The Road from ECUs to DCUs

Introduction

As electronic vehicles become more commonplace, electronic control units (ECUs) are becoming the standard, embedded control system for automotive electronics. ECU systems provide safety and functionality — applications using ECUs include anti-lock brakes, four-wheel drive, electronic automatic transmission, active suspension, and airbags. Gradually, the use of ECUs has extended to vehicle body safety, networks, entertainment, and sensing controls.

The number of cars incorporating ECU systems are increasing year by year, with some high-end models featuring up to 100 ECUs. Figure 1 shows the current ECU architecture. The rapid incorporation of ECUs in vehicles poses a significant challenge to the electrical and electronic architecture, particularly for data processing and network security optimization.

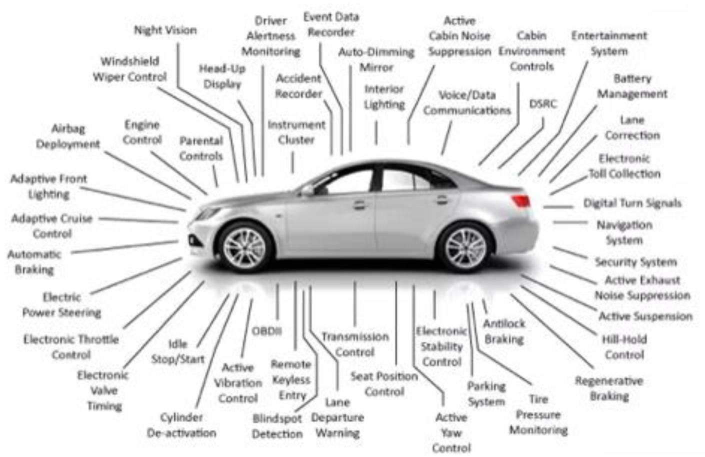

Figure 1: Current ECU Architecture

To solve the limitations of ECU architectures, domain control units (DCU) were developed to integrate ECUs and other sensors into a centralized control system for the entire vehicle. DCUs represent the future of automotive electrical and electronic architecture, as they are paramount to help emerging trends in smart driving and smart cockpit applications. DCUs also improve features such as the vehicle body, chassis, and power supply (see Figure 2).

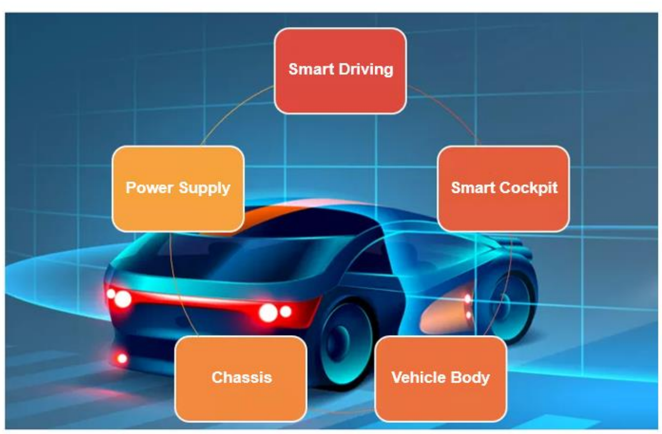

Figure 2: Future DCU Trends

Compared to conventional approaches and ECU systems, DCUs focus on integration, security, and core computing with robust hardware computing capacity and standardized interfaces. However, suppliers cannot solely rely on existing ICs to achieve a more complex and powerful DCU, which means that well-designed devices must meet the following criteria:

- Avoid the possibility of any single point of failure by considering all safety-related failures.
- Designed in a scalable, modular way using flexible lift levels that simplify the DCU redesign process for different grades and prices.
- Able to withstand the rigors of the automotive environment, including an expansive temperature range between sub-zero degrees Celsius to hundreds of degrees Celsius, as well as constant external noise and irritations.

MPS provides a power subsystem that helps streamline the product development path and the overall power module ecosystem to make the overall system more secure, scalable, and reliable.

MPS's Power Subsystem

MPS's power subsystem consists of over six different ICs, where each subsystem can operate harmoniously (see Figure 3). Some of the ICs are based on MPS's advanced process technology for traditional power management products, designed to provide ultra-high power density. The other ICs provide integrated timing control or voltage monitoring functions for analog products.

