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Intelligent Vehicle Multi-Domain Computing Industry Report, 2023

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Multi-domain computing research: in the coming first year of cross-domain fusion, major suppliers will quicken their pace of launching new solutions

As vehicle intelligence develops, electrical/electronic architecture begins to evolve from domain control centralized architecture to multi-domain fusion computing/central computing architecture. In this development trend, OEMs, Tier 1 suppliers and chip companies enjoy new market opportunities.

*In July 2023, SAIC unveiled a vehicle motion controller (VMC) for central coordination. Based on vehicle central fusion motion control, it enables a shorter cross-domain control link for vehicles, and allows for more efficient control over the body and chassis in the state of human driving or intelligent driving.

*In July 2023, BYD first introduced "Eyes of the God", its advanced intelligent driving assistance system that adopts the central computing platform + zonal domain controller deep collaboration system architecture.

Multi-domain Fusion Computing Layout of Some OEMs

OEM	Multi-domain Fusion	Terminal Functions/Advantages Enabled by Multi-domain Fusion
SAIC Motor	Galaxy 3.0 Cockpit-driving Integrated Computing Platform (Expected SOP in 2025)	All-scenario cross-domain fusion covers such functions as human-machine interface, intelligent driving, applications and entertainment, and even online shopping, to meet the real needs of ordinary users who pass the boring time.
	IM LS7 "Full-trip AI Cockpit" (launched on market in February 2023)	Include the following functions: Glance Sense, One Touch iAD, and Shua (this function is expected to become available in the fourth quarter). Empower intelligent cockpits with intelligent driving technologies, explore cockpit-driving integration, and then combine AI algorithms to launch the industry's first "Full-trip AI Cockpit" with all-domain fusion, aiming to minimize users' driving anxiety.
Neta Auto	A central supercomputing platform is being developed	Bring new safe driving experience and feature-rich cabin interaction experience to drivers and passengers.
BYD	DiSus System (SOP in 2023)	The active suspension can integrate with driving assistance perception components across domains to achieve active perception.
NIO	Self-developed Full-stack Intelligent Chassis Controller (ICC) (first installed on ET7)	Quickly respond to the prediction and decision made by the intelligent driving system to improve vehicle comfort. For example, in the NAD scenario, the intelligent domain fusion control system can control four-wheel drive distribution, brake-by-wire, variable suspension and other vehicle functions simultaneously, making vehicles better meet driver's expectations and effectively improving vehicle dynamic performance.
Leapmotor	The centralized electronic/electrical architecture (Leap3.0) adopts a central computing platform	<ul style="list-style-type: none"> Significantly reduce the number of controllers in the overall architecture, and also the density of wiring harnesses; Realize unconscious OTA updates; Enable full-ecosystem interaction in terms of recognition, computing, actuation, feedback, and learning at the intelligent cockpit level.

Source: ResearchInChina

Major Tier 1 suppliers step into the multi-domain computing field by virtue of their own strengths

From the perspective of layout, Tier 1 suppliers deploy multi-domain computing in a relatively flexible way. They rely on their own superiorities to lay out multi-domain fusion, for example, body and chassis, body and cockpit, and chassis and intelligent driving domains.

Multi-domain Computing Layout of Some Tier 1 Suppliers

Supplier	Multi-domain Computing + Zone Controller Solution	Overview	Implementation Time
Aptiv	Body Domain + Power Domain + Chassis Domain	The body + power + chassis three-domain fusion controller integrates a power and body controller, propulsion and chassis controller, data network router, gateway, firewall, zone master and data storage hub, etc.	2022
	Central Vehicle Controller (CVC)	Integrate ADAS, body, gateway and VCU functions, serving as one of the core systems for next-generation intelligent vehicle architecture.	/
Continental	Body Domain + Power Domain + Chassis Domain	Integrate body control domain, power domain, gateway and other functions.	2020
	Central Computing	A cross-domain fusion HPC that integrates body, intelligent cockpit, autonomous driving, and safety & motion domains.	2024
Bosch	Cockpit Domain + Intelligent Driving Domain	A central controller that integrates intelligent cockpit and intelligent driving to enable centralized E/E architecture.	2025
ZF	Body Domain + Power Domain + Chassis Domain	A vehicle motion domain controller that integrates body, power and chassis domains.	2022
	Body Domain + Cockpit Domain + Intelligent Driving Domain	The computing power is increased to 1,500 TOPS, the power consumption is 5 TOPS per watt, and the multi-domain translation of the single-domain software stack can be realized.	2024

UAES has established the special cross-domain control division, and has signed strategic cooperation agreements with ecosystem partners like Horizon Robotics, Neusoft Reach, ABUP, LEADMOVE, and TE Connectivity.

