Development of CITS and Automated driving in China

National ITS Center

2016/03/09
Contents

1. Overview of development status
2. CITS major projects
3. Standardization
4. Testing
1. Overview of development status

- Intelligent Vehicle
- Intelligent Infrastructure
- V2X communication platform
1.1 Intelligent Vehicle

- Made in China 2025

Aiming at *intelligent connected vehicle (ICV)*:

2020: Master Intelligent Driver Assistance Technologies

2025: Master Automatic Driving Technologies
Research for Academic

- Since 1990’s, some teams from colleges have engaged in IV
- Since 2008, a major project "Visual and Auditory Information Cognitive Computing" has been funded continuously by NSFC
  - 65 Cultivation Programs, 26 Key Programs, 4 Integration Programs
  - Annual “Intelligent Vehicle Future Challenge” promoting and facilitating the innovation and development of IVs.

Now, many colleges and universities teams:
  - HNU, TSHU, XAJU, SHJU,
  - NJUT, NUDT, AMT, CAS,
  - BJIT, WHU, TJU, BJUU

Beijing-Tianjin Expressway Autonomous Driving First Official Open Test by MTU
  - NSFC, NDRC, Third-party testing agency
R&D by auto industry

- FAW Group and NUDT for driverless car on highway
- Great Wall Automobile Co., Ltd. and MTU for autonomous vehicle on urban road and off-road
- BYD Automobile Co., Ltd. and BJIT for driverless car on urban road
- SAIC and MTU for driverless car on highway and urban road
- Yutong Automobile Co., Ltd. and Academician Li Deyi’s team for driverless bus
- Google, Baidu, Ali, LeTV for driverless car or intelligent connected car
1.2 Intelligent Highway

- Road-Vehicle Cooperative system Research and testbed---Beijing-Tianjin Expressway
New Generation T-GIS Service System

- High-precision and real-time cloud service
- Refined Surveying, adapt to vector, remote sensing, 3D data types
Transportation Key Management and Certificate Authority, TKCA

- Instantaneity, reliability, lightweight, low cost digital certificate format, with comprehensive key management mechanism and rapid certificate process.
- ID Cards for Certificate of vehicle and driver, access control, fast transaction, etc.
- Important control system for highway monitoring, tolling, traffic control, vehicle dispatch, logistics, etc.
1.3 V2I/V2V Communication

(1) DSRC: research and application

- Start at the end of last century
- Objective
  - Establish the V2I/V2V platform
- Milestones
  - GB/T20851-2007 Series Standards for ETC-DSRC
  - GB/T31024-2014 Series Standards for CITS-DSRC
    - peak rate: 155Mbps
    - comm radius: 1.5Km
    - Command channel and data channel

... Befitting for safety application
Extended application of DSRC Terminal

- **Bluetooth: Portable Mobile Terminal**
  - Establish the connection between on-board device and the Mobile Internet, realize on-line payment and other services

- **OEM: On-board Entertainment System and Control System**
  - Form connection between the CAN bus with outside

- **Application in parking lot**
DSRC terminal transaction accounts more than 35% of total transaction on JingCheng Highway, which gives more encourage of using DSRC to represent the traffic state.
LTE-V: Mobile communication for V2X

- R&I of LTE-V orientation for V2V application requirements.
- LTE-V: In ITS industry alliance – standards “General technical requirements of wireless communication technology based on LTE Internet of Vehicles”
  
  - Key performance optimization: time delay - ultra low
- High speed Wifi

![Diagram showing network connections with LTE-V, 2G/3G/4G, 5G, and Blue-Tooth]
1.4 Prospect for C-ITS and auto driving

- Infrastructure innovation providing safe environment for IV
  - High precision Dynamic Digital Map
  - Cyber Security
  - BeiDou
  - Communication

- Vehicle will be more and more intelligent driven by market and compatible with road

- Wireless COMM is important for C-ITS, and V2X is the key tech for closing the gap between in-vehicle sensors and cellular technology
Next step task

- Technology development policy
- Standardization
- Field test
- Road test--Demo and Pilot Project
- Market based + Government support
  - Intergovernmental cooperation:MOT, MIIT MPS
  - Full chain cooperation among government, manufactory, university, research institute, and implantation entity,
  - Third party test platforms
2. C-ITS major projects
(1) New transport Control and Operation Network

- **Function**
  - Interactive transport services
  - Intelligent driving
  - Dynamic adjust system parameters and management mode
  - Integrated system of EV and ITS
  - Integrated system of infrastructure and vehicle

- **Support by new technology**
  - Cyber-Physical System
  - Big Data
  - Cloud Computing
  - M2M
  - V2V, V2I, V2X
  - ... ...
(2) Study on policy of Vehicle-Infrastructure Cooperative technology

Overall goals

Technology policy-driven, preliminary research-supporting, promoting road passenger transportation, large freight vehicles, dangerous goods transport vehicles and other crucial commercial vehicle demonstration program as the starting point, clear the path of Vehicle-Infrastructure Cooperative Systems technology

Main Research Contents

- Construction planning of Vehicle-Infrastructure Cooperative Systems
- Commercial vehicle demonstration project program (open, closed Test – Verification technology)
- The relevant policy and standard advice
Ministry Development Project
• 2016-2019

Function
• Safety warning
• Safety information service
• Driving assistant
• ECO-Driving
• Fleet management

Team Leader
• RIOH
3. Standardization work
# Vehicle-Infrastructure Cooperative /Intelligent network standardization planning

