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Automotive Cockpit SoC Research Report, 2024

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Automotive Cockpit SoC Research: Automakers quicken their pace of buying SoCs, and the penetration of domestic cockpit SoCs will soar

Mass production of local cockpit SoCs is accelerating, and the localization rate will reach up to 25% in 2030.

Chinese electric vehicle makers are quickening their pace of purchasing domestic chips, so as to lessen their dependence on imported chips. According to the informal goals, it is expected that the overall penetration of homemade automotive chips will be increased to higher than 20% in 2025, and state-owned and private automakers will be encouraged to purchase domestic chips. This is undoubtedly a great boon to Chinese cockpit SoC vendors.

According to ResearchInChina's statistics, China's local cockpit SoCs took a just about 4.8% share of the Chinese passenger car market in 2023. Driven by policies and technological maturity, it is conceivable that the penetration of domestic cockpit SoCs will further rise, up to 25% in 2030.

At present, local cockpit SoC vendors are in the rapid development phase, speeding up the launch and mass production of new products. Quite a few local cockpit SoC vendors such as SemiDrive, SiEngine, AutoChips and Huawei have achieved large-scale mass production and covered much more passenger car models.

Local Cockpit SoC Mass Production in China

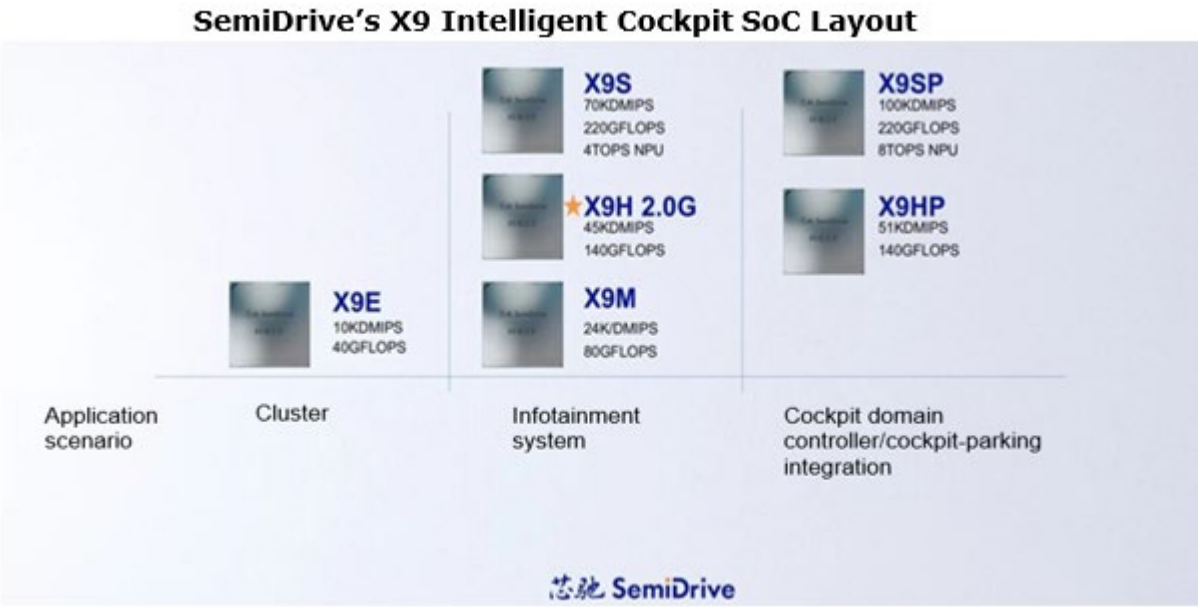
Vendor	Cockpit SoC	Shipments in 2023	Production Model
SemiDrive	X9, X9U, X9HP, X9SP, etc.	By the end of 2023, SemiDrive had shipped over **1 million** cockpit SoCs.	30+ models, .e.g., SAIC Roewe, Chery Jetour X70PLUS, Tiggo 7, Tiggo 8, Venucia VX6, Nissan Sylphy, BAIC BJ60 and Changan CS75PLUS.
SiEngine	SE1000A	By the end of 2023, SiEngine had shipped over **200,000** cockpit SoCs.	Lynk & Co 08, Lynk & Co 06 EM-P, Livan 7, etc.; designated by mainstream automakers including Geely and FAW for 20+ models.
AutoChips	AC8015	In 2023, AutoChips shipped over **1 million** AC8015 SoCs, with the total shipments hitting nearly **3 million** units.	Joint-venture auto brands, e.g., Volkswagen, Toyota, GM and Ford; Chinese independent auto brands, e.g., SAIC, FAW, GAC, Changan, Geely, Chery and Dongfeng.
	AC8025	Successfully lighted up and designated by 2 international OEMs	-
Huawei	Kirin 990A	-	Several models in cooperation with Huawei, e.g., AITO M7, M9, LUXEED S7, Avatr 11, and Avatr 12
UNISoC	A7870	In mass production	SAIC (possibly)
Rockchip	RK3588M	Mass-produced	GAC (possibly)

Source: ResearchInChina

SemiDrive's X9 family

SemiDrive's X9 family of intelligent cockpit products covers entry-level to flagship-level cockpit application scenarios, for example, cluster, IVI, cockpit domain control and cockpit-parking integration, meeting diverse needs, with shipments of over one million pieces, rich mass production experience and mature ecosystem.

Automakers like SAIC, Chery, Changan, GAC, BAIC and Dongfeng Nissan all have mass-produced models equipped with X9 SoC. Many leading automotive software ecosystem partners inside and outside China, such as AliOS, QNX, Unity, Kanzi, QT, Tinnove and CalmCar, have completed adaptation on SemiDrive X9. Now SemiDrive is China's first and the only chip company that has entered QNX's board support package (BSP) list.



Source: SemiDrive

Major Players' Cockpit SOC Products

In 2023, SiEngine mass-produced Longying No.1 SoCs for Geely Lynk & Co 08/06 and other models. With total shipments of 200,000 units in 2023, the product was designated for more than 20 models.

AC8015, AutoChips' entry-level cockpit SoC, has been shipped 3 million units in total, while the company's mid-to-high-end cockpit SoC AC8025 has been designated by two international OEMs and will come into mass production in 2024.
In line with the diversity of the automotive market, Chinese cockpit SoC companies also keep developing new products to adapt to the booming cockpit market and meet customer demand.

Just recently, SemiDrive launched X9H 2.0G, a new product in X9 SoC family. As an upgraded product of X9H, X9H 2.0G is developed for mainstream infotainment systems, and adopts a 16nm automotive-grade process, with the main frequency rising from 1.6GHz to 2.0GHz, the CPU compute of 45KDMIPS and the GPU compute of 140GFLOPS, catering to the increasing computing power requirement of cockpit infotainment systems and helping automakers further optimize cockpit experience.

While improving the performance of Cortex-A, X9H 2.0G is equipped with more Cortex-R cores. It has 3 pairs of dual-core lockstep Cortex-R5F, compared to X9H with 2 pairs. With a built-in high-performance HSM engine and an independent safety island, it complies with ASIL-B functional safety standards. More high-security lock-step Cortex-R cores allow for deployment of fast RVC/AVM, safe display and other functions. In addition, X9H 2.0G has a built-in lightweight NPU, which can accelerate AI applications such as voice recognition and DMS.

Block Diagram of SemiDrive X9H 2.0G

Source: SemiDrive

X9H 2.0G integrates high-performance VPU and supports 4K video encoding/decoding. It integrates rich video input/output interfaces, including MIPI DSI/CSI, Parallel CSI and LVDS. Also X9H 2.0G supports multiple memory interfaces (such as LPDDR4/4X, eMMC, QSPI and SDIO), high-speed interfaces (such as Gigabit Ethernet, PCIe3.0, and USB3.0) that support the TSN protocol, SPDIF and I2S audio interfaces, and general peripheral interfaces (such as I2C, SPI, ADC and UART). It also enables body CAN FD network access.

