C-V2X Enables Intelligent Transportation

Jiang Wangcheng
Huawei IoT Solution President

C-V2X: Cellular Vehicle-to-Everything
Huawei Connected Vehicle Strategy: Leverage ICT to Enable Mobility Transformation, Smart Vehicles, and Smart Roads

- **Ecosystem**
  - ITS
  - TSP
  - CP/SP
  - More...

- **Cloud platform**
  - V2X server
  - Traffic brain
  - TrafficGo
  - HUAWEI CLOUD

- **Network**
  - 4G/5G/C-V2X/ETH/PON...

- **Road**
  - RSU
  - RSS
  - Camera

- **Vehicle**
  - T-Box/Module
  - MDC
    (Mobile Data Center)

- **Security**
  - C-ITS
    - T-Box
    - RSU, RSS, and camera
    - Network
    - V2X server

- **Smart vehicle**
  - MDC

- **Smart road**
  - Smart camera
  - EI TrafficGo

MDC: Mobile Data Center; RSS: Road Side Server; EI: Enterprise Intelligence;
Huawei C-V2X Devices Support OEM and Aftermarket Solutions

**C-V2X chipset**  
(Balong 765)
- All-in-one Uu + PC5 + AP
- 3GPP Rel. 14
- Downlink peak rate: 1.6 Gbit/s
- 4CC CA + 4x4 MIMO
- 2CC CA + 8x8 MIMO
- DL 256 QAM

**OBU**  
(T-Box)
- V2X APIs for secondary development
- Develop V2X applications on the T-Box using Huawei APIs for differentiated design.
- Huawei provides GNSS, V2X stack, Vehicle, and Sensor APIs.

**V2X antenna**
- Performance optimization
- V2X PC5 5.9 GHz RF performance optimized to deliver omnidirectional coverage, with at least 300 meters of direct coverage and at most 1200-meter LOS

**RSU**
- World's first Uu + PC5 concurrency
- 4 kg | 3.5 L | 26 W | 23 dBm
- Uu + PC5 communication encryption
- BDS and GPS dual positioning systems
- Wired and wireless deployment modes
Product Roadmap for Huawei C-V2X Devices

**Now**

- **Chipset**
  - Balong 765
    - 3GPP R13/14 LTE Cat16/19
    - LTE-V2X

**2019**

- **Module**
  - ME959
    - March 2019 Marketing sample
    - December 2019 C sample

**2020**

- **Chipset**
  - Balong 50xx
    - 3GPP R16 5G NR
    - C-V2X

**2021**

- **Module**
  - MH5xxx
    - 52 x 52 mm
    - R16, 5G NR, LTE, C-V2X
    - E-Call, Open CPU, Ethernet

- **T-Box**
  - DA2300
    - June 2019 Marketing sample
    - March 2020 C sample
V2X Server, Smart Brain for C-ITS

- **Applicatin enablement**
  - C-ITS service
  - Big data service
  - AI

- **Security**
  - O&M

- **Traffic police system**

- **Public services**

- **Services for emergency & commercial vehicles**

- **Services for OEM telematics**

- **More**

- **Smart City Platform**

- **Device management**

- **Link encryption, certificate interaction, and abnormal behavior recognition**
- **Geographic redundancy, delivering 99.999% reliability**

- **Proactive maintenance on the entire network**
- **Quick fault locating and demarcation**

- **Sharing the same technical stack with the Huawei Smart City Platform**
- **Collaboration with environment monitoring and street lamp management**

- **Proactive maintenance**

- **Open ecosystem**
  - Open stack, big data, and AI capability
  - Third-party algorithm deployment framework

- **Millimeter-wave radar**, **RSS**, **C-V2X network**, **RSU**, **OBU**, **Camera**
Build Trust, Resilient, Privacy-valued, Integrated, and Efficient Security Architecture

Build trust, resilient defense architecture to deliver high safety and security. Scenario-specific grading defense resolves security and efficiency issues while complying with privacy requirements.

- C-ITS PKI/CA certificate system
- Encryption of transmission from devices to the cloud
- Reliable vehicle chipset
- RSU/OBU system TEE

- Unified IBS certification
- Lightweight V2X application certificate
- Lightweight transmission encryption algorithm
- Scenario-specific grading defense

- GDPR compliance
- Data privacy compliance analysis tool
- Data anonymization
- Data classification and protection

- Abnormal behavior detection
- Big data/AI event analysis
- Network security situation awareness
- C-ITS/CAD network-wide inspection tool

- Safety and security protection
- Remote vehicle security diagnosis
- CAN bus gateway intrusion detection
- Safety and security operations center (SOC)
City: China's First Urban C-ITS Demonstration Project

Urban C-ITS architecture

- Traffic control center
- V2X server
- Original public security network
- RSU
- Signal controller
- Intelligent transportation edge
- Camera

Offer 18 V2X use cases to improve traffic safety and efficiency

- Roads with C-V2X communication capabilities
- Vehicles with C-V2X communications devices installed; normal driving
- Complex road conditions, where there are both vehicles and pedestrians

Partners

Traffic Management Research Institute, MPS
Wuxi Traffic Police
China Mobile
Huawei
CAICT
TIAN-NET
Highway: China’s First Cooperative Automated Driving on Highways

