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Automotive Software Business Models and Suppliers' Layout Research Report, 2024

Sept. 2024

Software business model research: from "custom development" to "IP/platformization", software enters the cost reduction cycle

According to the vehicle software system architecture, this report classifies smart car software into three categories: basic software layer, application software layer, and cloud software layer, as well as several sub-categories.

Category 1	Segment 1	Segment 2
Basic software layer	Vehicle OS	Vehicle OS
	Cross-domain middleware	Cross-domain middleware
	Functional software - Application support layer	Basic service
		Algorithm model library
	Functional software-Functional middleware	Data abstraction
		Data flow framework
		Vehicle-cloud collaborative framework
		Security framework
	System middleware-Communication middleware	Communication middleware
		Management middleware
		SOA framework
		ARA
		OTA
		AI large model middleware
	Underlying OS（Kernel）	Cockpit OS
		Intelligent driving OS
		Vehicle-control OS
		MCU OS
	Hypervisor management process	Hypervisor

Category 2	Segment 1	Segment 2
Application software layer	Tool chain	-
	Vehicle control application	Body control software
		Chassis control software
		Power control software
		Energy management software
	Intelligent driving application	Intelligent driving algorithm
	Cockpit application	In-vehicle voice
		DMS
		HUD
		Acoustic system
		Navigation map
		Display UI

Category 3	Segment 1	Segment 2
Cloud software layer	Cloud platform	Cloud
	TSP/MNO data service	TSP platform
		Data platform
	OTA	OTA
	V2X	V2X

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The software development of OEMs is developing towards "platformization" to achieve cost reduction at the source

In 2024, the organizational structure of OEMs are adjusted more and more frequently, and strategies need to be adjusted in real time to cope with the fiercely competitive automotive market. Some OEMs adjust their organizational structure in order to stabilize the company's sales and other status quo, and some adjust their organizational structure, especially R & D business team, to promote the company's software and new business focus.

R&D Organizational Structure Adjustment of OEMs, 2024

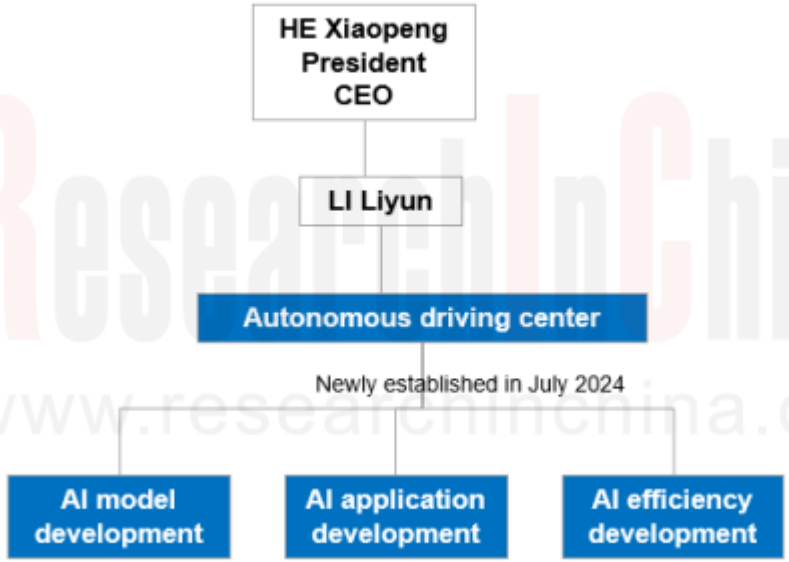
OEM	Time	Department	Before adjustment	After adjustment	Adjustment strategy
NIO	2024.06	Intelligent driving R&D department (Ren Shaoqing, Vice President of NIO Intelligent Driving R & D, is in charge)	Perception team Control team Integration team	Large model team (perception + regulation & control, led by Peng Chao, the former head of the NIO perception team) Delivery team (integration)	Will explore more explicitly the implementation of high-order intelligent driving with end-to-end large models
LI Auto	2024.07	Intelligent driving business department	-	End-to-end autonomous driving department (around 200 people)	End-to-end+VLM autonomous driving layout
XPeng	2024.08	Autonomous driving department	-	Three new functions of AI model development, AI application development, and AI efficiency development have been established	Strengthen layout of end-to-end Intelligent driving
Leapmotor	2024.06	Newly establish Intelligent Technology Research Institute	E/E business including intelligent team (intelligent driving, cockpit and HUD, etc)	Intelligent Technology Research Institute	-
	2024.08	Newly establish end-to-end R&D team		Intelligent driving team size expands to around 500 people	Strengthen layout of end-to-end Intelligent driving
XIAOMI	2024.09	Xiaomi autonomous driving team	Perception division Planning& Control division	End-to-end algorithm and function division	Responsible for development of mass production solutions, with the goal of delivering end-to-end intelligent driving within 2024
Geely	2024Q2	Geely Central Research Institute	Research teams of major brands such as cockpit, smart driving, EEA, electric, platform, etc of Geely Central Research Institute	Integration	R&D business integration, focus layout
SAIC	2024.08	SAIC R & D Institute	IM R & D business, Rising R & D business, SAIC R & D Institute	SAIC R & D Institute	R&D business integration, move towards big R&D institute
BYD	2024.01	BYD Planning Institute	BYD Planning Institute - Intelligent Connection Center and Intelligent Driving Center	BYD Automotive New Technology Research Institute(two centers integrated)	Cockpit-driving integration layout
	2024.05	BYD Department 5 -BYD Automotive New Technology Research Institute	BYD Department 5 - Advanced Intelligent Driving Department	Belongs to BYD Automotive New Technology Research Institute	Integrate advanced intelligent driving business strength
	2024.06	BYD Automotive New Technology Research Institute-Intelligent Driving Center	-	Newly establish Tianxuan Development Unit	End-to-end advanced intelligent driving layout

