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China Passenger Car Highway & Urban NOA (Navigate on Autopilot) Research Report, 2024

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NOA industry research: seven trends in the development of passenger car NOA

In recent years, the development path of autonomous driving technology has gradually become clear, and the industry is accelerating from L2 to L2.5/L2.9 and even L3. In this process, promoting popularization of Highway NOA and rapid development of Urban NOA has become a consensus of entire industry. Since 2023H2, the market competition for Urban NOA has become increasingly fierce. Major OEMs have accelerated the implementation of Urban NOA technology and gradually disclosed their development plans. Since 2023Q3, the development of passenger car NOA has entered the second half stage. Many automakers have actively deployed and used end-to-end foundation models and map-free solutions to promote the development of national intelligent driving into a new stage.

Currently, passenger car NOA faces the following evolution trends:

1. Highway NOA and Urban NOA penetration rates continue to increase
2. Urban NOA entering an arms race in 2023~2024
3. Since 2023, joint venture OEMs have accelerated their follow-up of Highway NOA
4. L2.9 and L2.5 are accelerating their penetration into the mid- and low-end markets, and the era of technological equality is quietly approaching.
5. The first year of map-free Urban NOA has arrived, and many OEMs have launched national intelligent driving solutions without HD maps
6. End-to-end foundation models are being adopted in vehicles to help upgrade intelligent driving
7. Vision-only perception route is regarded as one of new directions of technological development by more Chinese OEMs

Trend 1: Highway NOA and Urban NOA penetration rates continue to increase

Since Tesla first introduced Highway NOA to China in 2019, it has been rapidly implemented in 2022 and has now covered many domestic independent and joint venture brands. By the end of 2023, sales volume of domestic ADAS passenger cars with L2.5 and above reached 1.484 million, with a penetration rate of 7.1%, of which sales increased by 78.3% year-on-year.

By the end of 2024H1, sales volume of domestic new passenger cars with L2.5 and above ADAS models was 1.06 million, with a penetration rate of 11%; among them, sales volume of Highway NOA models was 328,000, with a penetration rate of 3.4% (excluding models with both Highway NOA and Urban NOA functions). Sales volume of Urban NOA models was 732,000, with a penetration rate of 7.6%.

Source: ResearchInChina

Trend 2: Urban NOA entering an arms race in 2023~2024

Led by OEMs such as Tesla, NIO/Xpeng Motors/Li Auto, and Huawei System, major domestic OEMs and solution providers have all moved towards Urban NOA, some of which have begun to installed in vehicles in 2023. From 2023 to 2024, Urban NOA enters an arms race, and many OEMs have successfully mass-produced L2.9.