X9H 2.0G and other products in the X9 family maintain the hardware Pin-To-Pin compatibility and software compatibility, and can use SemiDrive's reference design and mass production experience to greatly reduce R&D investment in switching and upgrading and accelerate the mass production process.

So far, X9H 2.0G has been designated by multiple OEMs, including independent and joint venture brands. The models involved will be mass-produced and rolled out as soon as late 2024.

As the competition in high-end cockpit SoCs becomes white-hot, the pattern changes from “one superpower and several powers” to “multiple powers”

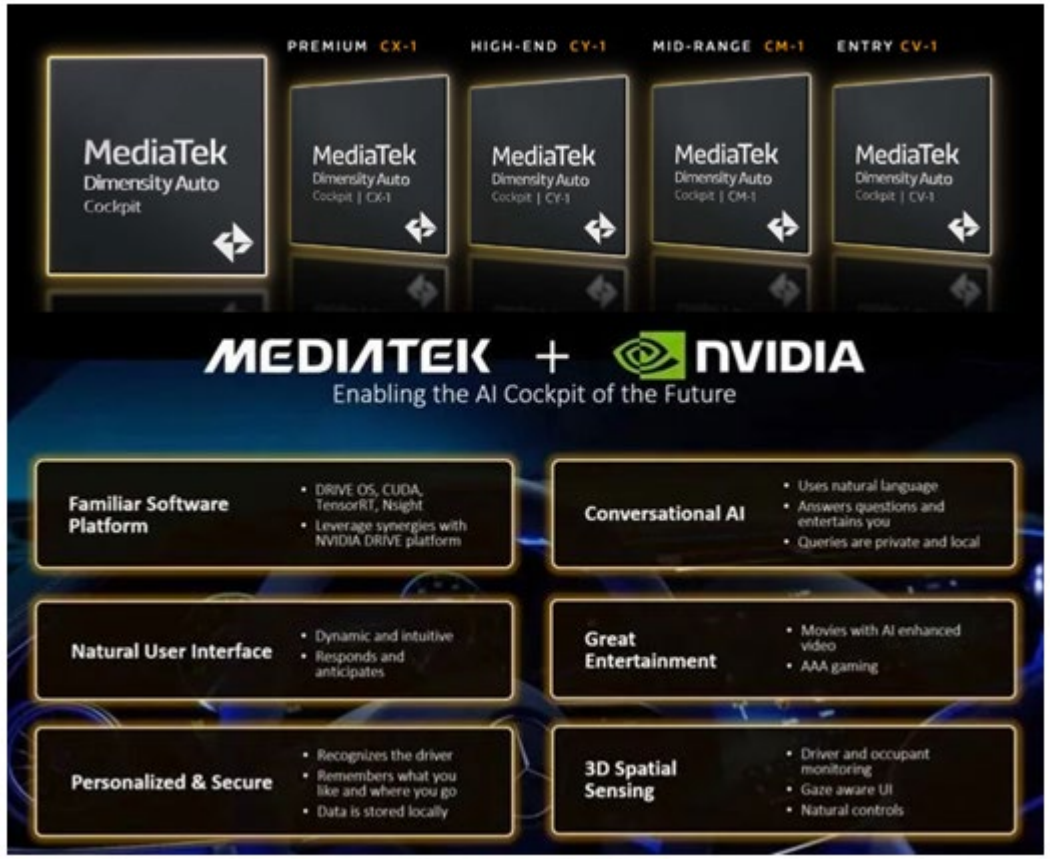
Qualcomm rules the roost in the high-end cockpit SoC market with the pattern of“one superpower and several powers”. Facing the intelligent cockpit market worth RMB100 billion and driven by introduction of vehicle AI foundation models and 3A games into cars, cockpit chip players such as Intel, NVIDIA, MediaTek, and AMD have also begun to make efforts to seize a larger market share.

Starting from 2024, cockpit SoCs will see a new market melee, and the battle for the next hegemon will officially kick off.

MediaTek: partnered with NVIDIA to lay out 3nm cockpit SoCs to challenge Qualcomm's dominance.

In March 2024, MediaTek, which features the most cost-effective cockpit SoCs, together with Nvidia, a dominant leader in intelligent diving SoC field, announced four new automotive SoCs within its Dimensity Auto Cockpit portfolio: CX-1, CY-1, CM-1, and CV-1. Based on a 3nm process (the most advanced for cockpit SoC), the SoCs integrate a state-of-the-art ARM v9-A system and NVIDIA’s next-gen GPU accelerated AI computing and NVIDIA RTX graphics. The AI-enabled Dimensity Auto Cockpit platform runs large language models (LLMs) in the car. To help lower bill-of-material (BOM) costs, the Dimensity Auto Cockpit CX-1, CY-1, CM-1, and CV-1 chipsets are highly integrated with built-in multi-camera HDR ISP and audio DSP to enable multiple functions such as AR HUD and electronic rearview mirrors. The Dimensity SoCs can reduce BOM cost, offer high computing power and low power consumption, and have flexible AI architecture and high scalability. They can cover several vehicle segments from premium to entry-level. They are planned to be mass-produced and installed in vehicles in 2025.

This is a new challenge posed by MediaTek and Nvidia to Qualcomm, so to speak. They will leverage MediaTek’s market share and customer resources in the cockpit market and Nvidia’s high-performance AI technology and brand to seize a share in the cockpit market.



Source: Nvidia

Intel SDV SoC Family

Intel: Driven by AI foundation models, Intel officially announced its return to the cockpit market, and plans to put AI PCs on vehicles

At CES 2024, Intel announced plans to drive the company's AI everywhere strategy into the automotive market, focusing on SoCs for intelligent cockpits, electric vehicle (EV) energy management and open automotive chip customization. Intel launched the first generation of the SDV SoC family. It is expected to restore the glory of Apollo Lake which prevailed in the high-end cockpit market.

The product integrates Intel's AI acceleration technology, supports 12 applications such as camera-based driver and occupant monitoring, electronic mirrors, high-definition video conference calls and PC games, and can run in multiple operating systems simultaneously. In order to reduce the cost as much as possible, it seems to compete with AMD V1000 series or Qualcomm SA8155. Geely's ZEEKR brand will be the first OEM to use Intel's new family of SDV SoCs in 2024.

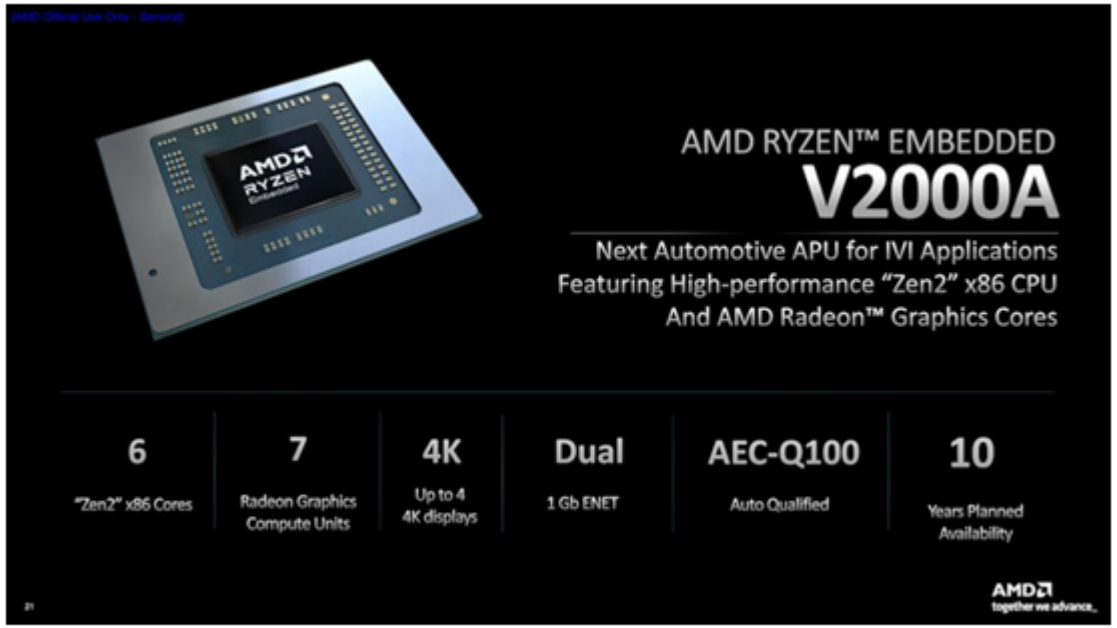
Source: Intel

AMD Ryzen™ Embedded V2000A

AMD: launched V2000A, a new-generation high performance automotive product which outperforms Qualcomm 8295.

