V2X R&D PROGRESS IN CHANGAN

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Director, Advanced Communication Lab
Changan Auto
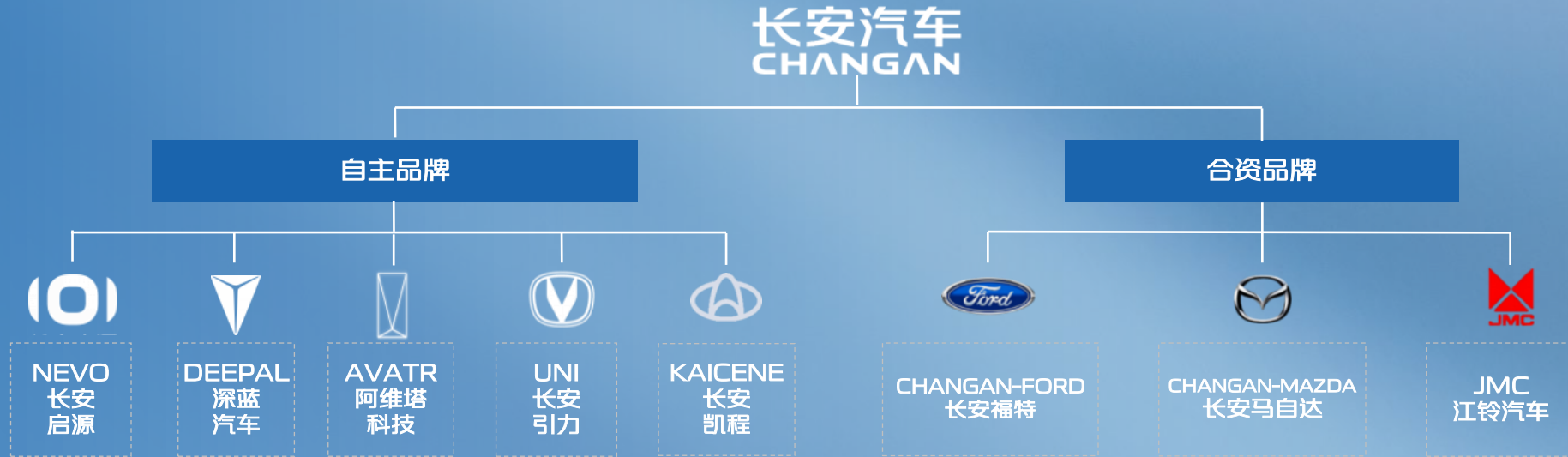
科技长安　智慧伙伴

CONTENTS

长安汽车
CHANGAN

1.长安汽车介绍
ABOUT CHANGAN

BASIC INFORMATION OF CHANGAN

企业基本信息

Diversified brands: ENVO, DEEPAL, AVATR, UNI, KAICENE，Changan Ford，Changan Mazda, JMC, etc.

涵盖长安启源、深蓝、阿维塔、长安引力、长安凯程等自主品牌，以及长安福特、长安马自达、江铃等合资品牌。

Rich product line-up: Models covering passenger vehicles, pick-ups and light-duty commercials.

产品覆盖乘用车、皮卡和轻型商用车市场。

长安汽车 CHANGAN

自主品牌	合资品牌

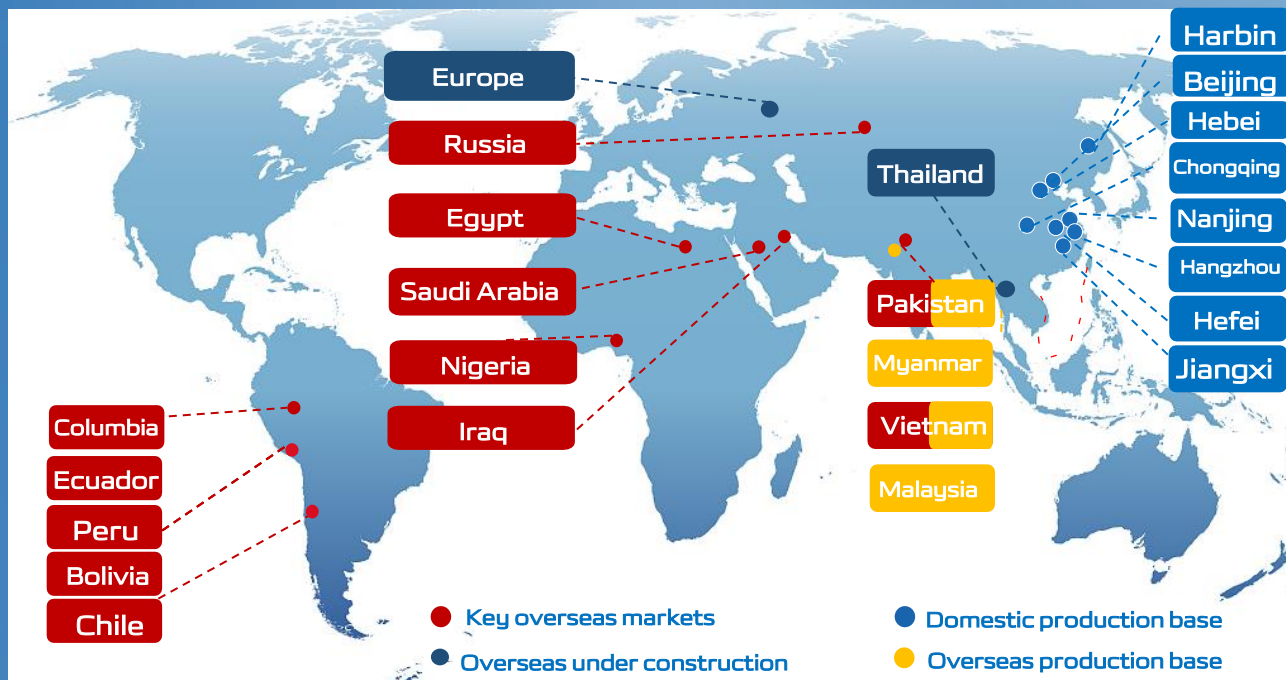| NEVO 长安 启源 | DEEPAL 深蓝 汽车 | AVATR 阿维塔 科技 | UNI 长安 引力 | KAICENE 长安 凯程 | CHANGAN-FORD 长安福特 | CHANGAN-MAZDA 长安马自达 | JMC 江铃汽车 |