Source: ResearchInChina

XPeng Motors has continued to adjust its organizational structure

In recent years, XPeng Motors has continued to adjust its organizational structure on a large scale, and at the same time proposed a number of measures such as cost reduction and efficiency increase, budget reduction, etc., to face the intelligent and highly competitive automotive market. In July 2024, XPeng Motors' autonomous driving department ushered in another organizational restructuring. Xpeng's autonomous driving department established three new segments: AI model development, AI application development, and AI efficiency development. The AI model development department is mainly responsible for end-to-end model development, which is to strengthen the layout of AI end-to-end intelligent driving technology.

XPeng Motors Autonomous Driving Center Establishes Three New AI Divisions



Source: ResearchInChina

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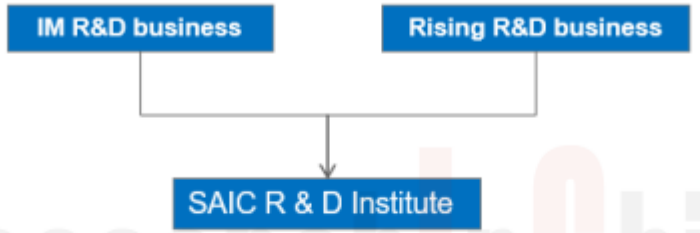
SAIC adjusted its organizational structure

In August 2024, SAIC is unifying R & D business of IM and Rising brands into SAIC Group Innovation Research and Development Institute (referred to as SAIC R & D Institute). Among them, the R & D teams of IM and Rising brands, as well as technical projects such as power batteries, intelligent driving, and chassis, will be centrally migrated to SAIC R & D Institute, and unified and coordinated by R & D Institute. This model of centralizing the R & D power of all its sub-brands and developing them uniformly is the "large R & D institute" model commonly used by automobile manufacturing groups. Through this model, the platform and standardized layout of products are carried out to achieve equal sharing of R & D costs and strive to reduce costs at the source.

SAIC R & D Institute integrates R & D business of IM and Rising brands



- Provide vehicle development services to Roewe, MG, IM and Rising
- Have an independent financial and personnel system
- In specific projects, a strong project management system is implemented, and cross-departmental strong project teams are established under the leadership of each brand. In accordance with the unified GVDP process, they are responsible for the progress, cost and quality of the project. During the project, the strong project team is responsible for the assessment. The R & D Institute dispatches corresponding personnel to provide technical services.

