Development and Prospects of C-ITS in China
中国车路协同技术发展现状与展望

National ITS Center

2016/6/23

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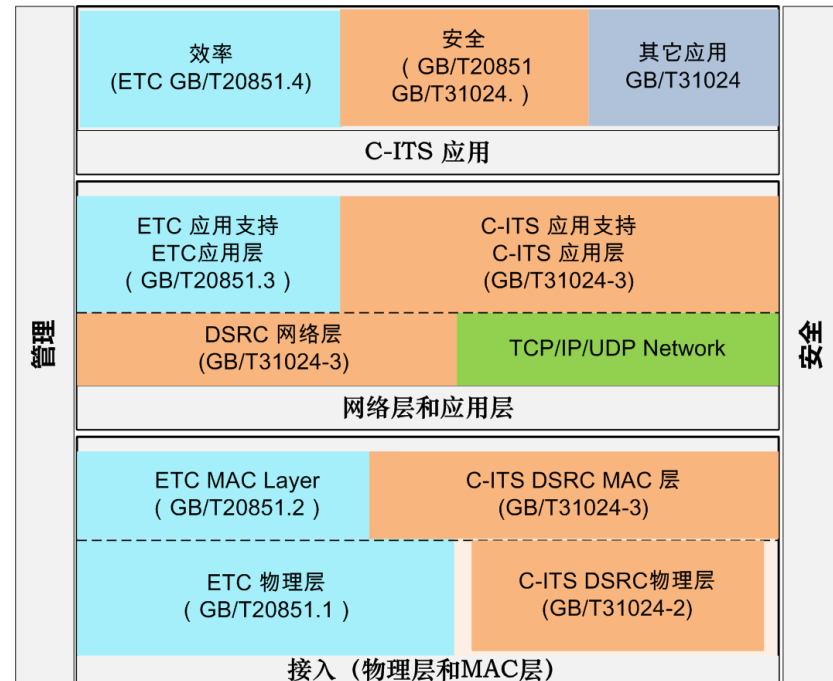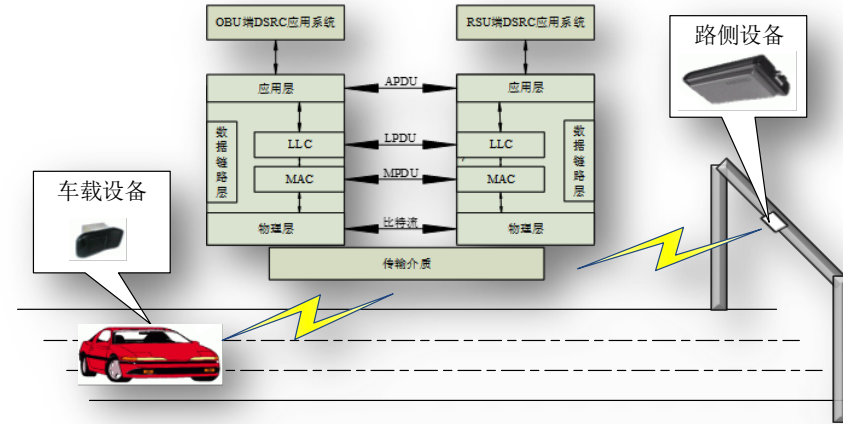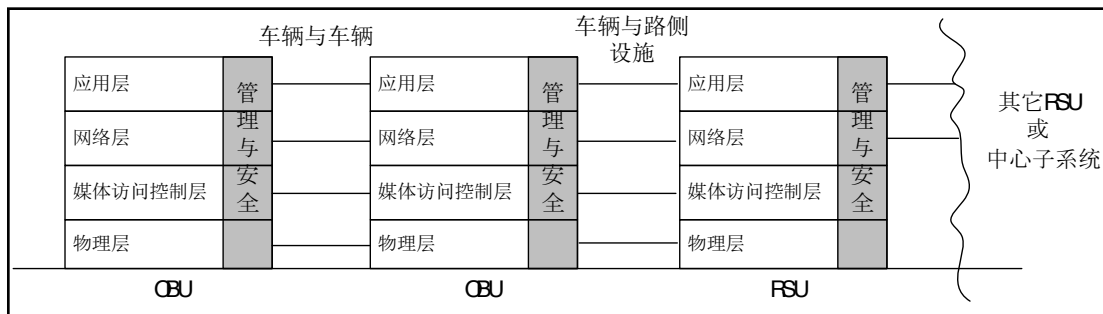
1. Current situation

(1) DSRC-research and application

- **Start at the end of last century**

- **Objective**

  - **Establish the V2I/V2V platform**

- **Milestones**

  - **2007: GB/T20851-2007 Series Standards for ETC-DSRC**
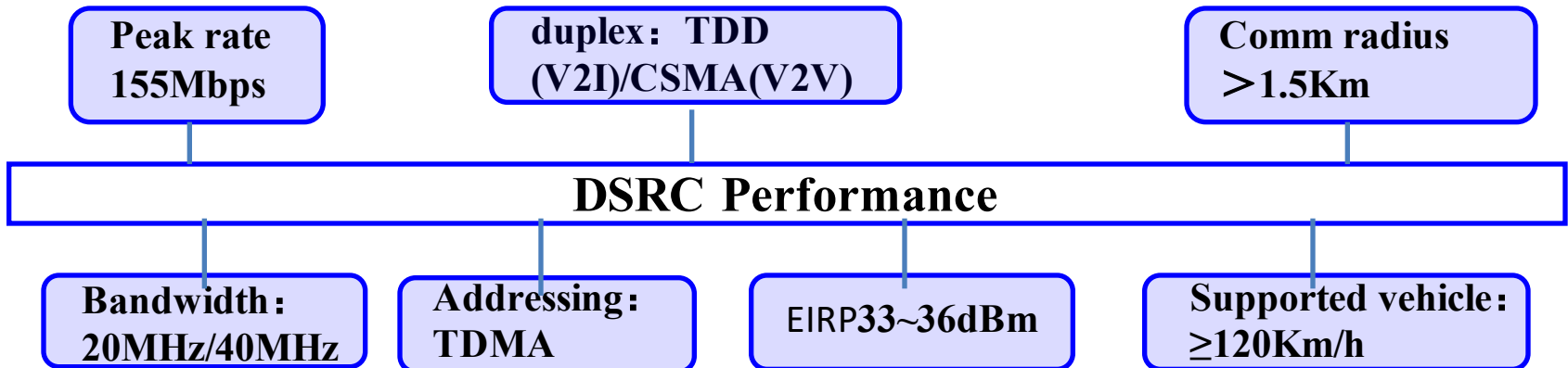 - **2014: GB/T31024-2014 Series Standards for CITS-DSRC**

