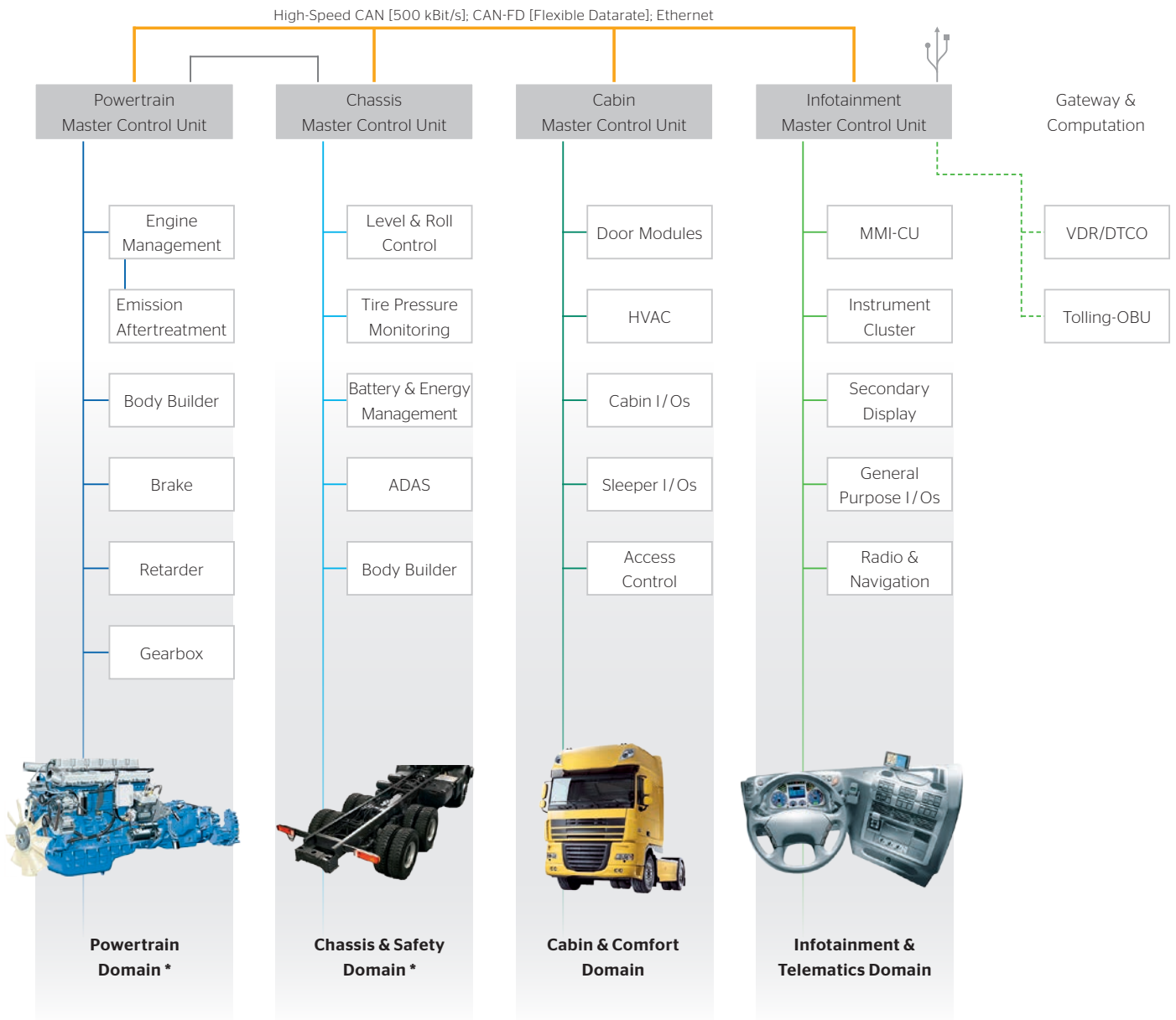


Electronic Vehicle Management

Forward-looking vehicle management solutions



Example of the decentralized electrical/electronic architecture for the future.



- Interdomain Backbone (High-Speed CAN, 500 kBit/s)
- Redundant CAN
- USB
- Powertrain Subnet (High-Speed CAN)

- Chassis Subnet (High-Speed CAN)
- Cabin Subnet (Low-Speed CAN)
- Infotainment Subnet
- * Safety relevant

Optimal usage of domain controllers.

The E/E-architecture of a modern commercial vehicle typically has a two-stage structure: One control unit dedicated to each functional range generally is located as close as possible to the individual aggregates of the powertrain. Complexity and costs of the vehicle management can be significantly reduced through full use of the vehicle control unit's potential.

The powertrain related control units (ECUs) like engine, clutch, transmission / retarder controller and / or the brake systems (ABS / EBS) are interconnected via high-speed CAN buses.

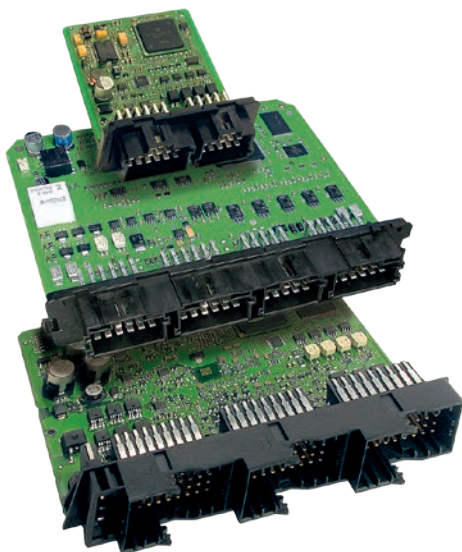
A modern vehicle architecture with a VCU (Vehicle Control Unit) as powertrain master controller provides easy to test units and features clearly defined system interfaces and limits – this simplifies development and production processes.