Source: ResearchInChina

Multinational automakers strengthen cooperation with China's local software supply chain

At present, the localization development of multinational automakers in China has entered a new stage. This is different from the previous "sewing" auxiliary decoration and development, but to fundamentally restructure the system, actively adjust the strategy, and actively layout to cope with the new changes in China's auto market. It can be summarized as follows:

• Increase China's local investment and R & D center layout. For example, in March 2022, Mercedes-Benz announced the establishment of a R & D center in Shanghai to further expand its R & D layout in China. The Shanghai R & D center will focus on intelligent interconnection, autonomous driving, software and hardware development and big data. In April 2023, Volkswagen Group announced that it will invest about 1 billion euros to establish a R & D, innovation and procurement center focusing on intelligent connected electric vehicles.

• Further open up the authority of China's local teams and strengthen China's local customization strategy. At present, Mercedes-Benz, BMW, Volkswagen and other foreign automakers have proposed China's local customized development model to further open up the authority of China's local teams.

• Actively cooperate with local Chinese suppliers. For example, Mercedes-Benz has in-depth cooperation with Momenta, Tencent, AISpeech, etc.; Volkswagen has in-depth cooperation with ThunderSoft, Horizon, XPeng Motors, etc.

Major multinational automakers strengthen localization in China

OEM	Time	Layout
上海通用汽车 SHANGHAI GM	Aug-23	Established a local software and digital business team in China to accelerate the development and iteration of software technology and the creation of digital services and ecosystems for the company's products
		By 2025, SAIC-GM is expected to invest 70 billion yuan in this field
M z	Mar-22	Mercedes-Benz established a "Shanghai R & D Center" to further expand its R & D layout in China, focusing on areas such as intelligent connectivity, autonomous driving, software and hardware development, and big data
	Jun-23	The Shanghai R & D Center was upgraded to Mercedes-Benz (Shanghai) Digital Technology Co., Ltd., the largest overseas digital R & D center under the Group
	Apr-24	Mercedes-Benz (Shanghai) R & D center is opening, and the size of the R & D team will reach 600 by the end of the year
BMW	Jul-23	The BMW Group's new Shanghai R & D center was also officially opened
TOYOTA	Aug-23	Toyota renamed and upgraded its largest R & D center in China
Audi	Nov-22	Audi China R & D Center was fully upgraded
	May-24	SAIC Group and Audi signed a cooperation agreement, officially launching the joint development of SAIC Audi Advanced Digitized Platform intelligent digital platform, and the new car will be rolled out in 2025

OEM	Time	Layout
VW	May-23	Volkswagen established Volkswagen (China) Technology Co., Ltd. (VCTC) in Hefei, its largest R & D center outside of Germany. VCTC will focus on R&D of intelligent connected vehicles to achieve 100% localization for Volkswagen
	Jul-23	Volkswagen pays $700 million for a 4.99% stake in XPeng Motors
	Sep-23	Fully acquired Shanghai Muchuan Industrial Design and integrated it into CARIAD China's UX & UI Design Center (CARIATIVE)
	Sep-23	CARIAD and ThunderSoft jointly established CARThunder, with Volkswagen holding 49% of the shares, focusing on cockpit connection business
	Nov-23	CARIAD and Horizon jointly established CARIZON, Volkswagen holds 60%, Volkswagen invests about 2.40 billion euros, focusing on smart driving business
	Apr-24	Volkswagen announces an additional $2.70 billion investment in China to expand its production and innovation center in Hefei, Anhui Province
	Apr-24	In April 2024, Volkswagen Group and XPeng Motors signed EEA Technology Strategic Cooperation Framework Agreement. The two parties worked together to create Volkswagen's next-generation China's local E/E architecture CEA, which is expected to be applied to Volkswagen brand electric models produced in China from 2026
	Jun-24	SAIC Group signed a number of technical cooperation agreements with Volkswagen, Volkswagen (China) Investment, VCTC, and SAIC Volkswagen on new product projects, including the development of three plug-in hybrid models in China and two pure electric models
	Jul-24	XPeng Motors and Volkswagen Group signed a strategic cooperation and joint development agreement for E/E architecture technology. The two parties will fully invest in the development of industry-leading E/E architectures for CMP and MEB platforms produced by Volkswagen in China