DSRC- V2X

- National Standard: Build up a tunnel for high speed information exchanging(V2X) under any moving condition
- The reference architecture and key performance of DSRC system are proposed

DSRC：
- **Compatible with others**
- **Befitting for safety application.**

Peak rate 155Mbps

duplex：TDD (V2I)/CSMA(V2V)

Comm radius ＞1.5Km

DSRC Performance

Bandwidth：20MHz/40MHz

Addressing：TDMA

EIRP**33~36dBm**

Supported vehicle：≥120Km/h

ETC

- **Adapt to economic differences, isolation among provincial tolling systems, both manual and automatic tolling, compatibility with bank IC card**

- **Standard System and Application Testing for compatibility, connectivity, uniformity of the entire industry and ease for industry access**
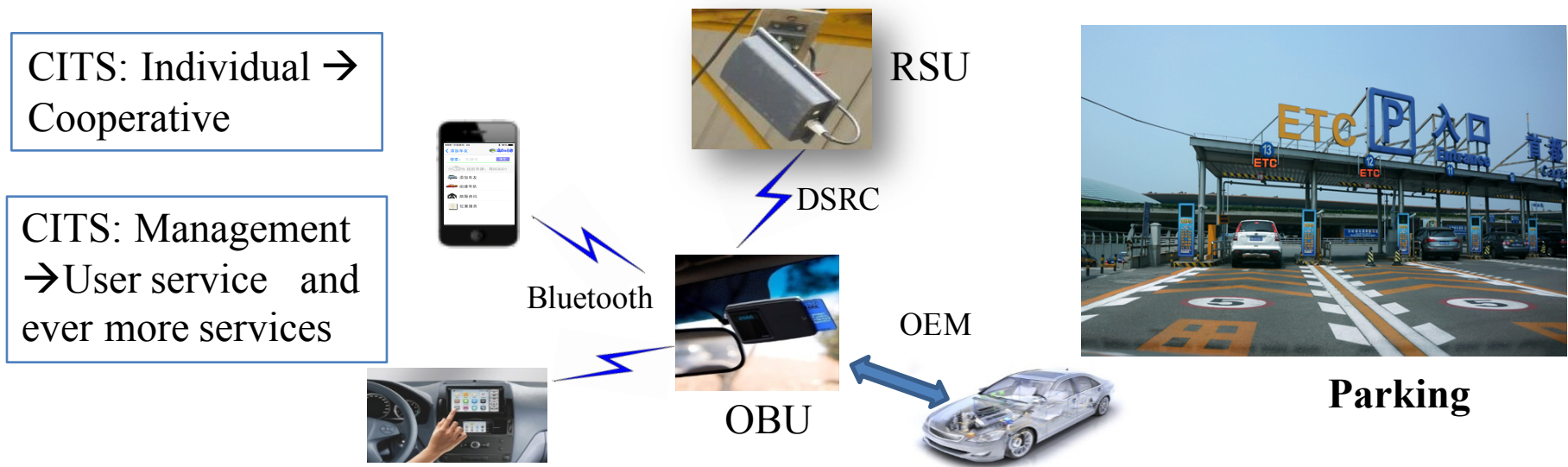
- **Industrialization**

  - Cover 29 provinces
  - >12000 ETC lanes
  - >31,000,000 users
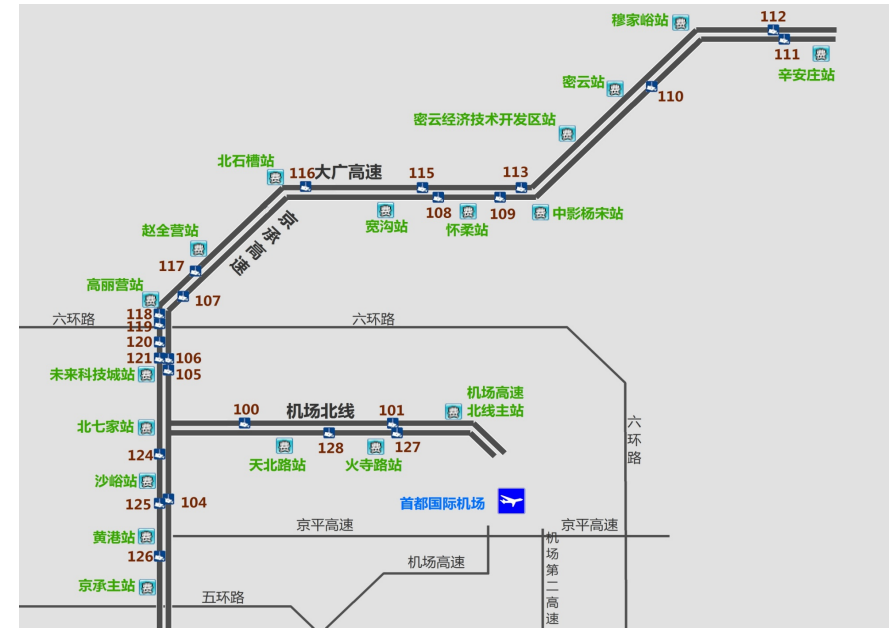 - >17000 service locations
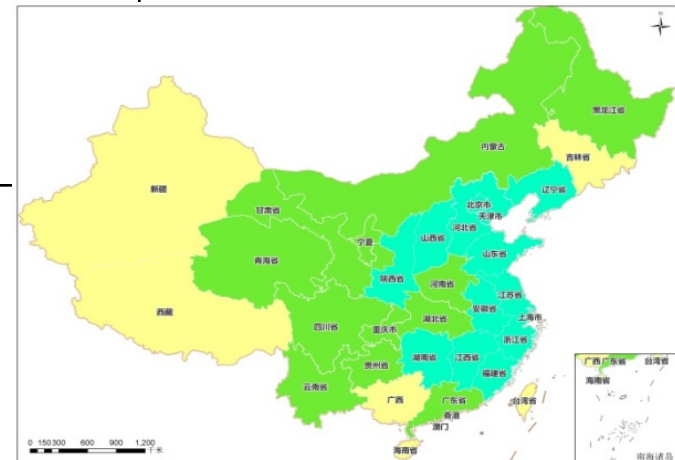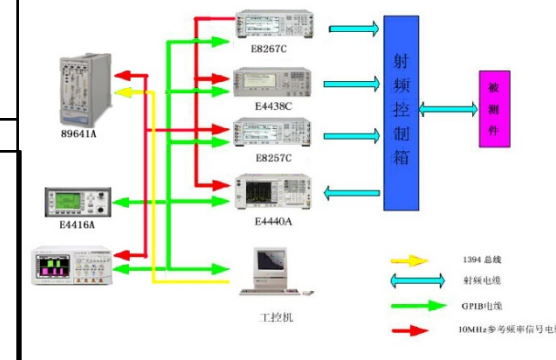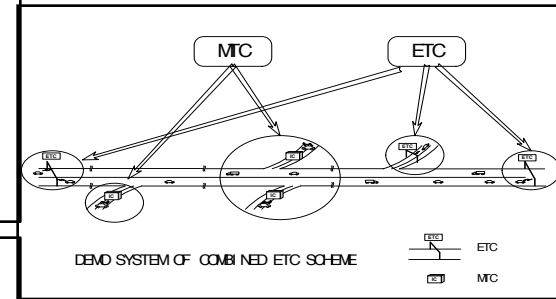
Extended application of DSRC

