Overview on System Safety Standards and Practices for ICVs and NEVs in China
A Different Approach

William Zeng

SCSSS2025_SafeCamp2025

9 Sept.2025, Stockholm

William Zeng (Licentiate of Engineering) and Roben Automotive

Married with one daughter and one son - Live in Torslanda/Gothenburg, Sweden

- **30+ years work experience cross a number of industry segments**
  - Industrial automation mainly
- **7+ years R&D in ABB Sweden – Process Automation and Substation Automation**
  - System engineer
  - Member of Swedish national technical standardization committee SEK/TK 65
- **10+ years with ABB China (Beijing and Shanghai)**
  - Cross a number of industry domains e.g. Metals, Oil, Gas and Chemical, Pulp & Paper, Miming, Marine
  - A number of role-taking as Automation Technology Specialist, DCS Product Manager, Functional Safety Champion, Sales & Marketing Manager, Team & Business development and management, Technical Standardization Leader
  - Leadership roles in key regional technology associations (FF and PROFIBUA/PROFINET)
  - Member of national Technical Committee SAC/TC124 and its Sub-Committees (SC4 and SC10 – Functional Safety centered) in China
- **5+ years in CEVT (China Euro Vehicle Technology AB) since Sept. 2017**
  - System Safety Management at both system level (powertrain domain) and vehicle level
  - Participate in and lead a number of product development projects from system safety perspective
  - System Safety support in various forms (training, evaluation, standard clarification, etc.)
- **Roben Automotive AB in 2nd half 2022, be part of the golobal ROBEN Network**
  - CEO and Founder
  - Technical and Management Consultancy
  - System Safety Management in product & process development
  - Interactions with CN market







Examples of international conferences ROBEN presented in recent years

Roben staff is on various SAE and VDA conferences and standardization committees
Also, Roben is a frequent speaker at a variety of events. Some highlights:

The cure for overgrown process garden, or why engineers give up with ASPICE
SAE World Congress 2026, Detroit, MI, USA (scheduled)

Western markets: Trade-off between safety & security mechanisms and service & repair costs
SAE China Safety & Security Symposium 2025 – Shanghai, China (in cooperation with Rivian-VW Technologies)

The challenging balance between regulations in RMI, EU7 Anti-tampering, R156 SW Updates, R155 CyberSec, etc.
SAE OBD Europe 2025 – Porto, Portugal

Briefing on Functional safety and Cyber security standards, regulations and practices in vehicle automation systems
(IEC) SAC/TC124 and sub-committees Annual Plenary Meeting 2024 – Shanghai, China

Diagnostics: Vehicle Health from Driver to AI
SAE Vehicle Automation Symposium 2024 – Frankfurt, Germany

Holistic approach streamlined vehicle Functional Safety & Cyber Security engineering
Scandinavian System & Software Safety 2023 – Stockholm, Sweden

Euro7 On Board Monitoring & Virtual Sensors
SAE OBD Europe 2023 – Prague, Czech Republic (in cooperation with DEP)

Design considerations fail-operational steering system
SAE OBD Americas 2022 – Anaheim CA, USA (in cooperation with Chassis Autonomy)

The ever-changing powertrain – OTA changes in powertrain lifetime
SAE Powertrains & Fuels 2022 – Krakow, Poland

Diagnostics & Safety concept for a two-speed e-axle
SAE OBD Europe 2021 - Digital

Driver behavior assumptions in safety situations for automated driving
IQPC HMI/Interior for automated vehicles – Berlin, Germany

ROBEN

Statement

What to be presented is based upon my own observations

personal views

System Safety

in an extended context beyond technology only

Do the names sound familiar to you … ?

CATL 宁德时代

Baidu 百度

Alibaba

deepseek

DiDi

NIO

XPENG

Li Auto

京东

ZEEKR

BYD

UEFA EURO 2024™ Official Partner

LEAPMOTOR

UNITREE

MG

GWM

GEELY

dji

HUAWEI

apollo

autox

TikTok

pony.ai

LOTUS

HESAI

robosense

小红书

POP

caocao

WeChat

LaBuBu

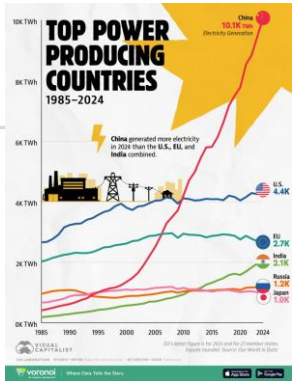
CHERY

CHANG 亿航

Haier

Tencent 腾讯

China Auto industry in the global context



- Largest global automotive market by production & sales
  - 31M+ units in production and sales in 2024
    - 22.89M+ units passenger cars – 10.9M NEVs (47.7%)
    - 6.41M units exported (led by Chery Auto.)
- NEVs & ICVs are national strategic priorities
  - 60% of global NEV sales
  - 70%+ of global EV batteries made in China
- Strong industry policies and support measures (subsidies & incentives) as well as coordinated implementation
- Extensive EV supply chain & dynamical Eco-systems
- Comprehensive Infrastructure top-rated
- Innovation & Entrepreurship – Result oriented
- Leading in AI together with US - Data-driven Iteration
- Fast development cycle - Business Scale
- Undergoing **consolidation**

Standard-equipped penetration rate of L2 and L2+ ADAS functions in China's passenger car market

- 48% (66.4% for NEVs) in 2024
- 56% (82.6% for NEVs) in H1 2025
  - > 7% L2++

The number of charging piles in China-EU-USA

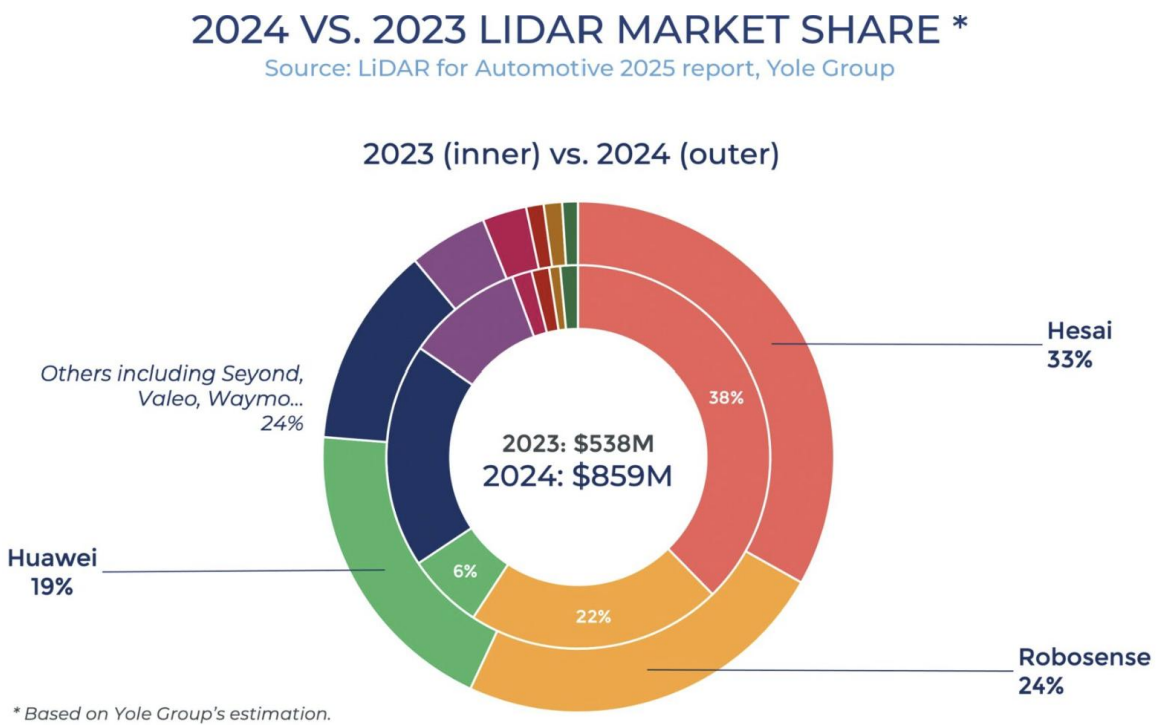
- CN: 4.096M (public) + 12.04M (private) by H1 2025
  - 12.82M (3.6M public + 9.25M private) in 2024
- EU-27: 0.88M i(public) in 2024 – 1M+ in Jul. 2025
- USA: 0.37M expected in 2025

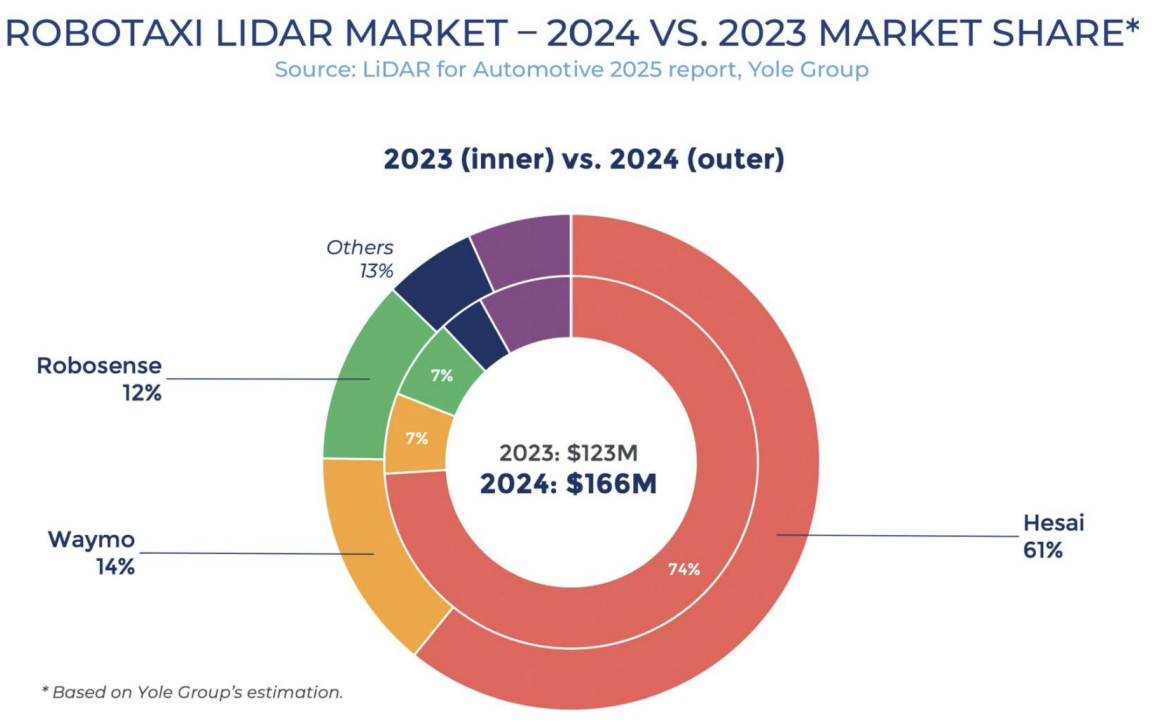
The number of 5G base stations in China-EU-USA