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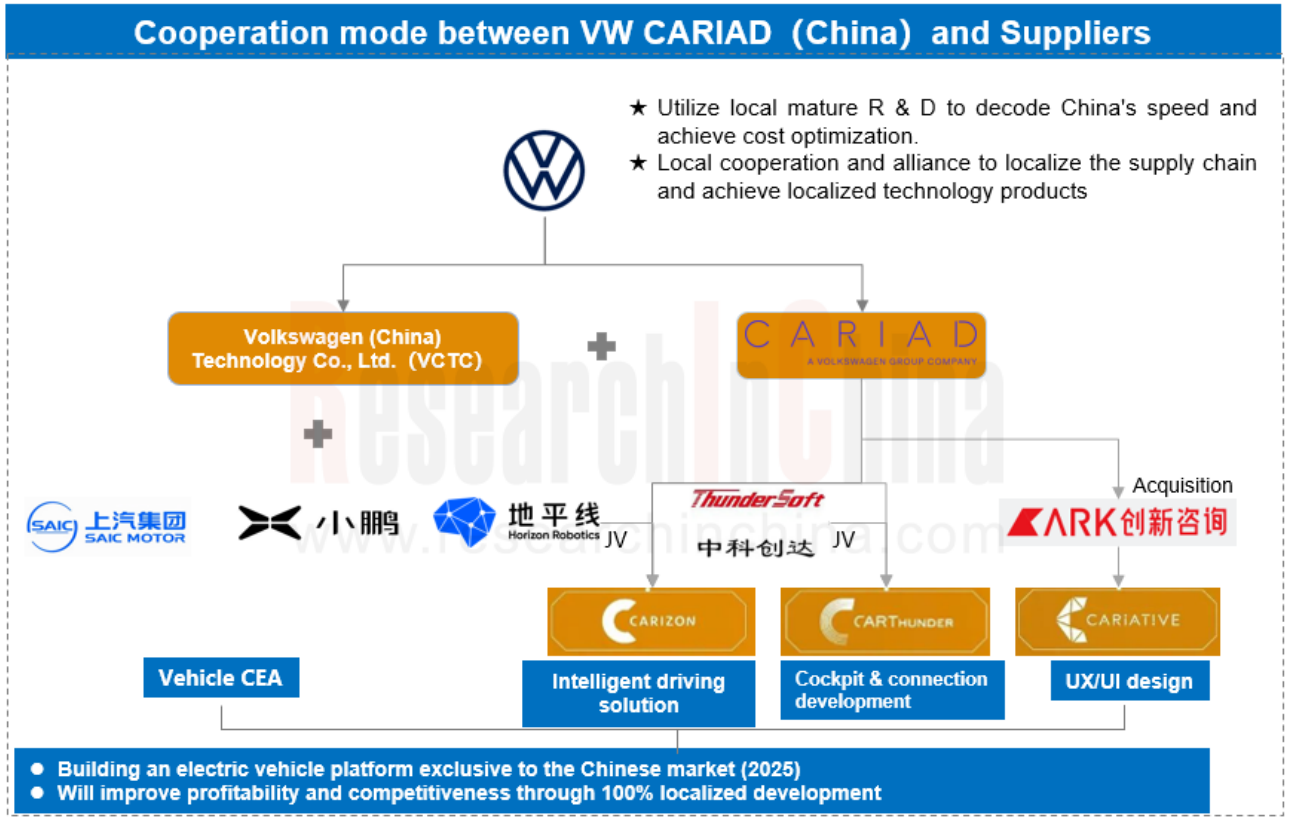
Volkswagen Group has actively promoted the layout of intelligent software

In recent years, Volkswagen Group has actively promoted the layout of intelligent software. In Chinese market, Volkswagen Group has completely delegated the R & D decision-making power to the team in the Chinese market. From hardware platform of the model to electronic and electrical architecture to intelligent driving, cockpit, and even design, the local team makes independent decisions and makes local solutions. Volkswagen is responding to the challenges of its development in China and reshaping its software business by strengthening partnerships and leveraging external expertise.

In May 2023, Volkswagen Group announced the establishment of the largest R & D center in Hefei besides the German headquarters, investing about 1 billion euros, namely Volkswagen (China) Technology Co., Ltd., to systematically strengthen R & D strength "in China, for China". On April 11, 2024, Volkswagen Group (China) announced that it would invest 2.50 billion euros to further expand production and innovation center in Hefei, Anhui.

