

Domain Controller Research: Four Types of Players in Autonomous Driving Domain Controllers and Three Types of Players in Cockpit Domain Controllers

In the next 2-3 years, OEMs will focus on upgrading EEA to accelerate the introduction of domain controllers

The EEA upgrade will be the focus in the next 2-3 years, which will accelerate the introduction of domain controllers. The automotive EEA upgrade is mainly reflected in three aspects: software architecture, hardware architecture, and communication architecture. Software architecture will gradually realize hierarchical decoupling, hardware will develop from distributed style to Domain controller/centralized style, and automotive network backbone will develop from LIN/CAN bus to Ethernet.

It is expected that most OEMs will still use mixed-domain EEA, that is, part of functional domains will be centralized to form a transition solution of "distributed ECU + domain controllers" and finally forge an architecture of "super controller (central supercomputer) + zonal control Unit (zone controller)". This EEA evolution may take up to 5-10 years.

From the perspective of OEM planning, autonomous driving domain, smart cockpit domain, and central control domain may become three main incremental domains.

EEA and Domain Controller Layout of Some OEMs

NIO "Distributed ECU + smart driving/smart cockpit domain" will further decoupleNIO ES6, ES8, EC6, the software and hardware of the vehicle in the future. Software will beET7 completed by OEMs as much as possible, and suitable hardware partners will be found according to functions. Xpeng Intelligent electric SEPA platform architecture; a new generation of EEA, 100% Xpeng P7, Xpeng G3 networked controllers based on SEPA platform architecture, independent R&D of the next generation of XPU autonomous driving domain controllers, intelligent control integration of driving and parking Lixiang Like Tesla, Lixiang builds a real-time operating system based on the Linux kernel. After mastering the underlying real-time operating system, it lays the foundation for the subsequent iteration of the underlying vehicle EEA and the Lixiang ONE upper firmware, which is also the foundation of the future software-defined smart electric vehicles. Neta Centralized domain architecture and the new architecture will be based on Ethernet. There are four domain controllers, sower domain controllers, and Al domain controllers. ZEEKR SEA and centralized electronic architecture (GEEA2.0): "IVI, air conditioning, seats, etc." domain, sports and energy (chassis, power, etc.) domain, and autonomous driving domain which are controlled by their respective highZEEKR ZERO computing power ECU. Core chips and components will be independently developed Dongfeng Voyah TNGA adopts the combination of central concentration + domain controllers with ECU to reduce costs and software is based on Aguity and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will beVoyah FREE mass-produced on Voyah's third model by the end of 2022<	OEMs	EEA	Representative models	
Xpeng Intelligent electric SEPA platform architecture; a new generation of EEA, 100% Xpeng P7, Xpeng G3 networked controllers based on SEPA platform architecture, independent R&D of the next generation of XPU autonomous driving domain controllers, intelligent control integration of driving and parking Like Tesla, Lixiang builds a real-time operating system based on the Linux kernel. After mastering the underlying real-time operating system, it lays the foundation for the subsequent iteration of the future software-defined smart electric vehicles. Neta Centralized domain architecture and the new architecture will be based on Ethernet. There are four domain controllers; smart cockpit domain controllers, autonomous driving domain controllers, power domain controllers and Al Neta U domain controllers. ZEEKR SEA and centralized electronic architecture (GEEA2.0): "IVI, air conditioning, seats, etc." domain, sports and energy (chassis, power, etc.) domain, and autonomous driving domain which are controlled by their respective highZEEKR ZERO computing power ECU. Core chips and components will be independently developed Dongfeng ESSA Smart Electric Architecture: equipped with a central computing platform and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will beVoyah FREE mass-produced on Voyah's third model by the end of 2022 Toyota TNGA adopts the combination of central concentration + domain controllers integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and Classic AUTOSAR's SOA for convenient software iteration and functional scalability. Great Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: SG+ audiovisual domain, driver assistance domain, new energy	NIO	"Distributed ECU + smart driving/smart cockpit domain" will further decouple the software and hardware of the vehicle in the future. Software will be completed by OEMs as much as possible, and suitable hardware partners wi be found according to functions.	⊵NIO ES6, ES8, ⊵ET7 II	EC6,
Like Tesla, Lixiang builds a real-time operating system based on the Linux kernel. After mastering the underlying real-time operating system, it lays the foundation for the subsequent iteration of the underlying vehicle EEA and the Lixiang ONE upper firmware, which is also the foundation of the future software-defined smart electric vehicles. Neta Centralized domain architecture and the new architecture will be based on Ethernet. There are four domain controllers: smart cockpit domain controllers, autonomous driving domain controllers, power domain controllers and Al domain controllers. ZEEKR SEA and centralized electronic architecture (GEEA2.0): "IVI, air conditioning, seats, etc." domain, sports and energy (chassis, power, etc.) domain, and autonomous driving domain which are controlled by their respective highZEEKR ZERO computing power ECU. Core chips and components will be independently developed Dongfeng ESSA Smart Electric Architecture: equipped with a central computing platform and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will beVoyah FREE mass-produced on Voyah's third model by the end of 2022 Toyota TNGA adopts the combination of central concentration + domain controllers (the whole vehicle is symmetrically divided into multiple zones according to the physical space), which is a typical Zonal-EEA, whose hardware is integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and Classic AUTOSAR's SOA for convenient software iteration and functional scalability. Great Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain, driver assistance domain, new energy domain, body domain, and drivingGreat Wall Order Inte	Xpeng	Intelligent electric SEPA platform architecture; a new generation of EEA, 100% networked controllers based on SEPA platform architecture, independent R&I of the next generation of XPU autonomous driving domain controllers intelligent control integration of driving and parking	, Xpeng P7, Xpeng) ,	G3
Neta Centralized domain architecture and the new architecture will be based on Ethernet. There are four domain controllers: smart cockpit domain controllers, neta U domain controllers. ZEEKR SEA and centralized electronic architecture (GEEA2.0): "IVI, air conditioning, seats, etc." domain, sports and energy (chassis, power, etc.) domain, and autonomous driving domain which are controlled by their respective high/2EEKR ZERO computing power ECU. Core chips and components will be independently developed Dongfeng ESSA Smart Electric Architecture: equipped with a central computing platform and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will beVoyah FREE mass-produced on Voyah's third model by the end of 2022 Toyota TNGA adopts the combination of central concentration + domain controllers (the whole vehicle is symmetrically divided into multiple zones according to the physical space), which is a typical Zonal-EEA, whose hardware is integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and Classic AUTOSAR's SOA for convenient software iteration and functional scalability. Great Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain, driver assistance domain, new energy domain, body domain, and drivingGreat Wall WEY control domain. Future upgrade to the growable Zonal EEA with the fourth-Mocha, etc. generation central computing unit as the core	Lixiang	Like Tesla, Lixiang builds a real-time operating system based on the Linux kernel. After mastering the underlying real-time operating system, it lays the foundation for the subsequent iteration of the underlying vehicle EEA and the upper firmware, which is also the foundation of the future software-defined smart electric vehicles.	x e eLixiang ONE d	
ZEEKR SEA and centralized electronic architecture (GEEA2.0): "IVI, air conditioning, seats, etc." domain, sports and energy (chassis, power, etc.) domain, and autonomous driving domain which are controlled by their respective high/ZEEKR ZERO computing power ECU. Core chips and components will be independently developed Dongfeng ESSA Smart Electric Architecture: equipped with a central computing platform and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will beVoyah FREE mass-produced on Voyah's third model by the end of 2022 Toyota TNGA adopts the combination of central concentration + domain controllers (the whole vehicle is symmetrically divided into multiple zones according to the physical space), which is a typical Zonal-EEA, whose hardware is integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and "Classic AUTOSAR's SOA for convenient software iteration and functional scalability. Great Motor Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain, driver assistance domain, new energy domain, body domain, and drivingGreat Wall WEY	Neta	Centralized domain architecture and the new architecture will be based on Ethernet. There are four domain controllers: smart cockpit domain controllers autonomous driving domain controllers, power domain controllers and A domain controllers.	n ¦Neta U	
Dongfeng Voyah ESSA Smart Electric Architecture: equipped with a central computing platform and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will beVoyah FREE Toyota TNGA adopts the combination of central concentration + domain controllers (the whole vehicle is symmetrically divided into multiple zones according to the physical space), which is a typical Zonal-EEA, whose hardware is integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and Classic AUTOSAR's SOA for convenient software iteration and functional scalability. Great Motor Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain, driver assistance domain, new energy domain, body domain, and drivingGreat Wall control domain. Future upgrade to the growable Zonal EEA with the fourth-Mocha, etc.	ZEEKR	SEA and centralized electronic architecture (GEEA2.0): "IVI, air conditioning seats, etc." domain, sports and energy (chassis, power, etc.) domain, and autonomous driving domain which are controlled by their respective high computing power ECU. Core chips and components will be independently developed	l, d nZEEKR ZERO y	
Toyota TNGA adopts the combination of central concentration + domain controllers (the whole vehicle is symmetrically divided into multiple zones according to the physical space), which is a typical Zonal-EEA, whose hardware is integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and Classic AUTOSAR's SOA for convenient software iteration and functional scalability. Great Motor Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain, driver assistance domain, new energy domain, body domain, and drivingGreat Wall WEY control domain. Future upgrade to the growable Zonal EEA with the fourth-Mocha, etc.	Dongfeng Voyah	ESSA Smart Electric Architecture: equipped with a central computing platform and SOA, it supports 5G technology and vehicle OTA. Dongfeng SOA will be mass-produced on Voyah's third model by the end of 2022	n eVoyah FREE	
Great Motor Wall Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain, driver assistance domain, new energy domain, body domain, and drivingGreat Wall WEY control domain. Future upgrade to the growable Zonal EEA with the fourth-Mocha, etc. generation central computing unit as the core	Toyota	TNGA adopts the combination of central concentration + domain controllers (the whole vehicle is symmetrically divided into multiple zones according to the physical space), which is a typical Zonal-EEA, whose hardware is integrated with ECU to reduce costs and software is based on Adaptive AUTOSAR and Classic AUTOSAR's SOA for convenient software iteration and functional scalability.	s e d d	
5	Great Wa Motor	Coffee Intelligence, V3.5 platform and V4.0 EEA: 5G+ audiovisual domain driver assistance domain, new energy domain, body domain, and driving control domain. Future upgrade to the growable Zonal EEA with the fourth generation central computing unit as the core	, gGreat Wall -Mocha, etc.	WEY



