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Automotive Cockpit Domain Controller Research Report, 2024

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X86 architecture VS ARM architecture: AMD V2000, Intel Malibou Lake lead the x86 AI cockpit

Research on cockpit domain controller: Facing x86 AI PC, multi-domain computing, and domestic substitution, how can cockpit domain control differentiate and compete?

X86 architecture VS ARM architecture: AMD V2000, Intel Malibou Lake lead the x86 AI cockpit

1) ECARX · Makalu computing platform, the world's first AMD V2000 mass production installation

For a long time, Qualcomm has dominated the high-end cockpit SoC, and "ARM + Android" is the mainstream framework for smart IVI. With the rise of smart cars, users' demand for differentiated cockpits such as 3D HMI, AI large models, and large-scale games is growing, and "x86 + Linux" architecture has attracted the attention of automakers.

Under ARM architecture, the CPU is relatively not so good in performance, the core frequency is relatively low, but the advantage is that the heat dissipation performance is good; the CPU under x86 architecture has a large demand for computing, so the computing power is super, the core frequency is relatively high, and there are high requirements for heat dissipation. The advantage of x86 is to run large software. The typical representative of x86 is Tesla, and IVI operating system is Linux-based secondary development.

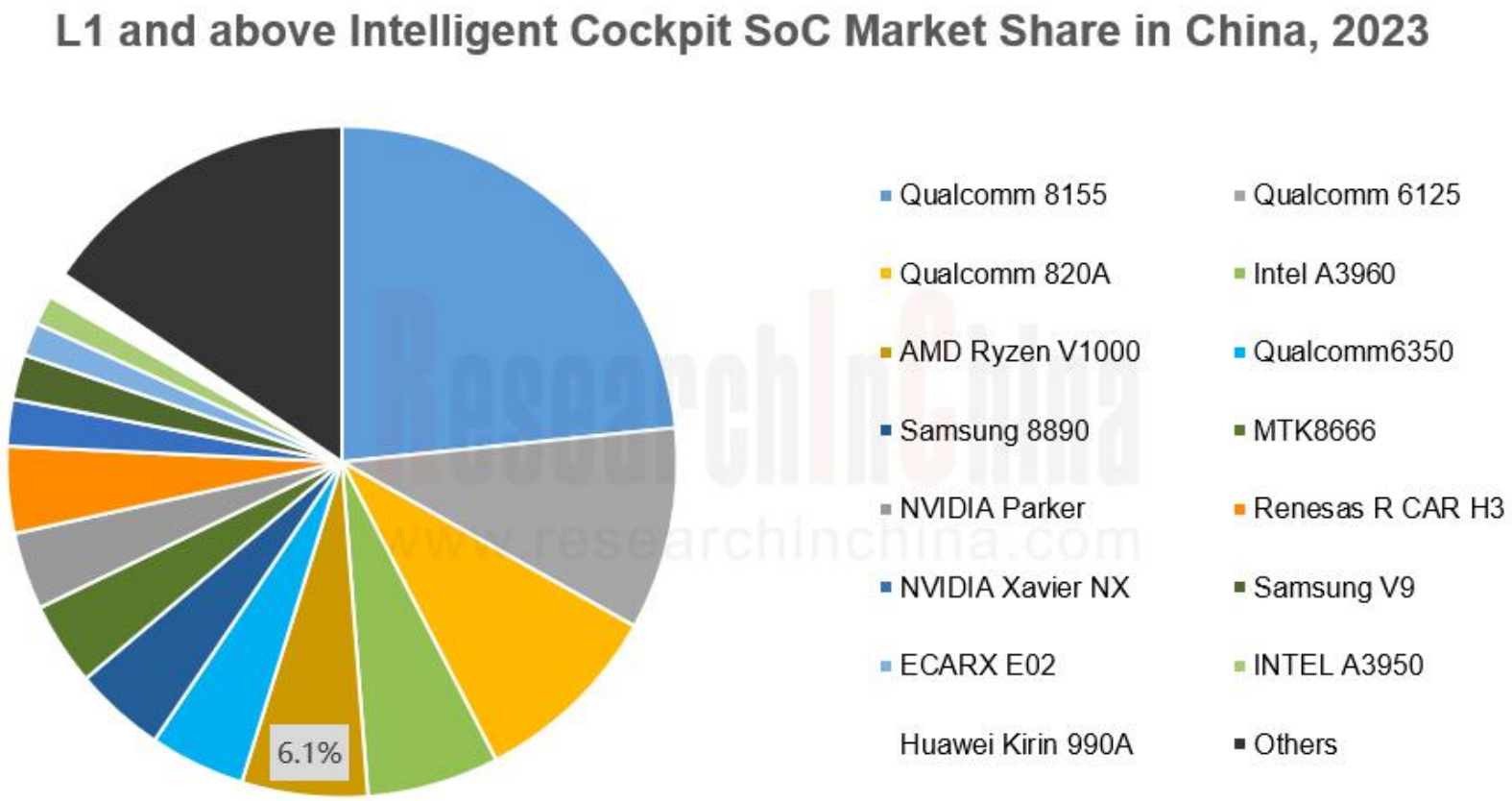
	ARM architecture	X86 architecture
Process	Most single thread design	Ultra-thread design
CPU performance	Lower than x86	Strong
Frequency	Low core frequency and small size	High Low core frequency
Heat dissipation	Lower than x86	High
Ecosystem	Good compatibility with Android, mature ecosystem	Compatible with Linux, virtualized compatible with Android