AMD, the PC chip giant that entered the cockpit market through Tesla, also works on SoC. At the beginning of 2024, AMD introduced the Ryzen™ Embedded V2000A Series processor. Built on 7nm process technology, 'Zen 2' cores and high-performance AMD Radeon Vega 7 graphics, the AMD Ryzen Embedded V2000A Series processor provides a new class of performance. It delivers high-definition graphics, with enhanced security features and automotive software enablement through hypervisors in addition to support for Automotive Grade Linux and Android Automotive. The V2000A Series is designed for gaming. For the cockpit market that more highlights entertainment experience, it is undoubtedly a high-end series with both high performance and high cost performance. It will be first installed on Smart models.

The CPU performance of V2000A is about 360-370kDMIPS, 88% higher than the previous V1000 series, and much higher than Qualcomm SA8295P.



Source: AMD

Qualcomm SA8295

Qualcomm: with SA8295 widely used in vehicles, work to deploy the next-generation cockpit SoCs

It must be admitted that with 8155 Qualcomm has become a king in the cockpit SoC market, too dominant to shake. Since October 2023, SA8295P, its fourth-generation cockpit SoC with a 5nm process, has been mass-produced and mounted on models like Jiyue 01, New Mercedes-Benz E-Class and Galaxy E8. As of March 2024, over 20 models had been announced to be launched on market with Qualcomm SA8295. Meanwhile, Qualcomm's fourth-generation SoC 8255 has also been production-ready, and it will first land on Neta L.

In addition to automotive-grade products, Qualcomm is also a major supplier applying consumer-grade chips to cockpits. BYD is a major customer of its consumer-grade cockpit chips.
In 2023, BYD launched a new high-end brand named Yangwang. The first model Yangwang U8 carries a 4nm 5G high-performance cockpit chip customized in cooperation with Qualcomm, presumed to be Snapdragon 8+ Gen1 (SM8475). The chip boasts 16GB RAM and LPDDR 5X memory, and also integrates 5G baseband technology, with the fastest download rate of 1G/second. It is 100% compatible with the Android ecosystem, and its configuration is comparable to the top-class tablet PCs unveiled in 2022. Cockpit SoCs are being launched at an ever faster pace, close to the consumer market.
To follow the trend towards cockpit-driving integration, in 2023 Qualcomm unveiled Snapdragon Ride Flex family of SoCs, high-performance cockpit-driving integration products, all with a 4nm process and AI compute not lower than 2000TOPS. This family can act as a bridge between new and old solutions and reduce the sunk costs of iteration for automakers. It is expected to be mass-produced in 2024.

Main Models Equipped with Qualcomm SA8295, as of March 2024

Brand	Model	Launch/SOP	Cockpit SoC
Jiyue	Jiyue 01	October 2023	Qualcomm SA8295
ZEEKR	ZEEKR 001 FR	October 2023	Qualcomm SA8295
	ZEEKR 007	December 2023	Qualcomm SA8295
	2024 ZEEKR 001	February 2024	Qualcomm SA8295
	ZEEKR MiX	~April 2024	Qualcomm SA8295
Mercedes-Benz	Mercedes-Benz E-Class	December 2023	Qualcomm SA8295
Xpeng	Xpeng X9 (MPV)	January 2024	Qualcomm SA8295
Geely Galaxy	Galaxy E8	January 2024	Qualcomm SA8295
Li Auto	Li MEGA (MPV)	March 2024	Qualcomm SA8295 (high performance version)
	Full Range of 2024 Li Series (L7, L8, L9)	Released in March 2024	Qualcomm SA8295 and Qualcomm SA8295 (high performance version)
	Li L6	~To be launched in April 2024	Qualcomm SA8295
Leapmotor	Leapmotor C10	March 2024	Qualcomm SA8295
	Leapmotor C16	~To be pre-sold in April 2024	Qualcomm SA8295 (possibly)
NIO	Full range of 2024 models (ES8, EC7, ES6, EC6, ET5T)	Delivered in March 2024	Qualcomm SA8295
	2024 ET5	~To be delivered in April 2024	
	2024 ET7	~To be released in April 2024	
	2024 ES7	~To be delivered in May 2024	
	NIO ET9	~To be launched in Q1 2025	Qualcomm SA8295
	ONVO L60	~To be launched in May 2024	Qualcomm SA8295
Xiaomi	SU7	~Launched on March 28, 2024	Qualcomm SA8295
IM Motors	IM L6	~To be launched in H1 2024	Qualcomm SA8295
Jiyue	Jiyue 07	~To be launched in 2024	Qualcomm SA8295
Neta Auto	Neta L	~To be pre-sold in April 2024	Qualcomm SA8255

Source: ResearchInChina

Amid the needs for cost reduction, high computing power and high integration, chiplet technology is often mentioned in the cockpit SoC market

In the evolution of intelligent vehicles, automotive chips, especially high-compute automotive SoCs, constantly make breakthroughs in performance and cost. On the one hand, advanced processes are improving, with the great potential to catch up with consumer chips. On the other hand, chiplet technology creates new possibilities.

As advanced processes iterate to 5nm and 3nm, Moore's Law gradually slows down, and the development costs and difficulty of advanced processes increase day by day. Yet not all chip vendors can spread the high R&D costs through multiple large-scale application markets as Nvidia and Qualcomm. In this regard, the semiconductor industry has begun to expand new technology routes in an attempt to continue Moore's Law, and the concept of chiplet was thus proposed.

In high-compute automotive SoC fields (such as cockpit), starting from 2023 multiple companies have said that they will deploy the next generation of high-performance SoCs using chiplet technology.

