China Readiness for LTE-V2X Commercialization

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Road safety and traffic efficiency a global crisis

1.35M
People die each year on the roads worldwide

$305B
Congestion cost in the US alone

28%
Of all carbon emissions from transportation

Driving fatalities and injuries

Transport inefficiency

Greenhouse gas emissions
5G

Efficient use of energy and utilities

Safer, autonomous transportation

Reliable access to remote healthcare

Precision agriculture

Improved public security

Sustainable smart cities and infrastructure

Digitized logistics and retail

Powering the digital economy

>$13 Trillion

In goods and services by 2035*

Powering automotive industry

>$2.4 Trillion

In goods and services by 2035*

*来自《5G经济》报告，该报告是由Qualcomm委托，由IHS Markit、Penn Schoen、Berland和Berkeley Research Group开展的独立研究报告
C-V2X
Established the foundation of C-V2X for safety in Rel-14/15 with continued evolution in Rel-16 5G NR for advanced use cases

- **V2V**
  - Vehicle-to-vehicle
  - e.g., collision avoidance safety systems

- **V2P**
  - Vehicle-to-pedestrian
  - e.g., safety alerts to pedestrians, bicyclists

- **V2I**
  - Vehicle-to-infrastructure
  - e.g., traffic signal timing/priority

- **V2N**
  - Vehicle-to-network
  - e.g., real-time traffic/routing, cloud services

- Release 14/15 C-V2X standards completed
- Broad industry support with 5GAA
- Global trials started in 2017
- Qualcomm® 9150 C-V2X chipset announced in September, 2017
- Integration of C-V2X into the Qualcomm® Snapdragon™ Automotive 4G and 5G Platforms announced in February, 2019

Qualcomm 9150 C-V2X and Qualcomm Snapdragon Automotive 4G/5G Platforms are products of Qualcomm Technologies, Inc. and/or its subsidiaries
5905-5925 MHz was allocated and dedicated for LTE-V2X

• OBU is license exempted, RSU need to apply for frequency license

• The first batch of frequency RSU licenses were granted in Jan, one in Tianjin and the other in Hainan province. The validity period is 1 year.

• The first LTE-V2X module has received TA certificate

• Further study NR V2X spectrum in FuTURE Forum and CCSA
MIIT Supervised Pilot projects

10 pilot testbeds with different focuses
Constructing Collaborative ITS
MoT issued top-level design plan to support application demonstration

➢ "Development Plan of Modern Comprehensive Transportation System in the 13th Five-Year Plan", Promoting Intelligent Transportation Construction.

➢ 9 provinces as pilot

Yanchong Highway (Beijing): 33.2 kilometers, two-way, four-lane

China’s first vehicle & road collaborative test of real highway scenario in December 2018
Mushrooming C-V2X Ecosystem in China

13+ OEMs announced 2020/21 SOP plan
C-V2X Cross Industry Coordination

**Framework Agreement on strengthening Cooperation in C-V2X Standards for Automobile, Intelligent Transportation, Communication and Traffic Management**

| SAC/TC 485 Telecommunication | • Supervised by MIIT  
|                            | • Focus on interoperability related standards |
| SAC/TC 114 Automotive       | • Supervised by MIIT  
|                            | • Focus on the use of C-V2X in automotive application |
| SAC/TC 268 Transportation   | • Supervised by MoT  
|                            | • Focus on the use on C-V2X in road-side infrastructures |
| SAC/TC 576                 | • Supervised by MPS  
|                            | • Focus on the use of C-V2X in traffic management |

《基于LTE-V2X直连通信的车载信息交互系统技术要求》国家标准项目
“Technical requirements of LTE-V2X PC5 based OBU system” national standard

2018.11.17，Xiongan
## LTE-V2X Standardization in China

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*Note: Red means the part of plan.*
Constructing C-V2X Testing and Certification Architecture

Stand cross-industry collaboration of automotive and ICT. Seek for the unification and mutual recognition with international industry organizations. **Guidance will be published by the end of 2019**

1. Technology status
2. Product Function Problems
3. Test items and specifications

- Interoperability
- Product’s quality
- Reducing product failures
- Verifying functions

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**The Evolution of access layer Security to vehicle Information Security**