- **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**
- **ETC application in parking lot**

CITS: Individual → Cooperative

CITS: Management → User service and ever more services

RSU

DSRC

Bluetooth

OBU

OEM

Parking

Extended --Information collection and path recognition
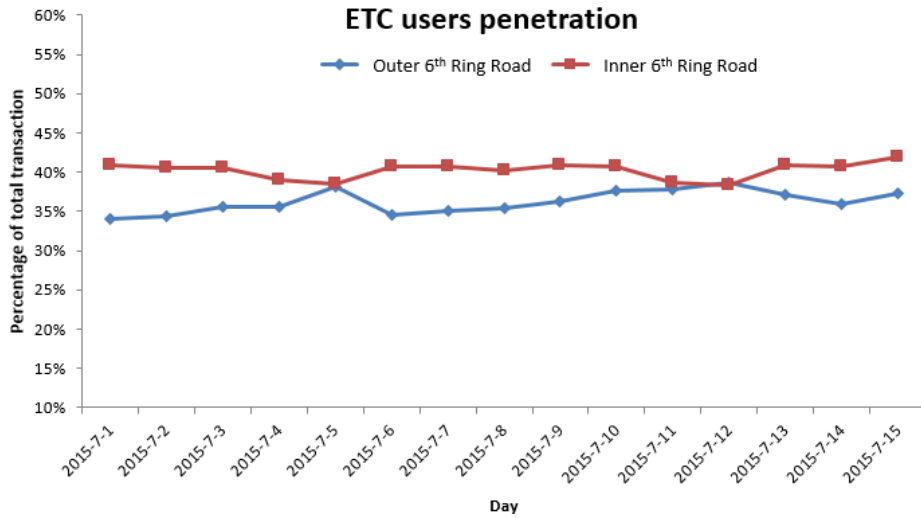

ETC Transaction accounts more than 35% of total transaction on JingCheng Highway, which gives more encourage of using DSRC to represent the traffic state.
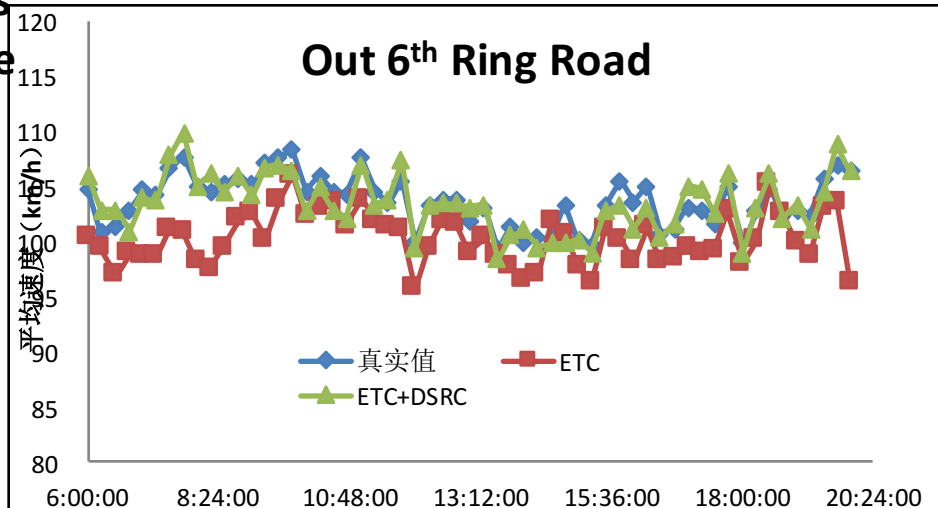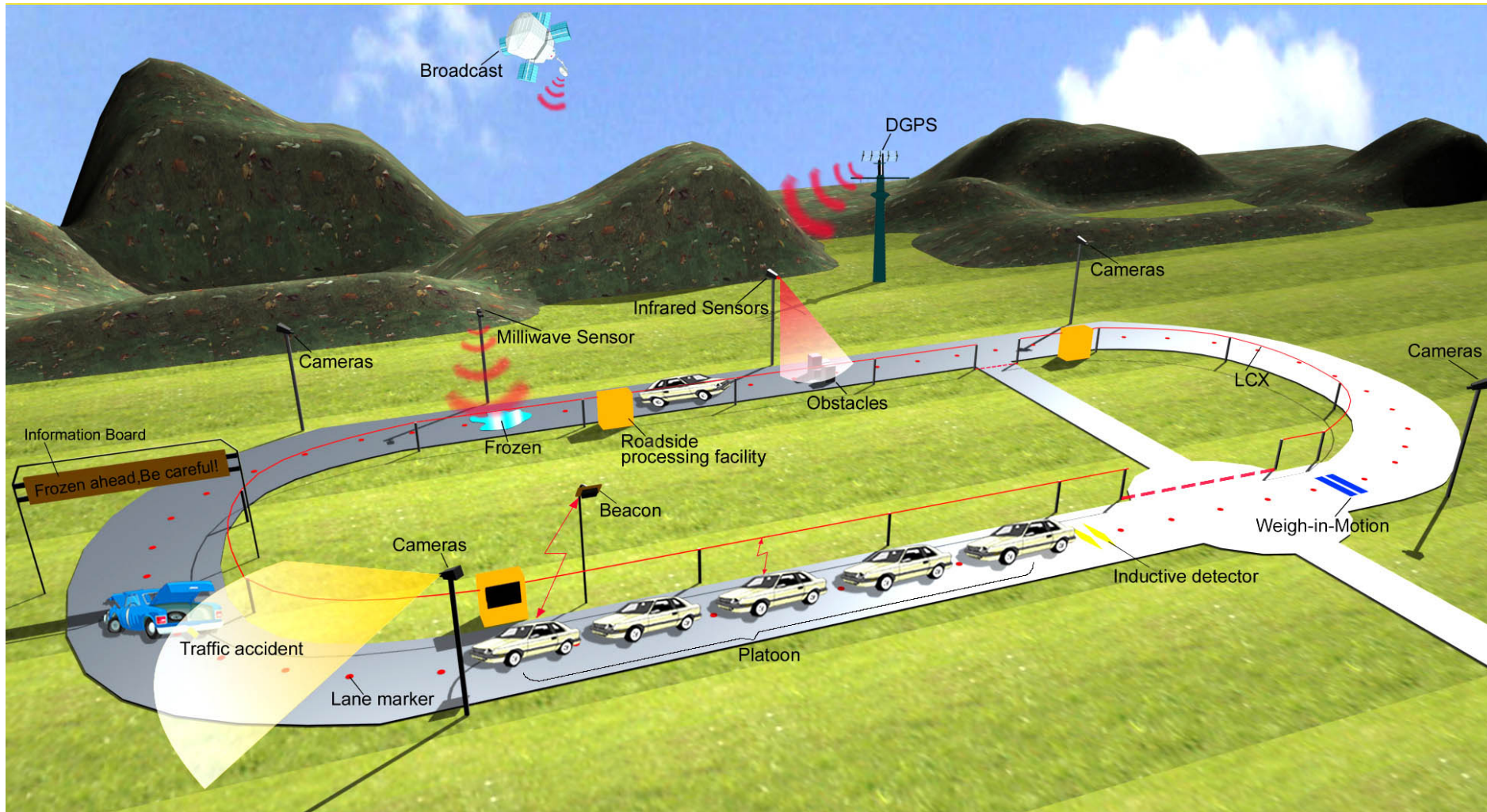
Mobile communication for V2X