Major Chip Vendors Will Adopt Chiplet Technology to Lay out Automotive SoCs

Vendor	SoC	Description	SOP
Intel	1st Generation SDV SoC	• This product will be **built with chiplet technology, and based on Intel's brand-new open chiplet platform.** • Through Intel's Universal Chiplet Interconnect Express, the third-party chiplet can be integrated into Intel's automotive products, breaking from the traditional model of using monolithic SoCs.	Mass production in 2024
MediaTek	Dimensity Auto Cockpit Portfolio: CX-1, CY-1, CM-1, and CV-1	• 3nm process • Develop and integrate NVIDIA GPU, NVIDIA AI and graphics computing IP, and **achieve high-speed interconnect between the main chip and GPU chiplet based on chiplets.**	Released in March 2024, and to be mass-produced in 2025
Renesas	5th Generation R-Car SoC	• The SoC is oriented to high performance applications. • **Chiplet technology will be used to create a flexible platform that can be customized to meet various requirements for each use case.** • The new platform will offer multiple processor sets from entry-level to higher-end models. • Integrate a variety of IPs such as AI accelerators and IPs by partners and customers into a single package. • Give users the option to customize designs according to their needs.	To be launched in 2024

Source: ResearchInChina

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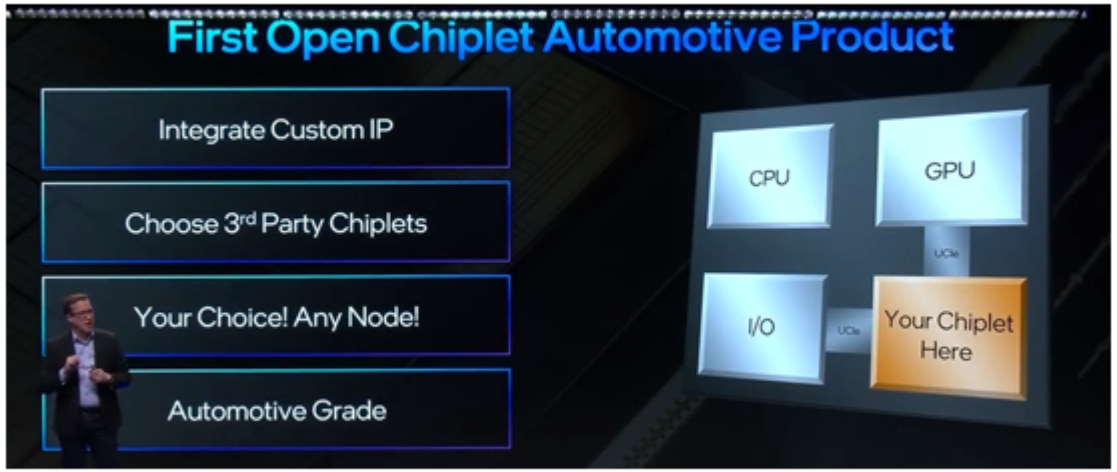
Amid the needs for cost reduction, high computing power and high integration, chiplet technology is often mentioned in the cockpit SoC market

At the beginning of 2024, Intel launched the first SDV SoC family built on chiplet technology. Through Intel's Universal Chiplet Interconnect Express, the third-party chiplet can be integrated into Intel's automotive products, breaking from the traditional model of using monolithic SoCs. Based on the chiplet architecture, Intel can provide a customized computing platform, that is, the chiplet designed by OEMs is integrated with Intel's CPU, GPU and NPU to satisfy the diversified computing power combinations of the OEMs.

In terms of 3D packaging, Intel will work with Interuniversity Microelectronics Centre (IMEC) to ensure the packaging technologies meet the rigorous quality and reliability requirements of the automotive industry.

Intel's open chiplet platform strategy eliminates the risk of vendor lock-in for automakers and promotes competition and innovation in the market, but it needs to convince automakers to adopt its SoCs to build a strong ecosystem and succeed in the automotive industry.

Intel Built the Industry's First Open Chiplet Automotive Platform



Source: Intel

In the 3nm automotive SoC design on which MediaTek and NVIDIA work together, the high-speed interconnect between the main chip and the GPU chiplet is realized using chiplet technology.

In January 2024, 12 Japanese automakers, components manufacturers and five semiconductor companies formed Advanced SoC Research for Automotive (ASRA), aiming to develop more efficient next-generation automotive SoCs using chiplet technology, build automotive chiplet technology by 2028 and install SoCs in production vehicles in 2030.

Table of Content (1)

1 Overview of Automotive Cockpit SoCs
1.1 Performance Comparison between Cockpit SoCs
1.1.1 Overview of Cockpit SoCs
1.1.2 Composition of Cockpit SoCs
1.1.3 Design Process of Cockpit SoCs
1.1.4 Development History of Cockpit SoCs
1.1.5 Comparison between Main Cockpit SoCs (1)
1.1.6 Comparison between Main Cockpit SoCs (2)
1.1.7 Comparison between Main Cockpit SoCs (3)
1.1.8 Comparison between Main Cockpit SoCs (4)
1.1.9 Comparison between Main Cockpit SoCs (5)
1.1.10 Comparison between Main Cockpit SoCs (6)
1.1.11 Cockpit SoC Ranking by CPU Compute (1)
1.1.12 Cockpit SoC Ranking by CPU Compute (2)
1.1.13 Cockpit SoC Ranking by CPU Compute (3)
1.1.14 Cockpit SoC Ranking by CPU Compute (1)
1.1.15 Cockpit SoC Ranking by CPU Compute (2)
1.1.16 Cockpit SoC Ranking by NPU Compute
1.1.17 Specifications of Cockpit SoC Memory
1.1.18 Software Operating System Supported by Cockpit SoCs
1.1.19 Display and Cameras Supported by Cockpit SoCs
1.1.20 Automotive-grade Safety Certification of Cockpit SoCs
1.1.21 Functional Safety Certification and Implementation Methods of Cockpit SoCs

1.2 Summary of Cockpit SoC Market, 2023-2024
1.2.1 Cockpit SoC Development Planning of Major Companies: Overseas
1.2.2 Cockpit SoC Development Planning of Major Companies: China
1.2.3 Development Features of Cockpit SoC Market, 2023-2024 (1)
1.2.4 Development Features of Cockpit SoC Market, 2023-2024 (2)
1.2.5 Development Features of Cockpit SoC Market, 2023-2024 (3)
1.2.6 Development Features of Cockpit SoC Market, 2023-2024 (4)

2 Automotive Cockpit SoC Configuration and Strategy
2.1 Cockpit SoC Market Size
2.1.1 Global Intelligent Cockpit SoC Penetration
2.1.2 China's Intelligent Cockpit SoC Penetration
2.1.3 China’s Intelligent Cockpit SoC Market Size
2.1.4 Intelligent Cockpit SoC Installations in China, 2022
2.1.5 Market Share of Intelligent Cockpit SoCs (by Supplier) in China, 2022
2.1.6 Market Share of Intelligent Cockpit SoCs (by Chip Model) in China, 2022
2.1.7 Levels of Intelligent Cockpit

2.2 Cockpit SoC Competitive Pattern
2.2.1 Overview of Cockpit SoC Competitive Pattern
2.2.2 Market Pattern of Cockpit SoCs for Low-to-mid-end Models
2.2.3 Cockpit SoC Market for Mid-to-high-end Models
2.2.4 Competitive Pattern of Foreign Cockpit SoC Vendors
2.2.5 Cockpit SoC Pattern of Chinese Companies
2.2.6 Cockpit SoC Vendors Provide "Hardware+Software" Integrated Solutions
2.2.7 Consumer-grade Chips Are Used in IVI Systems
2.2.8 The Cockpit SoC Supply of OEMs Is Still Mainly Based on the Tier1 Model
2.2.9 The Automotive Cockpit SoC Supply Model Has Gradually Changed
2.2.10 Cost Structure of Cockpit Domain Controllers
2.2.11 Cockpit SoC Shipment Price
2.2.12 Cockpit SoC Application Trends of Major OEMs

2.3 Intelligent Cockpit SoC Selection Strategy for Models by Price Range
2.3.1 Cockpit SoC Configuration Strategy for Models Priced at RMB500,000 and Above
2.3.1.1 Intelligent Cockpit SoC Configuration of Models Priced at above RMB500,000 in China, 2023
2.3.1.2 Intelligent Cockpit SoC Selection for Main Models Priced at above RMB500,000 in China, 2023-2024
2.3.2 Intelligent Cockpit SoC Configuration Strategy for Models Priced at RMB400,000-500,000
2.3.2.1 Intelligent Cockpit SoC Selection for Models Priced at RMB400,000-500,000 in China, 2023-2024

Table of Content (2)