Competitive Landscape of Autonomous Driving Domain Controllers (Some Players)



With the evolution of automotive EEA from distributed domain to centralized domain, the relationship between automakers and automotive electronics suppliers is undergoing profound changes. The number of automotive electronics suppliers will gradually decrease, while the status of domain controller suppliers will become more important and attract more entrants.

We divide autonomous driving domain controller players into four categories: Global Tier1 suppliers (system integrators), Local Tier1 suppliers (system integrators), autonomous driving domain controller software platform vendors, and OEMs.



Source: ResearchInChina



1.OEMs

In the long run, the number of ECUs in the centralized EEA will decrease and the functions will be weakened. The dominance may be transferred from suppliers to OEMs. For example, the EEA of Tesla's self-developed central computer CCM + zonal body controller is at least 5 years ahead of traditional OEMs. Domestic start-ups, such as NIO, Xpeng, WM Motor, Lixiang, SAIC IM, etc., have developed or will develop autonomous driving domain controllers in order to master the autonomy of the underlying hardware of software-defined cars and achieve more powerful OTA upgrades.

Xpeng plans to self-develop XPU autonomous driving intelligent control unit to break the interaction barriers between the previous four domains, achieve deeper domain integration, and integrate the intelligent control of driving and parking.

Although more and more leading automakers have their own software R&D teams to independently develop domain controller hardware and corresponding software, it is almost impossible for them to research all by themselves. They will still rely on suppliers in terms of hardware design and manufacturing, and more standardized "middleware"; especially from a single domain to cross-domain (body domain, cockpit domain, autonomous driving domain), the complexity has increased exponentially, and the importance of cross-domain (multi-domain integration) high-performance computing software platforms will become more prominent, and the value of domain controller software platforms of Enjoy Move Technology, Neusoft Reach and TTTech will gradually appear.

