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# China ADAS Redundant System Strategy Research Report, 2023

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# Redundant System Research: The Last Line of Safety for Intelligent Vehicles

Redundant design refers to a technology adding more than one set of functional channels, components or parts that enable the same function to places where a system or device plays a critical role in accomplishing a task, so as to ensure that the system or device can still work normally when a part fails, lowering failure probability and improving reliability.

As the level of driving assistance gets ever higher, human drivers are gradually being replaced by vehicle systems. To ensure that vehicle systems are always in operation, redundant systems are essential. In the future, redundant systems will become standard configurations for L3 and higher-level driving assistance.

At present, the redundancy for ADAS ranges from perceptual positioning (environmental monitoring), controller (brain) and actuator (braking and steering) to communication (control over information transmission) and power supply (support for failure and degradation).

## ADAS Redundant System Scope and Mainstream Methods

Scope	Mainstream methods	Solutions	
Perceptual positioning redundancy	Redundant perception such as LiDAR, high-definition cameras, radar, ultrasonic sensors, HD maps and high-precision positioning.	Realize the complementary capabilities of perception hardware, and strengthen the perception capabilities.	
Controller redundancy	Arrange two high-performance intelligent driving computing platforms to support the hot switching safety mechanism after a single computing platform fails	Realize the dual-intelligent driving domain control of "dual-core brain" with high computing power and high stability	
Actuator redundancy	Brake redundancy	"Mechanical redundancy + electronic redundancy" brake solution with dual-safe failure mode	Realize reliable brake control in the full speed range of 0-120km/h
	Steering redundancy	EPS hardware adopts dual CPUs, dual drive axles and dual winding motors.	Realize power steering when any single circuit fails
Communication redundancy	Dual-connected two-way brake-by-wire, steer-by-wire and power-by-wire communication links	Realize communication hot switching amid any communication failure (switching without shutdown)	
Power supply redundancy	In case of power failure, the intelligent driving system can be controlled independently and safely.	Compensate for power supply redundancy in centralized architectures (for example, the failure of a single component in bias power supply may cause a large system failure)	

# Six Redundant Systems of Great Wall Motor

Most of vehicle models (like Great Wall WEY Mocha, NIO ET Series, Li Auto L8/L7 Max and Volvo EX90) with ADAS functions such as NOH, NGP and NOP are equipped with fully redundant systems.

Coffee Intelligence, Great Wall Motor's department for redundant systems, released six redundant systems in 2020, including perceptual redundancy, controller redundancy, architecture redundancy, power redundancy, brake redundancy and steering redundancy, which debuted on WEY Mocha in May 2021.

Perceptual redundancy adopts a multi-source heterogeneous sensor solution and L+R+V fusion. Controller redundancy uses dual controllers that run around the clock and back up each other. Brake redundancy uses Bosch's ESP+iBooster combination. Steering redundancy applies the third-generation intelligent steering product developed by HYCET EPS System, an affiliate of Great Wall Motor, with dual winding motors, dual-motor position sensors, dual CPUs and dual controllers. Communication redundancy adopts dual communication architectures with three independent physical communication links supporting each other. Power redundancy applies the "double insurance" design consisting of dual power supply and dual circuits.

## Six Redundant Systems of Great Wall Motor



Source: Great Wall Motor



# Volvo released EX90

In November 2022, Volvo released its flagship SUV - EX90, which is its first production model equipped with a safety redundant system and is expected to be available on the Chinese market in mid-2024.

The perceptual redundancy for this car adopts a LiDAR+radar+camera+ ultrasonic radar out-cabin solution, in which LiDAR is provided by Luminar, with a detection range of 250 meters. The in-cabin solution first introduces a driver understanding system (DUS) consisting of two in-vehicle cameras and a capacitive steering wheel. As for controller redundancy, there are two sets of parallel cooperative computing platforms packing NVIDIA DRIVE Orin and NVIDIA Xavier chips with the computing power up to 286 TOPS. In addition, the vehicle features fully redundant design in braking, steering, power supply and communication.

As intelligent vehicle architectures evolve, redundant systems are evolving as well. For example, JIDU ROBO-01, released by Jidu Auto in June 2022, carries Jidu Auto's self-developed high-level intelligent architecture - JET, which integrates the EEA and SOA operating system. Its backup solution for “cockpit domain + intelligent driving domain” fusion is based on Qualcomm 8295 with AI compute of 30 TOPS, supporting intelligent driving redundancy. When the intelligent driving fails in extreme cases, the intelligent cockpit can take over the vehicle and let it stop safely.



