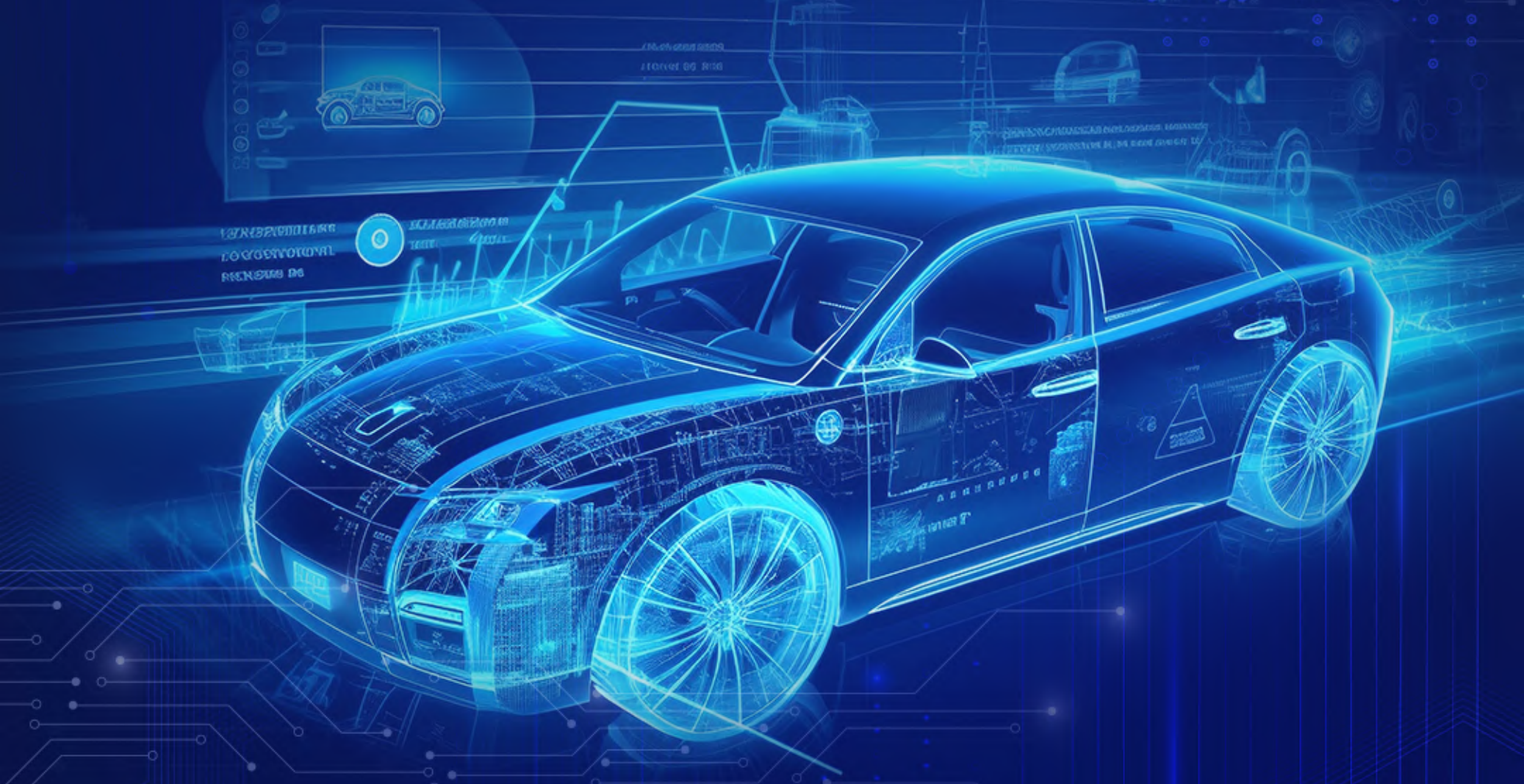
SRMTech
ideas@work

High-Performance Computers (HPCs) in Software-Defined Vehicles



As vehicles become increasingly software-driven, automotive computing requirements are fundamentally reshaping vehicle architecture.

High-Performance Computers (HPCs) provide the foundation required to support this transformation, enabling the scale of software, centralization of intelligence, and continuous evolution across the vehicle lifecycle.

To understand why HPCs are now essential, we need to look at the evolution of Vehicle E/E architecture.