2.3.2.2 Intelligent Cockpit SoC Selection for Main Foreign Brand Models Priced at RMB400,000-500,000in China, 2023-2024
2.3.2.3 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at above RMB500,000 in China, 2023-2024
2.3.3 Intelligent Cockpit SoC Configuration Strategy for Models Priced at RMB350,000-400,000
2.3.3.1 Intelligent Cockpit SoC Selection for Models Priced at RMB350,000-400,000 in China, 2023-2024
2.3.3.2 Intelligent Cockpit SoC Selection for Main Foreign Brand Models Priced at RMB350,000-400,000 in China, 2023-2024
2.3.3.3 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB350,000-400,000 in China, 2023-2024

2.3.4 Intelligent Cockpit SoC Configuration Strategy for Models Priced at RMB300,000-350,000
2.3.4.1 Intelligent Cockpit SoC Selection for Models Priced at RMB300,000-350,000 in China, 2023-2024
2.3.4.2 Intelligent Cockpit SoC Selection for Main Foreign Brand Models Priced at RMB300,000-350,000 in China, 2023-2024
2.3.4.3 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB300,000-350,000 in China, 2023-2024
2.3.5 Intelligent Cockpit SoC Configuration Strategy for Models Priced at RMB250,000-300,000
2.3.5.1 Intelligent Cockpit SoC Selection for Models Priced at RMB250,000-300,000 in China, 2023-2024
2.3.5.2 Intelligent Cockpit SoC Selection for Main Foreign Brand Models Priced at RMB250,000-300,000 in China, 2023-2024
2.3.5.3 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB250,000-300,000 in China, 2023-2024
2.3.6 Intelligent Cockpit SoC Configuration Strategy for Models Priced at RMB150,000-250,000
2.3.6.1 Intelligent Cockpit SoC Selection for Models Priced at RMB150,000-250,000 in China, 2023-2024
2.3.6.2 Intelligent Cockpit SoC Selection for Main Foreign Brand Models Priced at RMB150,000-250,000 in China, 2023-2024
2.3.6.3 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB150,000-250,000 in China, 2023-2024 (1)
2.3.6.4 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB150,000-250,000 in China, 2023-2024 (2)
2.3.7 Intelligent Cockpit SoC Configuration Strategy for Models Priced at RMB150,000 and Below
2.3.7.1 Intelligent Cockpit SoC Selection for Models Priced at RMB150,000 and Below in China, 2023-2024
2.3.7.2 Intelligent Cockpit SoC Selection for Main Foreign Brand Models Priced at RMB150,000 and Below in China, 2023-2024
2.3.7.3 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB150,000 and Below in China, 2023-2024 (1)
2.3.7.4 Intelligent Cockpit SoC Selection for Main Independent Brand Models Priced at RMB150,000 and Below in China, 2023-2024 (2)

2.4 Cockpit SoC Installation of Overseas Suppliers, 2023-2024
2.4.1 Qualcomm’s Cockpit SoC Installation in Models and Trend, 2023-2024
2.4.1.1 China’s TOP20 Brands by Installation of Qualcomm Cockpit SoCs in L1+ Intelligent Cockpit Vehicles, 2023
2.4.1.2 China’s TOP20 Models by Installation of Qualcomm Cockpit SoCs in L1+ Intelligent Cockpit Vehicles, 2023
2.4.1.3 Distribution of Qualcomm Cockpit SoCs in Models by Price Range, 2023
2.4.1.4 Models Announced to Adopt Qualcomm’s Next-generation Cockpit SoCs, 2024
2.4.2 AMD’s Cockpit SoC Installation in Models and Trend, 2023-2024
2.4.3 Samsung’s Cockpit SoC Installation in Models and Trend, 2023-2024

Table of Content (3)

2.5 Cockpit SoC Installation and Trends of Chinese Suppliers, 2023-2024
2.5.1 SemiDrive's Cockpit SoC Installation in Models and Trend, 2023-2024
2.5.2 Huawei's Cockpit SoC Installation in Models and Trend, 2023-2024
2.5.3 MediaTek's Cockpit SoC Installation in Models and Trend, 2023-2024
2.5.4 SiEngine's Cockpit SoC Installation in Models and Trend, 2023-2024

3 Key Development Trends of Automotive Cockpit SoCs
3.1 Topic 1: Mass Production of Qualcomm 8295 Has Started, and Who Will Be the Next?
3.1.1 What Do OEMs or Tier1 Suppliers Value Most When Choosing A Cockpit SoC? (1)
3.1.2 What Do OEMs or Tier1 Suppliers Value Most When Choosing A Cockpit SoC? (2)
3.1.3 Logic behind Qualcomm Snapdragon 8155 Being Recognized
3.1.4 Business Model Logic of Fourth-generation Qualcomm Snapdragon SA8295P
3.1.5 The Upgrading of High-end Cockpit Chips Accelerates, and Mass Production of Qualcomm Snapdragon 8295 Starts
3.1.6 What Can Qualcomm Snapdragon 8295 Bring to Intelligent Vehicles?
3.1.7 Who are Laying out the Next-generation High-performance Cockpit SoCs?
3.1.8 Possible Ways to Surpass Qualcomm

3.2 Topic 2: Do Server/PC Solutions Buck the Next-generation Cockpit SoC?
3.2.1 AMD VS Qualcomm
3.2.2 "ARM+Android" VS "X86+Linux"
3.2.3 Do Server/PC Solutions Buck the Next-generation Cockpit SoC? (1)
3.2.4 Do Server/PC Solutions Buck the Next-generation Cockpit SoC? (2)
3.2.5 Main Products with X86 Architecture in the Cockpit Field (1)
3.2.6 Main Products with X86 Architecture in the Cockpit Field (1)
3.2.7 Optimal Combination of X86 Architecture and Self-developed Linux Desktop System in the Cockpit Field
3.2.8 AMD's Cockpit Cases
3.2.9 X86 Architecture Cockpit Cases

3.3 Topic 3: Breakthroughs in Cockpit SoC Localization
3.3.1 Local Cockpit SoC Companies Work to Develop New Products amid the Localization Trend
3.3.2 Domestic Cockpit SoCs Are in the Phase of Mass Production and Deployment in Vehicles
3.3.3 Barriers to Cockpit SoC Localization
3.3 Ways to Cockpit SoC Localization
3.3.5 The Pace of Localization Quickens in the Trend towards Cost Reduction and Efficiency Improvement
3.3.6 Cases

3.4 Topic 4: How Will Cockpit SoCs Develop in the Trend towards Cockpit-driving Integration
3.4.1 As EEA Evolves, Cockpit-driving Integration Is around the Corner
3.4.2 Main Layout Modes of Automotive Central Computing Platforms
3.4.3 Vehicle Central Computing Platform Architecture Solution 1
3.4.4 Vehicle Central Computing Platform Architecture Solution 2
3.4.5 Intelligent Cockpit Development Forms in the Trend towards Cockpit-driving Integration
3.4.6 Requirements for Chips in the Trend towards Cockpit-driving Integration
3.4.7 Cockpit SoCs Are Moving towards Central Computing SoCs
3.4.8 Challenges to Central Computing SoCs
3.4.9 Progress in Cockpit-driving Integration Chips
3.4.10 Main Cases

3.5 Topic 5: Optional CPU, GPU and Other Modules for Next-generation Cockpit SoCs
3.5.1 Must-Have Capabilities for Cockpit SoCs
3.5.2 Cockpit SoC Processes Are Getting Ever Smaller, and 3nm Chips Have Been Released
3.5.3 Cockpit SoC Products Have Ever Requirements for CPU/GPU Compute (1)
3.5.4 Cockpit SoC Products Have Ever Requirements for CPU/GPU Compute (2)

Table of Content (4)