At the same time, starting from 2023, Volkswagen will cooperate with Horizon, ThunderSoft, XPeng Motors, SAIC and other local Chinese companies in the fields of E/E architecture, cockpit, intelligent driving, UI/UX and so on.

Cooperation mode between VW CARIAD (China) and Suppliers



Source: ResearchInChina

Software suppliers promote "customized development" to "IP/platformization" layout, the software R&D cycle is greatly compressed, and the cost reduction cycle is started

The IP/platformization layout of the software supplier's products helps OEM reduce costs and increase efficiency

At present, the automotive software business mainly includes customized software development and design, technical services, software IP authorization/licensing, and system integration, and the fees mainly include one-time fee NRE, software authorization/licensing, and royalty paid per piece.

In recent years, software suppliers in China's automotive market have mainly focused on software customized development or technical service business. Especially in the field of intelligent cockpit and intelligent driving. As to customized supply model, suppliers need to improve their company's reputation and expand market demand by developing new technologies and solutions through customized development with OEMs at the early stage.

With the emergence of mass production effect, in order to further improve efficiency and achieve large-scale product production at the same time, the software supplier business has gradually developed from "customization" to "IP/platformization". On the one hand, through IP or platformization product layout, OEMs can reduce costs and increase efficiency at a greater level, shorten the development cycle; on the other hand, it is more conducive to the large-scale replication of supplier business and the polishing and optimization of smart vehicle products, expanding the company's profit margins.

Taking cockpit platform products as an example, many suppliers offer cockpit platform products, which not only ensure high performance, but also achieve performance such as shortening development cycles and reducing costs through platform to meet the needs of highly competitive OEMs.

The development cycle of supplier cockpit platforms continues to shorten

Supplier	Intelligent cockpit products	Platform development cycle	Note
HARMAN	Ready Upgrade cockpit solution	The cycle of intelligent cockpit products on board is compressed to 6 to 12 months	Ready Upgrade includes three series of production-grade cockpit domain controllers, advanced software solutions, a range of pre-integrated features, and a complete set of customer-facing lightweight coding software development tools, which significantly reduces time to market and development costs for automakers.
			It can be supplied in an integrated manner or independently modular.
			Vehicle hardware and software can be upgraded throughout its lifecycle
			Reusable: Provides a product that can be reused across models and in different annual alterations of the same model.
BOSCH	The upgraded version of Bosch intelligent cockpit platform based on Qualcomm SA8255P chip developed in China	Production time can be reduced from an industry-leading 18 months to as little as 10 months	-

Supplier	Intelligent cockpit products	Platform development cycle	Note
畅行智驾	AquaDrive OS Smart Cockpit Solution Based on Qualcomm Snapdragon 8255 Chip	The solution reduces the prototype validation development time from 6 months to 2 months, and the mass production development cycle from 12 months to 8 months	-
PVT 掌锐电子	Front-mounted smart car Turn-key solution	It allows customers to reduce the project development cycle from 18 months to 6 to 8 months, and at the same time reduce manpower investment, from 30- 50 people to complete the project to 10- 20 people	
MEDIATEK	Dimensity Auto platform	In the optimization of the development cycle, MediaTek's time from project approval to mass production can be shortened to one year, while the industry takes an average of two years	MediaTek can help automakers reduce costs from three aspects: high hardware integration, shortened development cycle, and system performance optimization

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Cloud-native, AI large models help explore new models of software development and shorten development cycles

With the increasing complexity of automotive system software, especially the birth of new applications such as central computing and autonomous driving, application code has become more and more abundant, resulting in new ways of software development, deployment, and management to quickly meet a variety of changing consumer needs.