- CN: 4.251M (public) + 4.55M by H1 2025
- EU-27: 0.5M in 2024
- USA: 0.34M expected in 2025

Safety & Cybersecurity & Data Privacy remain very essential aspects of NEVs and ICVs

LiDAR deployment plays an important role in ICVs for safety





In 2024 Hesai delivered 501,889 LiDARs for

- ADAS: 456386 units
- L4 Robotaxi – top Robotaxi companies use Hesai's LiDARs with **61%** market share
  - WeRide, Pony-ai, Baidu Apollo Go, DiDi, Zoox, Momenta, AutoX, etc.
- Industrial Robots

Mercedes-Benz will use LiDARs from Hesai for their future vehicles equipped with DRIVE PILOT system

In China, over 150 production models already use LiDAR, from USD 25K to USD 120K vehicles

Src: Yole Group

A briefing of China NEVs and ICVs Evolution History

Strategic blend of policy foresight, technological breakthroughs and visionary leadership

Key Milestones and Policies

1 Early Policy Foundations (2001–2012)

863 Program (2001)
China's first systematic R&D push for EVs (Hybrid, BEV and Fuell Cell) - "Three Vertical, Three Horizontal" framework
Laid a groundwork for core competencies in batteries, motors, and control systems (Three E)

Ten Cities, Thousand Vehicles Pilot (2009)
Deployed 10K NEVs across 10 cities by 2012, primarily in public fleets, to accelerate market adoption and infrastructure development.

2012 Industry Development Plan
Set targets for NEV sales (0.5M units by 2015) and established R&D priorities, including battery energy density improvements

2 Market Expansion and Global Competitiveness (2013–2020)

NEV Purchase Subsidies (2013–2022)
Direct consumer incentives spurred annual sales growth f

Tesla Gigafactory Shanghai (2019)
The 1st fully foreign-owned EV plant in China
It has catalyzed domestic supply chains, with 95% local c

Dual-Credit Policy (2017)
Mandated automakers to meet NEV production quotas or

3 Post-Subsidy Innovation and ICV Integration (2021–Present)

2021 NEV Industry Plan
Targeted 20% NEV sales penetration by 2025 (achieved in

New Infrastructure Push (2020)
Invested USD 150B in 5G, V2X networks, and smart roads,

Data Security Regulations (2022):
Standardized ICV data management, balancing innovatio

Technological Breakthroughs

1 Batteries: From Dependency to Dominance

BYD Blade Battery (2020)
Revolutionized safety with a structural design that elimina

CATL's Qilin Battery (2022):
Achieved 255 Wh/kg energy density, enabling 1,000 km ran

Solid-State R&D
Tsinghua University's professor Ouyang Minggao led brea

2 Autonomous Driving and AI

Baidu Apollo (2017)
Open-sourced its L4 autonomous platform, partnering with FAW and BAIC to deploy Robotaxi fleets in 30+ cities. By 2025, Apollo Go had completed 10 million rides

Huawei ADS 2.0 (2023)
Eliminated reliance on high-precision maps, achieving city navigation in 50+ cities. Its "one-size-fits-all" solution powers AITO and Chery models

XPeng XNGP (2024)
Adapt end-to-end AI architecture and supports NGP (Navigation Guided Pilot) for Highway, City and Valet Parking - Lead AI-Defined- Vehicle development via Data-driven

3 Electrification of Core Components

BYD's SiC Chips (2021)
Reduced powertrain energy loss by 70%, breaking Infineon's monopoly and supplying Tesla

CATL's Cell-to-Chassis (CTC)
Integrated batteries into vehicle frames, boosting range by 15% and slashing production costs

Key Figures

1 Policy Architects

Wan Gang
As Minister of Science and Technology (2007–2018), he championed the 863 Program and NEV subsidies, earning the title "Father of China's EV Revolution
"Father of China's EV Revolution" as named

Li Keqiang
Professor in Tsinghua University pushed for ICV standardization and the "Made in China 2025" initiative, prioritizing EV-ICV integration.

2 Industry Titans

Wang Chuanfu (BYD)
Transformed BYD from a battery maker into a vertically integrated EV giant, with 2025 sales 5.52M units expected (4.27M in 2024)

Elon Musk (Tesla)
His Shanghai Gigafactory forced domestic automakers to innovate and globalized China's EV supply chain

Li Shufu (Geely)
Acquired Volvo Cars and Lotus, leveraging their tech for Zeekr's premium EVs and Geely's L3 autonomous systems

3 Innovators

He Xiaopeng (XPeng)
Developed the XNGP system and partnered with Volkswagen on EE architecture, marking China's first core tech export to a global OEM

Zhu Jiangming (Leapmotor)
Deep Vertical Integration with efficient R&D creating cost-effective smart cars like the C10, with 2025 sales up 107% YoY.
Partner with Stellantis for global push

Yu Chengdong (Huawei)
Built Huawei's smart car unit into a USD 10B business, powering 15+ car models across 8 brands

Global New Car Sales (Jan. – Jun. 2025)

2025年1～6月全球新车销量前11名

排名	车企	销量（万辆）	增减率
1	丰田	554	7%
2	大众	440	1%
3	现代汽车.起亚	365	1%
4	通用	298	8%
5	Stellantis	266	-7%
6	福特	215	-1%
7	比亚迪	214	33%
8	吉利	193	29%
9	本田	178	-5%
10	铃木	163	-2%
11	日产	161	-6%

Local brands outplay the international brands which are seeking inspirations & cooperation from the locals

Examples of business models: Competition & Cooperation

Huawei ”Five Realms” of HarmonyOS Intelligent Mobility

RMB 150K- 1.01M

Business Vertical Integration

Dynasty Series

Qin/Han/Tang/
Yuan/Song/E-SEED

Ocean Series

Dolphin/Seal/
Seagull/e2

Formula Leopard series off-road

Denza Series

Yangwang Series (U7&U8&U9) World Record

https://www.youtube.com/watch?v=CWmQpiFU9os

Briefing on Xiaomi Auto

China Speed

- In Mar. 2023 Xiaomi announced to start car business – On 1 Sept. 2021, Xiaomi Automobile Co., Ltd. is registered with RMB 10B.
- On 19 Mar. 2024, the Xiaomi Automobile Super Factory was officially inaugurated in Beijing with an annual production capacity of 300,000 units (1st and 2nd phases)
- Integrated Die Casting Technology
- Xiaomi **SU7** positioned as premium all-electric performance sedan was officially released on 28 Mar. 2024 – 135000 units delivered in 2024
  - 2.78S for 0-100 km, 265 km/h, 800V arch. for ultra-fast charging
  - "Supercar Slayer" in competing Tesla 3 and Porsche Taycan
- Xiaomi **YU7** (**SUV**) was released on 26 Jun. 2025 with its pre-orders exceeding 289,000 units within 1 hour of the official opening.
- On 10 Jul. 2025, the cumulative delivery of Xiaomi Automobile exceeded 300000 (0.3M) units – RMB 30B+ spent was said
- Xiaomi Group's market value placed 3rd in the world right after Tesla and Toyota and ahead of BYD
- Expected to becomes single season profitable in 2nd half of 2025
- Set up a robot laboratory in 2021, and later launched products like the bionic quadruped robot CyberDog and the full-size humanoid bionic robot CyberOne. In April 2023, Xiaomi registered & established "Beijing Xiaomi Robot Technology Co., Ltd." - 240+ robot-related patents have been filed up to 19 Aug. 2025
- Xiaomi integrates its tech in smartphones, smart homes and smart vehicles to build a full embodied intelligence ecosystem covering perception to execution.

Rank	Name	Market Cap	Price	Today	Price (30 days)	Country
1	Tesla TSLA	$1.062 T	$329.31	1.75%		USA
2	Toyota TM	$258.84 B	$198.60	0.39%		Japan
3	Xiaomi XIACF	$171.79 B	$6.69	2.62%		China
4	BYD 002594.SZ	$135.91 B	$15.07	0.58%		China
5	Ferrari RACE	$84.02 B	$471.50	1.80%		Italy
6	BMW BMW.DE	$64.44 B	$105.87	0.53%		Germany
7	Mercedes-Benz MBG.DE	$60.75 B	$63.10	0.04%		Germany
8	Volkswagen VOW3.DE	$58.15 B	$117.17	0.25%		Germany
9	General Motors GM	$54.32 B	$57.06	1.48%		USA
10	Maruti Suzuki India MARUTI.NS	$51.45 B	$163.65	0.04%		India

"Human x Car x Home" smart ecosystem

“2025 China Driverless Car Industry Market Environment Analysis and Consumer Behavior Survey Data“ by (Link)

2. Consumer Attitudes and Acceptance

- **42.31%** of Chinese consumers believe driverless cars are safer than human-driven vehicles, while **31.98%** still favor traditional driving [1].
- **69.5%** of consumers express willingness to purchase autonomous vehicles, indicating strong market potential [1].
- However, **62.73%** of consumers are concerned about **recognition and reaction capabilities**, while **45.39%** worry about **legal liability issues** [1].

3. Technological and Policy Developments

- China is advancing in **AI algorithms, high-precision maps, and automotive-grade chips**, with government policies supporting **demonstration zones and regulatory improvements** [1].
- **L2-level autonomous driving** has reached **50.56% penetration** in new energy vehicles, while **L3/L4** remains in testing phases [3].
- By 2030, **85% of vehicles** in China are expected to have **L2+ automation**, with **35% reaching L3+** [1].

4. Industry Challenges

- **Safety and technological maturity** remain key bottlenecks, particularly in **edge-case reliability** and **data security** [1].
- **Legal frameworks** for **accident liability** and **privacy protection** (e.g., **65.81%** fear personal data misuse) need strengthening [1] [6].

Src: iiMedia Research

Some of key Words in China 2025

When walking on the street in China you feel quiet and less smell of emission – due to rapid EV adaption in China
NEV is considered a default and a norm in China – No one talk about it

内卷
Involution

智驾平权
"Equal Access to Intelligent Driving"

AI-Defined-Vehicle

智能驾驶
Intelligent Driving

DeepSeek
Equal Access to AI

智驾座舱
Smart cockpit

端到端智能驾驶
End-to-End AI

2025年量产智驾上探，已经走到了L3落地元年
2025 is expected to see the start of mass production of L3 AD deployment

车 路 云 一体
Vehicle – Road – Cloud Integration

低空经济
Low-Altitude Economy

具身智能
Emboddied Intelligence

安全关注 & 法规跟进
Safety First – A shift from Innovation First triggered by the SU7 highway incident on29 Mar. 2025
Regulation & Law Enforcement

Xiaomi Incidents and action-takings by the Government

Xiaomi SU7 Anhui High-Speed Crash in NOA (Navigation on Autopilot mode in Mar. 2025: it collided with road barriers during highway construction, killing three occupants. The vehicle's doors failed to unlock, and the battery exploded, trapping victims. While Xiaomi claimed the driver had manually taken control before the crash, the family alleged design flaws in the locking mechanism and battery safety protocols. This incident exposed vulnerabilities in **autonomous driving handover protocols** and **battery thermal management**

January 2025 Recall and OTA Issues

Xiaomi recalled 12,521 SU7 vehicles due to software glitches in **intelligent parking assist**, which caused mis-judgments of static obstacles. The company resolved this via **OTA updates**, but the incident raised concerns about **unregulated software updates** and production quality control.