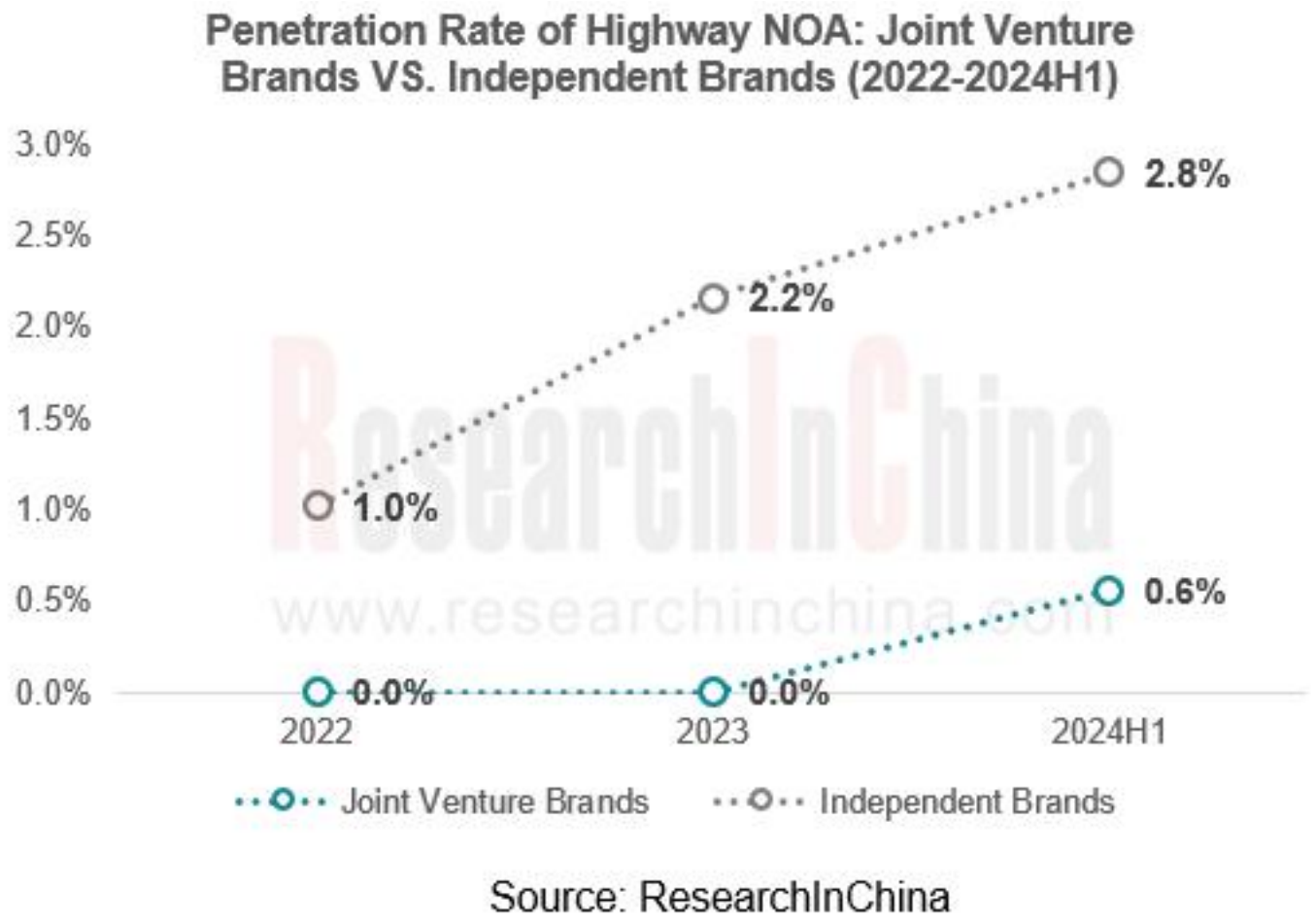
OEMs Accelerate Implementation of Urban NOA

OEM	Typical Model	Solution	2018-2019	2020	2021	2022	2023	2024
Tesla	All models	Map-free version	2018.10: Launched Highway NOA (perception-only), equipped with Model 3	2020.09: Started testing Urban NOA functions, pushed it in a small range		August: Urban NOA overseas test	September: Opened Urban NOA in the US	2024.09: Official announcement that FSD will be launched in China in Q1 2025
Xpeng Motors	All models	Map-free version		2020.10: Launched Highway NGP		2022.09, Xpeng Motors launched NGP (Guangzhou), and subsequently expanded to Beijing / Shanghai / Shenzhen / Foshan and other cities	2023.06: Beijing opened Urban NGP, and started developing Beijing map-free version of XNGP (G9/P7i/P5) 2023.11: Pushed map-free XNGP, covering 25 cities, 2023.12: Increased to 52 cities	2024.02: Push unlimited XNGP to users with smart driving experience 2024.05: End-to-end foundation model installed in vehicles 2024Q3: Push to the whole country 2024Q4: Achieving "Door-to-Door" 2025: Develop global XNGP
Li Auto	All models	Map-free version			2021.12: Launched Highway NOA (Li ONE firstly equipped)		2023.06: Pushed Urban NOA, which does not rely on HD maps, to early bird users 2023.09: Started to push internal beta version of Commute NOA, which will first cover 10 cities including Beijing, Shanghai, Guangzhou and Shenzhen. 2023.12, Li Auto listed the "110 cities open to full-scenario intelligent driving"	2024.05: Opened map-free NOA, AD Max 3.0 public beta 2024.06: OTA 6.0 Intelligent Driving map-free NOA upgraded, covering all models, can be driven nationwide
NIO	All models	Crowdsourcing mapping solution		2020.10: NIO delivered all Highway NOPs for NT 1.0 platform models equipped with Mobileye EyeQ4 chips		End of 2022: Started pushing Highway NOP+ based on NT2.0 platform	2023.06: NIO fleet started route verification in urban areas, and starts using the "swarm intelligence system" in urban areas in October End of 2023: 60,000 km to be opened	2024.04: Global NOP+ urban routes are fully launched (In terms of Urban NOP function, unlike other automakers that expand service coverage by "drive in cities", NIO focuses on deep optimization and precise coverage of specific road sections. This strategy aims to ensure that its intelligent driving system can still provide stable and reliable services under complex and changing road conditions.) 2024.05: Urban verification available mileage reached 1.03 million kilometers, covering 726 cities 2024H2: NIO plans to launch point-to-point global NOP 2.0 to achieve a point-to-point experience, and plans to spend another year to solve the problem of intelligent driving being easy to use across the country and improve urban experience to current level of Highway NOP.
Xiaomi	SU7	Light-weight map solution						2024.04: Delivered national version of Highway NOA function 2024.08: Announced Urban NOA being available nationwide