In December 2022, UAES released its vehicle computing platform (VCP), which uses the new-generation NXP S32G SoC and integrates functions of power and body domains, including vehicle control, BCM and gateway. For some projects, driving assistance functions are integrated;

In May 2023, UAES launched VCU8.5, a vehicle motion domain controller platform which systematically analyzes and designs the requirements of cross-domain fusion control and integrates such functions as EPB, FlexRay and Delay off.

In April 2023, Continental exhibited its cross-domain vehicle control high performance computer (HPC) for the first time. In addition to the original body control and gateway functions, this product also integrates chassis control applications. At present, Continental has secured two local orders in China, and the model GAC Aion Hyper GT will become the first production car carrying the product. It is expected that in 2024, this HPC will be installed on more than 30 different models of several automakers.



Source: Continental

In June 2023, PATEO CONNECT+ managed to develop its first vehicle central computing module (CCM). Based on the central gateway, this platform expands computing power, and integrates intelligent cockpit, ADAS, body and vehicle control functions.



Source: PATEO

Key technical support for multi-domain computing: multi-domain computing SoC, and cross-domain fusion software platform

At present, multi-domain fusion is seen mainly in two aspects: hardware and software. From a hardware integration perspective, multi-domain fusion features multi-SoC integration, that is, different domain controllers are integrated into one box composed of multiple SoCs or MCUs, and different functions are supported by different chips. The multi-domain fusion enabled by a single chip requires a SoC to complete different functions. There are now still some challenges in realizing single-SoC multi-domain fusion.

Multi-domain Computing SoC Product Layout of Chip Vendors

Vendor	Multi-domain Computing SoC Design Idea
Qualcomm	<ul style="list-style-type: none">● Snapdragon Ride SoC (Qualcomm SA8540P) and the 4th Generation Snapdragon Automotive Digital Cockpit Platform (Qualcomm 8295) enable multi-domain fusion computing;● Snapdragon Ride Flex: An integrated automotive supercomputing SoC where a single SoC supports digital cockpit, ADAS and AD functions simultaneously.
Nvidia	<ul style="list-style-type: none">● Nvidia Orin and Ampere SoCs support cockpit-driving integrated multi-domain computing;● Grouped software stacks for multi-domain computing: DRIVE Concierge and DRIVE Chauffeur software solutions, respectively for intelligent cockpit and autonomous driving; DRIVE IX software stack with in-cabin algorithm fusion;● Thor: a central computing chip. Use a Thor chip to build a controller that simultaneously provides computing power for multiple systems, e.g., automated parking, intelligent driving, IVI, instrument cluster and driver monitoring.
Renesas	<ul style="list-style-type: none">● Renesas R-Car M3 (central control domain) is applied to Continental's body high-performance computer (HPC).
NXP	<ul style="list-style-type: none">● NXP S32G399 (central control domain) is applied to Continental's second-generation body HPC, and has been designated by GAC Group.
SemiDrive	<ul style="list-style-type: none">● G9V is a high-performance processor for cross-domain fusion. A G9V processor enables the integration of core gateway and 3D cluster on a domain controller for future cross-core, cross-domain, cross-system SOA support.● SemiDrive Central Computing Architecture 2.0 (SCCA 2.0)
Black Sesame Technologies	<ul style="list-style-type: none">● C1200 (cross-domain fusion SoC) is combined with innovative fusion architecture, and clearly positioned for L2+ fusion computing.● A2000 (central computing chip).