Government Measures Post-Incidents

a). Regulatory Crackdown on Autonomous Driving Claims

Terminology Standardization: In April 2025, the Ministry of Industry and Information Technology (MIIT) banned terms like "自动驾驶" (autonomous driving) and "高阶智驾" (high-level autonomous driving), mandating "组合辅助驾驶" (combined assistance driving) instead. Features like **valet parking** and **remote control** were prohibited from being marketed.

OTA Restrictions: Companies must now **register OTA updates with regulators** and cannot push 未经测试的 software. Xiaomi's HyperOS 1.8.4 update (July 2025), which added **误加速抑制功能** (false acceleration prevention), was one of the first to comply.

b). Safety Standard Upgrades

Battery Safety: MIIT revised the *Electric Vehicle Battery Safety Requirements*, requiring batteries to **resist thermal runaway** without fire or explosion. Tests now include **internal heating triggers** and **bottom impact resistance**.

c). Cybersecurity: The *Automotive Cybersecurity Technical Requirements* (effective 2026) mandate encryption for vehicle-to-cloud data and third-party audits of software ecosystems.

d). Industry-Wide Reforms

L3 Automated Driving Pilots: In April 2025, China launched L3 certification pilots in 9 cities, assigning accident liability to automakers when L3 function is on

Driver Training Mandates: MIIT now requires EV manufacturers to offer **free advanced driving courses**.

Broader Implications for China's EV Industry

a). Regulatory Paradigm Shift

The Xiaomi incidents accelerated China's transition from **innovation-first** to **safety-first** governance. Companies like **NIO** and **XPeng** have followed Xiaomi's lead in **voluntary recalls** and **user education programs**.

b). Consumer Trust Challenges

A 2025 survey by the China Consumers Association found **68% of EV buyers distrust autonomous driving claims**, up from 42% in 2024.

c). Global Ripple Effects

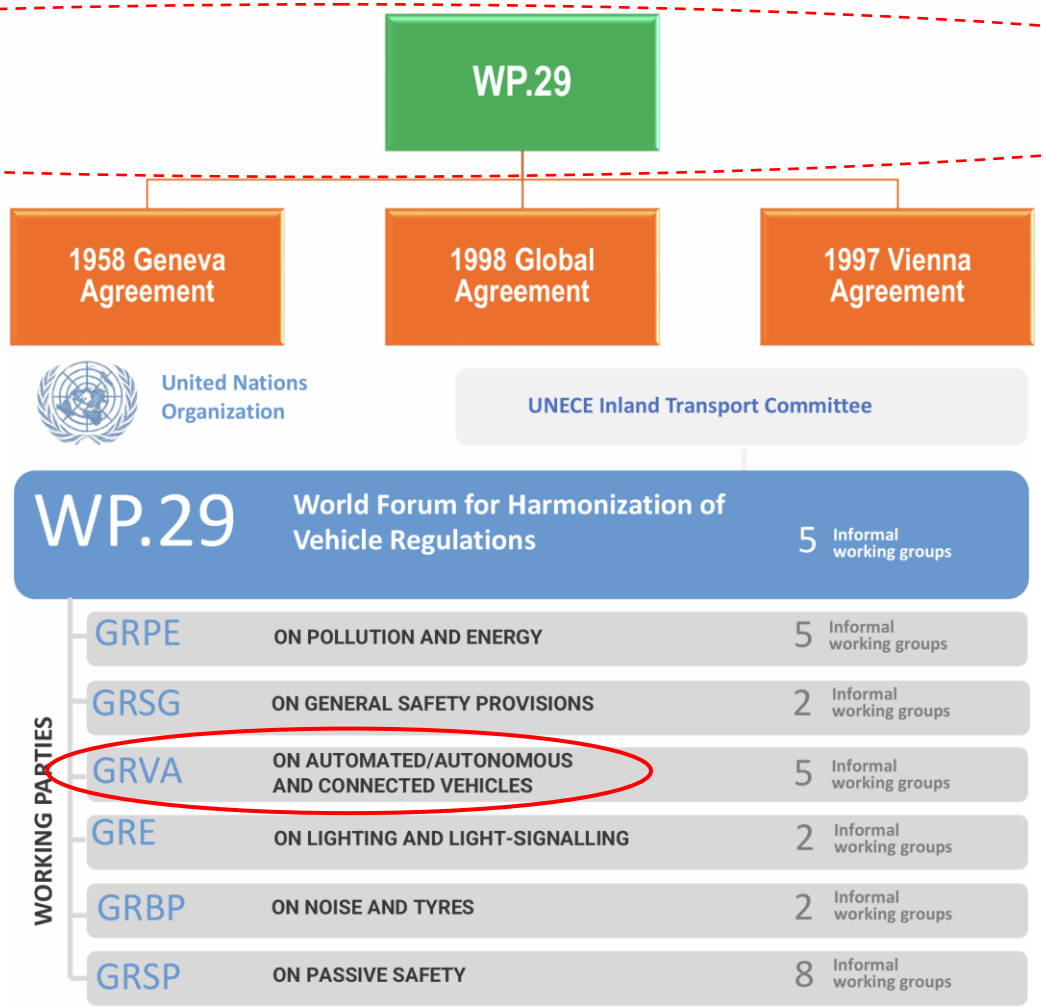
China's stricter standards are influencing international regulations. The EU's **UN R155 cybersecurity certification** now mirrors China's requirements for **over-the-air vulnerability assessments**.

Conclusion

The Xiaomi SU7 incidents and government responses underscore China's evolving approach to smart mobility: fostering innovation while ensuring accountability. While Xiaomi has weathered immediate crises through technical fixes and PR campaigns, the industry must navigate **stricter oversight**, **heightened user expectations**, and **global regulatory convergence**. The coming years will test whether China can balance its ambition to lead EV innovation with the imperative of public safety.

Landscape of Automotive Regulation and standardization on CASE NEV and ICV in China

中国汽车技术研究中心有限公司
China Automotive Technology and Research Center Co., Ltd.



NHTSA

ISO

IEC

SAE INTERNATIONAL

ITU

UN GTR on ADS

ISO 34505:2025(en)

Road vehicles — Test scenarios for automated driving systems — Scenario evaluation and test case generation

With development of vehicle connectivity and smart city ITU has further advanced and integrated into the automotive industry ICV sector has brought world's 3 major standardization organizations ever close together

- e-Call
- Expert Group on ADS
- C-V2X (LTE-5G)

China's Huawei and Xiaomi have successfully extended their ICT business into new auto CASE domain

Regulatory Compliance is a MUST for any CASE vehicle

UN R157 ALKS
w/Safety Man. System (SMS)
ISO 26262/GB/T 34590
ISO 21448/ GB/T 43236
ISO/SAE 21434
ISO 24089

UN R156 /GB 44496
SW Update and SUMS
ISO 24089 (SUE)
ISO 27001 (ISMS)

UN R155 / GB 44495
Cybersecurity and CSMS
ISO 21434 (CSMS)

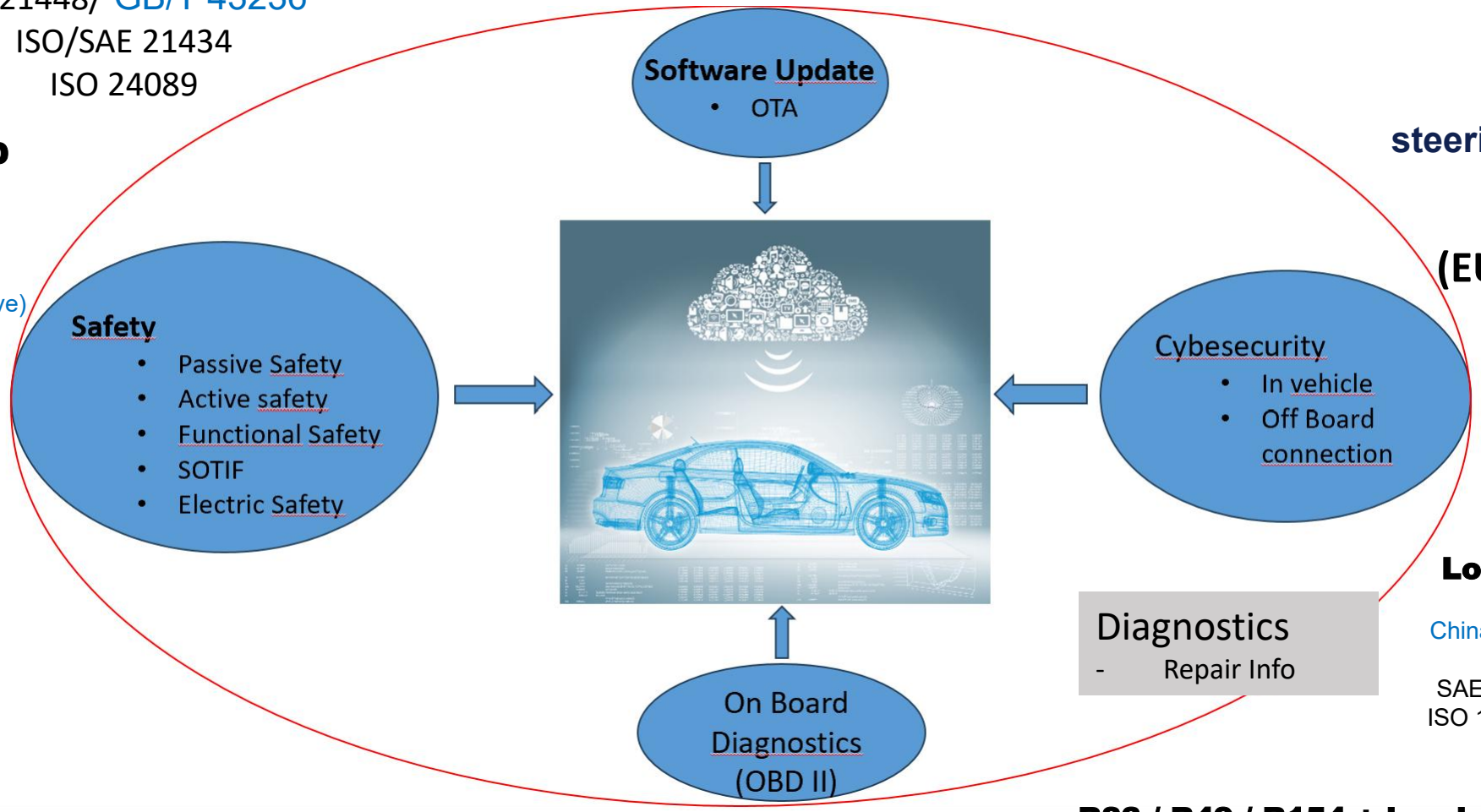
Additional ADAS/AD
UN R171 DCAS (L2)
w/Safety Man. System (SMS)
ISO/TR 5083 (L3 & L4)