Source: ResearchInChina

L1 and above Intelligent Cockpit SoC Market Share in China, 2023

In the automotive field, the leaders of x86 architecture chips are mainly AMD and Intel. Since 2023, AMD, Intel, and NVIDIA have begun to develop intelligent vehicle market, attempting to seize the high-end intelligent cockpit market share from Qualcomm.

At present, all Tesla models are equipped with AMD Ryzen V1000. According to the statistics of ResearchInChina, AMD Ryzen V1000 has begun to take shape, accounting for 6.1% of L1 and above intelligent cockpit SoC market.



Source: ResearchInChina

AMD has further launched the next generation product AMD Ryzen V2000A

On the basis of success of V1000, AMD has further launched the next generation product AMD Ryzen V2000A, which uses 7nm process technology and CPU peak computing power of 394K DMIPS, which is 88% higher than the previous generation V1000 series and better than Qualcomm's SA8295P. It supports 4 4K displays, has dual Gigabit Ethernet, and has passed AEC-Q100 automotive grade chip certification, supports Automotive Grade Linux and Android Automotive.

ECARX, Cinemo and Visteon are the first partners of AMD V2000A series. ECARX has partnered with AMD to launch ECARX Makalu computing platform, the world premiere AMD V2000A processor with x86 architecture, and AMD Radeon RX 6600 series of discrete graphics cards (optional), through its self-developed underlying virtualization technology to support different operating systems, such as Instrument OS (Linux), Android, Game OS (3A games).

Source: ECARX

In 2024H2, ECARX Makalu computing platform will be launched in mass production with Lynk & Co's pure electric model Z10 and smart wizard #5.

ecarx AMD LYNK&CO

ECARX cockpit domain controller	CPU: Radeon embedded V2000 + GPU: Radeon RX 6000	Lynk pure electric Z10

Lynk Z10: intelligent cockpit computing platform

15.4-inch super-large floating display, 2.5K resolution, LYNK Flyme Auto OS

Radeon RX 6000 independent graphics cards (optional), 8GB GDDR6 independent display memory, support 3A game installation

The features of ECARX Makalu computing platform include:

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*** Vehicle safety standards Hypervisor virtualization program:**
ECARX Technology has launched a self-developed Hypervisor virtualization program for vehicle safety standards for AMD V2000 and Radeon RX 6600 series independent graphics cards (optional). According to the disclosure of ECARX 2023 Techday, its computing power utilization is 11.7% higher than the industry level, and the virtualization performance loss is lower than the industry level by 67%. Based on this, the "Makaru" platform can run x86 operating system (rear entertainment screen Game OS) at the same time, based on the instrument RTOS (ASIL-B security level) developed by Linux, and the Flyme Auto operating system (central control screen) customized based on Android.