GLOBAL FOOTPRINT

全球产业布局

72,000 employees, creating over 1 million jobs across the industrial chain.
现有员工7.2万人，带动全产业链100余万人就业。

Our market capitalization stands at RMB 210 billion.
公司资产规模2100亿元。

Map Labels	
Europe	Harbin
Russia	Beijing
Egypt	Hebei
Saudi Arabia	Chongqing
Nigeria	Nanjing
Iraq	Hangzhou
Columbia	Hefei
Ecuador	Jiangxi
Peru	Thailand
Bolivia	Pakistan
Chile	Myanmar
	Vietnam
	Malaysia

- 🔴 Key overseas markets
- ⚫ Overseas under construction
- 🔵 Domestic production base
- 🟡 Overseas production base

73 branches & subsidiaries
家分子公司

12 manufacturing bases
个全球制造基地

22 Vehicle and new power plants
个整车及新动力工厂

63 countries & regions
个海外销售国家和地区

9000 dealerships / nearly 120,000 service staff
9000余家销售服务网点 / 近12万名专业服务人员

LEADING REPRESENTATIVE OF CHINESE BRANDS

中国品牌的典型代表

Total Sales in 2023

The total sales of Changan in 2023 exceeded

2.55 million units

长安汽车2023年

总销量突破255万辆

Private Brands

The total sales of private brands under Changan exceeded

2.09 million units

长安汽车自主品牌2023年

总销量突破209万辆

New Energy

The total sales of new energy under Changan exceeded

0.48 million units

长安汽车新能源2023年

总销量突破48万辆

Overseas

The overseas total sales of Changan in 2023 exceeded

0.35 million units

长安汽车2023年海外

总销量突破35万辆

GLOBAL R&D LAYOUT

全球研发布局

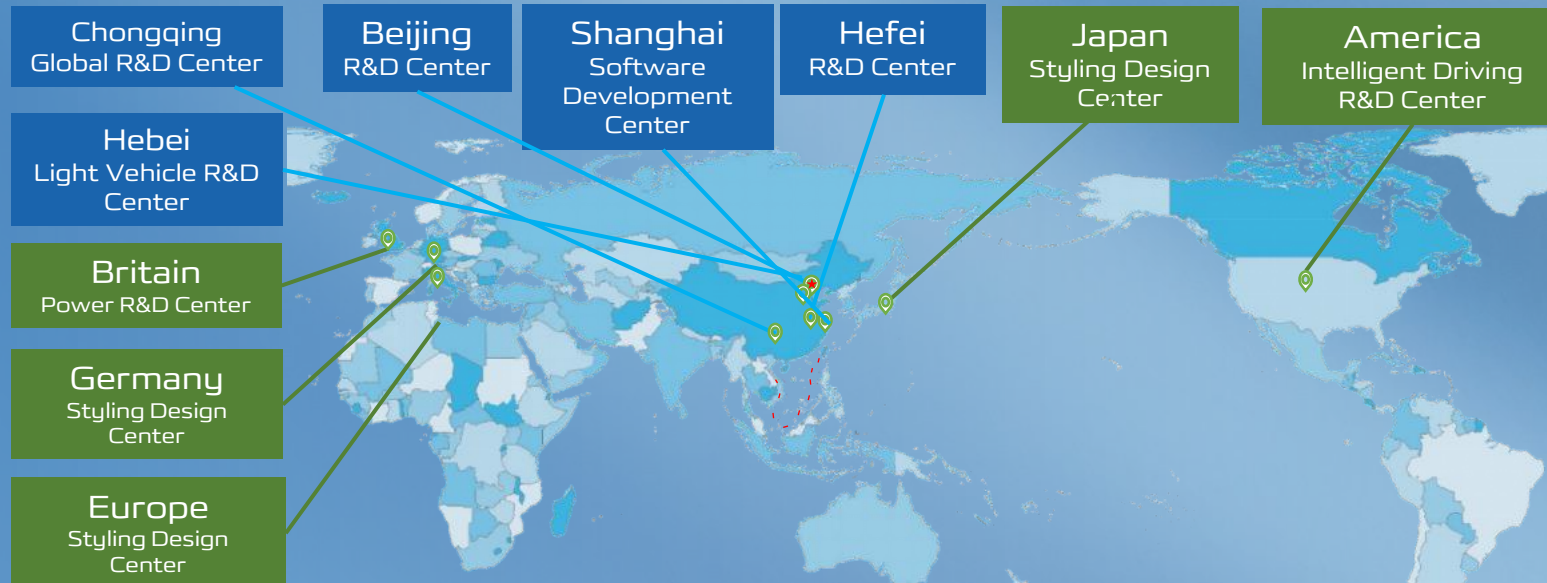Around-the-clock: Global R&D network of "six countries and ten centers".