GB/T 44721-2024 (L3 and above)
MIIT/CAQC certification
GB 44497

AI Safety and AIMS
ISO/PAS 8800:2024

Operational Safety
for DCAS and AD

(EU) 2024/1689 AI ACT
ISO/IEC 42001 AIMS



UN R79
steering equipment

(EU) 2019/2144 GSR
/GB 7258

More …

Diagnostics
- Repair Info

Local regulations
EU 2018/858 (RMI)
China MOT Disclosure Rules
GB/T 16739
SAE J1979-x/GB/T 18344-x
ISO 14229 UDS/ GB/T 40822

SAE J19790
ISO 14229

R83 / R49 / R154 + local regulations
SAE J1979-x/GB/T 18344-x
ISO 14229 UDS/GB/T 40822
GB 18352.6

Key events in AD and AD approaches – Baidu plays a key role in China's AD pursuit

Google¨s AD division established

Baidu AD team created dedicated to L4

"Project Titan" kicked off quietly by Apple in 2014

On 5 Jul. Baidu Apollo 1.0 has also become the first system-level open source in global AD

Honda Legend Hybrid EX's "TJA" L3 certified in JP in Mar. 2021

Argo AI (Ford + VW) shut down in Oct. 2022

DRIVE PILOT from **M-B** certified for SAE L3 for the US market in Sept. 2023

BMW Personal Pilot L3 in Nov. 2023

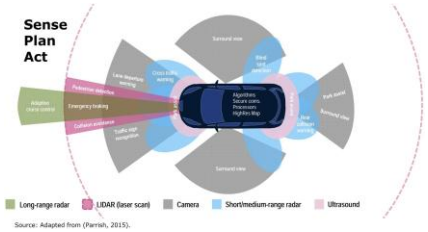
Apple withdraw from California's Autonomous Vehicle Testing Permit on public roads in Sept. 2024;
GM discontinue its Cruise robotaxi program in Dec. 2024 after USD ~~10B+~~ investment

USA 美国
Waymo
Cruise
Tesla
Motional
Gatik
Kodiak Robotics
Zoox
Nuro
Aurora Innovation
Plus.ai

EU 欧盟	
SE	Volvo Autonomous Solutions (VAS)
SE	Scania Autonomous Transport
SE	Einride
DE	MOIA
DE	Holon
	Fernride
FR	Navya Mobility
FR	EasyMile
SP/DE	Goggo Network
HU	aiMotive
FI	Sensible 4

Others 其它	
UK	Wayve
UK	Oxa
IL	MobileEye
JP	TIER IV 提雅智行
KR	Hyundai Mobis
KR	RideFlux
KR	Mars Auto
IR	MobileEye

China 中国
萝卜快跑 Apollo Go
文远知行 WeRide
小马智行 Pony.ai
安途智行AutoX autox.ai
滴滴自动驾驶 DiDi Autonomous Driving
轻舟智航 QCraft.ai
西井科技 WESTWELL
PIX Moving
地平线 Horizon Robotics
仙途智能 Autowise.ai
驭势科技 UISEE
华为 Huawei
初速度科技 Momenta
元戎启行 DeepRoute.ai
新石器 无人车NEOLIX
毫末智行 Haomo.ai
九识智能 ZELOS
既未科技 JiWei.ai
惠尔智能Whale Dynamic
卡尔动力KargoBot.ai
深向科技 deepWay
图森未来 TuSimple
智加科技 Plus
希迪智能驾驶cidi.ai
赢彻科技 Inceptio Technology
卓驭科技 Surrey Technologies



Multi-Sensor fusion with LiDAR, is seen conservative & safety-first path for ADS

Vision-Only by Tesla

End-to-End AI models (e.g. VLA) integrate Perception and Planning modules

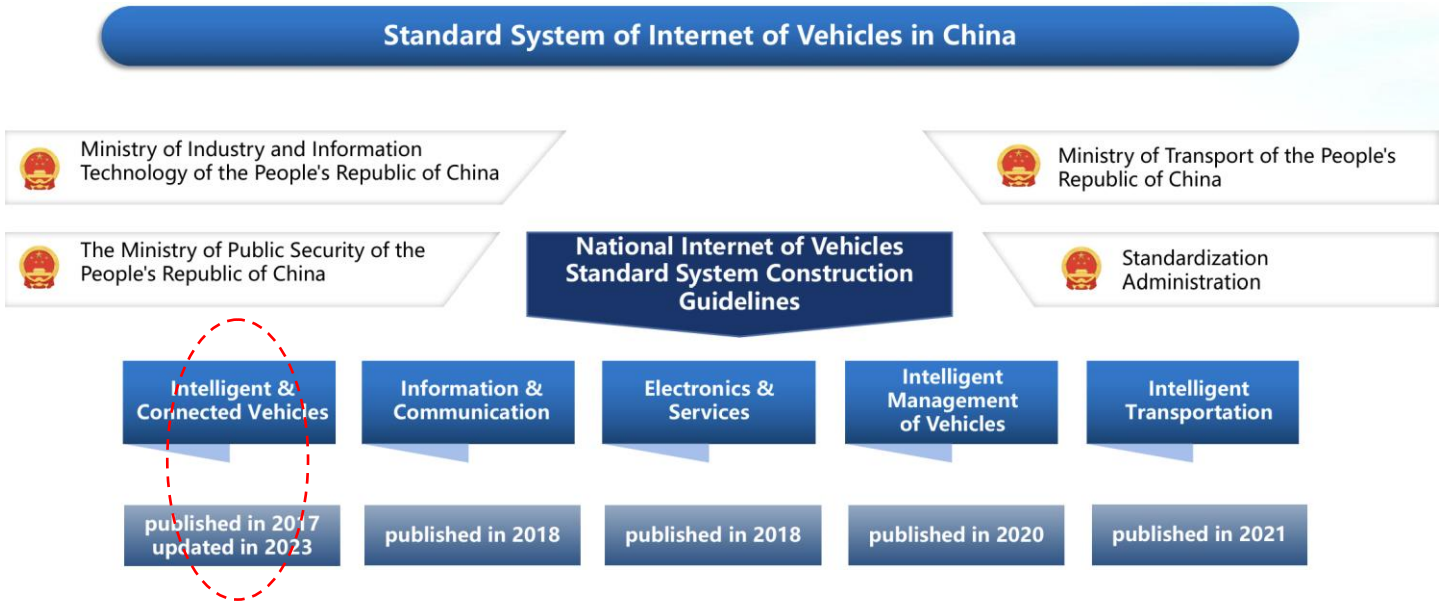
- Learning based with more quality data

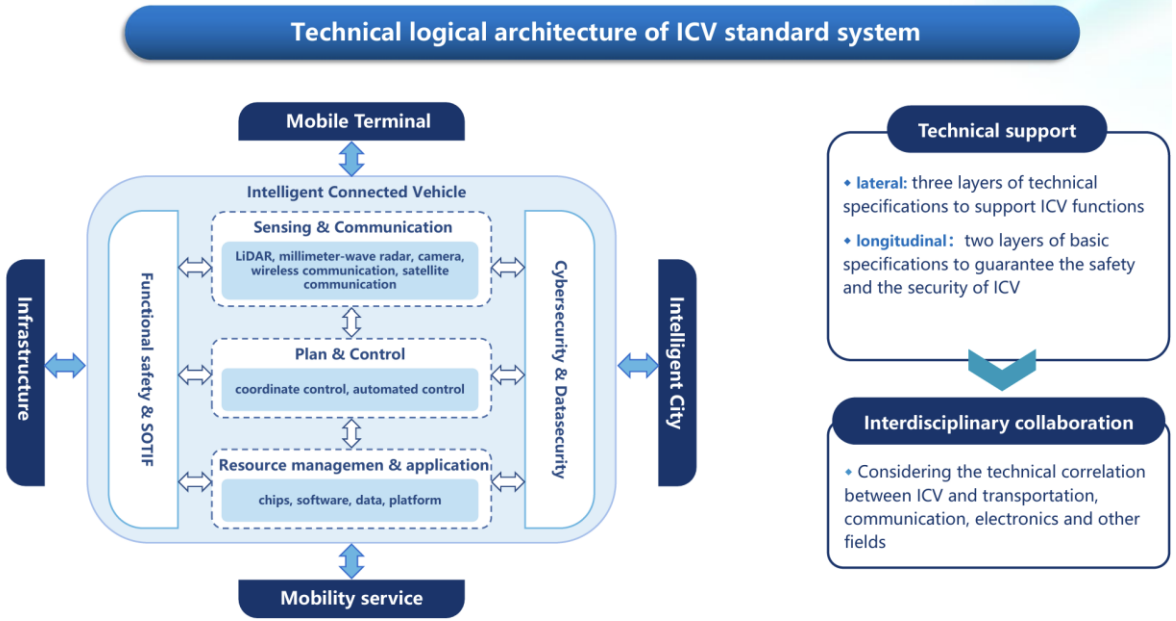
WeRide was listed on NASDAQ on 25 Oct. 2024, becoming the world's first Robotaxi stock.
Waymo completed a USD $5.6B financing on October 25 Oct. 2024 following its parent company's commitment in July to a multi-year USD5B capital injection.
Horizon Robotics listed on the Hong Kong Stock Exchange on 24 Oct. 2024 the largest technology IPO in Hong Kong stocks that year
2024 is seen the first year of AD implementation

China National Automotive Standards System Diagram (2025 ed.) published by CATARC

Standard Coordinates Industrial Development

A unified, safe and interoperable national framework





Definition of ICVs

- Vehicles that are designed with advanced features incl. environmental perception, self-decision-making and automated control, or interaction with external information, and even collaborative control functions.