*** Strong graphics rendering capability, support 3A games on board**
The ECARX Makalu computing platform has 394K DMIPS CPU performance, 10.1T FLOPS graphics rendering capability (1.8T built-in, 8.3T is an independent optional configuration), supports up to 32GB of independent memory, ITB SSD solid state drive, and pioneering 8GB GDDR6 high-speed independent video memory, which can realize ray tracing, real-time rendering of 3D environment and other functions. At the same time, ECARX technology and Unreal Engine have reached an ecological strategic partner to support large-scale 3A games and a rich Epic Games Store game ecosystem.

*** Flyme Auto operating system for smooth "Car Phone" interconnection**
All mobile phone applications are connected to the car, the car and the Pad (the central control screen video and the car control application are projected to co-pilot and rear PAD screen display, and the PAD also controls the central control screen in reverse to achieve multi-screen interaction)

As the competition in the field of intelligent cockpit continues to intensify, providing the ultimate and differentiated user experience has become one of the keys to competition in this field. Obviously, the "x86 + Linux" architecture becomes the best solution for current high-performance, immersive, 3A game cockpit solution in intelligent cockpit market. The innovative technology demonstrated by ECARX technology also indicates that the models equipped with the domain controller system will show outstanding performance when they are launched in the second half of the year.

Based on Intel Malibou Lake, Neusoft Group will introduce Neusoft C4 4.0 intelligent cockpit domain controller

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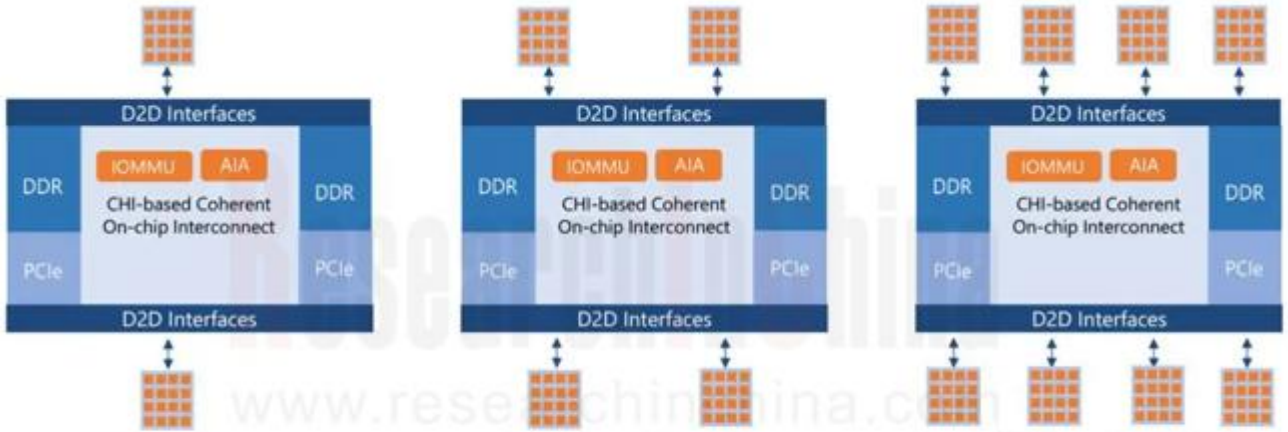
Intel is also seamlessly importing its application ecosystem built on x86 architectures into automobiles.

Intel launched the first software-defined automotive SoC chip at 2024 CES exhibition, and it is also the world's first automotive-grade chip using Chiplet. On the first chip, Intel adopted the more mature Intel 7 process technology. It is expected that in the future, Intel Intel 4 process and Intel 3 process will be integrated into it to achieve iteration. Geely Zeekr has made it clear that it will use this software-defined automotive SoC chip.

Intel is the leader in Chiplet field, and FOVEROS is the most critical 3D packaging technology in Chiplet field. Even TSMC is far inferior to Intel. Using Chiplet, custom IP can be placed in the chip module. Intel is also the leader of Chiplet UCIe interface standard. SDV SoCs also use the UCIe standard. UCIe Association members include Alibaba Group, AMD, ARM, Google, Intel, Microsoft, META, ASE, NVIDIA, TSMC, Qualcomm and Samsung.

Chiplet is very flexible, and the development results can be infinitely repurposed to adapt to high, medium and low-end models.