□ 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"

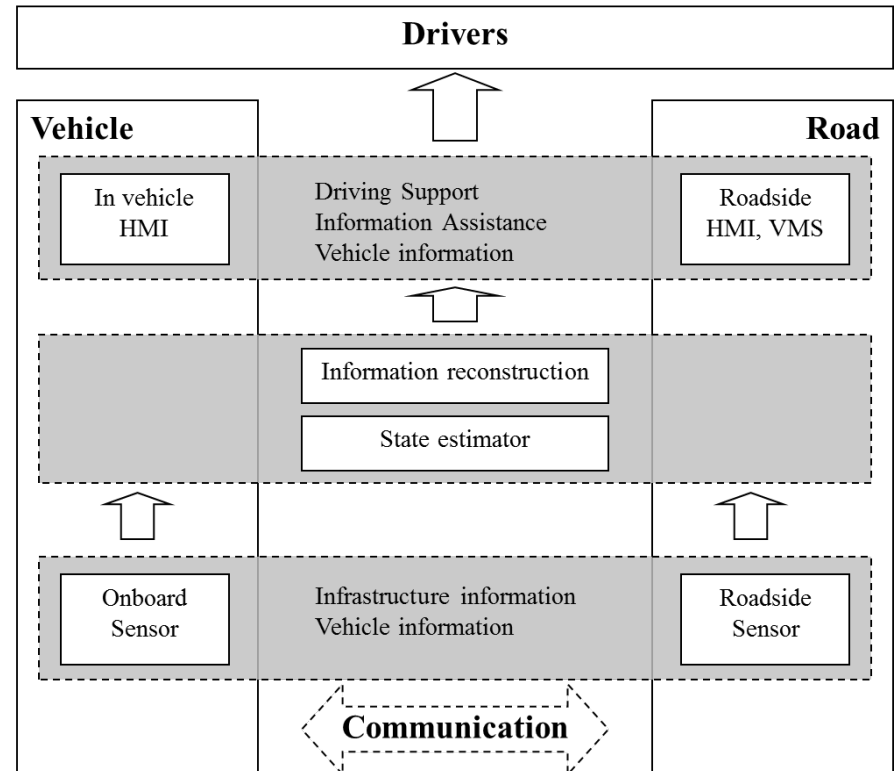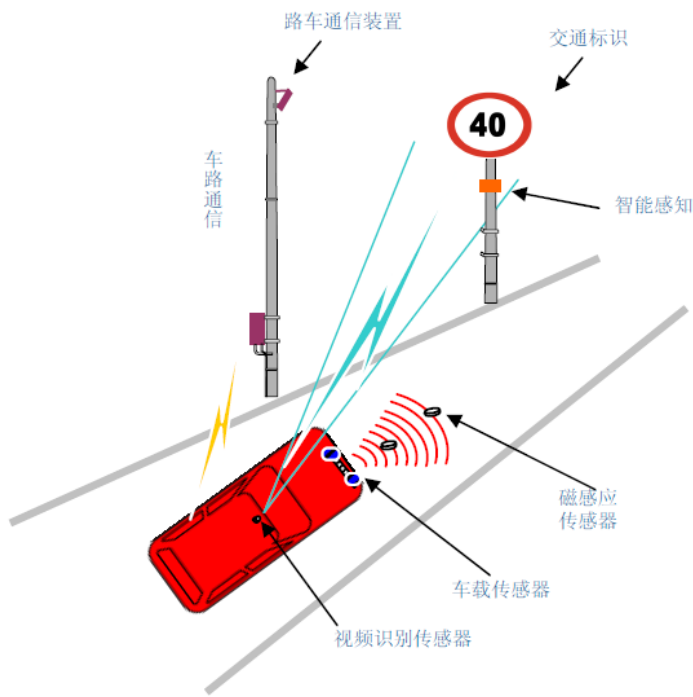- Key performance optimization: time delay- ultra low
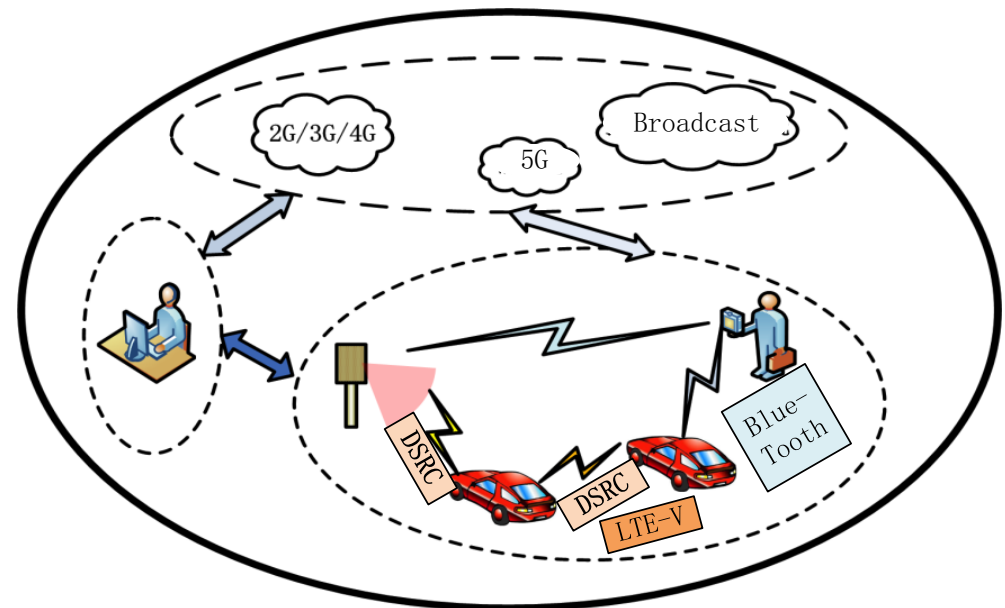
(2) Vision for Intelligent Highway System