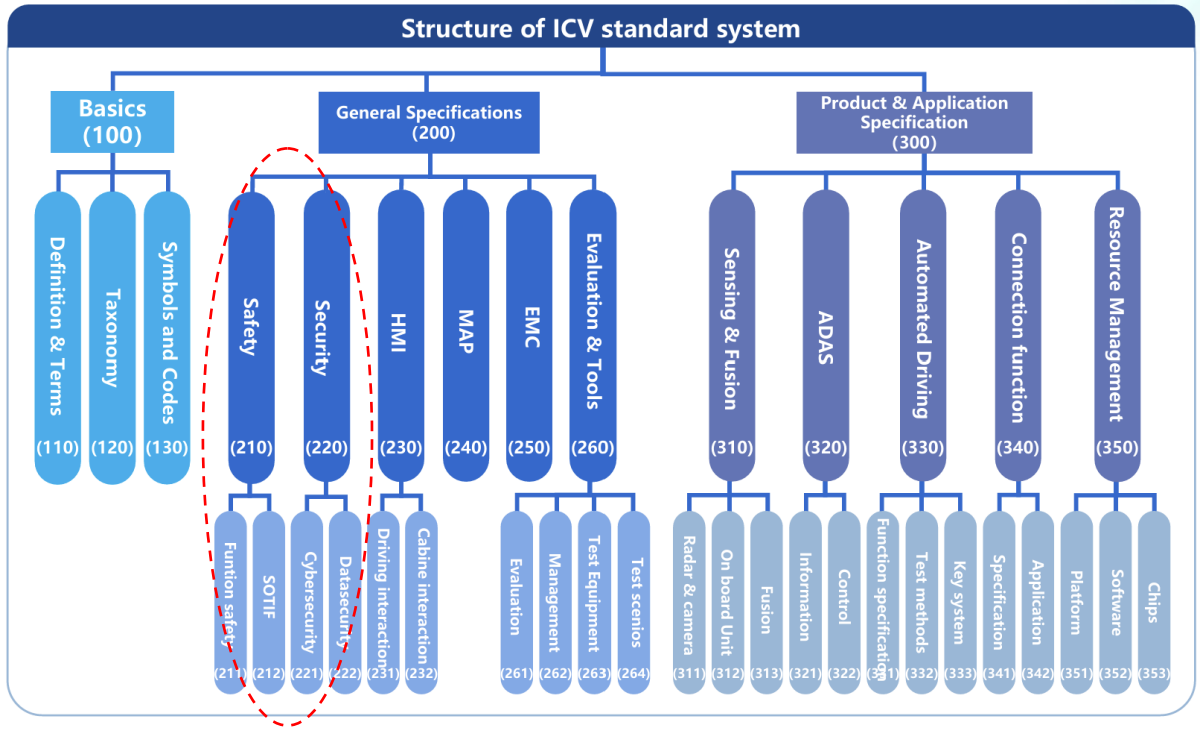
Ultimate goal of ICVs

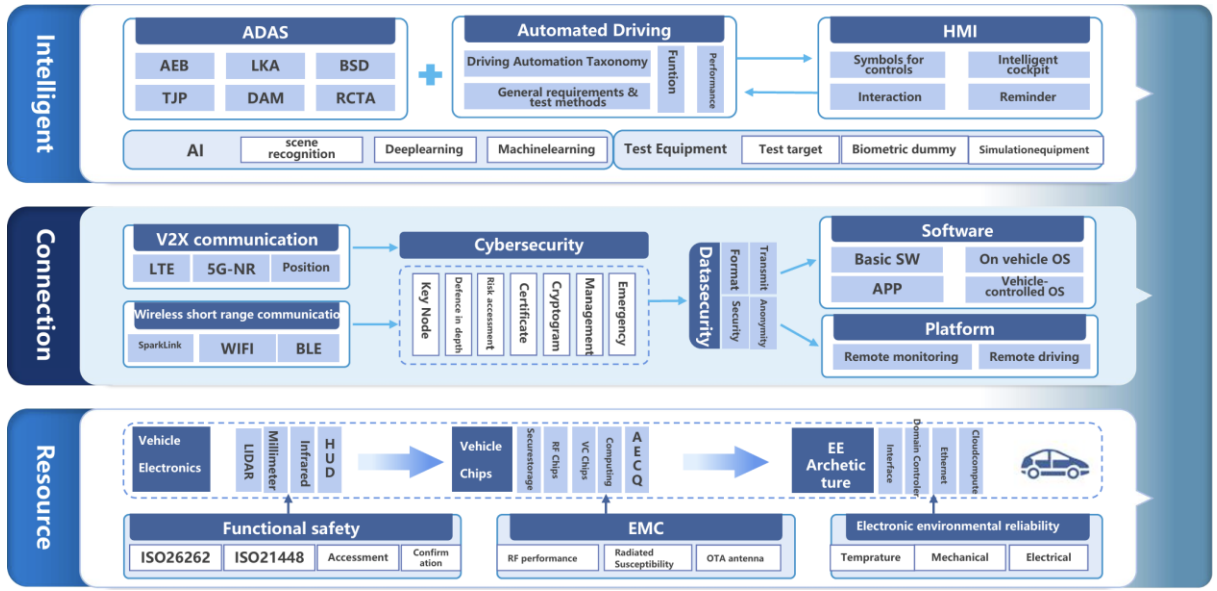
- The driver can be completely replaced, to achieve safe, efficient and energy-saving driving with zero casualties and zero congestion
  - ZERO Vision SE

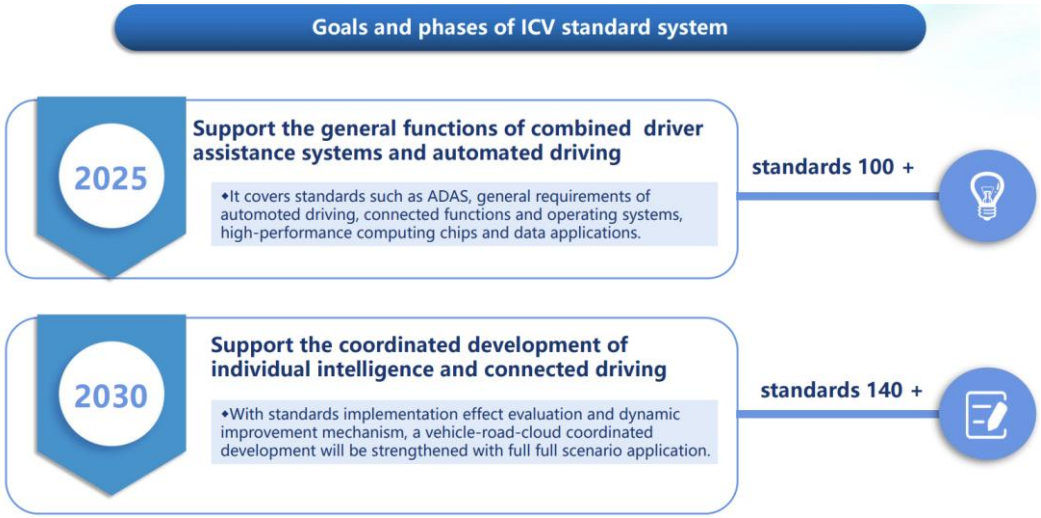
ICV Standard System in China (2023)

System Safety - CS – are integral parts

SAC/TC114







Vehicle-Road-Cloud Integration

initiative to facilitate ICV

VRCI System
Construction and Application Guide

车路云一体化系统

建设与应用指南

2024 年 10 月

目录

VRCI Practical Application Whitepaper

车路云一体化实践应用白皮书

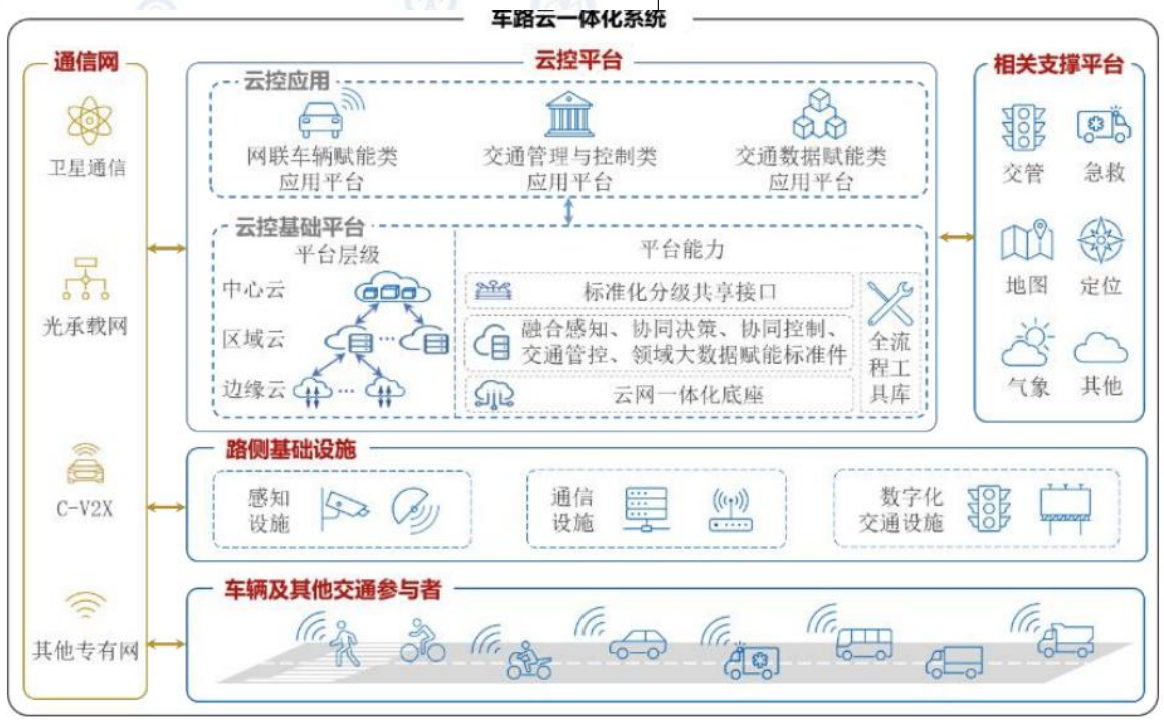


图1　车路云一体化智能网联汽车系统示意图

Vehicle-Road-Cloud Collaboration

The inevitable way to achieve high-level Automated Driving

Improving traffic safety and efficiency, enhancing the capabilities of assisted driving and autonomous driving, promoting data closed-loop, and driving the digital transformation of the whole society

- Improve traffic **safety** and **efficiency**
  - Beyond-visual-range cooperative perception reduces traffic accidents
  - Path planning reduces congestion, intention sharing reduces waiting, etc.

- Empower single vehicle intelligence for Scenarios that can't achieve or hard do well
  - Beyond-visual-range cooperative perception: occlusion, long distance
  - Swarm intelligence: intention sharing, platoon following, etc.
  - Sharing of Computing Power

- Help solve the problems of insufficient **data** and difficulty in **data sharing**
  - Relying on Road-Cloud data, generate data that can be used for AD testing and training, significantly alleviating the problem of insufficient data for vehicle companies.
  - The willingness of VRCI pilot cities to share data is much higher than that of vehicle companies.