"六国十地"全球研发布局，24小时协同研发。

16 technology research & product development centers, 17 tech companies.

共有16个技术研究、产品开发中心，17家科技公司。

A R&D team of 18,000 people from 30 countries (over 13,000 R&D staff).

拥有来自全球30个国家，1.8万余人的工程技术团队（研发人员1.3万余人）。

Chongqing
Global R&D Center

Beijing
R&D Center

Shanghai
Software
Development
Center

Hefei
R&D Center

Japan
Styling Design
Center

America
Intelligent Driving
R&D Center

Hebei
Light Vehicle R&D
Center

Britain
Power R&D Center

Germany
Styling Design
Center

Europe
Styling Design
Center

长安汽车
CHANGAN

2.长安对V2X的理解

OUR V2X UNDERSTANDING

"DUAL EYES + DUAL BRAIN"

打造"双眼+双脑"的车路云一体化技术

□ V2X Technology: Advances in communication and sensing enable vehicles to perceive road conditions in real-time, facilitating information exchange between vehicles, roads, pedestrians, and the cloud.

V2X技术：在单车智能基础上，通过先进的通信、感知、定位设备，对道路环境进行全域实时感知，按照约定的协议进行数据交互，实现车与车、车与路、车与人、车与云之间的信息交互共享。