□ **From 2002**

# Research on high level structure

- **Information Structure of Intelligent highway System**
- **Perception and Reconstruction of Environment**
- **Intelligent Signs and Detection**
- **Highway Wireless IOT Architecture(03 Major Special S&T programm）**

Information Technology Infrastructure (ITI)

- ❑ **New Generation T-GIS Service System**
  - ● **High-precision and real-time cloud service**
  - ● **Refined Surveying, adapt to vector, remote sensing, 3D data types**
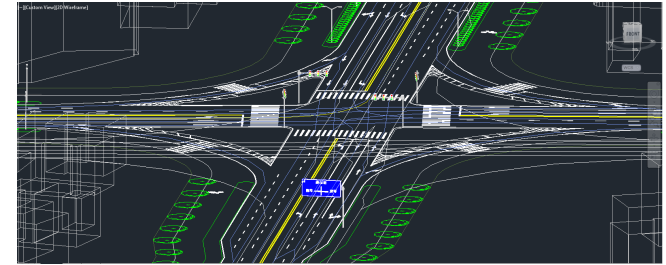
- ❑ **Next Generation Internet(IPv6) and Commercialization** (NDRC)
  - ● **Become member of CNNIC IP address assignment alliance**
  - ● **Manage /24 IPv6 address block, which includes as 2^{72} as IPv4 address amount**
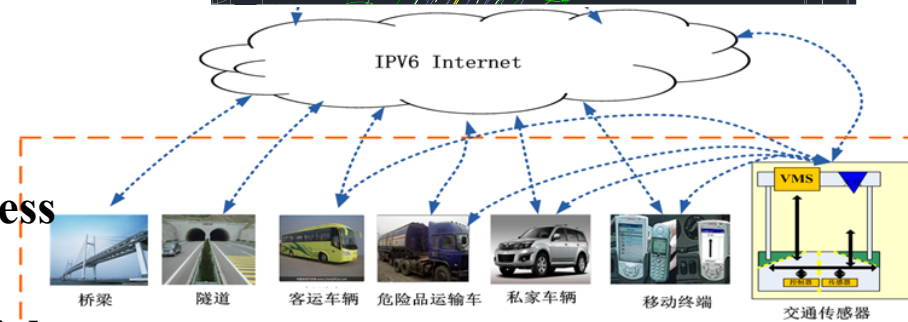
- ❑ **Transportation Key Management and Certificate Authority, TKCA**
  - ● **Instantaneity, reliability, lightweight, low cost digital certificate format, with comprehensive key management mechanism and rapid certificate process**
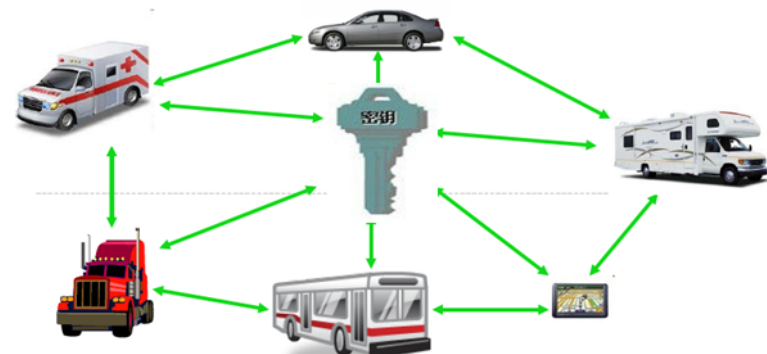
Safety Corridor on Expressway