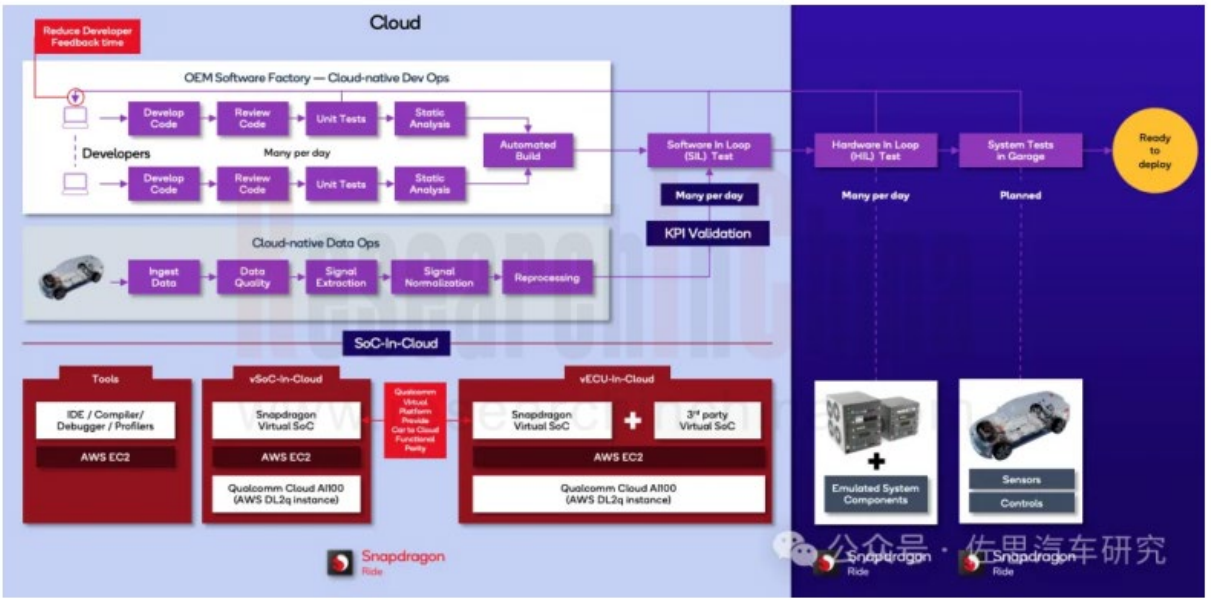
Among them, cloud-native software development, as a new development model, means moving to a cloud-based development model for automotive application development, enabling software development in the cloud and deployment directly on the edge of the car. Developers deploy and test automotive software applications anytime, anywhere, greatly shortening the development and deployment cycle of in-vehicle system applications.

Based on the open-source community, ETAS builds SDV. OS cloud-native solutions, provides SDV power builder chains, and provides customers with cloud-native development, deployment, and management and analysis solutions.

In addition, as technologies such as AI large models continue to mature, AI large models will lead a new model of automotive software development. More than 60% of automotive software code work will be replaced by large models, and basic application software and other products will continue to develop on a platform. At that time, the concentration of automotive software industry will further increase, and the industry's leadership will become inevitable. The upstream and downstream will enter the "flywheel acceleration" rally.

In September 2023, AWS and Qualcomm announced a collaboration. One of the core of the collaboration is a power builder and infrastructure based on cloud-native technologies to help automakers develop, test and deploy software in the cloud. The partnership project showcases a cloud-based development environment and virtualized Snapdragon SoC platform for testing and validating automotive software in the cloud. The entire architecture design takes full advantage of the flexibility and scalability of cloud computing, enabling developers to carry out efficient development work anywhere in the world.

Qualcomm and AWS software cloud native development model



Source: AWS

Vehicle-level OS platform, OEMs and suppliers coordinate layout

At present, vehicle OS products are mainly composed of standardized middleware such as Hypervisor, underlying OS, AUTOSAR, other core middleware and tool chains, etc., to realize the operating system of the central computing unit software system function.

At present, there are three main paths for OEMs in China to deploy vehicle OS: full-stack self-development, internal incubation of Tier1, and joint development.

Full stack self development

OEMs integrate internal advantages and R&D resources through self-research

Advantage:

The only dominance, the independent grasp of architecture upgrade route, a clearer division of tasks, and strong departmental collaboration

Master the independent R&D capabilities of the full technology stack and master the developer's ecological resources.