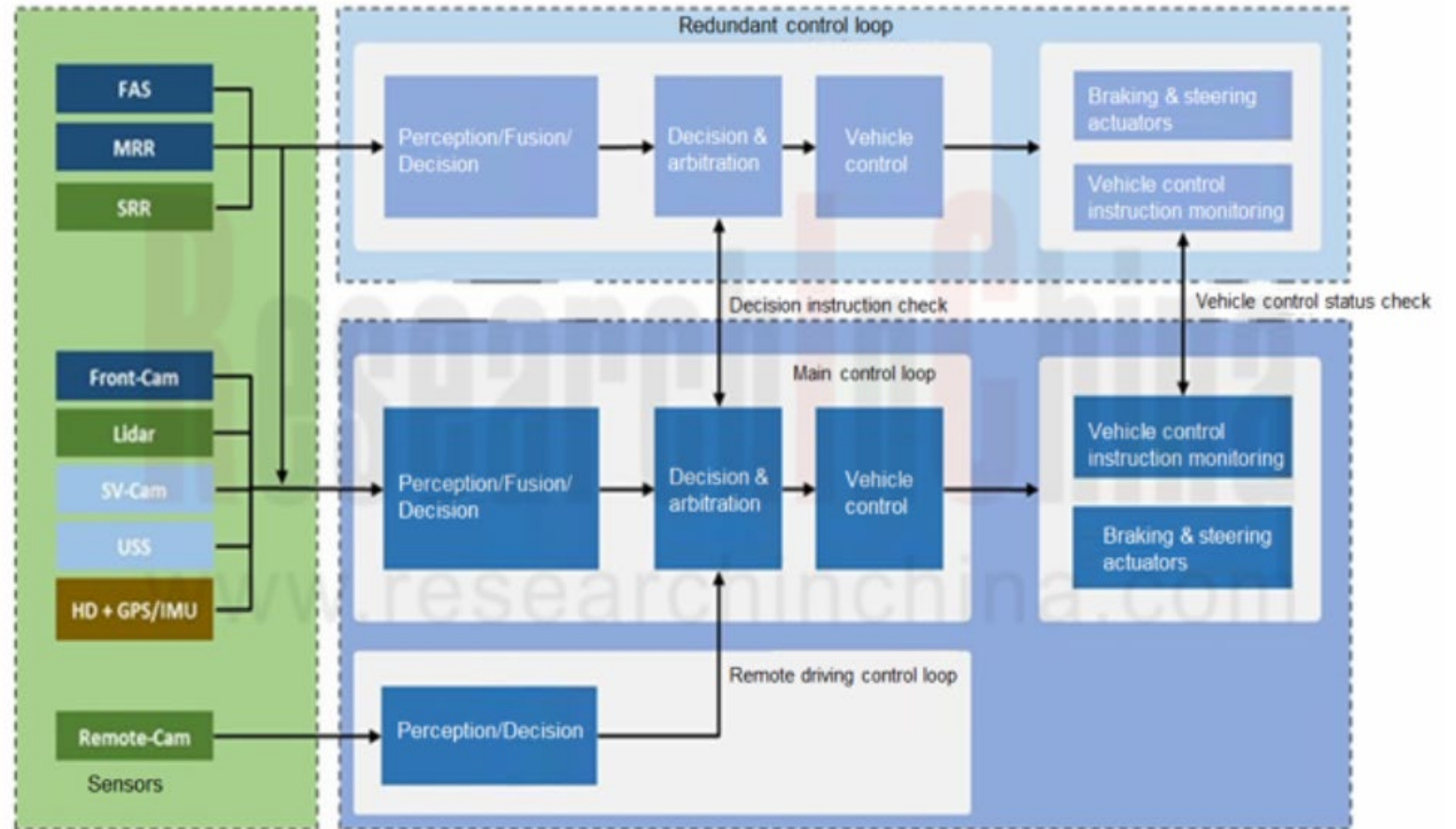
Source: Jidu Auto

# Redundant Systems of Foreign and Chinese Suppliers

Foreign suppliers offer comprehensive redundant designs. For example, the redundancy of Bosch's perception module adopts the multi-sensor redundancy solution composed of ultrasonic sensors, radars, cameras and LiDAR. The positioning module redundancy adopts the redundant positioning solution constituted by absolute positioning based on satellite signals and relative positioning based on road features. The decision module is redundantly configured with two core computing units (i.e. domain controllers). The actuator redundancy design covers the steering system, brake system and engine management system. For the brake system redundancy, three solutions are used: iBooster+ESP, IPB+RBU and DPB+ESP. The steering system redundancy solution adopts a steer-by-wire system, which is equipped with two motors, two sets of power supply and two sets of windings.

Moreover, Chinese suppliers are working to deploy redundant systems. Examples include Jingwei Hirain Technologies that developed R-EPS, a fully redundant EPS for L2-L4 autonomous driving, in August 2022.

## Functional Safety Solution of Jingwei Hirain Technologies



Source: Jingwei Hirain

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