3.5.5 Cockpit SoC Products Have Ever Requirements for CPU/GPU Compute (3)
3.5.6 Maximum AI Compute Required by Cockpit SoCs
3.5.7 How Many Functions Can Cockpit SoC Products Support
3.5.8 Cockpit SoC Design Schematic Diagram and Architecture
3.5.9 Main CPU Cores Adopted by Main Cockpit SoCs Currently
3.5.10 ARM Architecture CPU Core Used in Vehicles
3.5.11 Development of Qualcomm CPU Architecture and Cores Used in Cockpits
3.5.12 Optional CPU Cores for Next-generation Cockpit SoCs
3.5.13 Main GPU Cores Used in Main Cockpit SoCs Currently
3.5.14 Main GPU Cores Used in Main Cockpit SoC Products
3.5.15 Optional CPU Cores for Next-generation Cockpit SoCs

3.6 Topic 6: What Packaging Technologies Are Needed by Next-generation Cockpit SoCs?
3.6.1 High-performance Cockpit SoC Processes Become Ever More Advanced
3.6.2 Main Cockpit SoC Packaging Processes
3.6.3 Evolution of Cockpit SoC Packaging Technology (1)
3.6.4 Evolution of Cockpit SoC Packaging Technology (2)
3.6.5 Evolution of Cockpit SoC Packaging Technology (3)
3.6.6 The Evolution of Advanced Processes and the Slowdown of Moore's Era Facilitate Technological Innovation of Chiplets
3.6.7 Chiplets Facilitate the Development of High-compute Automotive SoCs (1)
3.6.8 Chiplets Facilitate the Development of High-compute Automotive SoCs (2)
3.6.9 Cockpit SoC and Chiplet
3.6.10 Chiplet Advantages
3.6.11 Chiplet Challenges
3.6.12 How Much Cost Can Chiplet Technology Reduce
3.6.13 Advantages of Chiplet Used in Cockpit SoC
3.6.14 Main Companies That Use Chiplets to Lay out Cockpit SoCs
3.6.15 Chiplet Integration Case (1)
3.6.16 Future Development Trends of Chiplet
3.6.17 Conventional Packaging VS Advanced Packaging
3.6.18 Main Types of Advanced Packaging
3.6.19 Underlying Packaging Technologies Supporting Chiplets
3.6.20 Mainstream Packaging Technologies of Chiplet
3.6.21 Advanced Packaging Technology Ecosystem Has Been Built
3.6.22 Main Companies Deploying Advanced Packaging
3.6.23 New Dynamics
3.6.24 Cases of Deploying Companies
3.6.25 Die-to-Die Chip-level Interconnect Standards
3.6.26 Other Interconnect Technologies

3.7 Topic 7: Transformation in Development Models and Supply Models of Cockpit SoCs under the Impetus of Intelligence
3.7.1 Automotive Chip Development Process Transformation
3.7.2 Novel Automotive Chip Development Process
3.7.3 Cockpit SoC Supply Model Transformation
3.7.4 Changes in Cockpit SoC Supply Demand of OEMs
3.7.5 Cases of Cockpit SoC Supply Model Transformation

4 Foreign Cockpit SoC Vendors
4.1 NXP
4.1.1 Automotive Processor Roadmap
4.1.2 Parameters of i.MX 95
4.1.3 i.MX 95 Adopts the Self-developed NPU
4.1.4 i.MX 95 Can Be Used in the Low-to-mid-end Cockpit Field
4.1.5 i.MX 8 Applications Processor Family
4.1.6 Main Performance Indicators of i.MX 8 Family (1)
4.1.7 Main Performance Indicators of i.MX 8 Family (2)
4.1.8 i.MX8QM Software Stack Module
4.1.9 Typical Cockpit Application Solutions of i.MX
4.1.10 i.MX 6 for the Low-to-mid-end Market
4.1.11 i.MX Partner Ecosystem
4.1.12 Operating Systems Supported by i.MX

Table of Content (5)

4.1.13 AI Algorithms Supported by i.MX
4.1.14 i.MX and Future Cockpit System
4.1.15 i.MX and Future Cockpit System
4.1.16 Latest Cockpit Dynamics

4.2 Texas Instruments
4.2.1 TI Cockpit Chip
4.2.2 J6
4.2.3 Texas Instruments Has a Place in the Mid-end Cockpit Processor Market
4.2.4 Parameters of Jacinto 6
4.2.5 Cockpit Solutions and Partners of Jacinto 6

4.3 Renesas
4.3.1 Profile
4.3.1 The Fifth-generation R-Car Planning
4.3.2 Chip Business
4.3.3 The Automotive Product Line Was Further Expanded through the Acquisition of Dialog
4.3.4 The Automotive Product Line Was Further Expanded through the Acquisition of Dialog
4.3.6 High-end Integrated Cockpit Solutions in Cooperation with Dialog
4.3.7 High-end Cockpit Solutions Featured with Tactile Sensing in Cooperation with Dialog
4.3.8 Chip Capacity Expansion Plan
4.3.9 Automotive Market Segment: R-Car Series
4.3.10 R-Car Series for Cockpit Processors
4.3.11 Cockpit SoC Product Line
4.3.12 Main Features of Cockpit SoCs
4.3.13 R-Car Gen3e
4.3.14 Digital Cluster with Integrated Driver ID on R-CARE 3e
4.3.15 Android Integrated Cockpit on R-Carm3e
4.3.16 Integrated Non-virtualized Intelligent Cockpit Solution
4.3.17 Low-Cost Digital Instrument Cluster Reference Design
4.3.18 Cockpit Trends
4.3.19 R-Car in Future Automotive Architectures
4.3.20 EEA Strategy
4.3.21 R-Car Software Development Kit (SDK)
4.3.22 Software Platform
4.3.23 Software-as-a-Service Platform
4.3.24 Virtual Development Environment
4.3.25 Integrated Development Environment
4.3.26 Dynamics

4.4 Qualcomm
4.4.1 Profile
4.4.2 Digital Chassis
4.4.3 Development History of Cockpit SoCs
4.4.4 The Evolving Snapdragon Cockpit Platform Integrates Rich Software Ecosystems
4.4.5 Cockpit Platform Integrates Multiple Functions
4.4.6 Scalable Software Ecosystem of Cockpit Platform
4.4.7 4th Generation Snapdragon Cockpit Platform
4.4.8 Common Software Architecture of 4th Generation Snapdragon Cockpit Platform
4.4.9 Parameters of SA8295P
4.4.10 4th Generation Snapdragon Cockpit Platform: QAM8255P
4.4.11 3rd Generation Snapdragon Cockpit SoC
4.4.12 3rd Generation Snapdragon Cockpit SoC
4.4.13 Parameters of Snapdragon SA8195P
4.4.14 1st and 2nd Generation Snapdragon Cockpit SoC
4.4.15 Major Cockpit Platform Customers
4.4.16 Snapdragon Ride Flex SoC (1)
4.4.17 Snapdragon Ride Flex SoC (2)
4.4.18 Functional Safety Layout of Snapdragon Ride Flex SoC
4.4.19 Software Reference Architecture of Snapdragon Ride Flex SoC
4.4.20 Central Computing Chip: SA8775
4.4.21 Software Reference Architecture of SA8775
4.4.22 Other Cockpit-related Chips: Industry-grade QCS8550/QCM8550
4.4.23 Latest Cockpit Dynamics

Table of Content (6)

4.5 Intel
4.5.1 Cockpit Processor Layout
4.5.2 First-generation SDV SoC
4.5.3 Hardware Architecture of SDV SoC
4.5.4 Software Architecture of SDV SoC
4.5.5 SDV SoC's Efficiency Advantages In Hardware-based Physical Separation
4.5.6 Launch of AI PC Processors
4.5.7 Chip Customization Service
4.5.8 A3900 Processor

4.6 Samsung
4.6.1 Cockpit Processors
4.6.2 Cockpit Processor: V920
4.6.3 Cockpit Processor: V9
4.6.4 Cockpit SoCs
4.6.5 Automotive SoC Roadmap
4.6.6 Strategic Cooperation with SemiDrive