Source: ResearchInChina

Trend 3: Since 2023, joint venture OEMs have accelerated their follow-up of Highway NOA

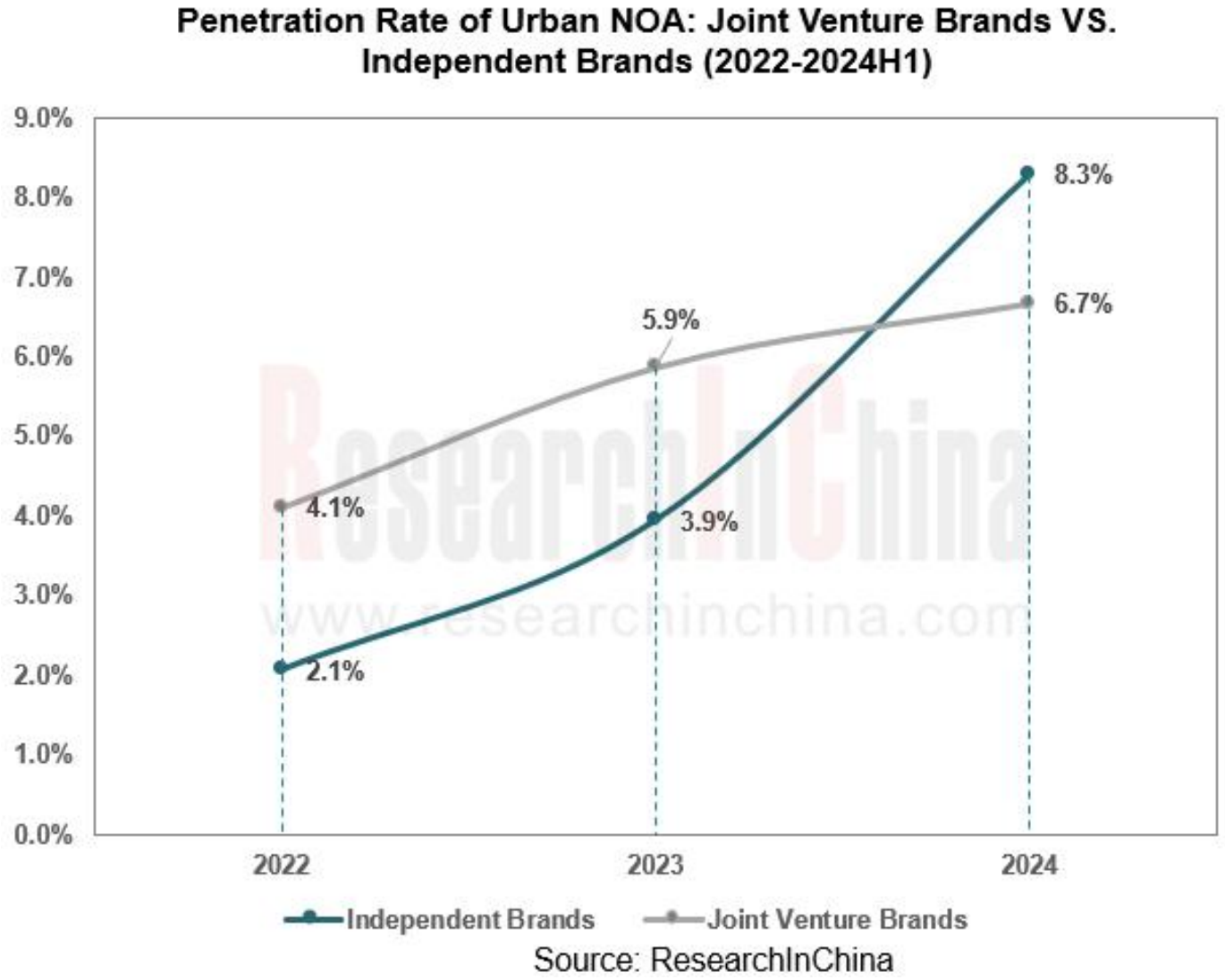
From the perspective of OEM type, in 2022, Highway NOA enterprises concentrated in local market, and no foreign capital has entered. Since 2023, joint venture OEMs have begun to accelerate their follow-up of Highway NOA. As of 2024H1, sales of joint venture OEM Highway NOA models in China reached 54,000 units, with a penetration rate of 0.6%. From 2022 to 2024H1, the sales and penetration rate of independent OEM Highway NOA models continued to rise. By the end of 2023, its sales had reached 454,000 units, a year-on-year increase of 124.5%; the penetration rate reached 2.2%, an increase of 1.2 percentage points year-on-year. In 2024H1, its sales reached 275,000 units, with a penetration rate of 2.8%.