Source: Network

Features of the Intel Malibou Lake-based Neusoft C4 4.0 intelligent cockpit domain controller include:

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Features of the Intel Malibou Lake-based Neusoft C4 4.0 intelligent cockpit domain controller include:

* Intel Malibou Lake chip based on x86 architecture
* Powerful computing power: PC-level processor with 7nm process technology, with powerful performance (up to 400 + DMIPS CPUs supported)
* Powerful AI capabilities: A complete AI toolchain enables offline large models to be deployed in the car to meet user privacy needs and bring the best user experience with low latency. First Time Token < 1.5S (supports 6 billion parameter edge large models)
Powerful gaming capabilities: support independent GPU, experience 3A-level games in the cabin
* Powerful ecosystem: Supports Android's original ARM ecosystem with Houdini virtualization technology

Hardware Specifications of Neusoft C⁴ 4.0 Intelligent Cockpit Domain Controller (Based on Intel Malibou Lake)

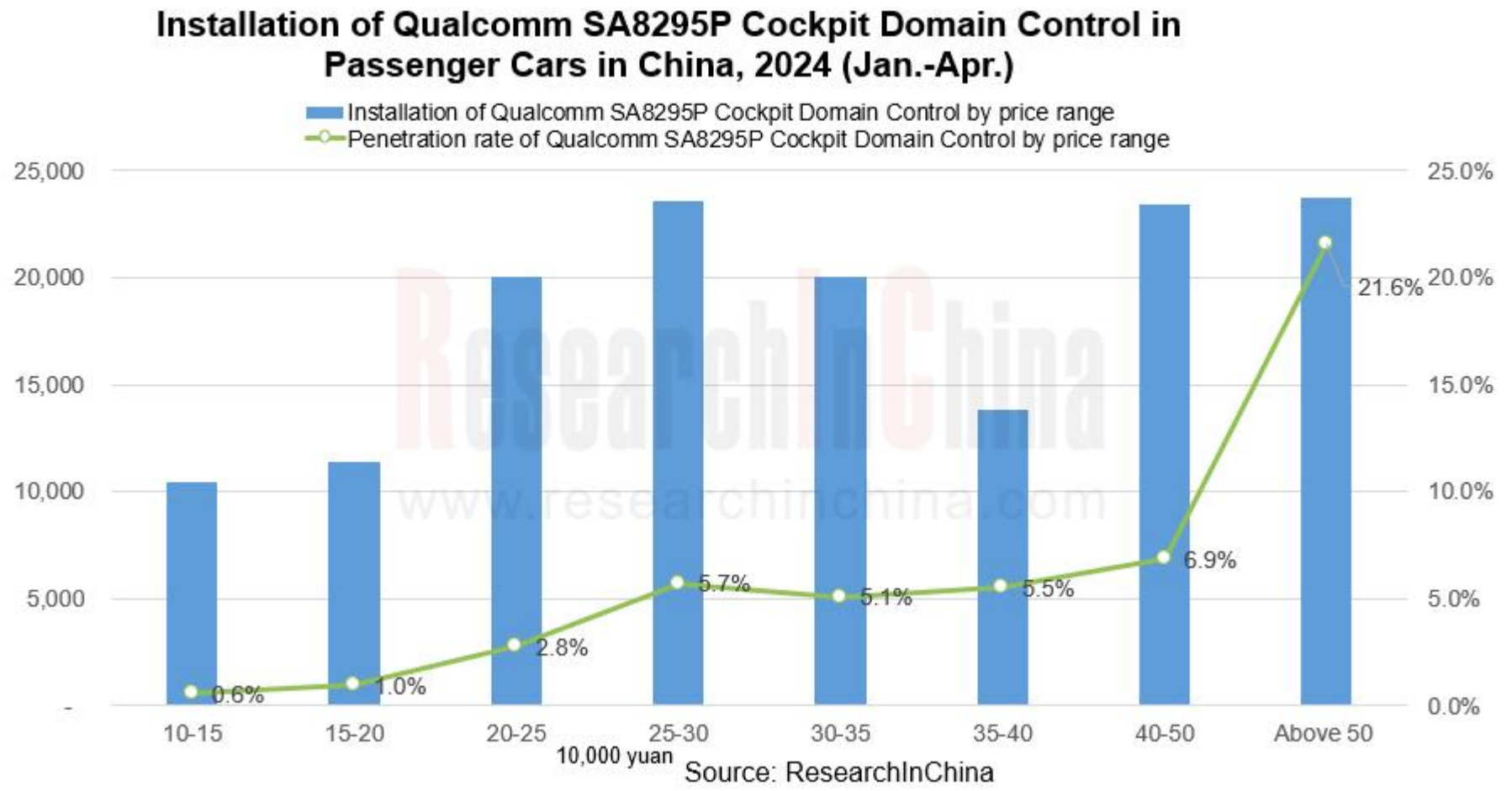
Source: Neusoft

Qualcomm SA8295/8255 Domain Controller Platform: Cockpit-Driving-Parking integration and multi-domain computing are key application directions