4.7 NVIDIA
4.7.1 Revenue
4.7.2 Deep Learning Processors
4.7.3 Cooperation with MediaTek to Create Intelligent Cockpit Chips and Lay out the High-end Market
4.7.4 Automotive Central Computing Chips
4.7.5 Deep Learning Processors: Orin
4.7.6 Deep Learning Processors: Parker
4.7.7 Mercedes-Benz MBUX Used NVIDIA's Chips

4.8 Telechips
4.8.1 Focus on Low-to-mid-end and LCD Clusters
4.8.2 Development History of Dolphin Cockpit Processor
4.8.3 Cockpit Chip: Dolphin 5
4.8.4 Cockpit Chip: Dolphin 3 Series
4.8.5 Cockpit Chip: Dolphin+ Series
4.8.6 Major Customers
4.8.7 Cockpit Application Solutions
4.8.8 Dolphin 3 Intelligent Cockpit Solution
4.8.9 iGentAI's Intelligent Cockpit Platform Solution Based on Dolphin 3
4.8.10 iGentAI's Intelligent Cockpit Solution Based on Dolphin 5
4.8.11 Cockpit Dynamics

4.9 AMD
4.9.1 Automotive Processor Layout
4.9.2 Automotive Digital Cockpit Chip Layout Roadmap
4.9.3 The Latest Cockpit Chip: V2000A
4.9.4 The Latest Cockpit Chip: V2000A
4.9.5 Application Cases of V2000A
4.9.2 The Cockpits of Tesla's Full Range of Models Will Use AMD Processors
4.9.7 Embedded V1000 Series
4.9.8 Embedded V2000 Series
4.9.9 Major Automotive Intelligent Cockpit Customers

5 Chinese Cockpit SoC Vendors
5.1 SemiDrive
5.1.1 Profile
5.1.2 X9 Cockpit Series Products
5.1.3 Cockpit Chips: X9
5.1.4 Block Diagram of X9 Series Application Solution
5.1.5 Released the Latest Cockpit Product X9H 2.0G
5.1.6 Block Diagram of X9H 2.0G Reference Solution
5.1.7 X9SP All-scenario Cockpit Processors
5.1.8 Flagship Cockpit Processor: X9U
5.1.9 Block Diagram of X9U Application Solution

Table of Content (7)

5.1.10 The Second-generation Central Computer Architecture
5.1.11 Cockpit-Parking Integrated System
5.1.12 Cockpit-driving Integrated Controllers Based on SemiDrive's Chips
5.1.13 Domestic Centralized Central Computing Units Based on SemiDrive's Chips
5.1.14 Cooperation Models (1)
5.1.15 Cooperation Models (2)
5.1.16 Overseas Business Layout
5.1.17 Application and Mass Production
5.1.18 Application and Mass Production: Cockpit Customers
5.1.19 Dynamics

5.2 MediaTek
5.2.1 Cockpit Chip Development
5.2.2 Launch of Dimensity Auto Platform
5.2.2 Launch of Dimensity Auto Cockpit Platform
5.2.4 Cooperation with NVIDIA in Creating Intelligent Cockpit Chips and Laying out the High-end Market
5.2.5 Released the Latest Dimensity Cockpit Chip
5.2.6 Released the Latest Dimensity Cockpit Chip
5.2.7 MT8666
5.2.8 MT8675
5.2.9 MT8675 Chip Platform Virtualized Intelligent Cockpit Solution
5.2.10 MT2715
5.2.11 MT2715 Cockpit Domain Controller Solution Based on Virtualized Isolation
5.2.12 MT2715-based Cockpit System Architecture
5.2.13 MT2712
5.2.14 Cooperation with ECARX
5.2.15 Cockpit Development Planning

5.3 Huawei Hisilicon
5.3.1 Cockpit Chip: Kirin 710A
5.3.2 Cockpit Chip: Kirin 990A

5.4 AutoChips
5.4.1 Cockpit SoC
5.4.2 Cockpit SoC Product Matrix
5.4.3 Cockpit Processors: AC8025
5.4.4 Example of Cockpit Design Architecture Based on AC8025
5.4.5 Cockpit Processors: AC8015
5.4.6 Cockpit Processor System Architecture
5.4.7 Integrated Light Cockpit Solution (1)
5.4.8 Integrated Light Cockpit Solution (2)
5.4.9 Architecture of Integrated Light Cockpit Solution
5.4.10 SoC Software and Hardware Integrated Cockpit Solution
5.4.11 Cockpit Chip Development Planning
5.4.12 Partners & Customers

5.5 SiEngine Technology
5.5.1 Profile
5.5.2 Development History
5.5.3 Intelligent Cockpit Chips: Longying No.1
5.5.4 Key Parameters of Intelligent Cockpit Chips
5.5.5 Cockpit Chip Software and Hardware Reference Design Platform
5.5.6 Development Planning
5.5.7 High-end Cockpit Solutions
5.5.8 Flagship Cockpit Solutions
5.5.9 Single-chip Cockpit-parking integration Solutions
5.5.10 Cockpit-driving Integration Solutions
5.5.11 Cooperation with ECARX and FAW to Develop an Intelligent Cockpit Platform based on Longying No.1

5.6 Rockchip
5.6.1 Profile
5.6.2 Development History
5.6.3 Automotive Solution Application - Passenger Car Series

Table of Content (8)

5.6.4 Automotive Solution Application - Commercial Vehicle Series
5.6.5 Automotive Solution Application - Commercial Vehicle Series
5.6.6 Advantages of Self-developed IP
5.6.7 RK3588M - “One-chip + Multi-screen” Solution
5.6.8 RK3588M - “One-chip + Multi-screen” Solution
5.6.9 RK3568M - Center Console + AVM Integration Solution
5.6.10 RK3358M - Full LCD Cluster and Center Console
5.6.11 RK3308M - Automotive Audio and Voice Solutions
5.6.12 RV11 - DVR Solutions
5.6.13 Localized Cockpit Solutions (1)
5.6.14 Localized Cockpit Solutions (2)

5.7 UNISoC
5.7.1 Profile
5.7.2 Intelligent Cockpit Chip: A7870
5.7.3 Intelligent Cockpit Chip: A7862
5.7.4 Software and Hardware Platform-based Products Can Adapt to a Variety of User Scenarios
5.7.5 Intelligent Cockpit Domain Controller Platform

5.8 Allwinner Technology
5.8.1 Automotive Market Layout
5.8.2 Development History of Automotive SoCs
5.8.3 Cockpit Processors: T7
5.8.4 T7 Solution Architecture
5.8.5 Cockpit Processors: T5
5.8.6 SoC Development Route
5.8.7 Major Automotive SoC Customers

6 Cockpit SoC Application Trends of OEMs
6.1 BYD
6.1.1 Cockpit Chip Planning
6.1.2 New DiLink Cockpit Platform
6.1.3 Cockpit-driving Integration Layout
6.1.4 Development History of Cockpit SoCs
6.1.5 Use Qualcomm 5G Solution Chips for Effective Cost Reduction
6.1.6 Overseas Models Will Be Equipped with Qualcomm 8155 Cockpit Solution
6.1.7 Cockpit SoC Distribution by Brand
6.1.8 Cockpit SoCs of Dynasty Series
6.1.9 Cockpit SoCs of Ocean Series
6.1.10 Cockpit SoCs of Yangwang Brand
6.1.11 Cockpit SoCs of Denza Brand
6.1.12 Cockpit SoCs of Fangchengbao
6.1.13 Xuanji Architecture

6.2 Tesla Cockpit SoC
6.2.1 Intelligent Cockpit Hardware Iteration (1)
6.2.2 Intelligent Cockpit Hardware Iteration (2)
6.2.3 HW 4.0 Cockpit Domain
6.2.4 System Architecture of MCU3.0 Infotainment Control Unit
6.2.5 Hardware Configuration of MCU3.0 Infotainment Control Unit