Evolution of Vehicle E/E Architecture

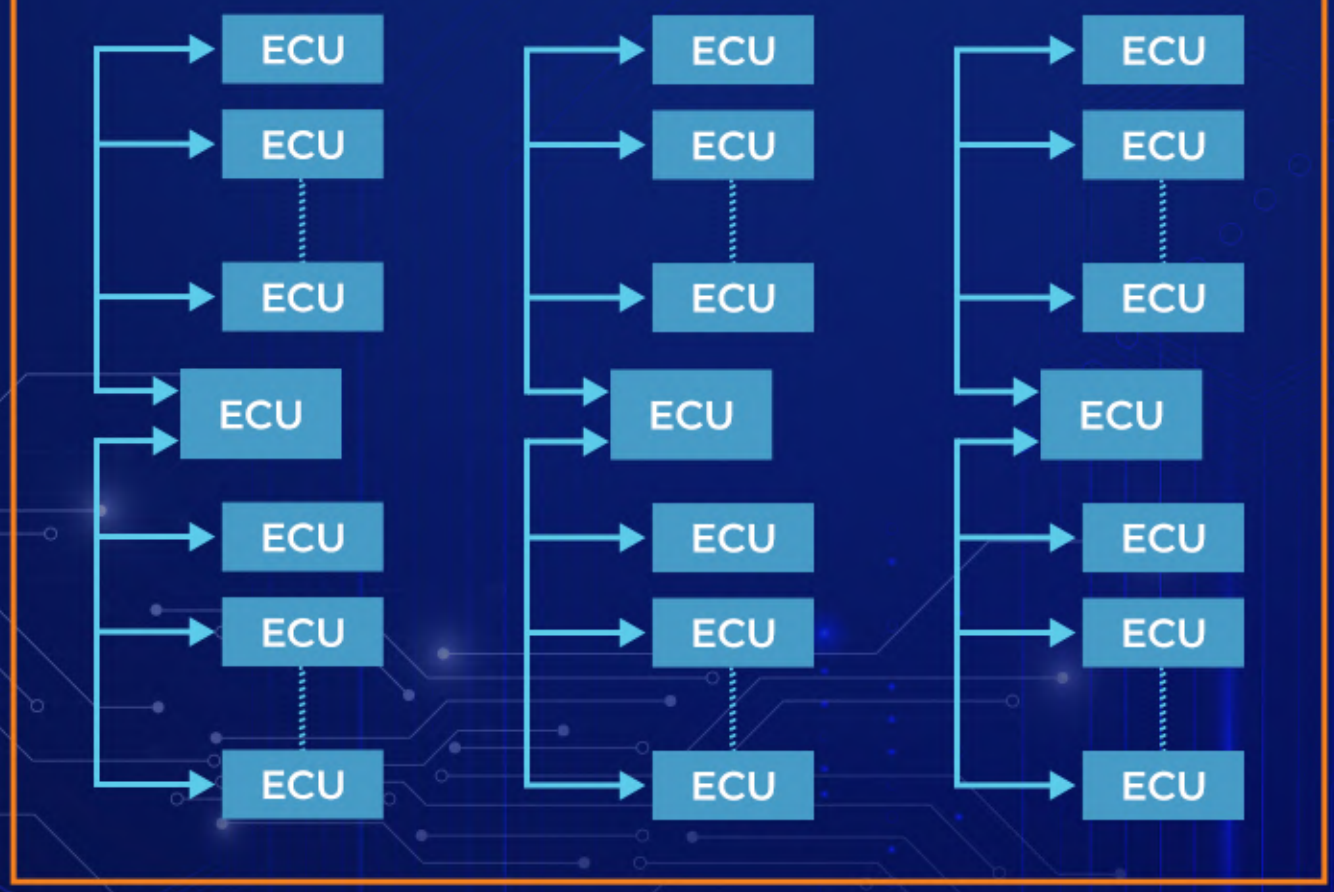
PAST
Traditional ECU-Based Architecture

Vehicles were built using many small, distributed ECUs placed across the vehicle.

Each ECU ran independent software with limited processing capability and minimal interaction with other systems.

This approach worked when vehicle functions were largely independent and software-driven capabilities were considerably limited.