Source: ResearchInChina

Penetration Rate of Urban NOA: Joint Venture Brands VS. Independent Brands (2022-2024H1)

In 2023, sales volume of joint venture brand Urban NOA was 604,000 units, with a penetration rate of 5.9%, up 1.8 percentage points year-on-year; sales volume of independent brand models was 423,000 units, with a penetration rate of 3.9%, up 1.8 percentage points year-on-year. From 2023 to 2024H1, the penetration rate of independent brand Urban NOA models further accelerated. As of 2024H1, the sales penetration rate of independent brand Urban NOA increased from 3.9% at the end of 2023 to 8.3%. This trend shows the rapid layout of many independent brands in intelligent driving field and the increasing acceptance of domestic consumers for L2.9 ADAS products.



Trend 4: L2.9 and L2.5 are accelerating their penetration into the mid- and low-end markets, and the era of technological equality is quietly approaching

From the perspective of price, Urban NOA functions have grown most significantly in models priced at 200,000-300,000 yuan. In 2024H1, especially in the "200,000-250,000 yuan" market segment, Urban NOA's installation volume grew fastest, and the era of technological equality has quietly arrived. This trend shows that in 2024, ADAS technology is accelerating its penetration into mid- and low-end markets, gradually becoming popular, and becoming a standard configuration for future daily family cars.

In the field of Highway NOA, L2.5 has been extended to models in two price ranges of "100,000-150,000 yuan" and "150,000-200,000 yuan". According to ResearchInChina data, penetration rate of domestic passenger car Highway NOA models priced at "100,000-150,000 yuan" and "150,000-200,000 yuan" increased from 0.02% and 0.29% at the end of 2023 to 0.08% and 1.39% in 2024H1, respectively. Taking the iCAR03 Family, a new energy electric brand under Chery Group, as an example, on June 12, 2024, iCAR 03 launched two new intelligent driving versions with an official price of 149,800 yuan and 159,800 yuan. iCAR 03 Intelligent Driving belongs to the L2.5 and has Highway NOA functions.