Highway C-ITS architecture

- ITS: Intelligent Transportation System
- Meteorological monitoring
- V2X server
- RSU: Roadside Unit
- RSS: Intelligent awareness node
- Camera
- UI/T-Box

Use V2X to identify scenarios requiring deceleration and trigger vehicle response

1. Speed limit sign recognition and response (V2X)
2. Reduce speed and change lanes to avoid road construction
3. Change lanes for overtaking
4. Pull over for emergencies

- Some highway sections with C-V2X communication capabilities
- Vehicles installed with C-V2X communication devices; driving at high speed
- Closed road
Campus: Smart Roads and Smart Vehicles Enable Automated Parking and Pickup in the Last Mile

C-ITS architecture in medium- or low-speed scenarios in the campus (in planning)

Cloud
- Parking lot management system
- V2X server
- Road network operations system
- TSP
- Mobile app

Road + Network
- RSS
- Millimeter-wave radar
- Smart camera
- Signal controller
- Convergent sensing
- Roadside unit
- DGPS
- 4G/C-V2X/5G

Vehicle
- Parking lot
- Automated parking and pickup in the last mile
- MDC OBU

- Campus road with C-V2X communication capabilities
- Vehicles with C-V2X communication devices installed; driving in medium- or low-speed.
- A small number of traffic lights
- Fixed route

Mobility:
- Automated parking and pickup in the last mile

Logistics:
- unmanned delivery vehicle

Sanitation:
- unmanned sweeper
How Do We Prepare for the Commercial Use of C-V2X in 2020?

- Vertically: Put the top use cases into commercial use to lay a foundation for large-scale commercial use.
- Horizontally: Evolve new functions to stimulate OEM and aftermarket markets.
China Policies and Industry Force Boost C-V2X

Rising to Chinese standards

LTE-V2X standards rise to national standards in China. LTE-based Vehicle Networking Wireless Communication Technology
• General Technical Requirements
• Technical Requirements of Air Interface
• Technical Requirements of Message Layer
• Technical Requirements of Security
• Technical Requirements of System

Cooperation between four standards committees

On November 17, 2018, the standards committees of automotive, ITS, and road traffic announced that the communications industry standards would be used for the content related to basic communication.

Release the 5.9 GHz direct-link frequency band

Administrative Regulations on Use of Frequency Band 5905-5925 MHz in Direct-Link Communication of Internet of Vehicles (Intelligent Connected Vehicles) (Trial)
• Allocated the 5905-5925 MHz band as the dedicated frequency band to be used for direct-link communication technology for intelligent connected vehicles using LTE-V2X technology.

Interoperability test

Test cross communication modules, in-vehicle devices, and vehicles
• Module: Huawei, Datang, and Qualcomm
• Device: Huawei, China TRANSINFO, Neusoft, and other five manufacturers
• Vehicle: 11 automotive OEMs
Jointly Promote the Construction of the C-ITS Standard System

Based on C-ITS, focus on the development of four types of standards to prepare for the large-scale commercial use of C-V2X.

<table>
<thead>
<tr>
<th>Interconnection standards</th>
<th>Service and application standards</th>
<th>Product standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Air interface application message set</td>
<td>• Forward collision warning</td>
<td>• OBU</td>
</tr>
<tr>
<td>• Interface between V2X entities and ITS devices</td>
<td>• Crossroad collision warning</td>
<td>• RSU</td>
</tr>
<tr>
<td>• Interfaces between V2X products</td>
<td>• Second collision warning</td>
<td>• RSS</td>
</tr>
</tbody>
</table>

Security standards  Lay a foundation for trust and reliability.

<table>
<thead>
<tr>
<th>Basic security standards</th>
<th>Communication security standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data interface for C-ITS exception detection</td>
<td>• V2X security certificate management regulations</td>
</tr>
<tr>
<td>• Classification of IoV information security levels</td>
<td>• C-ITS PKI digital certificate format</td>
</tr>
<tr>
<td>• General standards for C-ITS OTA security upgrade</td>
<td>• V2X security application interface specifications</td>
</tr>
<tr>
<td>• IoV GDPR evaluation criteria</td>
<td>• V2X security test implementation specifications</td>
</tr>
</tbody>
</table>
Basic ICT Capabilities Support Connected Vehicle Ecosystem and Promote the Development of Intelligent Transportation

- Vehicle sensors
- DbW technologies
- Aftermarket OBUs
- HMIs
- Roadside sensors
- Intelligent traffic lights
- Algorithms
- High-precision maps
- ITS ISVs
- Mobility
- UBI

 Chipset, module, mobile data center (MDC), communication module, network, IoT platform, and HUAWEI CLOUD
Huawei C-ITS Vision

➢ Enable bi-directional interaction between vehicles and roads to become the standard configuration, and infrastructure.

➢ Use technologies to prevent and restrict unsafe behavior, reduce the accident rate, and improve the controllability of safety.

➢ Carry out smart traffic management to improve road traffic safety and efficiency.

➢ Evolve normal automatic driving to use vehicle-road cooperation, and reduce the cost of relying on the vehicle as the sole provider of sensing information.