Traditional Architecture



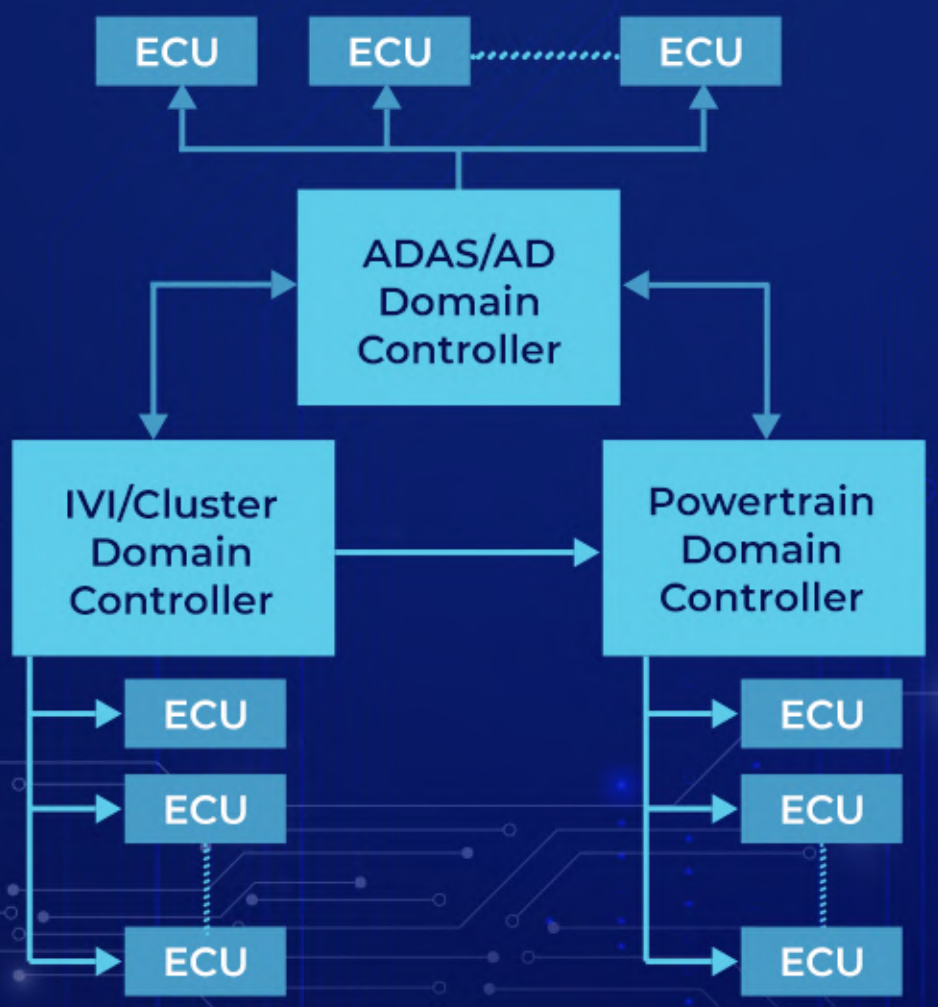
PRESENT
Domain-Centric Architecture

As vehicle functionality expanded, ECUs were grouped by function into domains such as powertrain, safety, body, and infotainment.

Each domain was managed by a dedicated domain controller that coordinated multiple ECUs and software functions within that domain.

This improved local control and performance. However, system-wide features still required complex coordination across domains, limiting scalability as software complexity increased.