□ Vehicle-Road-Cloud Integrated System: Integrates physical and digital spaces of humans, vehicles, roads, and the cloud using advanced technologies, aiming for a coordinated, safe, energy-efficient, and effective intelligent vehicle transport system.
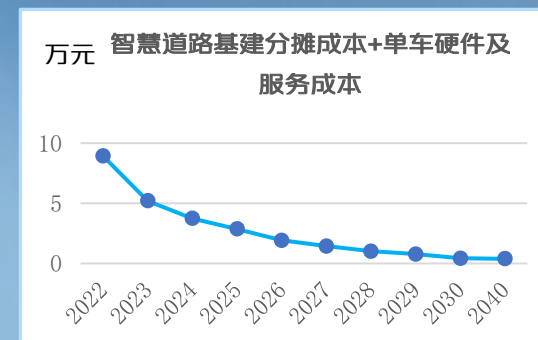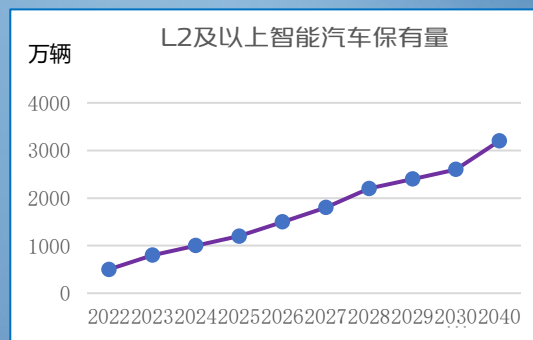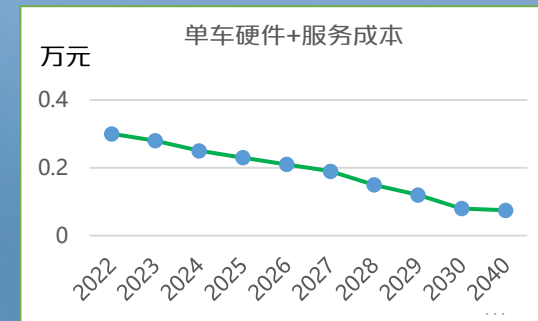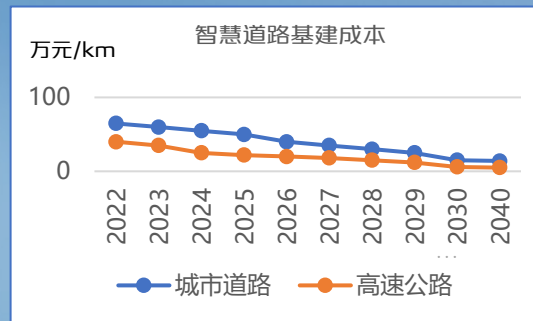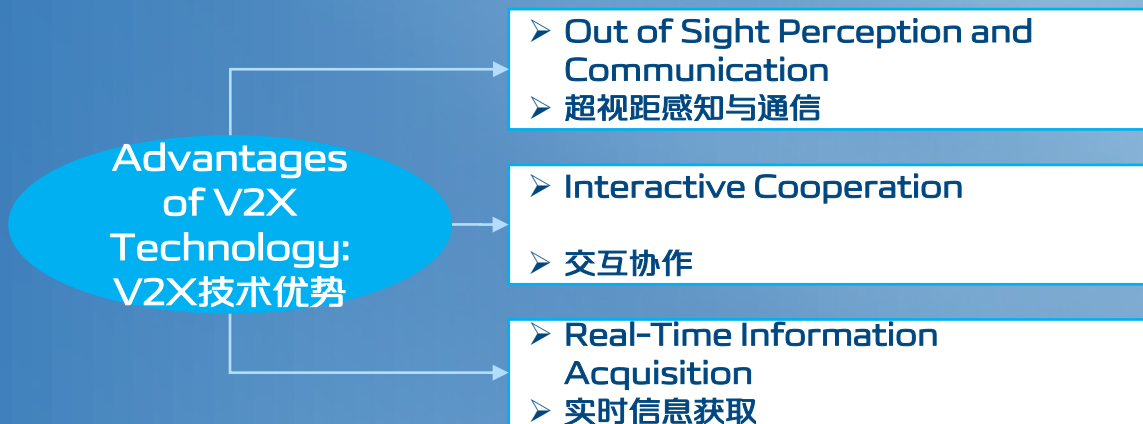
车路云一体化系统：通过新一代信息与通信技术将人、车、路、云的物理空间、信息空间融合为一体，基于系统协同感知、决策与控制，实现智能网联汽车交通系统安全、节能、舒适及高效运行的信息物理系统。
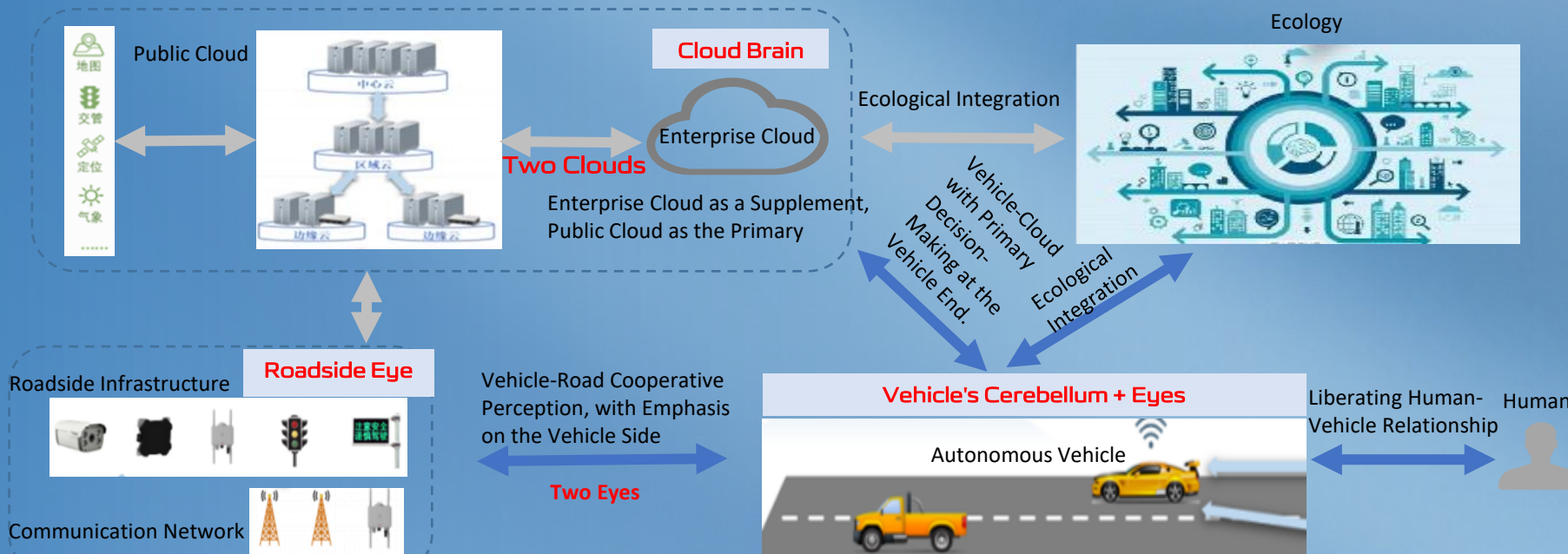
VALUE OF V2X FOR INTELLIGENT CONNECTED VEHICLES

V2X对智能网联汽车的价值

- ☐ Empowerment: V2X technology enhances vehicle perception, enabling comprehensive, real-time interaction between vehicles, roads, people, and the cloud, thus improving safety, efficiency, and user experience.
  赋能：V2X技术可扩展单车感知能力，实现全方位的车-车、车-路、车-人、车-云实时动态信息交互，从安全和效率上提高车辆智能化、网联化水平，提升用户体验。

- ☐ Cost Reduction: The shared cost per vehicle for V2X will tend to decrease as the technology matures and road construction schemes become standardized.
  降本：V2X单车分摊成本会随着技术的成熟及道路建设方案的标准化呈现减少趋势

Advantages of V2X Technology:
V2X技术优势

➤ Out of Sight Perception and Communication
➤ 超视距感知与通信

➤ Interactive Cooperation
➤ 交互协作

➤ Real-Time Information Acquisition
➤ 实时信息获取

智慧道路基建成本
万元/km
100 ─ 0
2022 2023 2024 2025 2026 2027 2028 2029 2030 2040
━●━ 城市道路 ━●━ 高速公路

单车硬件+服务成本
万元
0.4 ─ 0.2 ─ 0
2022 2023 2024 2025 2026 2027 2028 2029 2030 2040

L2及以上智能汽车保有量
万辆
4000 3000 2000 1000
2022 2023 2024 2025 2026 2027 2028 2029 2030 2040