2.Global Tier1 suppliers (systems integrators)

In the future automotive EEA, especially in the "central computing unit + zone controller" stage, the software and hardware are completely decoupled, and the hardware is peripheral. The real challenge for automakers lies in the software architecture. The traditional automotive supplier system will be greatly impacted, while the value of software suppliers will be further highlighted, and there will be some giants in domain controller software.

In response to this trend change, global Tier1 giants are also actively building independent software platform products to cope with the competition. Both Bosch and ZF launched middleware designed for autonomous driving in 2020.

In July 2020, Bosch launched Iceoryx, a middleware for advanced autonomous driving, compatible with ROS2 and Adaptive AutoSAR interfaces to meet the requirements of different development periods (pre-ROS, mass production of Autosar).

In December 2020, ZF released ZF Middleware, providing a modular solution that can be integrated into automakers' software platforms. At the same time, the middleware will be installed on mass-produced vehicles in 2024.

It is worth noting that foreign Tier 1 suppliers dabble in underlying system R&D and build a bridge between system and software applications while accomplishing functions. Bosch and ZF have successively released middleware products, hoping to centrally configure autonomous driving solutions for OEMs through a comprehensive sensor layout so as to simplify system integration, lower development costs and accelerate product launch.



In addition, ZF will establish a global software center in 2021 in order to meet the challenges of future automobile software requirements.

The Latest Middleware Released by ZF

ZF Middleware enables efficient communication between software functions and smart hardware



3.Autonomous driving domain controller software providers

New vendors focusing on the development of autonomous driving software platforms are particularly worthy of attention. The domain controller platform vendors starting from software may challenge traditional Tier1 suppliers.

Taking TTTech (the domain controller software supplier of Audi zFAS) as an example, more than 25 models equipped with "MotionWise" (TTTech's domain controller software platform) have been mass-produced globally. In China, TTTech and SAIC have established a joint venture named Technomous, which has already produced iECU autonomous driving domain controllers for SAIC's member companies.

Domestic companies such as Enjoy Move Technology, Neusoft Reach, Untouch, and Nullmax have also launched domain controller software platforms to seize market opportunities. Domain controller software platforms (middleware) (between automotive operating systems and software applications) mainly abstract computer hardware from software applications, and also serve as a communication bridge between applications. As the communication architecture transfers from the "signaloriented" type to the "service-oriented" type, the value of domain controller middleware will become more prominent.



The communication architecture transfers from the "signal-oriented" type to the "service-oriented" type



Source: UAES

Domain controller middleware builds a bridge between automakers and Tier 2, namely the so-called Tier 1.5 that connects the software of automakers and Tier 1 to the hardware of Tier 2. The new development model will promote software suppliers to become important players in the automotive industry. Domain controller middleware requires high-level software, and more and more start-up software vendors have begun to dabble in this market, which will challenge Tier1 suppliers who are good at hardware.

Some Domain Controller Software Vendors





4.Local Tier1 suppliers (systems integrators)

More and more local Tier1 suppliers have self-developed domain controllers to build an autonomous driving full-stack solution that integrates software and hardware. The innovatively developed intelligent driving operating systems AOS, VOS and MDC Core run on Huawei's MDC computing platform hardware, with a complete development tool chain. Partners can develop algorithms and applications on the basis of MDC to form an industrial ecosystem. The Huawei MDC810 computing platform has been mass-produced on the BAIC ARCFOX α S (Huawei HI).

Freetech, a Chinese ADAS supplier supporting Geely, Changan, Chery and Baoneng, has begun the research and development of domain controllers. It is committed to providing full-stack solutions for cost-sensitive massproduced passenger cars. Based on the mature L2 system, Freetech has designed a modular, tailorable, and expandable software and hardware integration technology architecture, developed and launched an autonomous driving domain controller solution for mass production, including ADC20, ADC25, and ADC30 domain controllers, as well as provided OEMs with autonomous driving systems with flexible configuration.

Freetech's Domain Controller Technology Roadmap









www.researchinchina.com

Desay SV provides the autonomous driving domain controller IPU03 for Xpeng P7, with the shipments exceeding 10,000 units in 2020 and mass production, IPU04 based on NVIDIA's ORIN computing platform is also under development and is planned to be launched in Lixiang in large scale in 2022. As one of Nvidia's six global partners, Desay SV has occupied the core position.

In addition, Hong Jing Drive, Pony AI, IDRIVERPLUS, Jingwei Hirain Technologies, and Yingbo Supercomputing have also deployed autonomous driving domain controllers. On the one hand, they provide support for their own system integration solutions. On the other hand, they are actively developing OEMs as customers and offer them with software and hardware solutions. For example, Hong Jing Drive has reached deep cooperation with JAC and formed a joint venture named "Yuchi Smart", and Yingbo Supercomputing has provided Chery New Energy with L2.99 autonomous driving domain controllers.

Smart cockpit domains incorporating more and more ADAS functions will prevail

In the end, a smart car will become a mobile supercomputer and data center, and a new Wintel will be born. In the future, the core technologies of the advanced autonomous vehicle era will include computing platforms, operating systems and application software. After 2030, autonomous driving highperformance chips and cockpit control chips will be further integrated into central computing chips as the autonomous driving technology roadmap matures, hereby improving computing efficiency and reducing costs through integration.



Future Development Trend of Automotive Electronic/Electrical Architecture (EEA):



Under this trend, cockpit electronics companies, including Tier1 suppliers and software vendors, are seeking to integrate more and more ADAS functions (typically autonomous parking, DMS, and more advanced L1/L2 ADAS functions) into the cockpit domain and enhance the functional safety level of the smart cockpit domain.

Similar to intelligent driving domain controllers, a large number of domain controller software vendors have emerged in the field of smart cockpits. Megatronix, a software infrastructure provider that only has a history of two years, recently announced that it has raised over USD100 million in financing, and has accepted cockpit platform orders from OEMs such as HYCAN 007 and Lixiang. Investors have begun to attach importance to the broad prospects of this market.