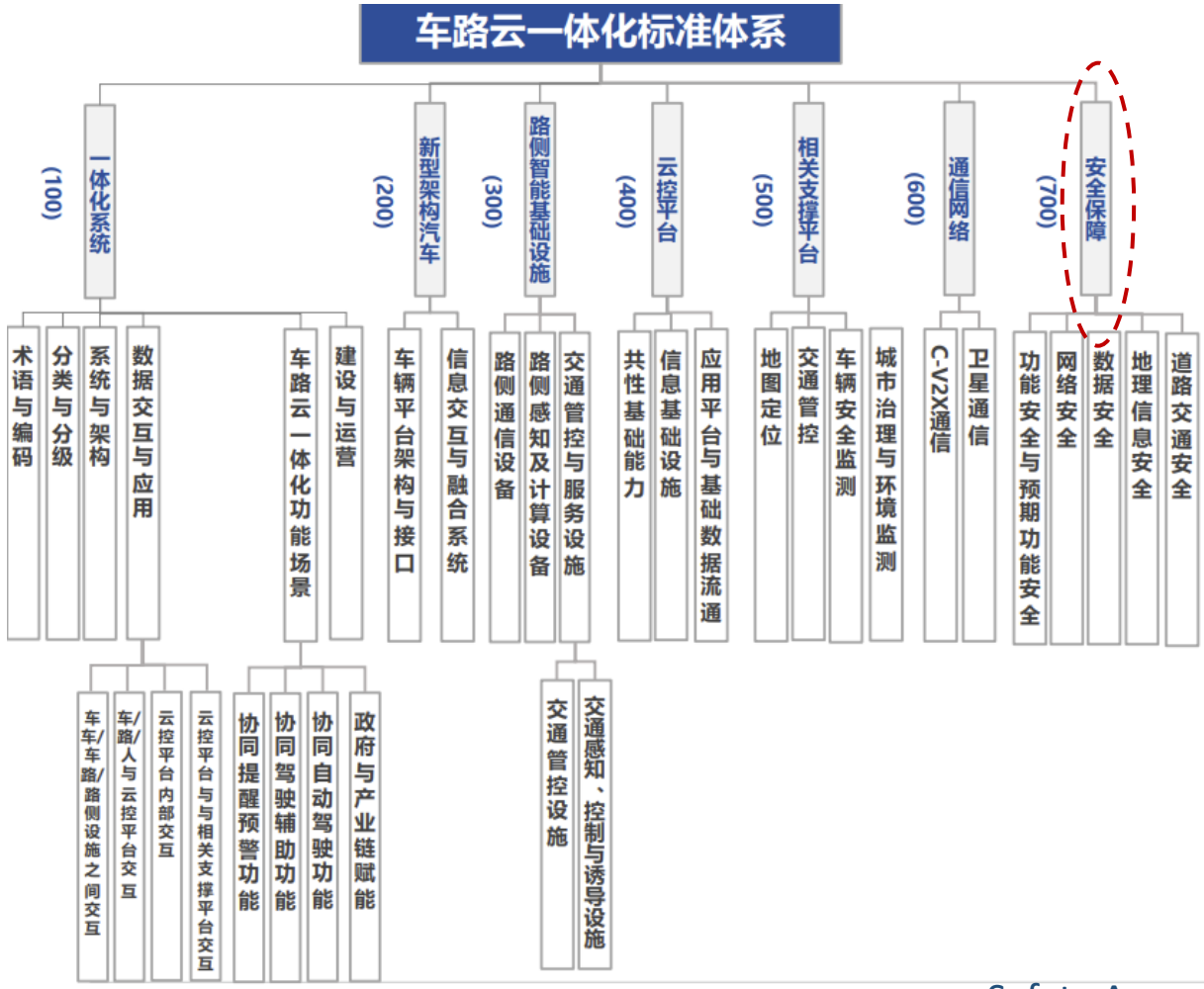
- Promote & facilitate the **digital transformation** of society
  - Leverage and make full use of the achievements and infrastructure such as transportation digitalization, traffic management digitalization, and urban digitalization. As a typical data application field, the integration of vehicle, road and cloud will continue to promote the process of digital transformation.

阶段	基础设施部署	车辆	频谱和互通性	收益和技术支持
短期目标 2024-2028	• 20%国家高速公路部署V2X • 前75个城市区域有25%的信控路口启用V2X • 12个可互通的网络安全部署 • 在至少10个州使用5.895-5.925 GHz频段的20笔拨款	• 2家OEM承诺到2027年推出具备5.9 GHz功能的车辆	• 2家安全凭证管理系统（SCMS）提供商展示可互通的安全凭证管理 • 3家设备供应商和2+家OEM展示互通性 • FCC完成5.9 GHz频段的第二次报告	• 3个关于V2X部署收益/成本案例研究 • 25家活跃的V2X支持者成员 • 10场区域实践培训活动
中期目标 2029-2031	• 50%国家高速公路部署V2X • 前75个城市区域有50%的信控路口启用V2X • 25个可互通的网络安全部署 • 全国40%的十字路口安装了V2X	• 5种车型支持5.9 GHz应用 • 3次基础设施运营商（IOO）数据被2家OEM车辆使用 • 4家供应商、3家OEM展示可互通的连接	• 在5.9 GHz频段展示5个V2X用例 • 在5.9 GHz频段之外展示5个V2X用例 • 20个公共机构展示互通性 • 2个提供商使用可互通的SCMS凭据 • 市场上有10种经过认证的设备	• 6个用例（2个涉及弱势交通参与者）记录V2X安全收益 • 50家活跃的V2X支持者成员撰写进展报告
长期目标 2032-2036	• 国家高速公路V2X完全部署 • 前75个城市区域有85%的信控路口启用V2X • 50个可互通的网络安全部署 • 跨50个州的可互通的5.9 GHz操作 • 全国75%的十字路口安装了V2X	• 6家推出支持5.9 GHz应用车辆，用于安全用例 • 20款车型支持V2X	• 5个V2X用例在所有50个州的5.9 GHz频段运行 • 5个V2X用例在5个州的5.9 GHz频段之外运行 • 20种经认证的设备主导了部署的V2X技术基础	• 10个已部署运行5年的收益/成本数据 • 75名活跃的V2X支持者成员共同赞助的最金项目

V-C-R Multi-Element Fusion

Vehicle-Road-Cloud Integration Standard System

Group Standard T/CSAE 295:2023_China Society of Automotive Engineers (C-SAE)



100 一体化系统

车路云一体化术语与编码、分类与分级、系统与架构、各子系统数据交互规范
协同提醒预警功能、协同驾驶辅助功能、协同自动驾驶功能、政府与产业链赋能功能场景技术要求
车路云一体化系统全生命周期管理，涵盖建设、部署、运营及维护等

200 新型架构汽车

车辆新型电子电气架构、通信设备车内交互接口等。
车载通信终端、车载定位系统、融合C-V2X的智能驾驶系统

300 路侧智能基础设施

路侧通信设备、路侧感知及计算设备技术要求与测试方法、质量管理要求
公安、交通等行业交通管控与服务设施的技术要求与信息发布规范等。

400 云控平台

云控基础平台的共性基础能力与信息基础设施
云控应用系统的通用架构、实现方式、基础数据应用等

500 相关支撑平台

高精动态地图平台数据模型与表达、生产更新、应用服务、质量检测和地图审查要求
卫星导航增强定位服务平台及数据产品要求
交通管理、安全监测、城市治理与环境监测平台能力要求

600 通信网络

4G/5G蜂窝通信、LTE-V2X、卫星通信的无线通信技术、设备规范、通信协议及互操作性等标准

700 安全保障

车路云一体化系统功能安全/预期功能安全、网络安全、数据安全、密码应用、身份认证要求、跨行业身份互认机制
时空数据安全传输、安全处理、地图数据产品安全管理
车路云一体化交通事故处理规范、道路通行安全要求

Safety Assurance

- FuSa and SOTIF
- Network Secuirity
- Data Security
- Georgraphy information security
- Road Transporation safety

Src:

Vehicle-Road-Cloud Integration Deployment Pilot Cities (city consortium)

20 cities with differentiated testings for intended scenarios
"Vehicle-Road-Cloud All-domain Collaborative Intelligence"

2024 -2026

Main objectives

1. Construct intelligent roadside infrastructure
2. Improve the on-board installation rate of vehicle (OBU)
3. Establish a city-level service management platform
4. Carry out large-scale demonstration applications
5. Exploring the safety applications of high-precision maps
6. Improve standards and testing evaluation systems
7. Build a cross-region identity mutual recognition system
8. Enhance the capacity for road traffic safety assurance
9. Explore new models and new forms of business

Each city (or City Consortium)

- Same architecture and unified standards
- Constructing urban-level infrastructure
- Leading large-scale vehicle-end applications

DB50/T 1571-2024 ("智能网联汽车自动驾驶功能测试规范")
Released by Chongqing local government


ICS 43.040
CCS T 41

DB50

重 庆 市 地 方 标 准

DB50/T 1571—2024

智能网联汽车
自动驾驶功能测试规范

2024-03-14 发布　　2024-06-14 实施

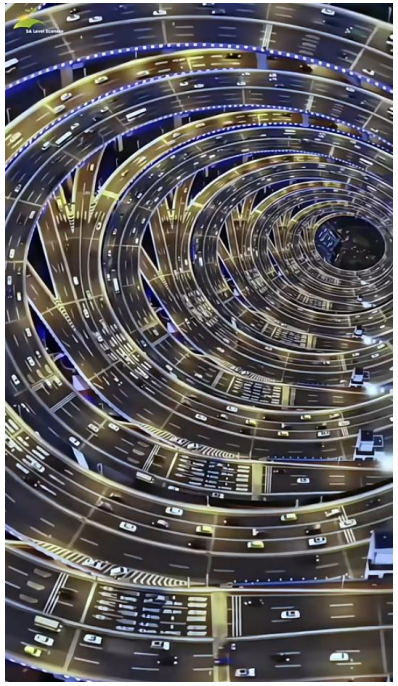
重庆市市场监督管理局　发布

Test Specification for Autonomous Driving Functions of Intelligent Connected Vehicles

Regional-first: Local standard
Aligns with GB/T but adds Chongqing's geographic challenges (vs. ISO 22737's generic low-speed focus).
C-V2X integration required

ISO 22737:2021 Intelligent transport systems — Low-speed automated driving (LSAD) systems for predefined routes — Performance requirements, system requirements and performance test procedures

