 Three Layers
Modules
Terminals
OEMs

Many Thanks for Your Attention