From the perspective of OEMs, the urgency of selfdeveloped cockpit domain controllers may not be as obvious as that of autonomous driving, mainly because: in the short to medium term, it is difficult for consumers to pay for cockpit function customization. For OEMs, they may potentially choose third-party software partners, and can actively explore the realization of software and hardware decoupling to achieve a better customer experience at low costs. In this context, ThunderSoft, Megatronix and other companies have emerged.

Competitive Landscape in Smart Cockpit Domain Controllers (Some Players)

Smart cockpit software platform vendors hope to

Tier1 suppliers continue to consolidate their advantages, enhance system integration capabilities, and build a full digital cockpit platform product line establish an open ecosystem in the automotive industry like the mobile phone industry to achieve thorough software and hardware decoupling. Visteon faurecia clarion ADAYO华阳集团 德慧西威 ▲ 诚迈科技 veoneer ontinental 3 HUAWEI HOPER BOSCH DENSO CLG Thunder Soft APTIV 中科测速 HARMAN 诺博汽车 HUAWEI Panasonic Megatronix HSAE 北斗星通 HarmonyOS REACH Neusoft东软 航盛 CUCKOO **EB** Elektrobit ADAYO 华丽集团 KOTET NIO 🕿 蔚来 TESLA OEMs are more willing to self-develop autonomous driving rather than cockpit domain controllers. For them, third-party software partners may be potential options, and they can actively explore the realization of software and hardware decoupling to reduce costs.

Source: ResearchInChina



www.researchinchina.com

The penetration rate of the domain controller market will swell in the next 5 years

In China, the industry is currently promoting mass production of L2+ autonomous cars on a large scale, and even L2++ or L2.9 autonomous driving, which is infinitely close to L3, is also rapidly being realized, mainly thanks to the impetus of Tesla Model series, NIO ES, Xpeng P7 and other models. ResearchInChina estimates that by 2025, the annual shipments of ADAS/AD domain controllers for passenger cars in China will reach 3.565 million sets, and the penetration rate of passenger car OEM autonomous driving domain controllers will reach 14.7%.

(Unit: 10k sets) 400.0 16.0% 350.0 14.0% 300.0 12.0% 250.0 10.0% 200.0 8.0% 150.0 6.0% www.resear 2 100.0 4.0% 50.0 2.0% 0.0 0.0% 2020 2022 2024 2025 2019 2021 2023 China's ADAS/AD domain controller (DCU) shipments (10k sets) - Passenger car penetration rate (%)

China's ADAS/AD Domain Controller (DCU) Shipments, 2019-2025E

Source: ResearchInChina



www.researchinchina.com

Companies Mentioned





www.researchinchina.com

Table of Content (1)

01 Automotive EEA Evolution

1.1 Automotive EEA Evolution

1.1.1 Automotive EEA Upgrade Involves Three Dimensions: Software Architecture, Hardware Architecture and Communication Architecture

- 1.1.2 Hardware Architecture Upgrade: from the Distributed to the Centralized
- 1.1.3 Hardware Architecture Upgrade: Domain Centralized EEA
- 1.1.4 Hardware Architecture Upgrade: Advantages of DCU Architecture
- 1.1.5 Hardware Architecture Upgrade: Computing Centralized + Zone Controller
- 1.1.6 Hardware Architecture Upgrade: Centralized EEA (Zonal EEA)
- 1.1.7 Hardware Architecture Upgrade: Vehicle Central Computer (VCC)

1.1.8 Hardware Architecture Upgrade: Multi-chip-based Software Deployment Architecture will also be SOA

1.1.9 Software Architecture Upgrade: Application of Adaptive AUTOSAR

1.1.10 Communication Architecture Upgrade: from Vehicle Backbone Network to Ethernet

- 1.2 EEA Cases of OEMs and Tier1s
- 1.2.1 Three-domain EEA
- 1.2.2 Chinese and Foreign OEMs' Deployments in New-generation EEA and DCU (1)
- 1.2.3 Chinese and Foreign OEMs' Deployments in New-generation EEA and DCU (2)
- 1.2.4 Volkswagen MEB EEA
- 1.2.5 BMW Layered EEA
- 1.2.6 DCU Architecture under Huawei Automotive Ethernet
- 1.2.7 Visteon EEA
- 1.2.8 Model 3 Network Topology Diagram
- 1.2.9 Toyota Zonal Architecture Concept
- 1.2.10 Volvo Zonal Architecture
- 1.2.11 Bosch Zonal Architecture Concept

02 Trends of DCU Software and hardware Architecture

- 2.1 DCU Architecture and Demand
- 2.1.1 Features of DCU Architecture
- 2.1.2 DCU Software and Hardware Development Requirements
- 2.1.3 DCU Software and Hardware Development Requirements (1): Hardware Architecture
- 2.1.4 DCU Software and Hardware Development Requirements (1): Software Architecture

2.1.5 DCU Software and Hardware Development Requirements (1): Interface

- 2.2 The Key is to Hold Controller Software Capabilities
- 2.2.1 "Software Defined Vehicle" DCU System Architecture
- 2.2.2 DCU Software Architecture Upgraded to Adaptive AutoSAR
- 2.2.3 Overall Trends for Software Defined Vehicle
- 2.2.4 SOA Automotive Software Deployed on DCU

2.3 The Value of DCU Middleware will be Highlighted

2.3.1 As Communication Architecture is Transformed from "Signal-oriented" to "Service-oriented", the Value of DCU Middleware is Highlighted

2.3.2 For Computing Basic Platform, there will be Tier1.5s and New Development Models

2.3.3 Tier1s Work to Deploy DCU Basic Software

2.3.4 Overview of Chinese and Foreign Providers Deploying DCU Basic Software 2.3.5 OEMs are Committed to Building an Intermediate Layer on an Open Source Dependence and Defining Communications and Services to Deduce System

Perspective and Defining Communications and Services to Reduce System Complexity

- 2.3.6 Middleware is the Key to Software Value Growth in Future
- 2.3.7 DCU Software Platform Providers Will Play a More Important Role
- 2.3.8 Global Automotive Software Market Size



Table of Content (2)