- **Beijing-Tianjin Expressway**
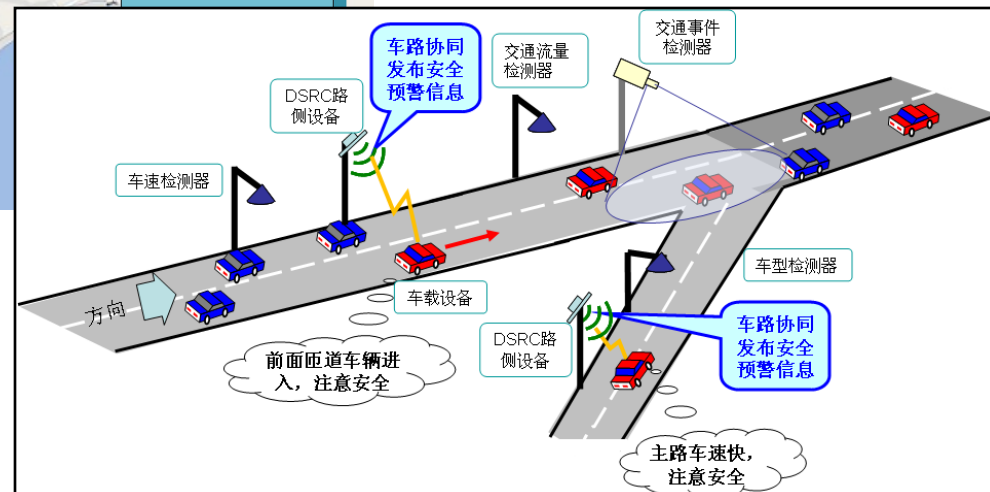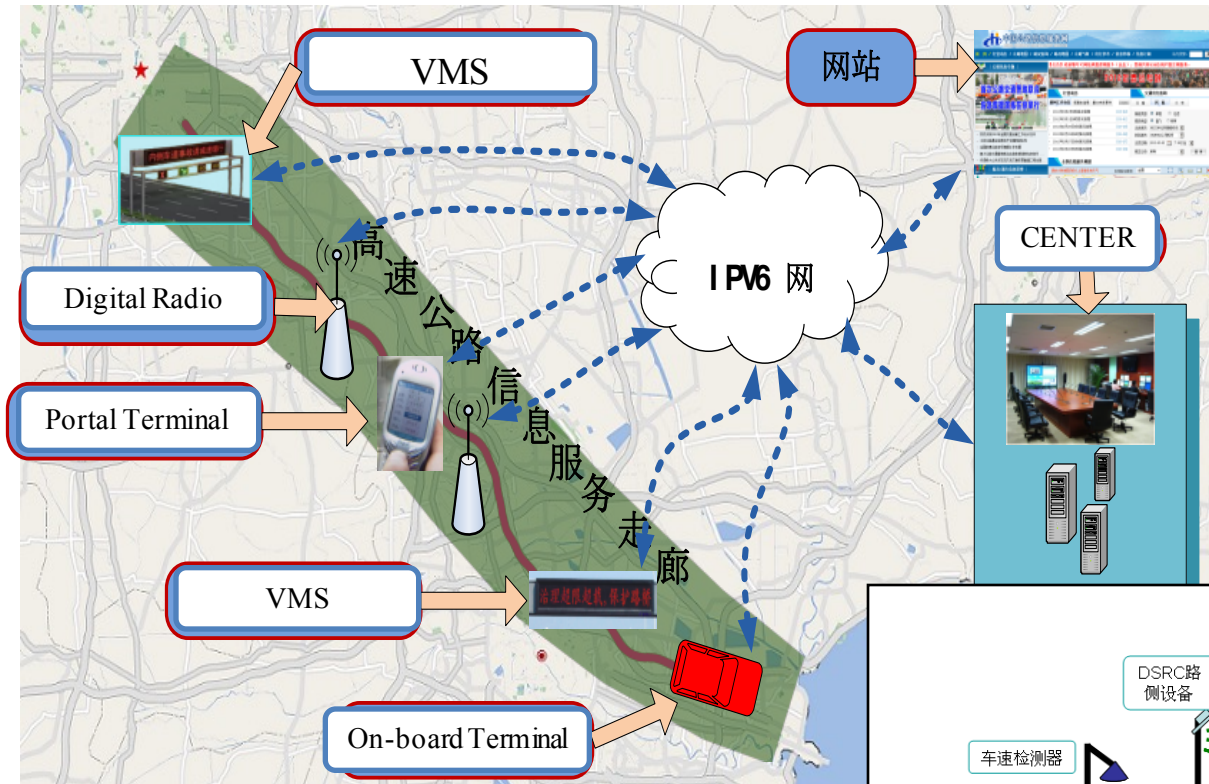
(3) Intelligent Vehicle Research

➤ **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.**

Research for Academic

Many colleges and universities teams:

- ❑ **HNU, TSHU, XAJU, SHJU,**
- ❑ **NJUT, NUDT, AMT, CAS,**
- ❑ **BJIT, WHU, TJU, BJUU**

2011, 863 program "Key Technology for Intelligent Vehicle-Infrastructure Cooperation System" by Tsinghua university and other partners.

- ❑ V2X for Intersection
- ❑ Speeding warning
- ❑ Collision warning
- ❑ Lane change assistance
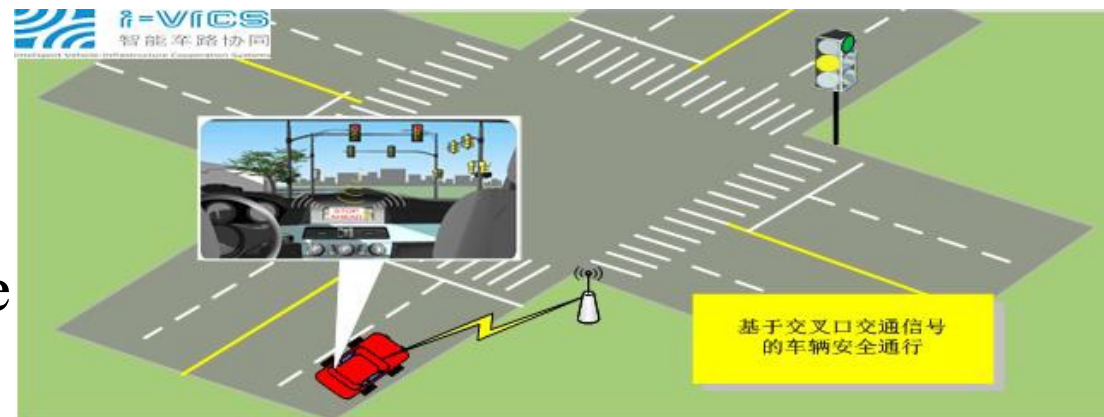
R&D by auto industry

➤ **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**

R&D by auto industry

➢ **SAIC and MTU for driverless car on highway and urban road**

➢ **Yutong Automobile Co., Ltd. and Academician Li Deyi's team for driverless bus**

➢ **Following Google, Baidu, Ali, LeTV for driverless car or intelligent connected car**

DEMO for IV

□ Made in China 2025

Aiming at **intelligent connected vehicle(ICV)**:

2020: **Master Intelligent Driver Assistance Technologies**

2025: **Master Automatic Driving Technologies**

Shanghai International Automobile City

2. Future Prospect

（1） Prospect for C-ITS

- Infrastructure innovation providing safe environment for IV

- 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

- Aim to set up cooperative system by integration of intelligent road, intelligent vehicle, and intelligent operating system
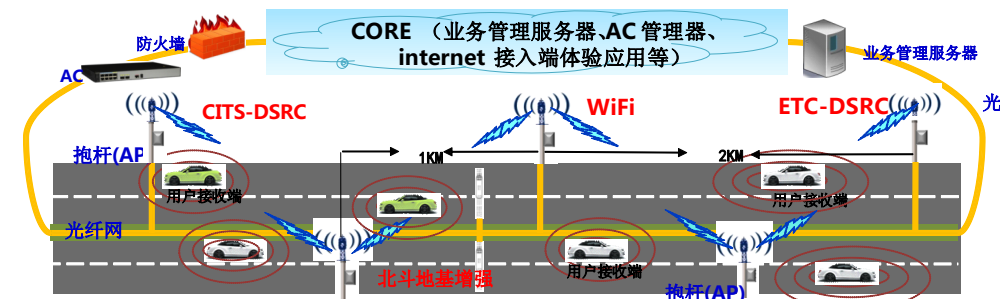
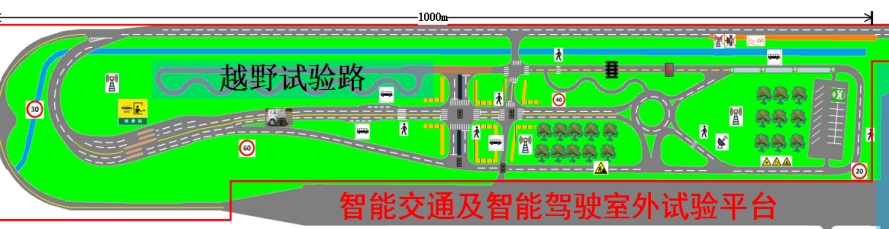# New Infrastructure