Source: ResearchInChina

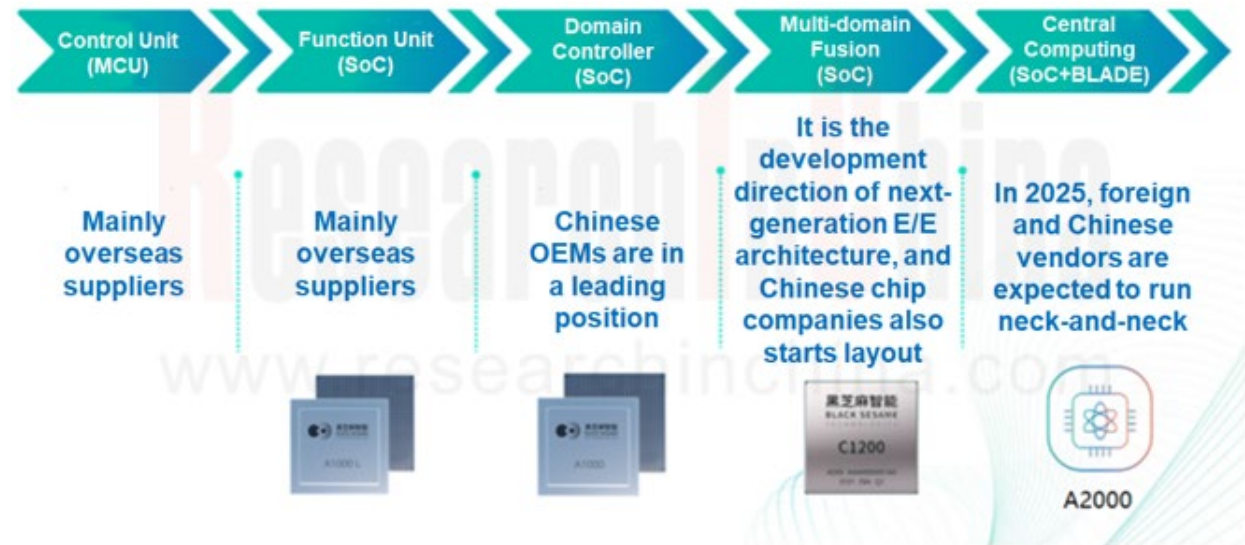
Black Sesame Technologies and Arraymo

In July 2023, Black Sesame Technologies announced C1200, the first product of the Wudang Series. As China's first automotive cross-domain multifunctional fusion computing chip, C1200 meets the requirements of autonomous driving, intelligent cockpit, body control and other computing functions.

Wudang C1200 packs A78AE (performance up to 150KDMIPS), an automotive high-performance CPU core that supports lockstep, the automotive high-performance GPU core G78AE, a built-in mature high-performance Audio DSP module, and the self-developed new-generation NeurallIQ ISP module that processes 1.5G pixels per second online. Moreover, C1200 also has a built-in ASIL-D Safety Island, and a Security Module subject to the National Cryptography Level 2 and EVITA full, meeting the reliability requirements of the highest vehicle safety level.

In addition to chips, the development of cross-domain fusion also needs to be supported by vehicle OS. In current stage, vehicle functional domains have yet to be fully integrated, and there is no intelligent vehicle operating system that can be applied directly for a long time in the world. This is an opportunity for Chinese vehicle OS providers to overtake on the bend.

Black Sesame Technologies' Chip Layout for Different Levels of E/E Architecture



Source: Black Sesame Technologies

Arraymo (ArcherMind Technology)

In April 2023, Arraymo, an arm of ArcherMind Technology, launched Fusion OS, a cross-domain fusion vehicle software computing platform which is mainly compatible with operating systems in different domains. Fusion OS quickly connects core functional domains such as intelligent cockpit, central control, and intelligent driving from the bottom layer for high integration of functional modules.

Intelligent Vehicle Multi-Domain Computing Industry Report, 2023 highlights the following:

*Multi-domain computing development ideas, including central domain controller, cockpit-driving integration, integration of cockpit and body domains, integration of chassis and intelligent driving domains, and central computing platform + zone controllers (development, main cases, etc.);

*Key technologies of multi-domain computing, including multi-domain fusion computing SoC, multi-domain computing software OS, multi-domain computing Ethernet, multi-domain computing gateway, and zone controller, (development trends, actual cases, etc.);

*OEMs' multi-domain fusion development planning, product R&D, technology layout, etc.;

*Chinese and foreign Tier 1 suppliers' products, technology layout, cooperation, etc. in multi-domain computing and zone controller.

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