- 2.4 New DCU Business Models
- 2.4.1 Design and Production of DCU: a New Cooperation Model between OEM and Tier1
- 2.4.2 Tier1s will Compete Fiercely in Core Full-stack Capabilities of DCU
- 2.4.3 R&D Cooperation between OEMs, Chip Vendors and Tier1s will Become a Trend 2.4.4 OEMs with Full-Stack Self-development Competence Tend to Independently Develop DCUs
- 2.4.5 Competitive Landscape of Autonomous Driving DCU Vendors (the Roles Claimed by the Four Parties of Players)
- 2.4.6 Competitive Landscape of Intelligent Cockpit DCU Vendors (the Role Claimed by the Three Parties of Players)

03 Autonomous Driving DCU Technologies and Market

- 3.1 Evolution of ADAS/AD Functions and DCU
- 3.1.1 ADAS Distributed ECU and ADAS/AD DCU
- 3.1.2 Relationship between ADAS/AD Controller and Levels of Automated Driving
- 3.1.3 L0-L2 Distributed System Solutions
- 3.1.4 L2+ Domain Centralized System Solutions: Multi-radar Domain Centralized Solution
- 3.1.5 L2+ Domain Centralized System Solutions: Multi-vision Domain Centralized Solution
- 3.1.6 L3-L4 Domain Centralized System Solutions
- 3.1.7 Development Trends of Autonomous Driving DCU

3.2 ADAS/AD DCU Solutions

- 3.2.1 Overview of Foreign OEMs' Deployments in ADAS/AD DCU (1)
- 3.2.2 Overview of Foreign OEMs' Deployments in ADAS/AD DCU (2)
- 3.2.3 Overview of Foreign OEMs' Deployments in ADAS/AD DCU (3)
- 3.2.4 Overview of Chinese OEMs' Deployments in ADAS/AD DCU (1)

- 3.2.5 Overview of Chinese OEMs' Deployments in ADAS/AD DCU (2)
- 3.2.6 Overview of Chinese OEMs' Deployments in ADAS/AD DCU (3)
- 3.2.7 ADAS/AD DCU Platform Solutions and Suppliers of Major OEMs in China (1)
- 3.2.8 ADAS/AD DCU Platform Solutions and Suppliers of Major OEMs in China (2)
- 3.2.9 ADAS/AD DCU Platform Solutions and Suppliers of Major Global OEMs

3.3 ADAS/AD DCU Technology Benchmarking

- 3.4 Application Trends of ADAS/AD DCU Master Chip
 3.4.1 The Race for Computing Force for Intelligent Driving is Setting off
 3.4.2 The Computing Force of Computing Platforms is Pre-embedded, and Software is Still Upgraded Over the Air (OTA)
 3.4.3 Mobileye Autonomous Driving Chip Solution
 3.4.4 Chip Vendors May Make a Further Transformation into Tier0.5s
 3.4.5 Mobileye's Next-generation Autonomous Driving Chip—EyeQ 6
 3.4.6 Nvidia's Next-generation Computing Platform Chip—Orin
 3.4.7 Renesas' Next-generation Autonomous Driving Chip—R-CAR V3H
 3.4.8 Qualcomm's New Snapdragon Ride Computing Platform
 3.4.9 Comparison of Parameters between Master Chips for Next-generation Autonomous Driving DCUs
- 3.5 ADAS/AD DCU Market Size and Prospect
- 3.5.1 Penetration of Autonomous Driving in China, 2017-2025E
- 3.5.2 China's Shipments of ADAS/AD DCU, 2019-2025E
- 3.5.3 ADAS/AD DCU Market Size in China, 2019-2025E

04 Intelligent Cockpit DCU Technologies and Market

- 4.1 Summary of Development Trend of Cockpit DCU
- 4.1.1 Development Trends of Intelligent Cockpit



Table of Content (3)

4.1.2 Block Diagram of Cockpit Entertainment Domain Software Architecture 4.1.3 Next-generation Intelligent Cockpit System Framework

4.2 Cockpit DCU Solutions of Tier1s and OEMs

- 4.2.1 Solutions of Typical Cockpit DCU Vendors (1)
- 4.2.2 Solutions of Typical Cockpit DCU Vendors (2)
- 4.2.3 Summary of Main Cockpit Software Solutions

4.2.4 Mass Production of Intelligent Cockpit Platforms of Major Global OEMs

4.2.5 Mass Production of Intelligent Cockpit Platforms of Major OEMs in China (1)

4.2.6 Mass Production of Intelligent Cockpit Platforms of Major OEMs in China (2)

4.3 Intelligent Cockpit DCU Master Chips

- 4.3.1 Development Trends of Cockpit DCU Chip
- 4.3.2 Development Trends of Future Cockpit Processor
- 4.3.3 Cockpit Processor Development Plans of Major Companies (1)
- 4.3.4 Comparison of Main Cockpit Processors (1)
- 4.3.5 Comparison of Main Cockpit Processors (2)
- 4.3.6 Comparison of Main Cockpit Processors (3)

4.4 Cockpit DCU Market Size and Prospect4.4.1 Global Cockpit DCU Shipments4.4.2 Intelligent Cockpit Market Size in China4.4.3 China's Shipments of Intelligent Cockpit DCU, 2019-2025E

05 Foreign DCU Vendors

5.1 Bosch

5.1.1 Autonomous Driving Product Lines

5.1.2 EEA: Evolution of Next-generation Automotive Architecture and Division of Labor Logic

5.1.3 EEA: Vehicle Central Computer (VCC) and SOA

- 5.1.4 Cockpit DCU: Architecture and Advantages
- 5.1.5 Cockpit DCU: Technical Solutions
- 5.1.6 Cockpit DCU: System Architecture
- 5.1.7 Cockpit DCU: SOP Plan
- 5.1.8 Cockpit Domain Fusion: Fusion Control Product System Architecture (1)
- 5.1.9 Cockpit Domain Fusion: Fusion Control Product System Architecture (2)
- 5.1.10 Cockpit Domain Fusion: Fusion Control Product System Architecture (3)
- 5.1.11 Autonomous Driving DCU: Evolution of DASy Technology
- 5.1.12 Autonomous Driving DCU: DASy1.0 Basic Edition
- 5.1.13 Autonomous Driving DCU: L1-L4 Development Plan
- 5.1.14 Autonomous Driving DCU: Development Plan for Computing Force