Post-maintenance costs are lower than other OEMs, and customization flexibility is high

Low supplier dependency and intellectual property rights

Disadvantage

High initial investment cost, huge capital and personnel investment, sunk cost, etc

Long development cycle and high requirements for team talent construction

The underlying software essentially offers little difference in consumer experience, and OEMs' self-developed investment in the underlying standard OS kernel and standard middleware software has a low return on investment

The internal sealed toolchain has high technical requirements for automobiles, making it difficult to attract external developers

Internally incubated tier1

Traditional OEMs establish software subsidiaries through incubation or jointly establish software companies with partners to strengthen their control over vehicle software technology

Advantage:

- Independently grasp architecture upgrade route, with clearer division of tasks and strong departmental collaboration
- Master the independent R&D capabilities of software, algorithms, chips and other full technology stacks, and master the developer's ecological resources
- Besides internal supply, external supply is possible

Disadvantage

- High input cost
- Long development cycle
- Difficulties in expanding external customers and may lack sufficient economies of scale

Joint development

OEMs achieve joint development through strategic in-depth cooperation with suppliers, establishment of joint ventures, investment and acquisition, etc

Advantage:

- Autonomous and controllable, reducing development costs
- High R & D efficiency, faster product iteration and lower R & D costs
- Both parties jointly expand the developer ecosystem, resulting in higher efficiency

Disadvantage:

- There are high requirements for cooperation planning and responsibility definition, and it is necessary to prevent the risk of conflict in the collaboration process;
- There may be disputes over architecture upgrade route
- There may be intellectual property disputes
- Low differentiation and high cost of customization

Source: ResearchInChina

Vehicle-level OS Product Layout of Suppliers

At present, except for some OEMs with strong R & D strength, most OEMs tend to implement the layout of the whole vehicle OS through the model of joint development with suppliers. In the face of the customized needs of OEMs, the supplier's software development team is an ideal partner for OEMs, which can cooperate in R & D and help customers quickly develop products, shortening product launch time.

In the face of the vehicle-level OS market, software suppliers have launched platform-based vehicle OS solutions and flexible supply methods to help OEMs quickly create suitable software platform products for central computing. For example, ThunderSoft launched the vehicle AquaDrive OS system, ArcherMind Technology's cross-domain vehicle Fusion OS, Kotei KCar-OS, ETAS's end-to-end vehicle OS solution, Huawei iDVP intelligent digital base, etc.

In addition, under the trend of SOA software frameworks, cooperation models such as OEMs, Tier1, and software developers are no longer chimney-like, but in-depth strategic cooperation models. Through partnerships and ecological integration, the entire OS can be more open and serve the development of the entire industry.

Vehicle-level OS Product Layout of Suppliers

Supplier		ThunderSoft	ArcherMind Technology
Product		AquaDrive OS	Fusion OS
Launch time		2023	2023
Cloud	Cloud service	• Full set of cloud service	•Fusion Cloud
	Tool chain	•Tool chain products	•Tool chain platform FusionStudio
Software	Application layer	•Kanzi/Native APP/ WEB APP •Auto API	•Application software/algorithm (OEMs develop) •SOA layer (**ArcherMind**+OEM customized development)
	Middleware	•ADAS/Instrument /IVI /CGW functional parts •Auto middle (functional middleware/power/upgrade etc) •Hybrid connect (SDV middleware /communication middleware) •Hybrid AI (data large model/intelligent commendation engine) •Hybrid Data (data middleware/data aggregation) •AI and database •Security /FUSA	•AUTOSAR CP+ AP •FusionWise middleware (communication /diagnosis/ time/ health/ storage/OTA, etc) • (Central/ cockpit/ intelligent driving/vehicle control security, etc) application domain Engine
	Underlying OS kernel	•Distributed Device •Container /linux/Andriod/QNX/RTOS	•Cockpit Fusion EX8.0 (AndriodS+QNX7.1) •FusionWise3.0 (linux+CP AUTOSAR OS) •FusionDrive2.0 (linux+CP AUTOSAR OS) •FusionWise3.0 (CP AUTOSAR OS)
	Hypervisor	•Hypervisor	•Hypervisor
Hardware	Hardware	•Cockpit-driving integration platform (Qualcomm, etc multi chips)	•Suitable for Qualcomm, NVIDIA, NXP, Horizon, Infineon, SemiDrive, etc
Partners		•Cerence, BlackBerry, TomTom, KPIT, ABUP, Volcano Engine, ETAS, AWS, ARM, Black Sesame Smart, Horizon, etc	•NVIDIA, Continental EB (AUTOSAR), BMW
Business model		•Flexible charging, charging according to project customization needs In-depth cooperation with OEMs, etc	• Adopt in-depth cooperation model, project joint development model, and charge NRE fees, etc Modular single-domain supply or cross-domain integration module integrated supply

Source: ResearchInChina

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