Sales of Passenger Car Models Equipped with Urban NOA (by Price Range) in China, 2022-2024H1 (10,000 units)

Price Range (RMB10,000)	2022	2023	2024H1
20-25	16521	122380	156898
25-30	109712	333063	278817
30-35	332509	221032	144248
35-40	66259	157226	44423
40-50	84430	172753	55778
>50	20521	23284	51636
Total	629952	1029738	731800

Source: ResearchInChina

Trend 5: The first year of map-free Urban NOA has arrived, and many OEMs have launched national intelligent driving solutions without HD maps

At present, the debate around "map-free" technology route has also risen to an unprecedented height, and getting rid of HD maps has begun to become a key R&D direction of more and more Chinese companies. Among many domestic OEMs, OEMs that have adopted map-free NOA solutions include but are not limited to: Li Auto, Xpeng Motors, Huawei System, GAC, Great Wall Motor, Zeekr, etc., and Xiaomi adopts the low-weight map solution. Taking Huawei as an example, the NCA (Navigation Cruise Assist) system launched by Huawei in December last year does not require HD maps and covers all types of public roads across China. Based on ADS2.0 platform, the system integrates BEV and GOD networks to improve road analysis capabilities.

In 2024, Huawei released Qiankun ADS3.0 system, which makes driving behavior more humanized through bionic neural networks and AI algorithms. In May 2024, Xpeng Motors announced that XNGP has achieved 100% map-free, and in cities and counties, core sections will be opened first to ensure the continuity of user experience. Even in areas without HD maps, through the combination of "navigation map + XNet perception capability + driving strategy", XNGP's functional performance is close to that in areas with HD maps.

Trend 6: End-to-end foundation models are being adopted in vehicles to help upgrade intelligent driving

In 2024, emerging OEMs announced that their self-developed foundation model would be applied to vehicles. Introduction of foundation model made the system more accurate and efficient in dealing with complex environments and dynamic changes. Through deep learning and real-time data processing, the foundation model can analyze road conditions in real time, make intelligent decisions, and provide drivers with a safer and more reliable driving experience. With the promotion of this solution, autonomous driving systems can be more widely used nationwide, improving driving flexibility and adaptability.

Li Auto believes that it is not possible to achieve autonomous driving above L4 by relying solely on One Model end-to-end. It proposed a new solution: "System 1 + System 2", namely, E2E (end-to-end foundation model) + VLM (visual language model). Currently, System 1 is in the "second generation: map-free, segmented end-to-end", which consists of two models, namely perception and planning. The biggest change is the removal of NPN, which does not rely on prior information. This generation of technology allows Li Auto to truly be able to drive across the country and can be driven with navigation only.

Trend 7: Vision-only perception route is regarded as one of new directions of technological development by more Chinese OEMs

In the evolution of Chinese intelligent driving technology, core technology architecture of the first half is highly dependent on LiDAR and HD map. This mode ensures the stability and safety of autonomous driving functions through complex sensor fusion technology and support of geographic information systems, especially in real-time updating and precise matching of HD maps.

As the second half of intelligent driving competition begins, the technical routes are showing a diversified development trend, which can be mainly divided into two categories:

The first technical route, represented by Huawei, adopts the strategy of "LiDAR multi-fusion perception + map-free solution/lightweight map solution + end-to-end foundation model". Under this framework, LiDAR provides high-precision perception data, combined with map-free or lightweight map solutions, reducing the system's dependence on HD maps. Meanwhile, the application of end-to-end foundation model further enhances system's autonomous learning and decision capabilities, making the autonomous driving system more flexible and reliable in complex environments.

The second technical route, represented by Tesla, Xpeng Motors, Jiyue, etc., mainly adopts the technical combination of "vision-only + map-free solution / HD map + end-to-end foundation model". In August 2024 , Xpeng Motors officially launched the AI Eagle Eye Vision Solution, which is a high-level intelligent driving solution with light radar (LiDAR has changed from mandatory to optional in L3). The first model equipped with AI Eagle Eye Vision Solution is the P7+, which will be officially launched in Q4.

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