智慧道路基建分摊成本+单车硬件及服务成本
万元
10 ─ 5 ─ 0
2022 2023 2024 2025 2026 2027 2028 2029 2030 2040

R&D HISTORY

研发历程

☐ Changan started researching V2X in 2012, and has been deeply involved in the development of China's V2X industry in terms of standard setting, application scenario exploration, and test and demonstration operations

长安最早从2012年开始研究V2X，在标准制定、应用场景探索、测试示范运营等多方面深度参与了中国V2X行业发展

2012年
承接国家"863"计划车联网项目
Undertake the national '863' plan car networking project

2015年
基于DSRC开展V2X应用研究
V2X application research based on DSRC

2017年
牵头制定中国第一部V2X应用层标准
Led the development of China's first V2X application layer standard

2018年
完成软件硬件从DSRC向LTE-V2X的移植和切换
Migration and switching of software and hardware from DSRC to LTE-V2X

2021年
开发中国V2X DAY1应用原型，开展测试演示和示范运行
Development of China V2X DAY1 application prototype, test demonstration and demonstration operation

2022年
自研V2X协议栈全栈软件，实现V2X功能服务化
Self-developed V2X protocol stack full-stack software, realizing V2X functionality as a service

2023年+
V2X量产落地探索，车路云一体化原型验证
V2X mass production landing exploration, Vehicle-Road-Cloud integration prototype verification

STANDARD SETTING

标准制定

☐ Changan led the development of China's first V2X application layer standard and participated in the development of a number of China's V2X national, industry, and group standards, and has now established a V2X enterprise standard system catalog and released various V2X enterprise standards.

长安牵头制定了中国第一部V2X应用层标准，并参与多项中国V2X国家、行业、团体标准制定，现已建立V2X企业标准体系目录，发布多项V2X企业标准
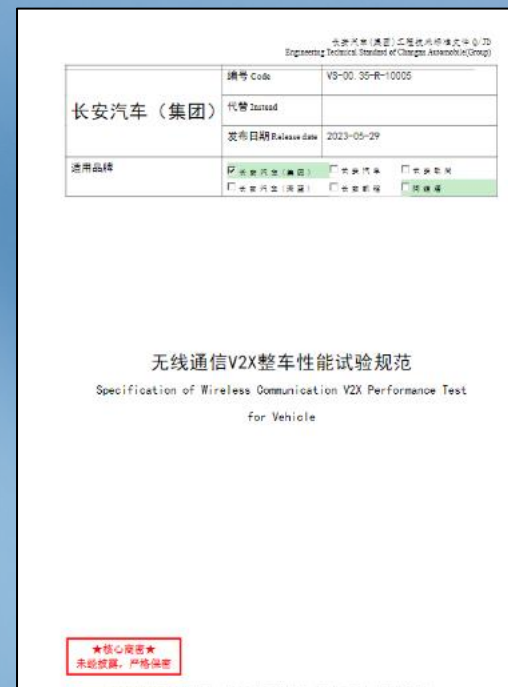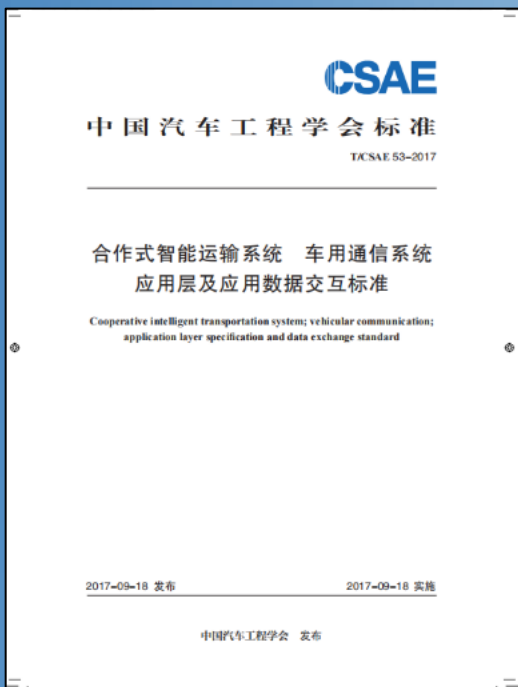
APPLICATION SCENARIO EXPLORATION