2) Qualcomm SA8295/8255 Domain Controller Platform: Cockpit-Driving-Parking integration and multi-domain computing are key application directions

Qualcomm's cockpit platform has undergone four evolutions. The first chip SA8295P, the fourth-generation cockpit platform product released in 2022, is gradually mass-produced in 2023 and has become one of the preferred solutions for domestic high-end intelligent cockpits.

According to the statistics of ResearchInChina, from January to April 2024, the total sales volume of passenger cars priced 500,000 yuan and above was 110,055 units, and the penetration rate of Qualcomm SA8295P cockpit domain controller in this price segment was as high as 21.6%.



Note: penetration rate, the numerator is the sales volume of models equipped with Qualcomm 8295 cockpit domain controller in the subdivided price segment, and the denominator is the overall sales volume of passenger cars in the subdivided price segment

SA8255P is not weaker than SA8295P in terms of performance specifications

The next step, Qualcomm Snapdragon SA8255P competitiveness began to emerge, compared with the previous generation of Qualcomm Snapdragon 8155 products in terms of CPU, GPU, AI, ISP and other aspects, it has significant improvement, and is cost-effective. SA8255P is not weaker than SA8295P in terms of performance specifications, such as:

* Support LPDDR5 memory, which exceeds LPDDR4X of Snapdragon 8295 in terms of memory rate, and is more than twice as large as the previous generation SA8155P, and the bandwidth is doubled;
* CPU computing power 230K DMIPS, NPU computing power 24TOPS, comparable to SA8295P;
* In terms of functions, it can expand "Cockpit-Driving-Parking integration", support APA, RPA, HPA, and expand L2 ADAS function, which can be used as a replacement for SA8295P, SA8775P and other products;
* SA8255P also provides built-in safety islands to save system costs for manufacturers.

Supplier	Product	Master SOC	NPU	Function integration feature	Cross domain	Mass production clients
Neusoft	C^4 4.0 cockpit domain controller	Qualcomm SA8295P Qualcomm SA8255P	24~48 TOPS	✓ Support dual operating system coexistence ✓ Support integrated AVM, infotainment, in-vehicle navigation, 5G in-vehicle communication, V2X vehicle-road collaboration, online application upgrade and other functions ✓ Up to 10 screens, 16 camera inputs (DMS, OMS, DVR, RVC/AVM, etc.) ✓ Support integrated landing of cockpit-parking/cockpit driving functions	✓Cockpit-driving-parking integration	Jiyue 01 Galaxy E8
	C^5 Vehicle HMI platform	Qualcomm SA8295P +NXP S32G	30 TOPS	✓Multi-domain collaboration such as Ethernet gateway, body control domain, cockpit domain control, ADAS, etc	✓ Cockpit-driving-parking integration ✓ Multi-domain computing	/
ECARX	Pikes intelligent cockpit computing platform	Qualcomm SA8295P	46 TOPS	✓Immersive 3D HMI, up to 64 million pixel display throughput ✓Support L2 ADAS function, and can deploy more AI functions: DMS, OMS, AI large model, APA, RPA, HPA	✓Cockpit-driving-parking integration	/
	Atlas intelligent cockpit computing platform	Qualcomm SA8255P	24 TOPS	✓Can expand "Cockpit-driving-parking integration", support APA, RPA, HPA, can expand L2 ADAS function ✓Can help Chinese automakers launch smart electric vehicles that meet the usage habits of local users in overseas markets, and help global vehicle brands upgrade their intelligent strategies	✓Cockpit-driving-parking integration	/
Desay SV	G9PH （Gen4 cockpit domain controller）	Qualcomm SA8295P	30 TOPS	✓Integrated parking, smart lights, electronic rearview mirrors and other functions ✓Support SOA, support atomization API	✓Cockpit-parking integration	Xiaomi SU7 Li L9
	G9SH （Gen4 cockpit domain controller）	Qualcomm SA8255P	24 TOPS	✓ Integrate full stack self-developed Intelligent software algorithms of Desay SV such as parking, projection and external power amplifier ✓ Support graphics and image rendering processing and smooth operation of car games ✓Support SOA, support atomization API	✓Cockpit-parking integration	/
Bosch	Premium cockpit domain controller	Qualcomm SA8295P	23 TOPS	✓Support up to 12 screens, 16 cameras connected ✓On the basis of 1.0 (8155) function, add AR navigation + ultra-high definition entertainment domain camera + multi-person multi-modal interaction + dynamic gesture interaction and other functions ✓ Cockpit-parking integration 2.0, integrating APA and RPA functions, supports iterative evolution of visual perception algorithms	✓ Cockpit-parking integration ✓Integrate Bosch APA	Independent OEM Overseas OEM
	Upgraded cockpit domain controller	Qualcomm SA8255P	24 TOPS	✓Support up to 10 screens, 16 cameras connected ✓Support up to 36Gb LPDDR5 ✓Cross-domain integration, APA integrated in cockpit	✓ Cockpit-parking integration ✓Integrate Bosch APA	International OEM
Visteon	Gen4 （Premium version）	Qualcomm SA8295P	23 TOPS@INT8	✓It supports 7 display drivers ✓Support ADAS functions such as LKA + EV mileage management + parking assistance + surround view ✓Surround View + DMS + Parking Assistance + Sentinel Mode + Digital Side Mirror + OTA + App Mall + Subscription Management + Driver Safety	✓Cockpit-parking integration	/