- ❑ **Infrastructure innovation by integrating more ICT and new energy technology, like the CPS, providing safe and friendly environment for IV**

  - – DSRC, WIFI, 5G and IPV6
  - – High precision dynamic digital map
  - – Cyber security system
  - – BeiDou
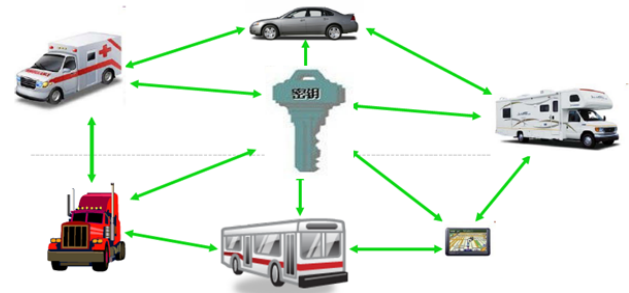
- ❑ **Impact assessment of the IV to road infrastructure**

- ❑ **Test and pilot project in closed and open roads**

New operation system

- **Utilizing advanced control method, improve the mixed traffic flow efficiency, as well as road network capacity**

- **Planned pilot projects**

  - Beijing-Tianjin Expressway smart corridor serve the IV
  - Bus platoon operation in BRT lanes
  - Commercial vehicle dedicated lane for Beijing to Zhangjiakou Expressway for 2022 Olympic winter games

New Transportation Service

- **Public transport become more customized and personalized**
  - Applications in Beijing

- **Personal transport become more shared and smart**
  - Car2go, Uber, DIDI taxi

- **New transport mode mixed using the IV and internet emerges**
  - Shuttle service in big park, community, hub
  - Singapore is building up a brand new transportation system with the help of MIT
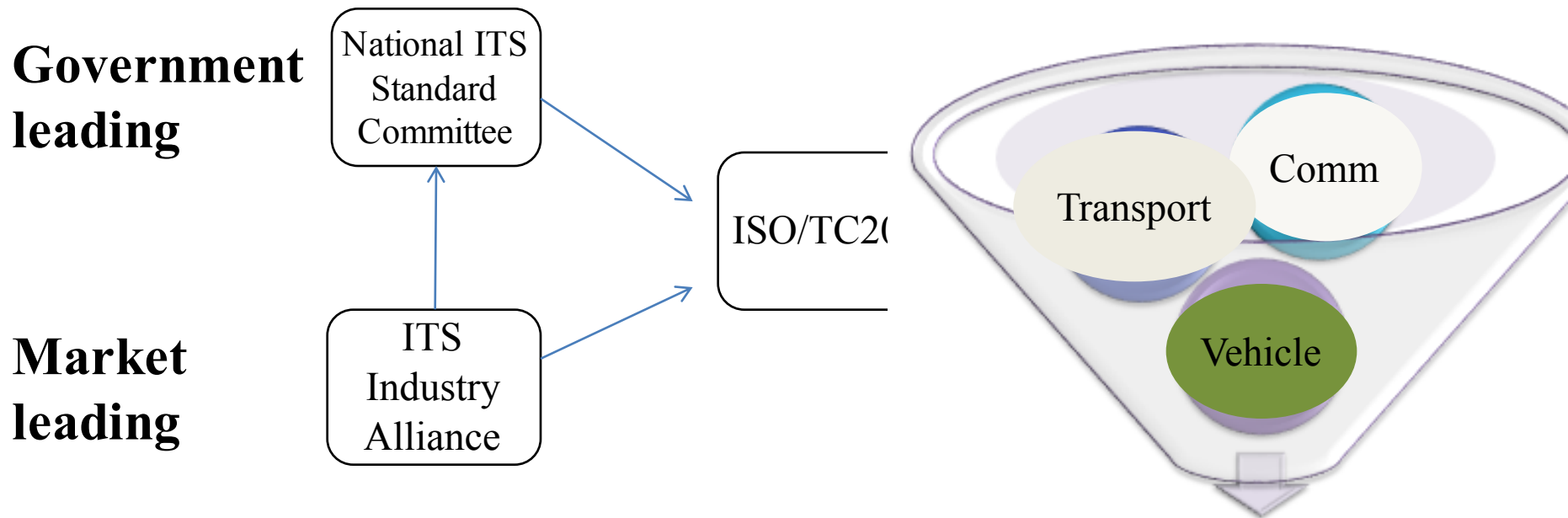
（2）Next step task