应用场景探索

☐ Multi-dimensional exploration of V2X application scenarios, has developed and verified 20+ V2X function prototypes, dedicated to meet the safety, efficiency, comfort and other requirements of driving and parking scenarios.
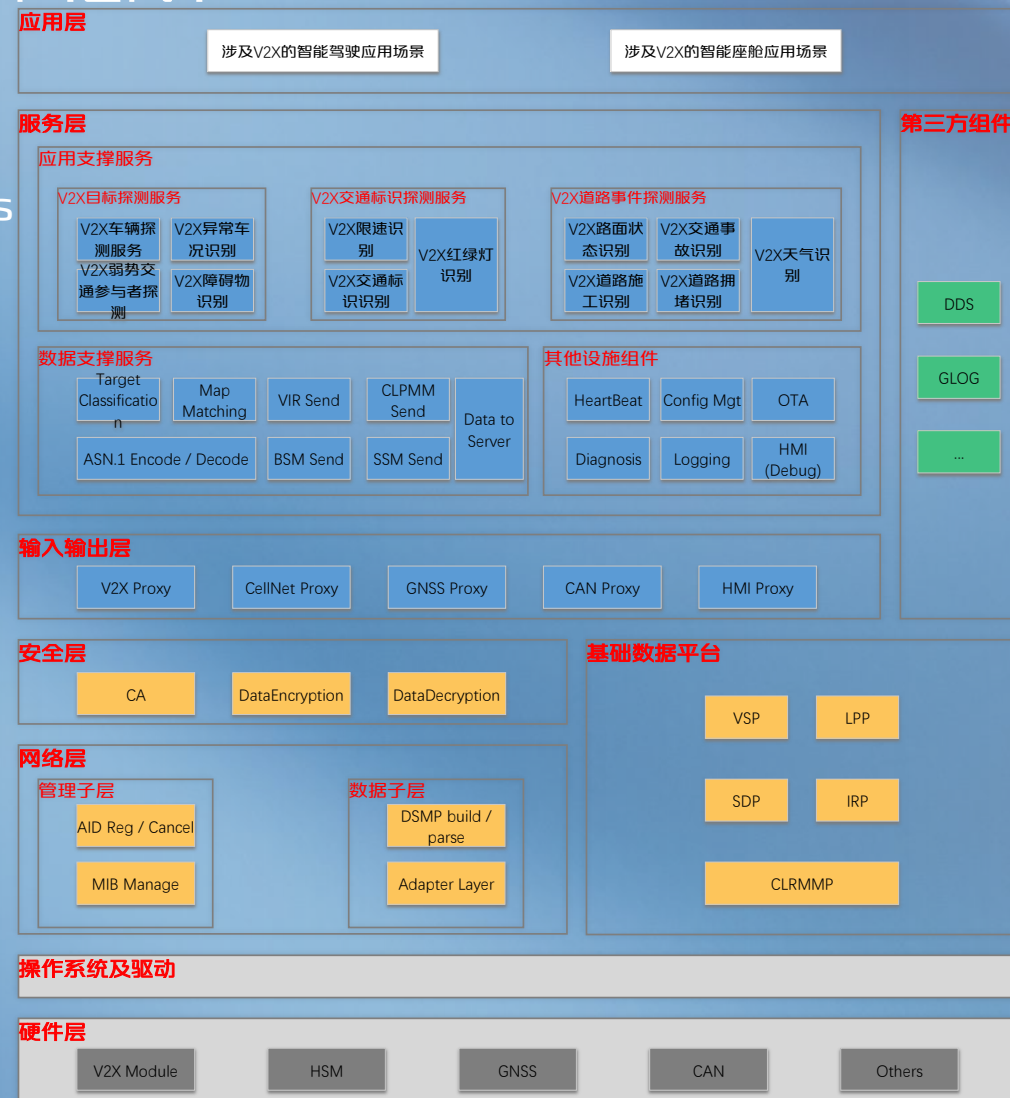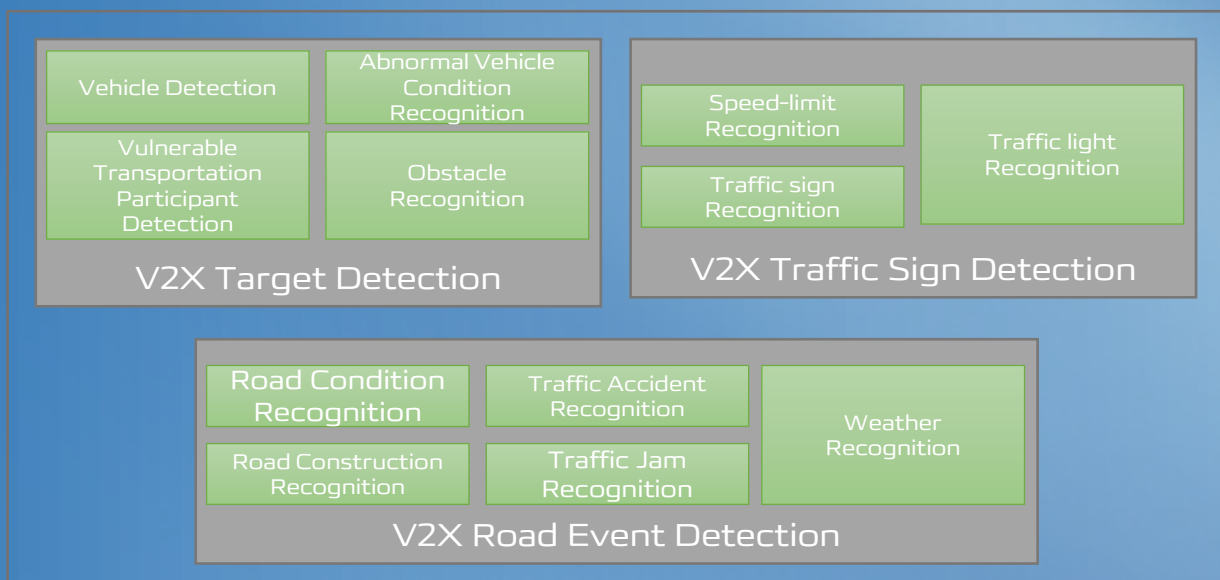
多维度探索V2X应用场景，已开发并实车验证20+项V2X功能原型，致力于满足行车和泊车两大用户场景下的安全、效率、舒适等诉求