Chongqing-Panlong Bridge

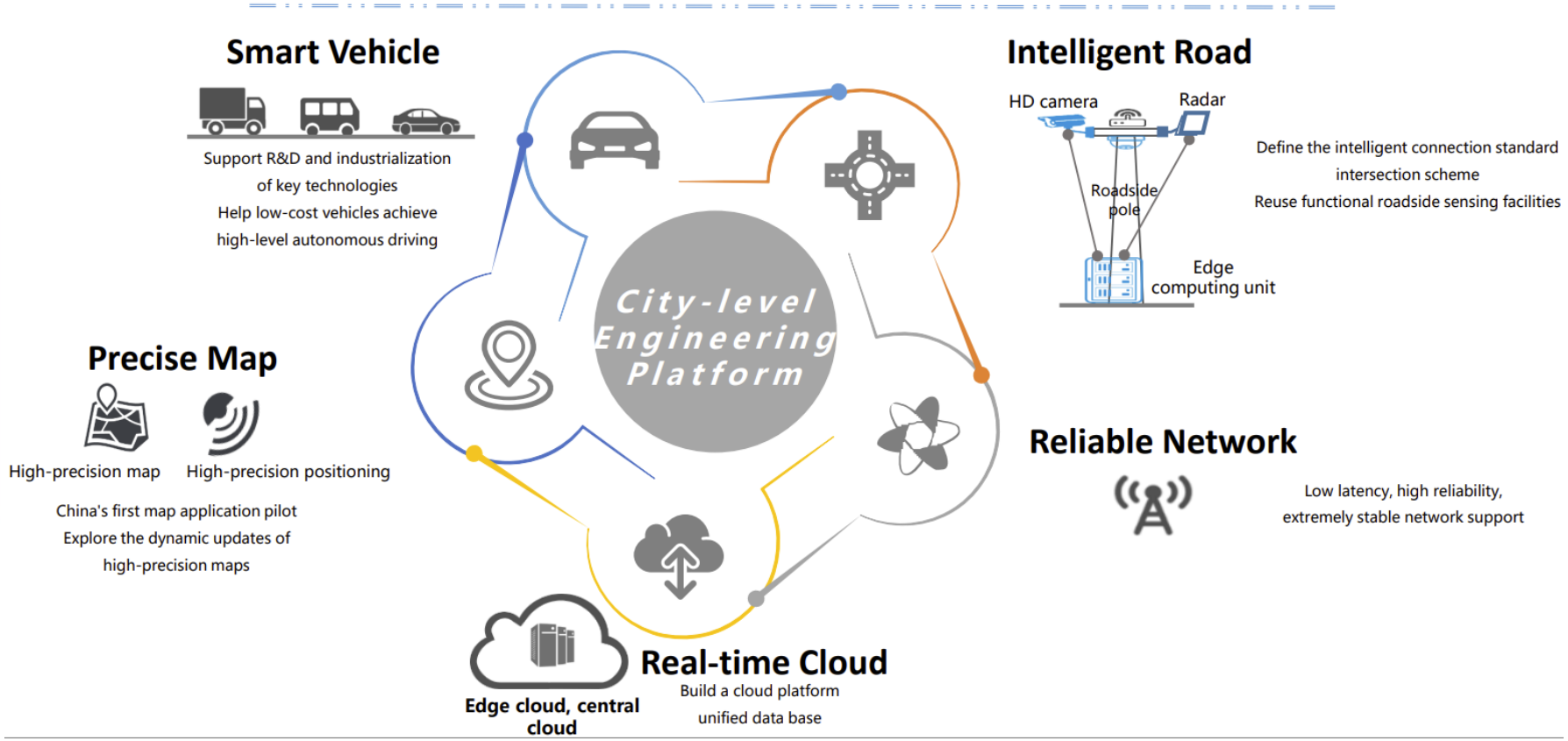


8D OVERPASS || HUANGJUEWAN INTERCHANGE Chongqing

Beijing High-level Autonomous Driving Demonstration Zone (BJHAD)

In September 2020, Beijing decided to build High-level Autonomous Driving Demonstration Zone dedicated for L4 ADS testing – The first of its kind in China as well as the world

- Utilizing VRCI Technology to empower AV function upgrades, effectively improving AV safety and traffic efficiency



Src: BJHAD office

Beijing High-level Autonomous Driving Demonstration Zone (BJHAD)

BJHAD | Application Achievements

北京市高级别自动驾驶示范区

60 kilometers intersections construction

Robotaxi

Unmanned Retail Vehicles

Autonomous Patrol Car

Autonomous Sanitation

Robobus

Autonomous Shuttle

Last Mile Delivery

Autonomous Trunk

23,800,000 km
Testing Mileage

40M km

2,000,000
Robotaxi Service Orders

4,460,000
AV delivery service

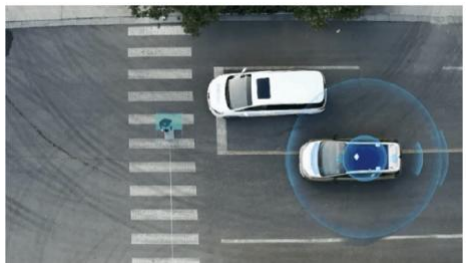
Up to now, road test licenses have been issued to 811 vehicles from 28 companies

442	85	340	3	11	10
Passenger vehicles	AVs without safety driver	Autonomous Delivery & Retail Vehicles	Autonomous shuttles	Autonomous Trunk	Connected buses

- 8 scenarios

By middle of 2025
- 1165 vehicles
- 36 companies

With an increase of 19.7% in traffic flow at key intersections, the average number of stops on green wave roads throughout the day decreased by 40.6%, the average travel time shortened by 13.7%, and the average speed increased by 15.1%.



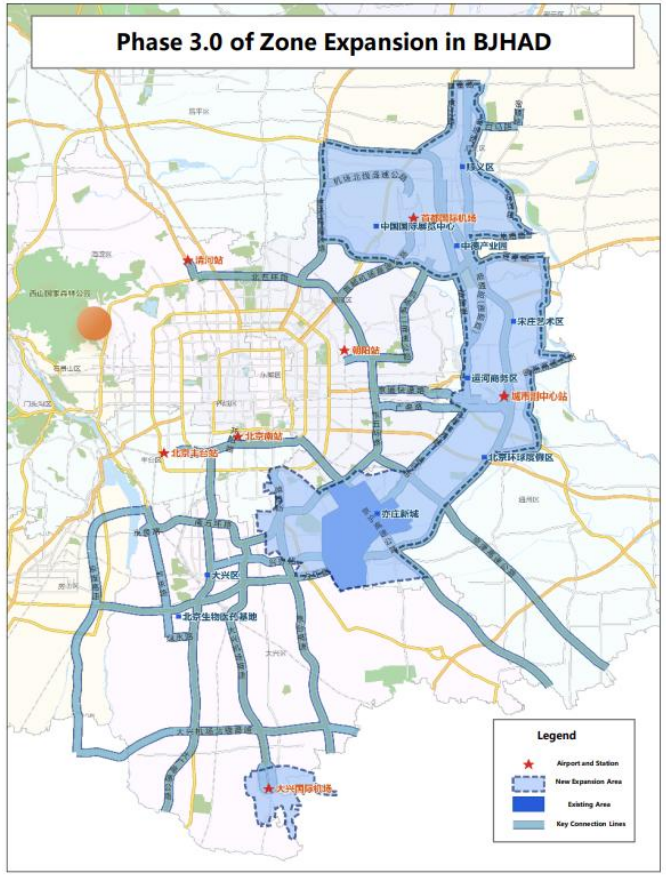
Decision-making timing for connected AEB at "ghost probe" advanced by 1.5S to 2.5S.

Compared to manual driving, cloud-controlled cruise control for highway logistics achieves an average fuel saving rate of 3.72% to 6.35%.

Beijing High-level Autonomous Driving Demonstration Zone (BJHAD) empower AV function upgrades, effectively improving AV safety and traffic efficiency

Our Commitment for the Future

北京市高级别自动驾驶示范区



Autonomous Driving Services to Every Corner of Beijing

In the future, the demonstration zone, building upon the existing **160 km^2**, will further expand to cover more of Beijing, reaching a total of **600 km^2**.


Daxing International Airport


Capital International Airport


Beijing South Railway Station

Chaoyang Station


Sub-center Station


Fengtai Station

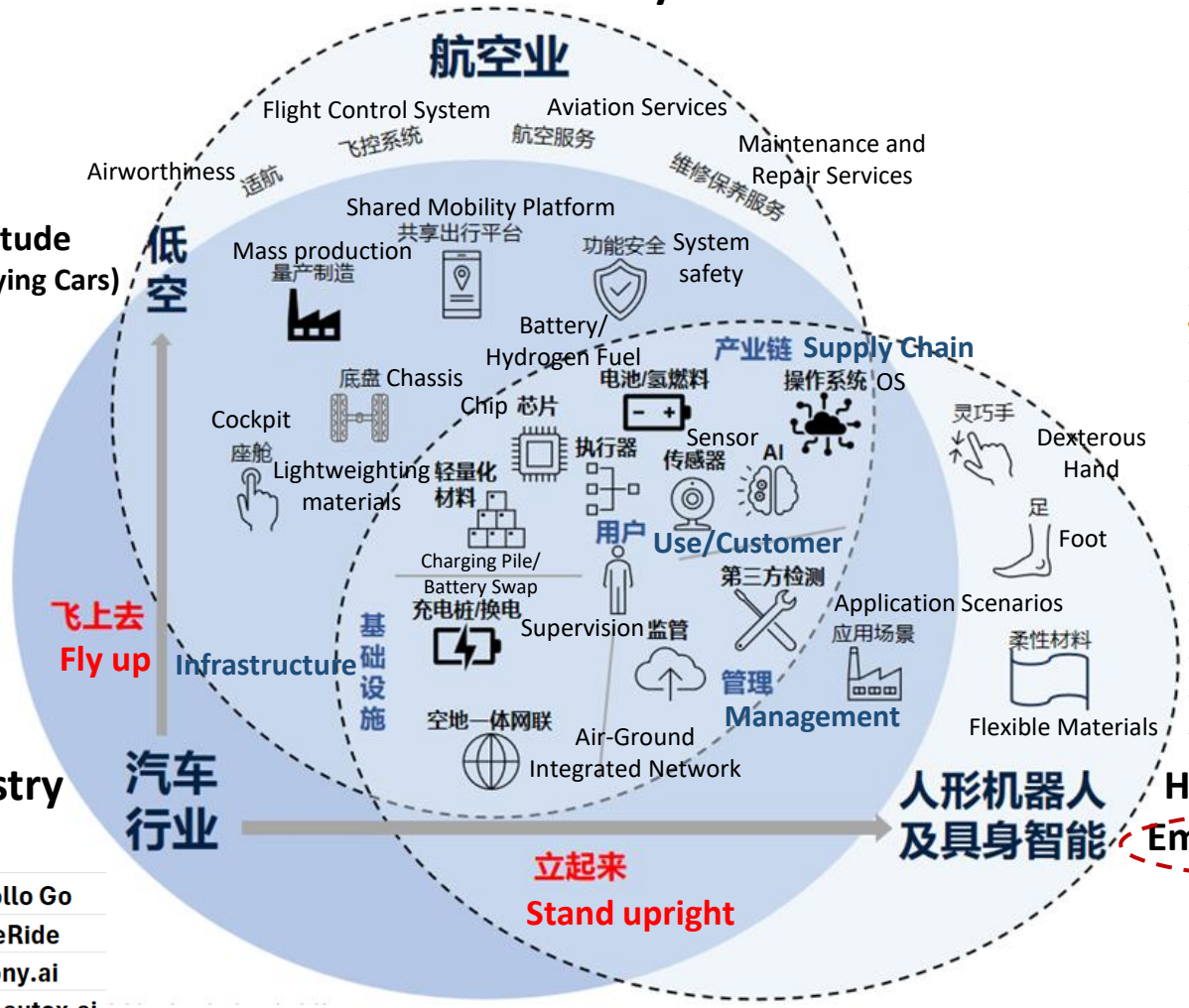

Qinghe Station

Phase 4.0 is coming to further extend to bigger area

Src: BJHAD office

Solid base in NEVs and ICVs enables other industry development

Relation & Synergy (80/20 Rule)