- **Standardization: National and Organization standards**

- **Test and Verification**

- **Demo and Pilot Project**

- **Law and Business Mode**
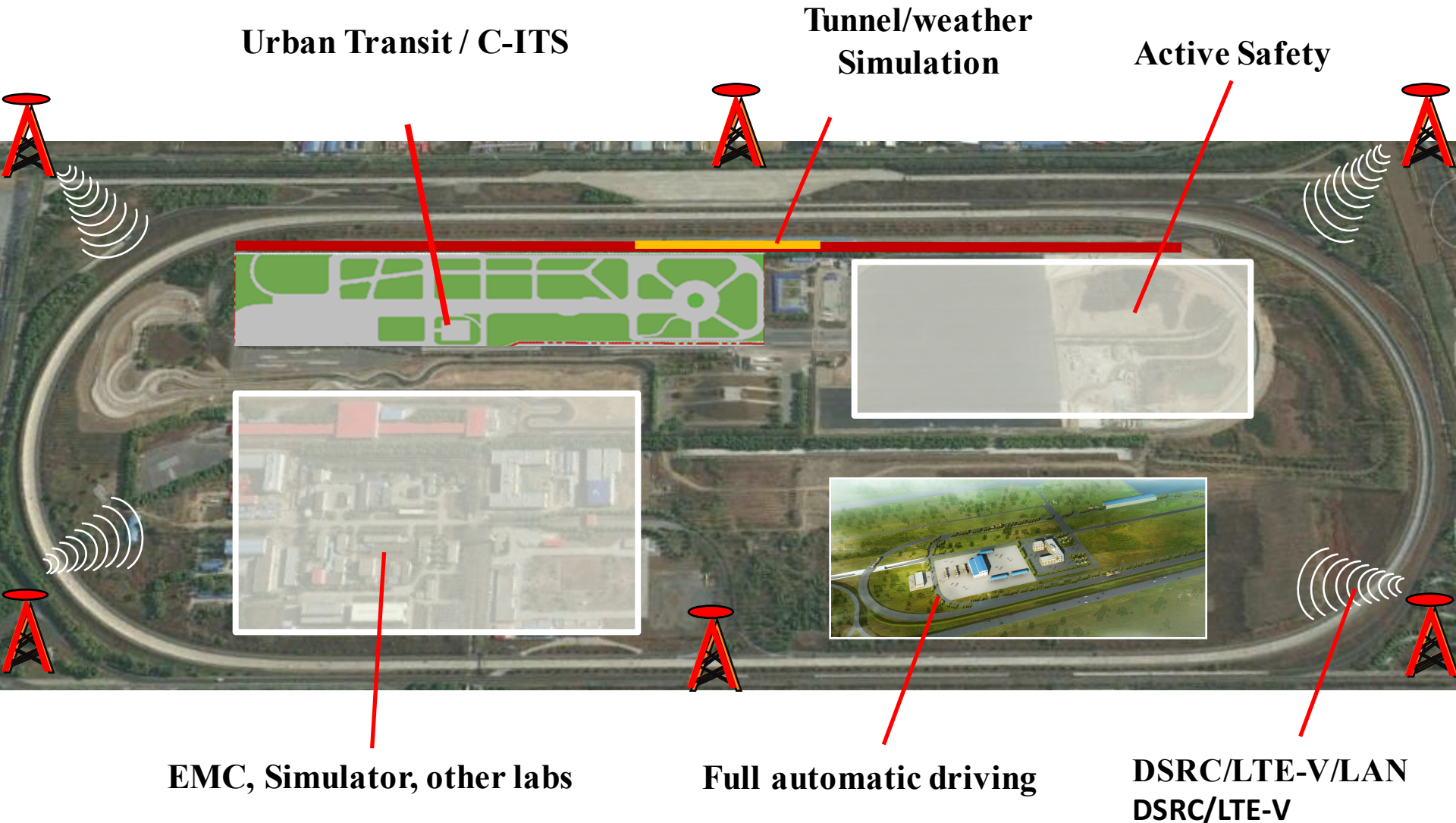 - Market based + Government support (MOT, MIIT)

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.)**

- **International Standards (ISO/TC204/TC22,IEEE,SAE,ETSI)**

Government leading

National ITS Standard Committee

ISO/TC2(

Market leading

ITS Industry Alliance

Transport

Comm

Vehicle

Test and Verification in controlled environment

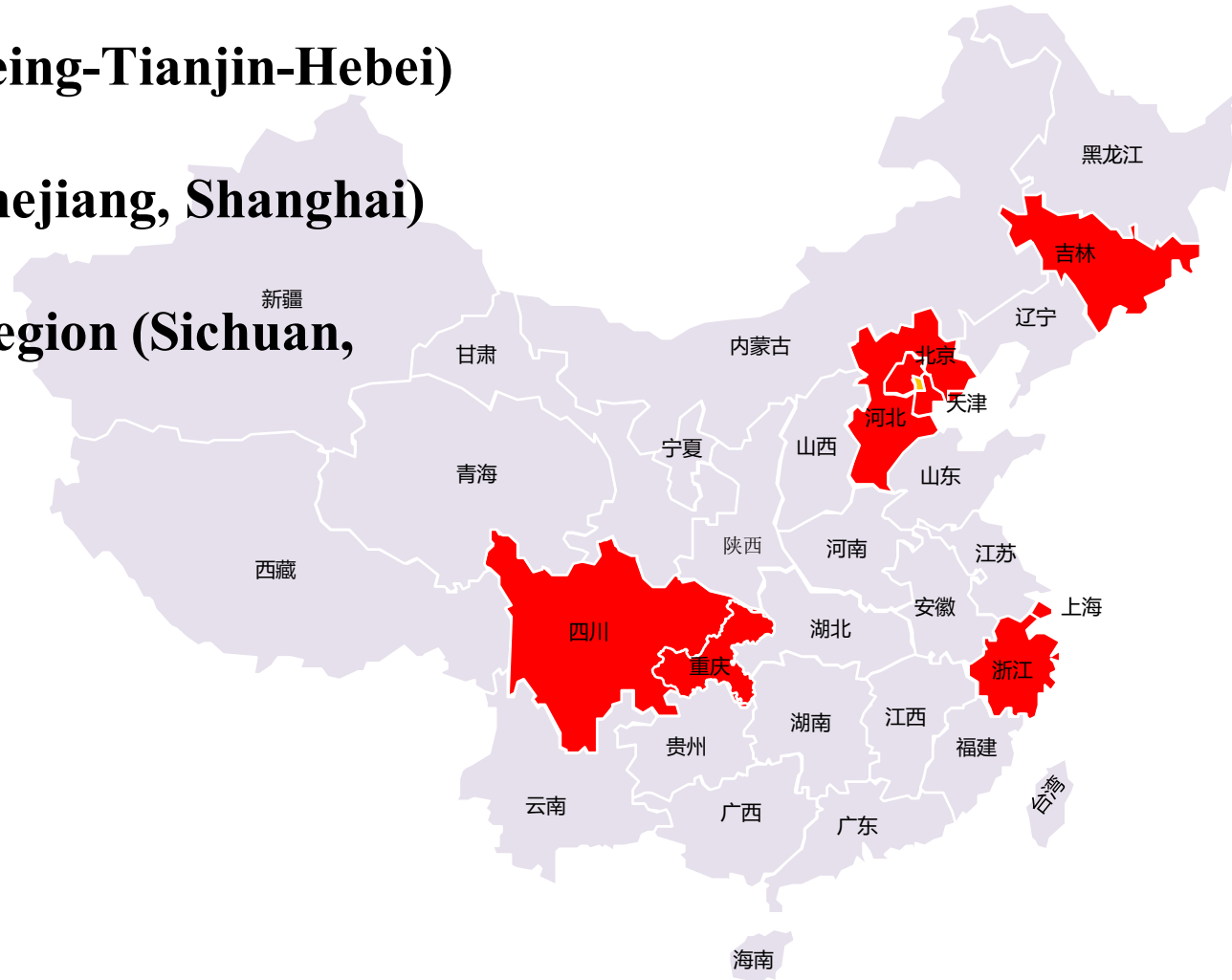

Urban Transit / C-ITS

Tunnel/weather Simulation

Active Safety

EMC, Simulator, other labs

Full automatic driving

DSRC/LTE-V/LAN
DSRC/LTE-V

Large scale road tests on open road

- **Northeast Region (Jilin)**

- **North China (Being-Tianjin-Hebei)**

- **South China (Zhejiang, Shanghai)**

- **Southwestern Region (Sichuan, Chongqing)**

- **……**

Thank you!