6.3 BMW Cockpit SoC
6.3.1 Cockpit SoC Evolution
6.3.2 IDC23 (1)
6.3.3 IDC23 (2)
6.3.4 IDC23 VS MGU22
6.3.5 MGU22
6.3.6 MGU21
6.3.7 MGU
6.3.8 Cooperation with Qualcomm in Cockpit, Intelligent Driving and Other Technical Fields

Table of Content (9)

6.4 Mercedes-Benz Cockpit SoC
6.4.1 Evolution of Cockpit Chips
6.4.2 CIVIC Cockpit Hardware (1)
6.4.3 CIVIC Cockpit Hardware (2)
6.4.4 NGT7
6.4.5 Third-generation MBUX
6.4.6 Second-generation MBUX
6.4.7 First-generation MBUX
6.4.8 NTG6 with Dual Architecture

6.5 Volkswagen Cockpit SoC
6.5.1 Cockpit SoC
6.5.2 ICAS3 Cockpit
6.5.3 ID.4 Cockpit
6.5.4 CNS 3.0 Architecture
6.5.5 Cooperation Dynamics (1)
6.5.6 Cooperation Dynamics (2)

6.6 Audi Cockpit SoC
6.6.1 Intelligent Cockpit SoC Evolution
6.6.2 MIB with Dual System Architecture
6.6.3 MMI System Architecture

6.7 GM Cockpit SoC
6.7.1 Intelligent Cockpit SoC
6.7.2 Chip Layout
6.7.3 Planning

6.8 Ford Cockpit SoC
6.8.1 SYNC Chip Evolution
6.8.2 The Next-generation Cockpit System Is Planned to Adopt Android Automotive System and NXP SoC
6.8.3 SYNC+ Chip Evolution
6.8.5 Cockpit SoCs of Main Models
6.8.2 New-generation Automotive Domain Controller
6.8.6 SYNC4.0 Hardware
6.8.7 Chip Layout Planning

6.9 Volvo Cockpit SoC
6.9.1 Cockpit SoC
6.9.2 Cockpit of XC90 BEV
6.9.3 Volvo and Qualcomm Cooperated to Deploy Intelligent Cockpits
6.9.4 Cockpit of EX90 SUV BEV

6.10 Toyota Cockpit SoC
6.10.1 Toyota Cockpit SoC
6.10.2 Dismantling of Tundra Cockpit
6.10.3 Intelligent Cockpit of GAC Toyota T-SMART
6.10.4 Intelligent Cockpit of FAW Toyota Space
6.10.5 Chip Layout

6.11 Hyundai Cockpit SoC
6.11.1 Cockpit SoC
6.11.2 The Cockpit System Will Use Samsung’s Chips
6.11.3 SDx Strategy

6.12 Nissan Renault
6.12.1 Cockpit of Nissan Flagship EV Ariya
6.12.2 Dismantling of Cockpit of Renault Mégane E-Tech Electric

6.13 Great Wall Motor Cockpit SoC
6.13.1 Intelligent Cockpit SoC Layout
6.13.2 Intelligent Cockpit SoC Configuration of Major Brands
6.13.3 Coffee Intelligence 2.0 - Intelligent Cockpit

Table of Content (10)

6.13.4 Intelligent Cockpit Domain Layout Planning of Nobo Automotive Systems
6.13.5 Intelligent Cockpit Domain Products of Nobo Automotive Systems
6.13.6 Coffee OS - Intelligent Cockpit Planning

6.14 GAC Cockpit SoC
6.14.1 Intelligent Cockpit Layout
6.14.2 High-performance Immersed Cockpit: ADiGO PARK Metaverse
6.14.3 Cockpit SoCs of Main Models
6.14.6 Computing Unit SoC of GAC AION X-Soul Architecture

6.15 Changan Cockpit SoC
6.15.1 Intelligent Cockpit SoC
6.15.2 Changan UNIBrain
6.15.3 Super Digital Platform Architecture
6.15.4 Intelligent Cockpit SoC of Main Models

6.16 SAIC Cockpit SoC
6.16.1 Intelligent Cockpit SoC
6.16.2 Latest-generation Galaxy Intelligent Cockpit Solution of SAIC Z-ONE
6.16.3 Z-ONE's Cockpit-driving Integrated HPC
6.16.4 Z-ONE's Intelligent Cockpit Computing Platform: ZCM
6.16.5 Z-ONE Galaxy? Cockpit-driving Integrated Computing Platform
6.16.6 Mass Production of the First Cross-domain Fusion Central Brain
6.16.8 IM AI Cockpit
6.16.7 Ecosystem Partners
6.16.9 Intelligent Cockpit SoC Configuration of Main Models

6.17 Geely Cockpit SoC
6.17.1 Cockpit SoC
6.17.2 Cockpit SoC Configuration of ZEEKR
6.17.3 Cockpit SoC Configuration of Lynk & Co
6.17.4 Cockpit SoC Configuration of Other Brand Models
6.17.5 Cockpit Chip Layout
6.17.6 Smart, ECARX and Immersive Intelligent Cockpit
6.17.7 Cockpit SoC Planning in Smart Geely 2025

6.18 BAIC Cockpit SoC
6.18.1 Passenger Car Cockpit SoC
6.18.2 Cooperation between BAIC BluePark and Huawei

6.19 Hongqi Cockpit SoC
6.19.1 Cockpit SoC
6.19.2 Chip Application Planning
6.19.3 Intelligent Cockpit Platform Chip
6.19.4 Cockpit-driving Integration Chip and "Flag" Intelligent Architecture
6.19.5 Cockpit SoCs of Main Models

6.20 Chery Cockpit SoC
6.20.1 Cockpit SoC Configuration of Major Brands and Models
6.20.2 Lion Intelligent Cockpit
6.20.3 Lion Ecosystem
6.20.4 Intelligent Cockpit SoC of EXEED STELLAR
6.20.5 AutoChips and Chery Built A Joint Laboratory for Automotive Chips

6.21 Dongfeng Voyah Cockpit SoC
6.21.1 Cockpit SoC
6.21.2 Cockpit of Voyah Passion
6.21.3 Cockpit of Voyah Dreamer
6.21.4 Cockpit SoCs of Dongfeng's Other Brands

6.22 Li Auto Cockpit SoC
6.22.1 Cockpit SoC Evolution
6.22.2 MEGA Cockpit
6.22.3 Cockpit of L9

Table of Content (11)

6.23 NIO Cockpit SoC
6.23.1 Cockpit SoC
6.23.2 Cockpit System Evolution (1)
6.23.3 Cockpit System Evolution (2)
6.23.4 Central Computing Platform (ADAM)

6.24 Xpeng Cockpit SoC
6.24.1 Cockpit SoC
6.24.2 Intelligent Cockpit System Iteration
6.24.3 Dynamics in Cooperation

6.25 Leapmotor Cockpit SoC
6.25.1 Cockpit SoC
6.25.2 Self-developed Intelligent Cockpit 3.0 (1)
6.25.3 Self-developed Intelligent Cockpit 3.0 (2)
6.25.4 Mid and High-end Cockpit Solutions
6.25.5 Released the First Cockpit-driving-parking Integration System

6.26 Hozon Cockpit SoC
6.26.1 Cockpit SoC of Neta Auto
6.26.2 Intelligent Cockpit Based on Neta Shanhai Platform 2.0
6.26.3 Neta and Autolink World Jointly Lay out the Latest Cockpit Domain Controller and Cockpit-Driving Integration Domain Controller
6.26.4 Neta Launched Haozhi Intelligent Vehicle Central Supercomputing Platform
6.26.5 Neta and Jingwei Hirain Cooperated on Central Domain Controllers

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