5.1.15 Established Cross-Domain Computing Solutions Division to Achieve Crossdomain Fusion

5.2 Visteon

- 5.2.1 Operation: Operation in 2020
- 5.2.2 Operation: Product Line
- 5.2.3 Operation: Development Plan for Cockpit Electronics and Autonomous Driving
- 5.2.4 EEA Planning: Three-domain Architecture and Zone Controller
- 5.2.5 EEA Planning: Function Allocation of Supper Core and Zone
- 5.2.6 EEA Planning: Challenges in Zonal Architecture
- 5.2.7 Intelligent Cockpit DCU: New-generation SmartCore in 2021
- 5.2.8 Intelligent Cockpit DCU: Product Parameters based on Qualcomm 8155/8195/6155 Platform
- 5.2.9 Intelligent Cockpit DCU: Typical Customer Groups
- 5.2.10 Autonomous Driving DCU: Upgraded DriveCore Technology
- 5.2.11 Autonomous Driving DCU: Advantages of DriveCore
- 5.2.12 Autonomous Driving DCU: DriveCore Architecture



Table of Content (4)

5.2.13 Autonomous Driving DCU: DriveCore Development Tools 5.2.14 Multi-Domain Fusion Idea

5.3 Continental

5.3.1 Autonomous Driving Product Line Layout
5.3.2 SOA-oriented DCU Development Concept (1)
5.3.3 SOA-oriented DCU Development Concept (2)
5.3.4 Features of SOA-based High Performance Computer (HPC)
5.3.5 Cockpit DCU: Integrated Interior Platform (IIP)
5.3.6 Cockpit DCU: Cooperation and Ecosystem
5.3.7 Autonomous Driving DCU: ADCU
5.3.8 Autonomous Driving DCU: AI Chip Layout

5.4 Veoneer

5.4.1 Autonomous Driving Product Line Layout
5.4.2 Active Safety Platform Architecture
5.4.3 L2+ Hands-off System
5.4.4 ADAS Software Stack Roadmap: ASP1.0-ASP3.X
5.4.5 ADAS ECU Products
5.4.6 ADAS/AD ECU: Zeus Supercomputer
5.4.7 ADAS/AD ECU: Functional Architecture
5.4.8 Autonomous Driving Software Development
5.4.9 2021 New Product Plan

5.5 ZF

5.5.1 Released Middleware Platform and Announced Establishment of a Global Software Center5.5.2 Middleware OS Architecture (1)5.5.3 Middleware OS Architecture (2)

5.5.4 Middleware OS Architecture (3)
5.5.5 Autonomous Driving DCU: New-generation ProAl Architecture
5.5.6 Autonomous Driving DCU: Development Route and Mass Production Plan
5.5.7 coASSIST Level 2+ Solution Co-developed by ZF and Mobileye Made a Debut with a RMB100,000 Economical Car
5.5.8 Autonomous Driving DCU: Core Customers
5.5.9 Cooperation between ZF and Microsoft

5.6 Aptiv

5.6.1 Smart Vehicle ArchitectureTM (SVATM) Design
5.6.2 Plan Mass-production of DCU Solutions in 2022
5.6.3 Satellite Architecture Platform for Autonomous Driving
5.6.4 Integrated Cockpit Controller (ICC): Features and Customers
5.6.5 Integrated Cockpit Controller (ICC): Development Plan
5.6.6 Integrated Cockpit Controller (ICC): System Architecture
5.6.7 Integrated Cockpit Controller (ICC): Product Planning and Technology Route
5.6.8 Ultra PAD Autonomous Driving DCU Created for BMW
5.6.9 BMW's Autonomous Driving DCU: Build Centralized Sensing Localization and
Planning (CSLP) Based on EyeQ 4/5
5.6.11 Autonomous Driving DCU: Audi zFAS Multi-domain Controller
5.6.12 Autonomous Driving DCU: System Structure of zFAS Multi-domain Controller

5.7 Denso

5.7.1 Intelligent Cockpit Technology Roadmap
5.7.2 Harmony Core? Integrated Cockpit System: Technical Solution
5.7.3 Harmony Core? Integrated Cockpit System: Features of Architecture
5.7.4 Harmony Core? Integrated Cockpit System: Customers
5.7.5 ADAS/AD Technology Framework



Table of Content (5)

5.8 Faurecia Clarion Electronics

5.8.1 Automotive Electronics Product Line

5.8.2 Automotive Electronics Ecosystem

5.8.3 Four Major Businesses of Faurecia

5.8.4 Faurecia Cockpit Intelligence Platform (CIP): One-core Multi-screen Fusion System

5.8.5 Faurecia Cockpit DCU: Create a Multi-screen Integrated Cockpit System 5.8.6 Faurecia Cockpit DCU: Cooperation on Chip

5.8.7 Hongqi H9 Intelligent Cockpit Co-developed by Faurecia and FAW Hongqi

5.9 Panasonic
5.9.1 SPYDR Cockpit DCU Business
5.9.2 Cockpit DCU Solutions: SPYDR 2.0, SPYDR 3.0
5.9.3 Cockpit Electronics Layout: SPYDR 2.0
5.9.4 Cockpit Electronics Computing Architecture: SPYDR 2.0
5.9.5 Cockpit System Software Architecture

5.10 Samsung Harman
5.10.1 Profile
5.10.2 Digital Cockpit Product Line
5.10.3 Digital Cockpit DCU: Technical Solution
5.10.4 Autonomous Driving DCU: DRVLINE
5.10.5 Autonomous Driving DCU: DRVLINE System Architecture
5.10.6 DCU Chips: Samsung Cockpit Processor—Exynos 88XX Series
5.10.7 DCU Chips: Samsung Cockpit Processor—Exynos Auto V9 Series

5.11 LG Electronics5.11.1 Volkswagen E3 DCUs Architecture5.11.2 Cockpit Entertainment DCU: ICAS3 (1)

5.11.4 Cockpit Entertainment DCU Software: WebOS 2.0 Open Source Platform 5.11.5 Cockpit Entertainment DCU Software: BlackBerry QNX Hypervisor 5.11.6 Cockpit Entertainment DCU Software: ACRN Hypervisor