<table>
<thead>
<tr>
<th>Scope</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>Definitions, terminology, data structure</td>
</tr>
<tr>
<td></td>
<td>The basic standards of classification</td>
</tr>
<tr>
<td><strong>Generic /Basic technology</strong></td>
<td>Information security</td>
</tr>
<tr>
<td></td>
<td>Lightweight security authentication</td>
</tr>
<tr>
<td></td>
<td>Trusted network system</td>
</tr>
<tr>
<td></td>
<td>Privacy protection</td>
</tr>
<tr>
<td></td>
<td>V-X communication</td>
</tr>
<tr>
<td><strong>Intelligent road</strong></td>
<td>Road information infrastructure</td>
</tr>
<tr>
<td></td>
<td>Communication network along the road</td>
</tr>
<tr>
<td></td>
<td>high-accuracy GIS</td>
</tr>
<tr>
<td></td>
<td>Adaptability of facilities along the road</td>
</tr>
<tr>
<td><strong>Intelligent vehicle</strong></td>
<td>fusion of electric vehicle and intelligent vehicle</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Cooperative application system</td>
</tr>
<tr>
<td></td>
<td>Reliability and robustness of application system</td>
</tr>
<tr>
<td><strong>Test</strong></td>
<td>Traffic engineering standard adaptability</td>
</tr>
</tbody>
</table>
A Multi-layer and cross-field Standard System

- National/industrial Standards (ITS, vehicles, telematics, etc.)
- Organization standards (Industry alliance or others)
- Company Standards (Self-enact, Open self-declaration, etc.)
## Existing crucial standard

### CITS-DSRC (Communication)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB/T31024.1-2014</td>
<td>Cooperative ITS DSRC Part1: General technical requirements</td>
</tr>
<tr>
<td>GB/T31024.2-2014</td>
<td>Cooperative ITS DSRC Part2: Medium Access Control Layer and Physical Layer</td>
</tr>
</tbody>
</table>

### Vehicle safety assistant

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB/T20608-2006</td>
<td>Intelligent transportation system-Full speed range adaptive cruise control system（FSRA）-test procedure</td>
</tr>
<tr>
<td>GB/T26773-2011</td>
<td>Intelligent transportation system-lane departure warning system-Performance requirements and test methods</td>
</tr>
<tr>
<td>GB20100504-T-469</td>
<td>Vehicle reversing safety assistant system-Performance requirements and test procedures</td>
</tr>
<tr>
<td>GB20100505-T-469</td>
<td>Vehicle lane change decision support system-Performance requirements and test procedures</td>
</tr>
<tr>
<td>GB20100506-T-469</td>
<td>Vehicle front collision warning system-Performance requirements and test procedures</td>
</tr>
<tr>
<td>GB/T20130072-T-469</td>
<td>Intelligent transportation system-lane departure warning system-Performance requirements and test methods</td>
</tr>
</tbody>
</table>

### Information Security

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011693-T0469</td>
<td>Intelligent transportation-Data security service</td>
</tr>
<tr>
<td>20130077-T-469</td>
<td>Transportation-Digital certificate format</td>
</tr>
<tr>
<td>20130080-T-469</td>
<td>Information security standard，100.104.6</td>
</tr>
</tbody>
</table>
Alliance or industry standards

- **C-ITS(V2X and data security)**
  - Cooperative ITS DSRC Part3: Network Layer and Application Layer
  - Cooperative ITS DSRC Part4: Equipment Application
  - CITS- Date structure
  - C-ITS: System framework model
  - C-ITS: Participants information interaction interface specification
  - C–ITS: The vehicle terminal front loading technical requirement
  - C–ITS: Information security general requirement
  - CITS-DSRC-Automotive application service test requirements
  - DSRC-Wireless interconnection vehicle unit-Internet Internet distribution
  - General technical requirements of wireless communication technology based on LTE Internet of Vehicles
  - Vehicular dedicated short range communication equipment-factory installed OBU
Intelligent driving and safety control

- Road operating vehicle-Vehicular gateway-Communication capability and technical requirements
- Intelligent transportation system-Full speed adaptive cruise control system-performance requirement
- Intelligent transportation system-Vehicle forward collision mitigation system-Operating performance
- Intelligent transportation system-Forward vehicle collision mitigation system-Performance requirements and test procedures
- Intelligent transportation system-Parking assist system-Performance requirements and test procedures
- Intelligent transportation system-Signal information and early warning system of the cooperative intersection-Performance requirements and test procedures
- Intelligent driving road test method---For highway
- Intelligent driving classification
- High precision navigation data model and exchange format for intelligent driving
4. Testing
4.1 Test condition in testing field of MOT

Urban Transit / C-ITS

Tunnel/weather Simulation

Active Safety

EMC, Simulator, other labs

Full automatic driving

DSRC/LTE-V/LAN
DSRC/LTE-V
Full automatic driving

- Accommodation lane: 2Km;
- Run all-weather 24-hour: 7-10 automatic vehicle
- V2X reliability test, Automated driving test, formation running test

Automatic level: Lv.2-lv.4

Long: 2 Km
(2) Shanghai International Automobile City (Group)

- Demo of IV
- Vehicle networking
- Include V2X\V2I\V2P\V2C
- Safety, efficiency, information services, 86 scene for automated vehicle in urban
(3) Test plan on actual road/area

- **Expressway** (Commercial Vehicle on accommodation lane+ General vehicle network)
  - Demonstration cities: Shenzhen, Beijing and Zhangjiakou, Foshan, Hangzhou
  - Expressway: Jingjintang Expressway, Fuquan Expressway, Zhuxin Expressway, Shandong Expressway, Ganyue Expressway, Zhejiang Expressway, Anhui Expressway

- **Urban traffic** (Public transit BRT, General public transit / taxi)
- **Automatic passenger ferry system at closed region** such as the stadium area, community, scenic spot, etc.
Thank you!