Do Not Pass Warning

Green Light Optimal Speed Advisory

Platooning

C-ADAS

VEHICLE PROTOCOL STACK DEVELOPMENT

车端协议栈开发

☐ Completed the design of V2X data servitization at the vehicle end, and realized the design of three major categories and twelve subcategories of atomic services
完成车端V2X数据服务化设计，实现三大类12小类原子服务设计

☐ Completely self-developed full stack of V2X protocol stack network layer, security layer, I/O layer messaging and service layer, and application layer
完全实现V2X协议栈网络层、安全层、I/O层、消息和服务层、应用层的全栈自研

V2X Target Detection

| Vehicle Detection | Abnormal Vehicle Condition Recognition |
| Vulnerable Transportation Participant Detection | Obstacle Recognition |

V2X Traffic Sign Detection

| Speed-limit Recognition | Traffic light Recognition |
| Traffic sign Recognition | |

V2X Road Event Detection

| Road Condition Recognition | Traffic Accident Recognition | Weather Recognition |
| Road Construction Recognition | Traffic Jam Recognition | |

应用层

涉及V2X的智能驾驶应用场景　　涉及V2X的智能座舱应用场景

服务层　　　　　　　　　　　　　　　　　　　　　　　第三方组件

应用支撑服务

V2X目标探测服务	V2X交通标识探测服务	V2X道路事件探测服务
V2X车辆探测服务 / V2X异常车况识别	V2X限速识别 / V2X红绿灯识别	V2X路面状态识别 / V2X交通事故识别 / V2X天气识别
V2X弱势交通参与者探测 / V2X障碍物识别	V2X交通标识识别	V2X道路施工识别 / V2X道路拥堵识别

DDS

GLOG

...

数据支撑服务　　　　　　　　　　　其他设施组件

| Target Classification | Map Matching | VIR Send | CLPMM Send | Data to Server | HeartBeat | Config Mgt | OTA |
| ASN.1 Encode / Decode | BSM Send | SSM Send | | | Diagnosis | Logging | HMI (Debug) |

输入输出层

| V2X Proxy | CellNet Proxy | GNSS Proxy | CAN Proxy | HMI Proxy |

安全层　　　　　　　　　　　　　　　　　　　　　基础数据平台

| CA | DataEncryption | DataDecryption |　　VSP　LPP

网络层

管理子层　　　　　　数据子层

| AID Reg / Cancel | DSMP build / parse |　　SDP　IRP
| MIB Manage | Adapter Layer |

CLRMMP

操作系统及驱动

硬件层

| V2X Module | HSM | GNSS | CAN | Others |

TEST AND EVALUATION CAPACITY-BUILDING

测试评价能力建设

☐ Professional model vehicle modification team and capability to modify V2X model vehicles of various automation levels based on customized architecture
具备专业的样车改制团队和能力，可基于定制化架构改制各种自动化等级的V2X样车

☐ A semi-enclosed site for V2X network connectivity testing, with intelligent roadside equipment such as communication, sensing, and computing
具备开展V2X网联化测试的半封闭式场地，场地内具备通信、感知、计算等智能路侧设备

☐ V2X emulation test bench being built to support V2X HIL and VIL emulation testing
正在搭建V2X仿真测试台架，支持V2X HIL和VIL仿真测试

TEST DEMONSTRATION & DEMONSTRATION OPERATION

测试演示&示范运营

☐ Participated in domestic and international V2X related test demonstrations and demonstration operations for many years

连续多年积极参与国内外V2X相关测试演示、示范运营实践活动

Invited to conduct a live V2X demonstration
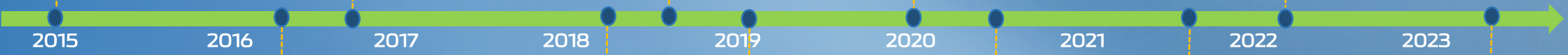
First cross-enterprise V2X interconnect demo

Wuxi World IOT Expo LTE-V2X City-level demonstrations

First to realize demonstration operation for the public

Changan Global R&D Center Campus V2X live vehicle testing

2015   2016   2017   2018   2019   2020   2021   2022   2023

Live Car Demonstrations at the MTC Annual Meeting

First public demonstration of L4 intelligent driving
（Fuzhou Digital China Summit）

Continuous participation in China C-V2X "three-span", "four-span" and "new-four-span" test drive program

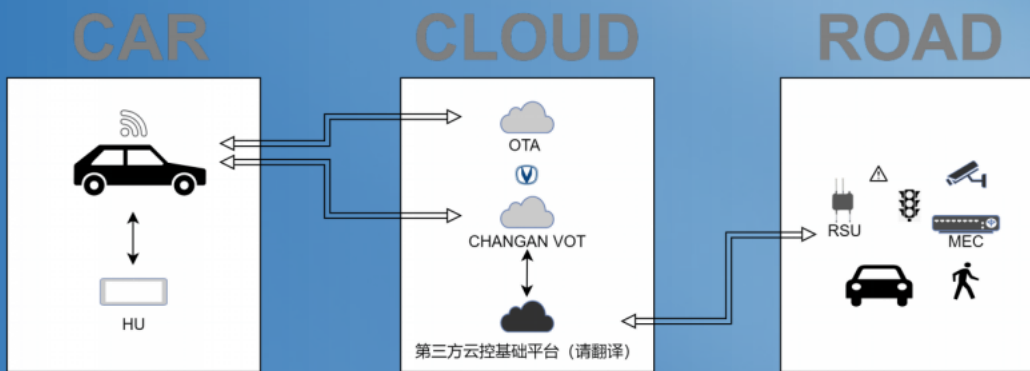Validation of C-V2X Functions Based on Map Secrecy Plug-in