5.12 Tesla Autopilot Platform

5.12.1 Development Route of Autopilot Hardware

5.12.2 Upgrade Path of Autopilot Functions: HW1.0—HW3.0

5.12.3 Overview of Major OTA Updates on Autopilot Functions

5.12.4 Hardware 4.0 to Use TSMC 7nm SOW Advanced Packaging Technology

5.12.5 Features of AutoPilot 3.0 DCU

5.12.6 AutoPilot 3.0 Chip: Equipped with Dual Redundant FSD Chip

5.12.7 AutoPilot 3.0 Chip: FSD Chip Architecture and Neural Network Processor (NNP)

5.12.8 Model 3 ECU Architecture

5.12.9 Model 3 ECU Multimedia and AutoPilot Motherboard

5.12.10 Model 3 Central Computing Module (CCM)

5.12.11 Summary of Parameters of DCUs for AutoPilot 1.0-3.0

5.12.12 Features of AutoPilot 2.5 DCU

5.12.13 Features of AutoPilot 2.0 DCU

5.13 TTTech

5.13.1 Profile

5.13.2 Autonomous Driving Solutions

5.13.3 Technical Advantages of Autonomous Driving Controller Platform

5.13.4 Safety Software Platform for Automated Driving: MotionWise

5.13.5 Cooperation with SAIC: Development of Central Decision Controller for Intelligent Driving

06 Chinese DCU Vendors 6.1 Huawei



Table of Content (6)

6.1.1	CCA	Archited	cture
-------	-----	----------	-------

6.1.2 Based on CC Architecture, Launched Three Major DCU Platforms: MDC, CDC, VDC

6.1.3 CDC Intelligent Cockpit Platform

6.1.4 HarmonyOS Intelligent Cockpit Platform and Pluggable IVI Module

6.1.5 Kirin 990A Automotive Cockpit Chip

6.1.6 MDC Autonomous Driving Computing Platform: Product Line

6.1.7 MDC Autonomous Driving Computing Platform: Parameters of MDC 210 and MDC 610

6.1.8 MDC Autonomous Driving Computing Platform: Recently Released MDC810

6.1.9 MDC Autonomous Driving Computing Platform: Ascend 910/310 Master Chip

6.1.10 MDC Autonomous Driving Computing Platform: Platform Framework

6.1.11 MDC Autonomous Driving Computing Platform: Hardware Platform

6.1.12 MDC Autonomous Driving Computing Platform: Software and Tool Chain

6.1.13 MDC Autonomous Driving Computing Platform: Automotive-grade Security Platform

6.1.14 MDC Autonomous Driving Computing Platform: ISO26262 and ASPICE Certification

6.2 Desay SV

6.2.1 Strategic Layout: Three Business Segments—Intelligent Cockpit, Intelligent Driving and Internet of Vehicle

6.2.2 Cockpit DCU: Leading Ideal ONE

6.2.3 Cockpit DCU: Tiggo 8 PLUS

6.2.4 Autonomous Driving DCU: Strategic Cooperation with Xpeng Motors and Nvidia

6.2.5 Autonomous Driving DCU: Application in Highway Pilot and AVP Solution

6.2.6 Autonomous Driving DCU: Features of IPU01-IPU04 and Progress in Mass Production

6.2.7 Autonomous Driving DCU: IPU01-IPU04 Technology Roadmap

6.2.8 IPU04 Used by Leading Ideal

6.2.9 Autonomous Driving DCU: IPU04 Hardware Architecture

6.2.10 Autonomous Driving DCU: IPU04 Software Architecture

6.2.11 Construction of ECU and DCU Ecosystems

6.3 Neusoft Group

- 6.3.1 Deployments in Intelligent Connected Vehicles
- 6.3.2 Example of Overall System Architecture of Intelligent Cockpit
- 6.3.3 Automotive Electronics Intelligent Cockpit: Cooperation with Geely Ecarx

6.3.4 Automotive Electronics Intelligent Cockpit: Cooperation with FAW Hongqi and Intel

6.3.5 Automotive Electronics Intelligent Cockpit: Cooperation with Great Wall Motor on Vehicle Computing Platform (VCP)

6.4 Neusoft Reach

6.4.1 Software Defined Computing (SDC) Solution

6.4.2 Core Platform of SDC Business: NeuSAR

6.4.3 Release of the Basic Software Product NeuSAR 3.0 and New ADAS & ADS Products

6.4.4 SDV Architecture

6.4.5 SDV Solutions

- 6.4.6 Basic Software Product: NeuSAR 3.0 (1)
- 6.4.7 Basic Software Product: NeuSAR 3.0 (2)
- 6.4.8 Software and Hardware Architecture for X-BOX 3.0 DCU for Autonomous Driving
- 6.4.9 Middleware and Ecological Software Kit
- 6.4.10 M-box ADAS DCU Mass-produced for New Baojun E300



Table of Content (7)

6.4.11 Basic Software Platform Product—NeuSAR 2.06.4.12 General DCU GPDC

6.5 Noble Automotive

6.5.1 Position of Intelligent Cockpit Business
6.5.2 Cockpit DCU Product Development Roadmap
6.5.3 IN7.0 Cockpit DCU (Based on Qualcomm 6155)
6.5.4 Cockpit DCU Software Solution
6.5.5 Formulated a Three-step Development Strategy

6.6 Foryou Group

- 6.6.1 4th-generation Intelligent Cockpit DCU
- 6.6.2 Release of Cockpit DCU and New-generation Intelligent Cockpit Solutions 6.6.3 AAOP2.0 Cockpit Open Platform: Layered and Hierarchical Technology Framework
- 6.6.4 AAOP2.0 Cockpit Open Platform: Integration from Infotainment to Intelligent Cockpit

6.6.5 Features of AAOP2.0 Cockpit Open Platform

6.7 Freetech

6.7.1 Autonomous Driving Product Roadmap
6.7.2 Autonomous Driving System Solutions
6.7.3 DCU System Product Roadmap
6.7.4 DCU: ADC20 Technology Architecture
6.7.5 DCU: ADC30 Product Architecture