Domain Architecture

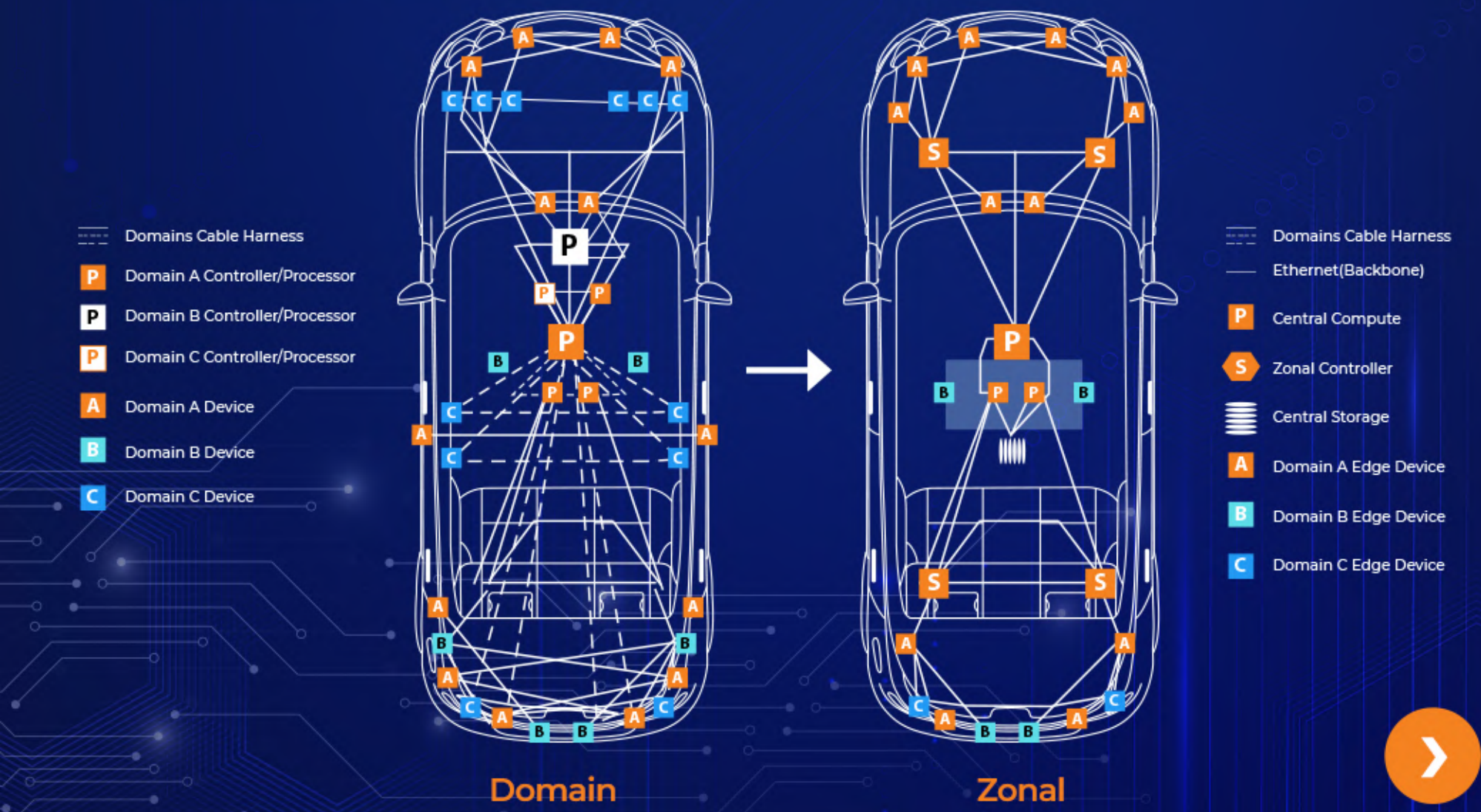


Why This Architecture No Longer Scales

As software-driven vehicle complexity continues to grow, distributed and domain-based architectures introduce structural constraints:

- As software-driven vehicle complexity continues to grow, distributed
- Wiring harnesses become heavier and more complex
- Compute resources are duplicated across controllers
- System integration and debugging become increasingly difficult
- Over-the-air updates are harder to scale safely
- Validation cycles grow longer and more costly

These constraints expose fundamental scalability limits, making the shift from domain-centric designs to zonal architectures with centralized compute essential.