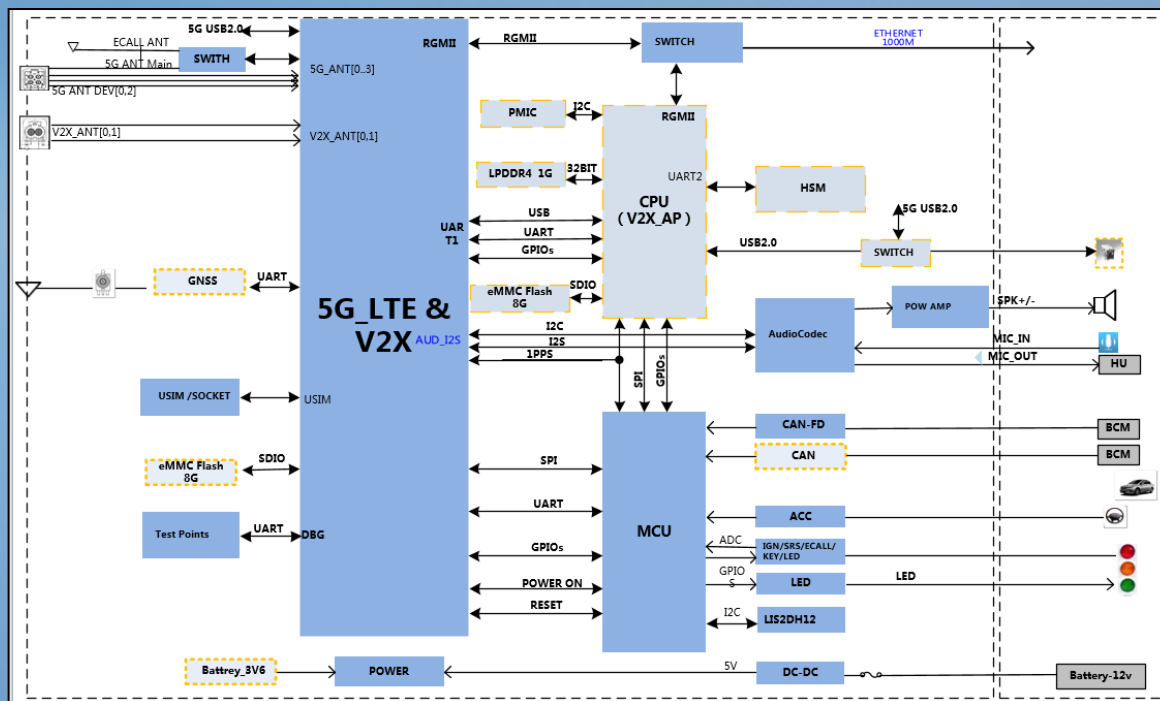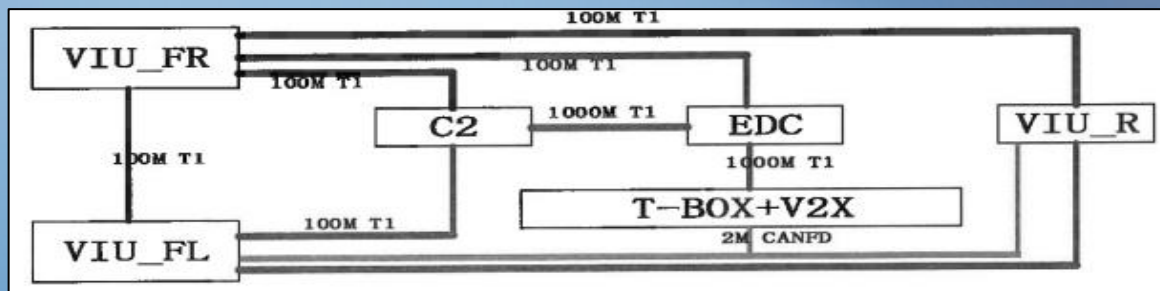# MASS PRODUCTION DEPLOYMENT PROGRAM VALIDATION

量产部署方案验证

☐ Exploring mass production deployment options for V2X functionality in different communication modes(Uu、PC5）

探索不同通信模式（Uu、PC5）下V2X功能的量产部署方案

CAR   CLOUD   ROAD

Third-party cloud control infrastructure platform

4.未来规划

FUTURE PLANNING

□ Recently the V2N solution has been used to promote the upgrade and deployment of V2X warning alerts on production vehicles

近期以V2N方案推进V2X预警提醒功能在量产车上的升级部署

□ Conducting prospective research on V2X and intelligent driving fusion, and choosing the right time to advance mass production

同步开展V2X与单车智能融合功能预研，择机推进网联式自动驾驶量产

基于Uu的网联预警提醒功能

Uu-based networking warning alert function

融合V2X的网联式自动驾驶功能

Connected automatic driving with V2X

Thank you for your attention!

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CHANGAN SMART PARTNER OF SCIENCE AND TECHNOLOGY

科技长安 智慧伙伴