6.8 Technomous6.8.1 Provide Customers with DCU Hardware and Software Platforms6.8.2 iECU Controller MotionWise Software Platform

6.8.3 Typical Application of iECU by Customers6.8.4 DCU Product Portfolio6.8.5 DCU Software Platform

6.9 Yingbo Super Computing

6.9.1 Profile

6.9.2 L2.99 Intelligent Driving DCU: Mass-produced for Chery Big Ant

- 6.9.3 L2.99 Intelligent Driving DCU: Technical Strengths
- 6.9.4 L2.99 Intelligent Driving DCU: Hardware Architecture
- 6.9.5 L2.99 Intelligent Driving DCU: Specifications and Interfaces
- 6.9.6 Software-defined ADAS All-in-one
- 6.9.7 Dual J3 Intelligent Driving DCU
- 6.9.8 Cooperation Mode of Intelligent Driving DCU
- 6.10 Baidu

6.10.1 Autonomous Driving Computing Platform—Apollo Computing Unit (ACU) (Sixi)
6.10.2 Autonomous Driving Computing Platform Roadmap
6.10.3 Technical Features of Autonomous Driving Computing Platform 1.0 (Wuren)/2.0 (Sixi)/3.0 (Sanxian)
6.10.4 ACU (Sixi) Uses TI TDA4 Processor
6.10.5 Apollo Promotes ANP+AVP Full-domain Intelligent Driving System

6.11 IN-DRIVING

- 6.11.1 Profile
- 6.11.2 Business Model and Core Businesses
- 6.11.3 Autonomous Driving DCU: Path of Iteration and Cost Reduction
- 6.11.4 Autonomous Driving DCU: TITAN 4
- 6.11.5 Autonomous Driving DCU: TITAN 3
- 6.11.6 Autonomous Driving DCU: TITAN 3 Parameters and Architecture



Table of Content (8)

6.11.7 Autonomous Driving DCU: TITAN 3 System Framework Diagram6.11.8 Autonomous Driving DCU: TITAN 3 Performance Indicators6.11.9 Autonomous Driving Software Platform: Athena6.11.10 Cooperation with Huawei

6.12 HiRain Technologies6.12.1 Profile6.12.2 ADAS DCU6.12.3 Features of ADAS DCU

6.13 Hong Jing Drive

6.13.1 Profile

6.13.2 Autonomous Driving DCU: ADCU

6.13.3 "Gemini" Computing Platform and Autonomous Driving Full-stack Technology Capabilities

6.13.4 Autonomous Driving System Architecture

6.13.5 Established the Joint Venture Anhui Domain Compute Co., Ltd. with JAC

6.14 Hangsheng Electronics

6.14.1 Product Layout

6.14.2 Intelligent Cockpit Ecosystem

6.14.3 Rapid Iteration Capability of Intelligent Cockpit

6.14.4 Intelligent Cockpit Customers: Cooperate with Dongfeng Venucia and NXP to Mass-produce Intelligent Cockpits

6.15 BICV6.15.1 Profile6.15.2 Intelligent Cockpit DCU

6.16 UAES
6.16.1 Extended DCU Platform—XCU
6.16.2 AUTOSAR-based Open Software Platform
6.16.3 SOA Application under New EEA
6.16.4 Zone Controller Architecture
6.16.5 Zone Controller Functional Unit: Regional Power Supply Center

6.17 Cookoo

6.17.1 Automotive Cockpit and Intelligent Driving Computing Platform Architecture

6.17.2 Cockpit and Intelligent Driving Product Lines

6.17.3 Intelligent Cockpit Product Route

6.17.4 Intelligent Cockpit Products

6.17.5 Intelligent Cockpit DCU: ACU202 Intelligent Cockpit Computing Platform

6.17.6 Intelligent Cockpit: AutoCabin

6.17.7 Intelligent Cockpit Software: CarNetOS

6.17.8 AutoWheel L2.5 Intelligent Driving System Solution

6.17.9 ACU202 Intelligent Cockpit Computing Platform (DCU)

6.17.10 AWU401 Computing Unit for Autonomous Driving

6.17.11 AWU401 Software Platform

6.18 ECO-EV
6.18.1 Profile
6.18.2 Intelligent Driving Products
6.18.3 ACU Hardware Platform
6.18.4 Autonomous Driving DCU for Meituan Autonomous Delivery Vehicle
6.18.5 Autonomous Driving DCU for Yutong L4 Autonomous Bus
6.18.6 EAXVA03 DCU
6.18.7 Software Platform Architecture



Table of Content (9)

6.19 Idriverplus

6.19.1 Automated Vehicle Operating System (AVOS) and Automated Vehicle Control Unit (AVCU)
6.19.2 AVOS Architecture
6.19.3 BrainBox (NVIDIA XAVIER Version)
6.19.4 BrainBox (NVIDIA TX2 Version)
6.19.5 SenseBox (NVIDIA Xavier Version)
6.19.6 SenseBox (NVIDIA TX2 Version)
6.19.7 BrainBox (Intel i7 Version) 6.22.2 NOVA-Box Computing Platform Solution (1)6.22.3 NOVA-Box Computing Platform Solution (2)6.22.4 NOVA-Box Computing Platform Solution (3)6.22.5 Partners

6.20 DJI Automotive
6.20.1 Intelligent Driving Solution
6.20.2 Self-developed Autonomous Driving DCU Products
6.20.3 Self-developed Autonomous Driving DCU Middleware

6.21 Enjoy Move
6.21.1 Technology and Products
6.21.2 Ecosystem Construction
6.21.3 High-performance Computing Software Platform: EMOS1.0
6.21.4 High-performance Computing Software Platform: Technical Features of EMOS1.0
6.21.5 High-performance Computing Software Platform: Multi-domain Fusion Software Platform
6.21.6 Multi-domain Fusion Computing Platform
6.21.7 Business Model

6.22 Superstar Future 6.22.1 Profile





Beijing Headquarters TEL: 010-82601561, 82863481 FAX: 010-82601570 Email: report@researchinchina.com

Website: www.researchinchina.com

WeChat: zuosiqiche



Chengdu Branch

TEL: 028-68738514 FAX: 028-86930659