Neusoft C4 and C5

Neusoft C4 Smart Cockpit Domain Controller (based on Qualcomm SA8295P)

* Support full-scene AI intelligent voice interaction, running Baidu SIMO voice assistant, 0.23s respond quickly;
* Integrate DVR (driving recorder), DMS (driver monitoring), AVM (Surround View 360) and other independent modules into the domain controller to realize multi-modal HMI;
* Combine CAN FD network, Ethernet network, LIN network, FlexRay, A2B and other networks throughout the entire vehicle ECU module to achieve high-speed information exchange between multi-domain controllers;
* Cockpit-parking integration and Cockpit-Driving-Parking integration, integrating 1V3R L2 ADAS driving function into one, while meeting the user's intelligent cockpit + intelligent driving premise, reducing costs

Neusoft C4 4.0 intelligent cockpit domain controller (based on Qualcomm 8295) was mass-produced in 2023 on Jiyue 01 and Galaxy E8 models. Neusoft Group also provides 5G T-BOX and related software services for Jiyue 01. In addition to the above two models, many well-known automakers are negotiating cooperation intentions, and related projects are expected to be launched in 2024.

Neusoft C5 vehicle HMI platform with scalable hardware design for cross-domain integration

* Adopt scalable hardware design around the concept of central computing power and domain integration, and rely on highly reusable and upgradable self-developed software;
* Integration of intelligent cockpit, body control, gateway, compatible with ADAS high computing power board;
* Neusoft independently develops SOA middleware to decouple software and hardware

Neusoft C5 vehicle HMI platform

Source: Neusoft

Localized chip domain controller platform: Localized product ecosystem thrives

3) Localized chip domain controller platform: Localized product ecosystem thrives

By the end of 2023, a number of local cockpit SoC suppliers such as SemiDrive, SiEngine Technology, and AutoChips Technology have announced that their products have achieved large-scale mass production, and are increasingly available in the passenger car market, with a continued trend from low-end to mid-to-high-end.

As of 2024H1, SemiDrive X9 series cockpit SoC has achieved a cumulative shipment of over 3.5 million, mainly in Chinese domestic brands and joint venture brand models.