**Based on modular-level RF, the ability of interference and anti-interference of the whole vehicle is finally embodied.**

**Basic V2X functions to onboard V2X performance**

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**PARTS**

- Reliability
- SAR
- EMC
- Antenna
- Application security
- V2X functional verification
- RF verification
- High layer interworking
- High layer protocol
- Navigation and positioning

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**MODULE**

- Information security
- V2X function
- Radio frequency
- Interconnection
- Protocol consistency
- Service rate
- resource management
- interface
- Power consumption

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**VEHICLE**

- EMC
- OTA
- Information security
- V2X performance
- Interference and anti-interference
- Interworking
- Navigation and positioning
- Rate
- Power consumption
- ...
2019 C-V2X Plugfest and “Four Layers” Interoperability Application Demonstration

- Realized C-V2X security authentication mechanism, demonstrated the maturity of China's C-V2X standard protocol stack
- Promoting the establishment of a safe and reliable C-V2X large-scale application environment

**KEY TASKS**

**C-V2X Terminals Security development**
- Initial security configuration and certificate application
- Secure computing like signature verification, decryption, etc

**CA platform setting up**
- Certificate authorizing and revocation
- Certificate signature, validation

**Testing**
- Security protocol conformance testing
- Open road V2V/V2I scenarios interoperability

**Organizer**

**Co-Organizer**

**Sponsors**

**International Cooperation**
Most large-scale cross industry interoperability demo until now

26 OEMS
11 Chipsets & Module
28 Terminals & Software
2 CA platform
5 Security Chipsets & Solutions positioning system & others

300+ Professionals work long days
Fully validated China C-V2X Standards

All implementations are based on China C-V2X standard protocol stack

Security Layer
General technical requirements of Security for Vehicular Communication based on LTE

Message Layer
Message Layer Technical Requirements for LTE-based Connected Vehicle Wireless Communication Technology【CCSA】

Network Layer
Network Layer Technical Requirements for LTE-based Connected Vehicle Wireless Communication Technology【CCSA】

Physical Layer
The Air Interface Technical requirements of Vehicular Communication based on LTE【CCSA】

Test Specs
- Air Interface Interoperability Testing document
- Network Layer Interoperability Testing document
- Message Layer Interoperability Testing document
In-lab Interoperability and Conformance Testing lay the key foundation

From Sep.9\textsuperscript{th} to Oct.13\textsuperscript{th} 2019, the protocol Interoperability and conformance testing for over 50 devices from more than 30 devices and software providers were conducted in the "Internet of vehicles technology innovation and evaluation laboratory" (MIIT key laboratory)
Successful Demonstration in Shanghai on Oct. 22-24, 2019

The demonstration was successfully held at the Shanghai International Automobile City open road, with total length of 11.4km. 50 cars formed 25 groups to demonstrate V2X application.

- **V2I scene**
  - SLW (Speed Limit Warning)
  - HLW (Hazardous Location Warning)
  - RLVW (Red Light Violation Warning)
  - GLOSA (Green Light Optimal Speed Advisory)

- **V2V scene**
  - FCW (Forward Collision Warning)
  - BSW (Blind Spot Warning)
  - AVW (Abnormal Vehicle Warning)

- **V2P scene**
  - VRU (Vulnerable Road User Collision Warning) 【OPTIONAL】

- **Attack scene**
  - Untrusted RSU and OBU will forge RSI and BSM messages to demonstrate V2X security
2000 +
Guests experienced
academicians, CTOs, officials, etc

1000 +
Trips
by 50 vehicles from 26 OEMs

20 +
Medias
mainstream, industry and social medias
Rapidly moving towards C-V2X commercialization.
  • RSU deployments are gaining momentum, 13+ OEMs announced 2020/21 SOP plan

MIIT allocated LTE-V2X spectrum from 5905-5925 MHz for a 20 MHz carrier
  • CCSA started studying spectrum for NR V2X, synergize with 5GAA ongoing works

SDOs from Communication, Automotive, Transportation and Traffic Management are collaborating on C-V2X series of standards
  • Most of the standards are ready and verified in 2019 C-V2X Plugfest and “Four-Layer” demonstration

Certification system is being constructed
  • The first LTE-V2X module has received TA certificate

C-V2X is on a fast track, target to the first SOP in 2H’2020