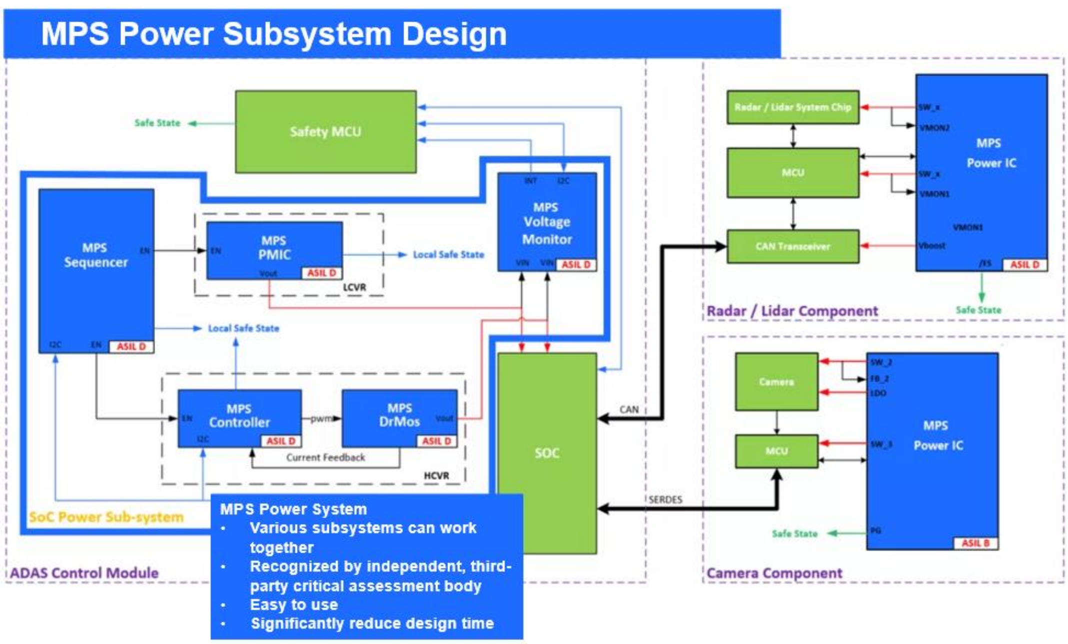

Figure 3: MPS Power Subsystem Design

In this power system, consider the typical functionality of each IC and the compatibility between devices. The MPS power subsystem design is recognized by an independent, third-party critical assessment body that follows industry-recognized ISO26262 safety regulations, and establishes common languages and protocols for automotive suppliers (see Figure 4).

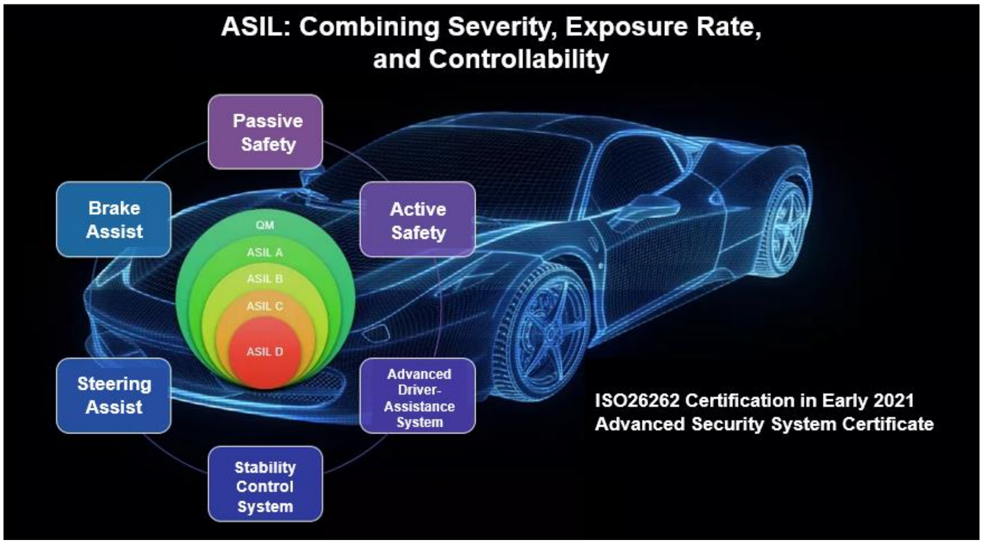

Figure 4: ASIL Features of the MPS Power Subsystem

Because it is likely that different modules may not work together in an optimized scenario, MPS helps customers consider several scenarios at the subsystem level.

MPS automotive solutions also prioritize scalability by targeting the entire product family rather than individual products. For example, in a pin-compatible product family, MPS can offer 4 to 6 different solutions that have the same package, pin-out, and specifications, with the exception of output current sizes.

Another approach proposed by MPS to improve product scalability is by using parallel solutions. Consider the MPQ4436, a low quiescent current, synchronous step-down switching converter with integrated internal high-side and low-side power MOSFETs. Multiple MPQ4436 devices can operate in parallel, from a one-part, two-part, or even four-part system to support a wider range of requirements (see Figure 5).

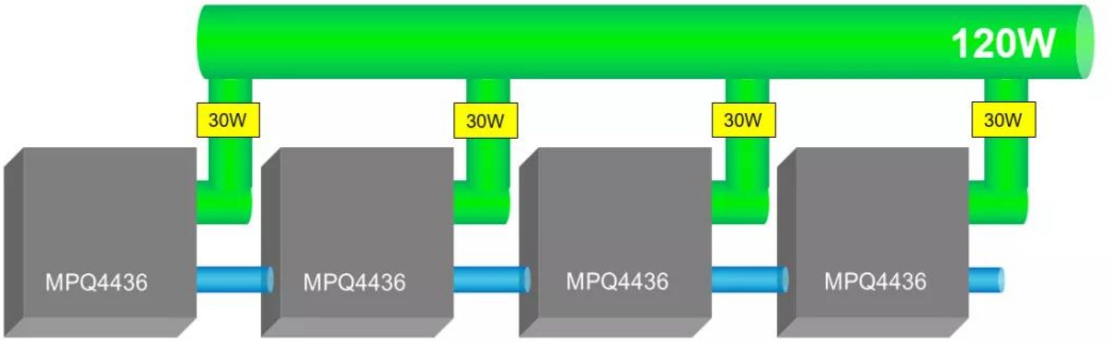

Figure 5: Parallel Operation with for MPQ4436 Devices

Conclusion

In this article, we discussed the transition from embedded ECU systems to centralized DCU systems, and explored MPS's power subsystem scheme that integrates various subsystems and achieves scalability. With the increasing electrification of vehicles and more advanced control systems, MPS offers innovative solutions and a broad product portfolio to help automotive customers efficiently upgrade their automotive systems.