Localized SoC Cockpit Domain Controller Product Platform

Supplier	Cockpit SoC products	Cockpit domain controller platform	Shipment
SemiDrive	X9E, X9M, X9H, X9S, X9HP, X9SP	✓ Neusoft ✓ Desay SV DS06C ✓ PATEO ✓ Hangsheng Electronics ✓ ADAYO ✓ Auto-Link AL-N1 ✓ KOTEI	✓ By the end of 2023, more than 2 million cockpit chips have been shipped ✓ By the first half of 2024, more than 3.5 million cockpit chips have been shipped
	X9CC	✓ Neusoft X-Center 2.0	
SiEngine	Longying No.1	✓ ECARX Antola ✓ BICV ✓ Desay SV ✓ Auto-Link	✓ By the end of 2023, shipments have exceeded 200,000
Huawei	Kirin 990A	✓ Huawei Kirin chip module and HarmonyOS	✓ In 2023, the installation volume is about 120,000 pieces, and the cumulative volume is about 200,000 pieces
AutoChips	AC8025	✓ Desay SV DS05A ✓ Hangsheng Electronics	✓ It has been designated by a number of domestic OEMs and two international OEMs
	AC8015	✓ ADAYO lightweight domain controller AVN ✓ Yuanfeng Technology ✓ NavInfo integrated lightweight cockpit solution	✓ In 2023, AC8015 shipments exceeded 1 million pieces, and cumulative shipments exceeded nearly 3 million pieces

Source: ResearchInChina

SemiDrive X9 series cockpit platform: for AI cockpit, central computing + zonal control architecture, it is rapidly iteratively upgraded

SemiDrive X9 series products fully cover the needs of various cockpit processors, including 3D meters, IVI, cockpit domain control, cockpit-parking integration, cockpit-drving-parking integration, central computing platform and other cockpit application scenarios from entry-level to flagship level, and are actively leading the development of AI cockpit products. The X9 series has become the mainstream choice for China's automotive-level intelligent cockpit chips, with dozens of blockbuster fixed-point models. SAIC, Chery, Changan, GAC, BAIC, Dongfeng Nissan, Dongfeng Honda and other automakers have all produced models equipped with X9 series chips.

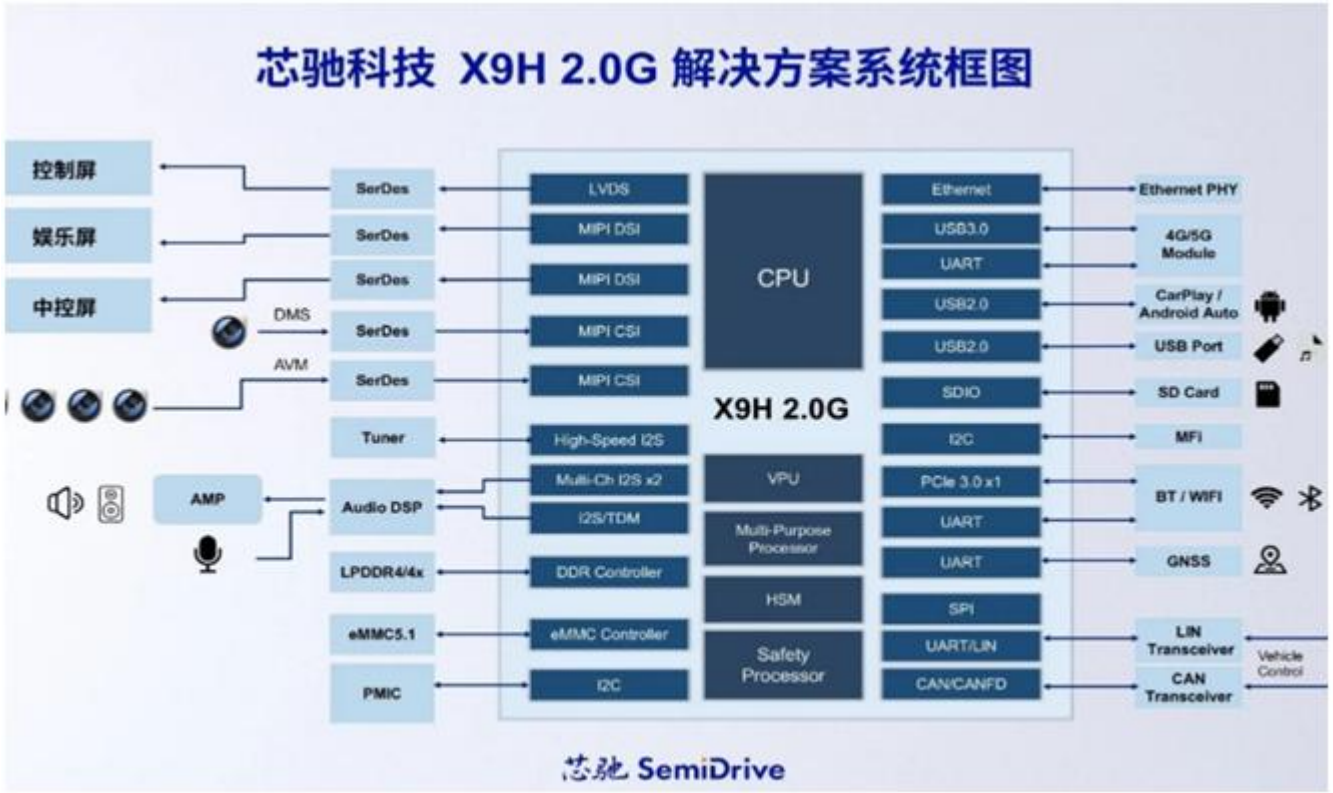
In March 2024, SemiDrive released X9H 2.0G, a new product of the smart cockpit X9 series, dedicated to providing a more powerful and cost-effective cockpit infotainment system-on-chip solution. To accelerate customer development, SemiDrive provides X9H 2.0G supporting software and hardware solutions for infotainment systems:

* Support up to 4 screens of independent display and multi-screen interaction to meet the needs of cockpit multi-screen, high-resolution, high-frame-rate and large-screen.
* At the same time, it supports cockpit applications such as voice assistants, audio-visual entertainment, and intelligent navigation.
* Maximum simultaneous 9-channel camera data input, complete coverage of cockpit requirements, support integrated high definition 360 surround view function and DVR function, built-in lightweight NPU realizes deployment and acceleration of DMS, OMS and other functions
* Support Bluetooth, WIFI, 5G module, Audio DSP module and other hardware resources.

SemiDrive launched "1 + N" central computing + zonal control architecture at Beijing Auto Show

In April 2024, SemiDrive launched "1 + N" central computing + zonal control architecture at Beijing Auto Show. A central computing platform CCU provides centralized computing power support for automotive intelligence, and N flexible and configurable zonal controller ZCUs can be adapted to different vehicle needs.

Under the "1 + N" architecture, SemiDrive released the central computing processor X9CC and a new generation of ZCU chip family.



Source: SemiDrive

ECARX · Antola 1000 series platform

ECARX · Antola 1000 series platform: equipped with 7nm chip "Longying No. 1" developed by SiEngine Technology, to achieve function expansions of cockpit-parking integration and cockpit-driving-parking integration

Whether it is the current important trend of cockpit-driving-parking integration, or the ultimate evolution of intelligent driving, domestic chips will play an increasingly important role. "Longying No. 1", as the first domestic high-performance 7nm automotive-grade cockpit SoC, since its launch in 2021, has completed large-scale delivery or more than 20 models in mainstream automakers such as Geely and FAW through ECARX's Antola series computing platform. At present, the cumulative shipment has reached 400,000 pieces, and the shipment is expected to reach 1 million pieces by the end of 2024.

ECARX's "Antola" series cockpit domain controller is equipped with high-speed memory, advanced power management module and corresponding software SDK on the basis of "Longying No. 1" SoC, which greatly improves the system integration, development efficiency and ease of use. According to its official data, compared with single SoC products, it has successfully reduced the number of pins by 40%, reduced the cost of components BOM by 80%, simplified the production process, reduced the failure rate, and can help customers shorten development cycle by 20%. At present, this series of domain control has been carried on Galaxy E5, Lynk & Co 06 EM-P, Lynk & Co 07 EM-P, Lynk & Co 08 EM-P VC, LEL380 and other models in large-scale production.

The core of competition in the era of automotive intelligence 2.0 will be vehicle intelligence and cross-domain integration, which is a competition for global electronic architecture and system solution integration with higher entry barriers. And Tier 1, like ECARX, which vertically integrates the underlying chip, software and application ecosystem, is more likely to occupy a place in the rapidly changing intelligent connected vehicle market.

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