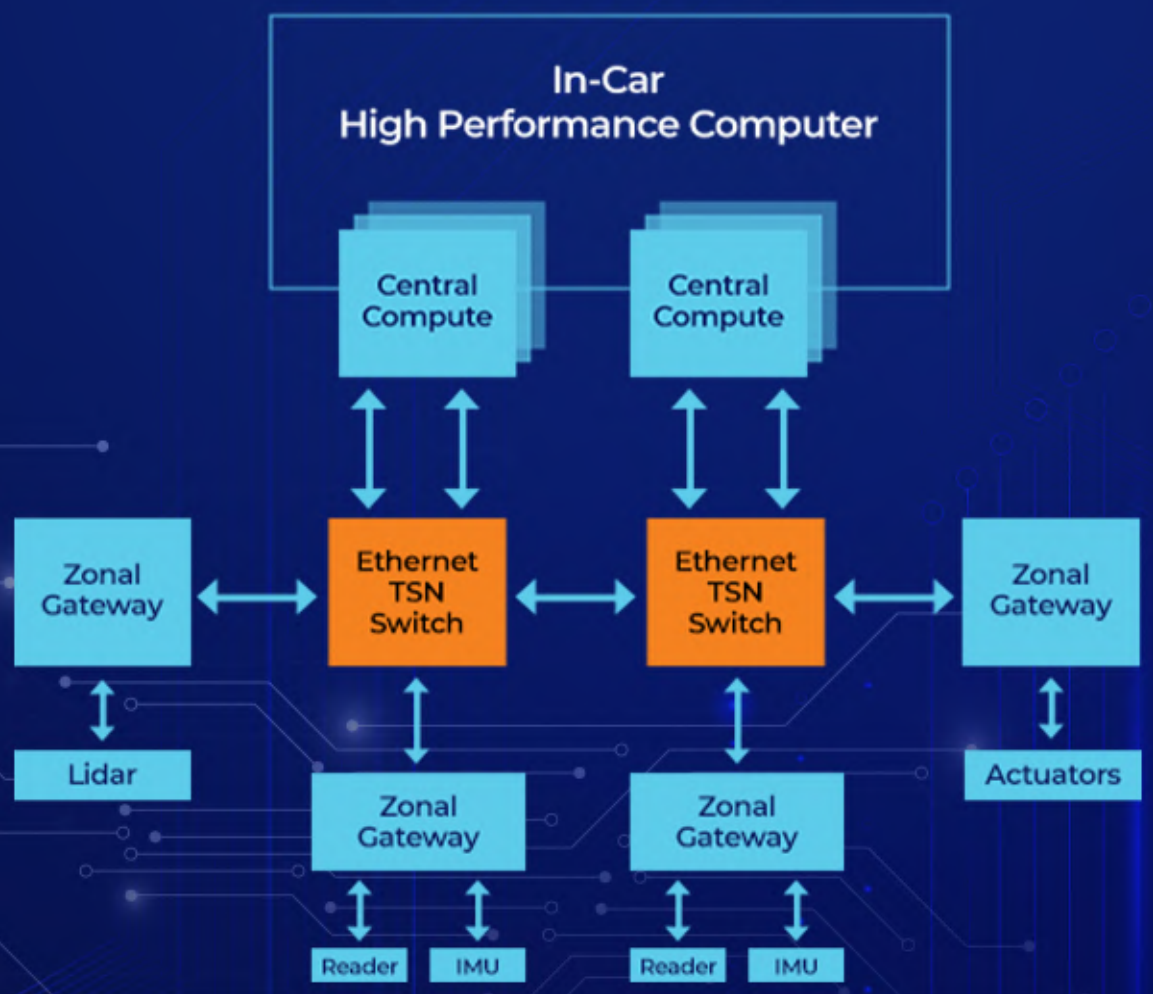
Evolving: Zonal Architecture with Central HPCs

In a zonal architecture, vehicle electronics are organized by physical zones rather than by functions.

Zonal controllers in each area manage local sensors and actuators, while one or more central **High-Performance Computers** provide vehicle-wide intelligence and coordination.

This approach reduces wiring complexity, simplifies system integration, and accelerates vehicle-wide software updates, enabling software-defined features to scale across the vehicle lifecycle.