大疆创新 DJI
道通智能 Autel Robotics
极飞科技 XAG

亿航 EHang
小鹏汇天 Xpeng AeroHT
沃飞长空 Aerofugia
沃兰特航空 Volant Aerotech
时的科技 TCab Tech
峰飞航空科技 AutoFlight Technology
科軒動力 EV Dynamics (Nanjing)
御风未来 Vertaxi Technology
广汽集团 GAC Group
长安汽车 Changan Automobile
奇瑞汽车 Chery Automobile

萝卜快跑 Apollo Go
文远知行 WeRide
小马智行 Pony.ai
安途智行AutoX autox.ai
滴滴自动驾驶
DiDi Autonomous Driving

宇树科技 Unitree
优必选 UBTech
智元机器人 AgiBot
傅利叶智能 Fourier Intelligence
智身科技 Zsibot
智元机器人 LIMX
思灵机器人 Agile Robots
它石智能 TaStone Robotic
达闼 CloudMinds
千寻智能 Spirit AI
高仙机器人 GSK Robotics
千寻智能 Spirit AI
逐际动力 LimX Dynamics
开普勒 KEPLER

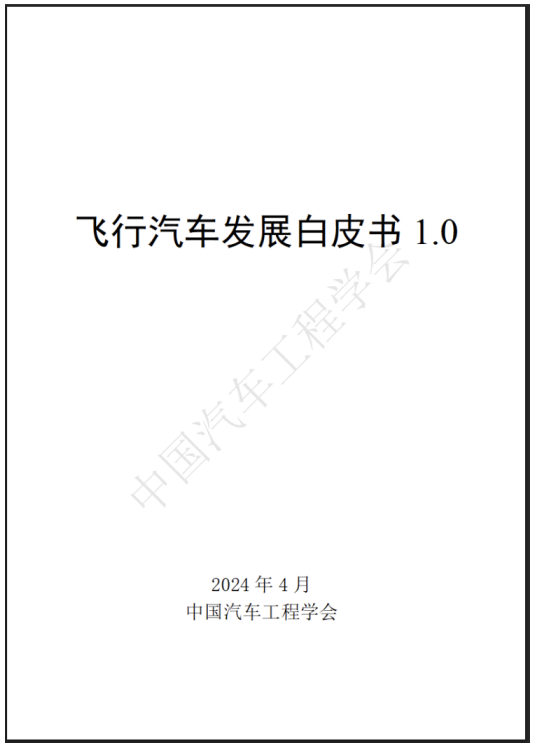
小米 Xiaomi
华为 Huawei
广汽集团 GAC Group
鹏行智能
长安汽车 Changan Automobile

70% of the supply chain in NEVs & ICVs could be reused by Humanoid & Quadruped Robots and Fly Cars

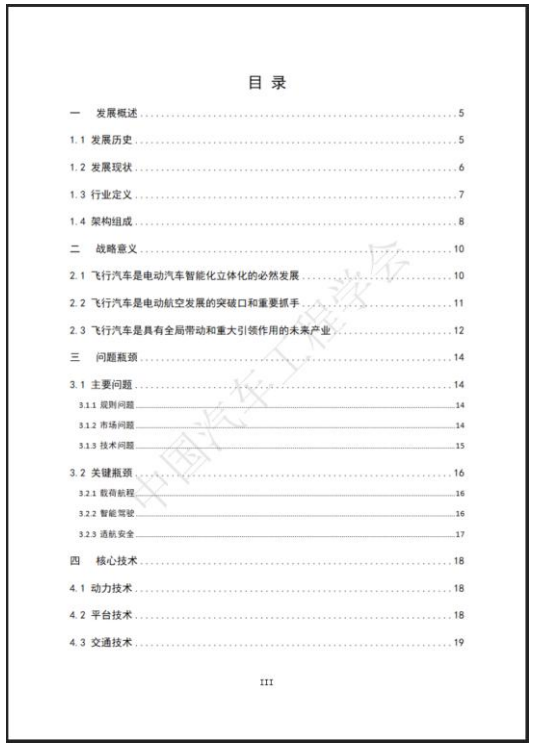
Flying Cars (eVTOL): a key component in “Low-Altitude Economy”

~~Aircars represent the inevitable development trend of intelligent and three-dimensional advancement in electric vehicles~~

“Aircar Development White Paper 1.0”
published by China SAE on 28 Apr. 2024


飞行汽车发展白皮书 1.0

2024 年 4 月
中国汽车工程学会


目 录

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- “Low-Altitude Economy” is seen as a national strategic emerging industry and a new quality productive force in Chinese government's work report.
- “Implementation Plan for Innovative Applications of General Aviation Equipment (2024 - 2030)” is published

China now accounting for over 70% of the world’s low-altitude unmanned aerial vehicle (UAV) patent applications and boasting over 50,000 enterprises engaged in related businesses with a business scale of RMB 1T projected by 2026.

Some examples of high-profile events on eVTOL and embodied Intelligence

EHang 184—the world's first passenger-carrying drone — showcased at CES 2016 Las Vegas

US based **Terrafugia** acquired by Geely in Dec. 2017

EHang EH216-S became the world's 1st model to obtain the triple certificates of TC/PC/AC in 2024 by CAAC

AutoFlight Achieves Aviation Milestone with World's First 2-Ton eVTOL Offshore Oil Platform Operation for 300km+ round-trip on 3 Aug. 2028

XPeng HT's global first split-type flying car "Land Aircraft Carrier" (X3-F), unit price: RMB 2.07M, Flight threshold to "C driver's license + 5 hours of flight training" – PC application accepted on 9 May 2025 - Mass production and delivery in 2026

- Global 800V High-Voltage Extended-Range Platform, Supports a comprehensive driving range of over 1000 kilometers
- Carbon fiber technology
- Intelligent Driving Hub: The land vehicle is equipped with an L4 ADS , which can independently complete the docking with aircraft and adapt to the site.

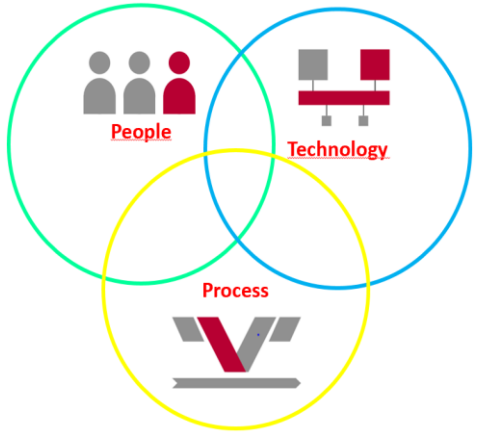
On 3 Sept. 2025, UBtech announced that it had obtained a RMB 250M procurement contract for humanoid robot products and solutions from a well-known domestic enterprise. This is the largest contract for humanoid robots in the world so far-

Efforts demonstrated in pursuing Safety

- In Sept. 2024 **Hesai Technology** becomes globally the first LiDAR supplier to obtain certificate for ISO 21448 Development Process compliance in addition to ISO 26262 and ISO/SAE 21434
- On 25 Apr. 2025 **Horizon Robotics** obtains world's first ISO/PAS 8800:2024 certificate, awarded by exida, for its AI Development Processes (in addition to ISO 26262 and ISO 21448 SOTIF)
- On 24 Jun. 2025 **Geely Auto** became the **first global automaker** to achieve ISO/PAS 8800:2024 certification for its AI Management system, validated by Germany's DAkkS through SGS audits in addition to the certificates for ISO 26262 and ISO 21448 SOTIF.
  - Geely is recognized as the world's first automaker to achieve the **triple safety certification**
- China New Car Assessment Program (C-NCAP) and the China Insurance Automotive Safety Index (C-IASI) have gradually incorporated ADAS functions like AEB and LKA into their scoring criteria
- **GB 38031-2025**: Electric vehicles traction battery safety requirements, is implemented from 1 Jul. 2025
- GB45672-2025: On-board accident emergency call system, will be compulsorily implemented on July 1, 2027.
- GB/T 44721-2024: Intelligent Connected vehicles - General technical requirements for automated driving systems, is implemented from 29 Sept. 2024 and will becomes a mandatory with an updated version
- In 2024 three mandatory standards are published, i.e. GB 44495 & GB 44496 & GB 44497
- On-going efforts to have following mandatory standards in place
  - *Safety Requirements for Combined Driver Assistance Systems of Intelligent and Connected Vehicles*
  - *Safety Requirements for Automated Driving Systems of Intelligent and Connected Vehicles*
- Dongchedi (懂车帝) ADAS testings broadcasted by CCTV (China Central Television) - **Public safety demonstration with** focus on the **safety and real-world performance** of smart car technology.

Summary and

- China has a structured Standard and Regulation framework for and industry specific policy on NEVs and ICVs - System Safety is an integrated part
- China has been implementing Vehicle-Road-Cloud Integration initiative to improve road safety and traffic flow in a big context together with the ICV development
  - Operational Safety
- Eco-systems along the supply chain are in place to further facilitate Embodied AI and Low-altitude Economy business development for cross-domain synergy
- Safety First is challenging in a dynamical changing environment with active innovation, but a MUST through a balance way
- Be Safe, Secure, Compliant and Environment Friendly in a sustainable & coordinated way…to achieve safe, efficient and energy-saving driving with zero casualties and zero congestion



Communications and interactions between & among parties are always a Plus & of help

Thanks for listnering !

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https://www.linkedin.com/search/results/all/?keywords=%23flyingcar&origin=HASH_TAG_FROM_FEED&sid=V~b

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Zhengfei Ren 任正非, Founder and CEO of Huawei 华为

Wenfeng Liang 梁文峰, CEO of DeepSeek 深度求索
Xingxing Wang 王星星, CEO of Unitree Robotics 宇树科技

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