Zonal Architecture



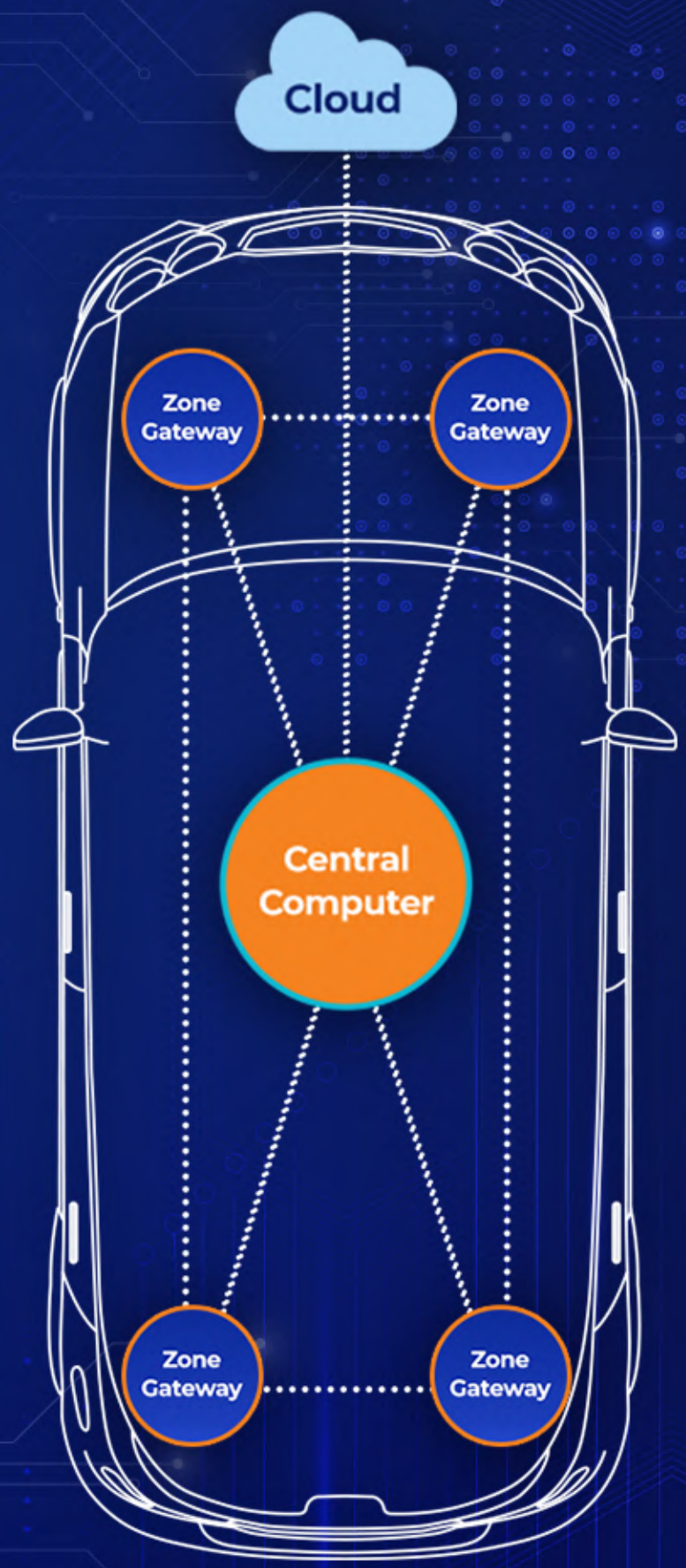
What is an Automotive HPC?

An automotive High-Performance Computer (HPC) is a centralized, high-performance compute platform that functions as the intelligence layer of the vehicle.

HPCs replace distributed ECUs with a unified compute environment capable of running multiple workloads in parallel across domains or zones.

They are designed to:

- Run multiple applications on shared hardware
- Support virtualization and workload isolation
- AI and perception workloads
- Manage secure over-the-air updates
- Aggregate sensor and vehicle data
- Enforce cybersecurity policies



Why High-Performance Computers are the Core in SDVs

Real-Time Intelligence

Enables safety-critical decisions by processing multi-sensor data in real time.

Continuous Software Updates (OTA)

Supports controlled, vehicle-wide software updates across the lifecycle.

AI & Perception Compute

Provides centralized compute for sensor fusion and autonomous workloads.

Simplified Architecture

Reduces ECU sprawl by consolidating functions into central compute platforms.

Scalable Software Foundation

Supports modular frameworks such as AUTOSAR Adaptive without requiring hardware redesign.

Where High-Performance Computers Deliver Impact

Advanced Driver Assistance Systems (ADAS)

Centralized AI processing for perception, lane assistance, and adaptive cruise control.

Digital Cockpit & User Experience

High-performance graphics, multi-display systems, and voice interfaces.

Energy & Power Management

Optimized battery performance, charging strategies, and energy recovery.

Vehicle-to-Everything (V2X) Connectivity

Real-time communication with vehicles, infrastructure, and cloud platforms.

Over-the-Air Updates & Software Features

Remote updates, feature activation, and continuous feature and capability expansion.

Advance your **Software Defined Vehicle** (SDV) portfolio with high-performance and scalable innovations with our capabilities on

- **Architecture & Platform Development**
- **ADAS Solutions**
- **Digital Cockpit Solutions**
- **OTA & Lifecycle**
- **Remote Diagnostics**

Talk to us! mobility@srmtech.com