The units can be manufactured and tested as complete modules (powertrain, chassis, cab) also simplifying the complete production logistics process.

The considerably reduced number of wirings results in cost benefits and quality improvement.

Ultimately the VCU provides a clearly structured control system architecture for the increasing number of system components requesting dynamic torque demands in modern vehicles.

Vehicle Management (VCU)



Advantages at a glance

- Vehicle dynamics application independent from development cycles in engine and transmission
- Wide system solution range
 - Platform control units with up to date Matlab®/Simulink® based application tool chain
 - Specific customer solution for hardware and software
- Compact cost optimized solution for cabin mounting IP 40
- High performance microcontroller to perform complex control applications
- Short interfaces to haptic HMI (pedals, stalk switches) result in improved EMC consistency
- Different data interfaces
 - CAN low-speed up to
 - CAN high-speed and CAN FD (Flexible Data Rate)
 - Ethernet for automotive application
 - LIN bus

Vehicle Management in the Vehicle Control Unit

To correctly coordinate the timing of the individual control units, e.g. during a gear change, the individual ECUs of the powertrain are subordinate to a vehicle control unit. This dominant VCU is responsible for the entire powertrain domain and coordinates the control tasks of the individual control units.

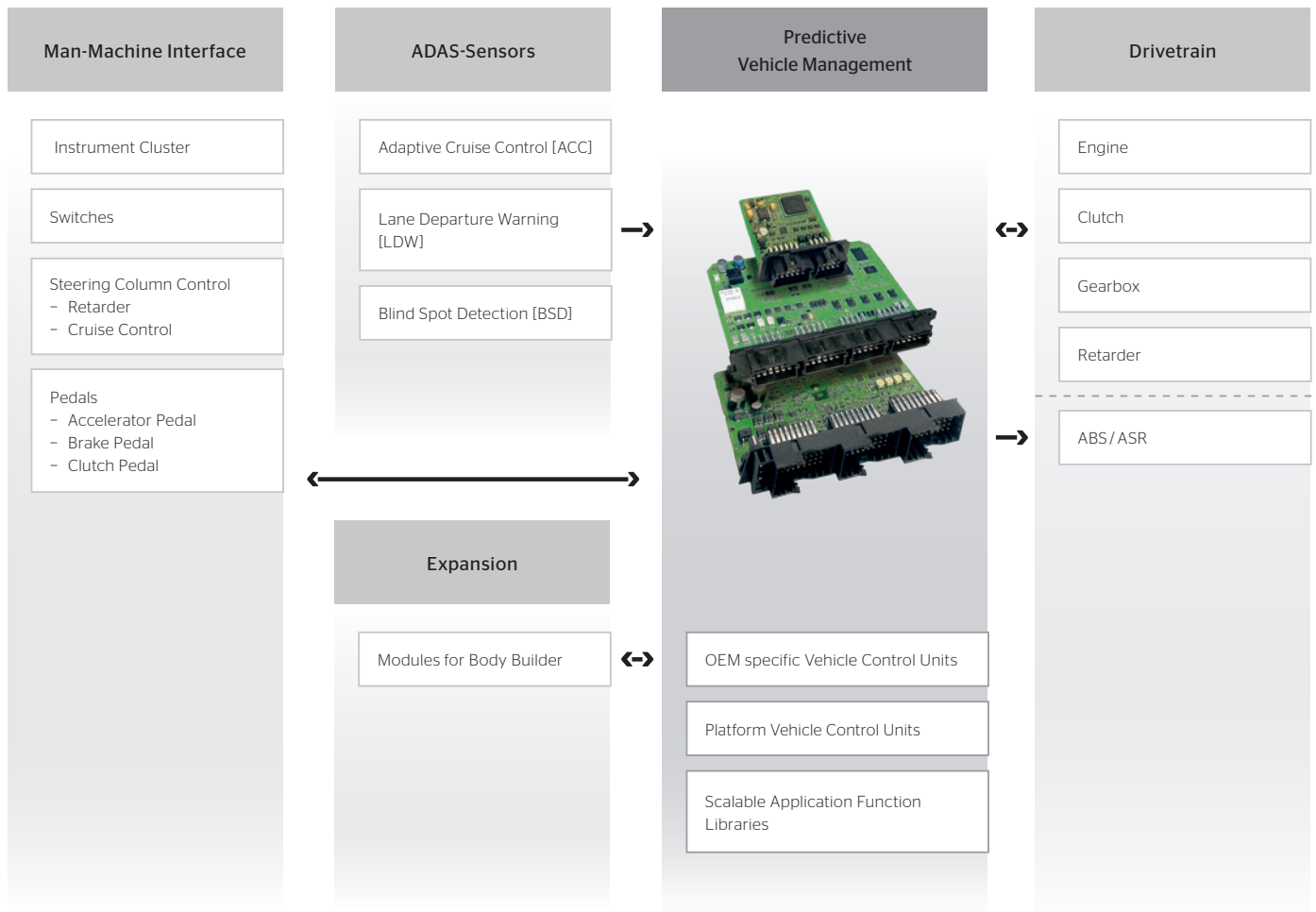
Nevertheless the driver can always intervene via pedals, steering wheel buttons, and direct operating switches, thus remaining the captain on board, while all systems installed are for support only and to reduce driver's workload significantly.

Centralization or decentralization?

VCUs are indispensable for vehicle management and therefore it is important to use these control units as efficiently as possible. Depending on the individual E/E-architecture it is possible to integrate previously separate installed ECUs into the VCU. The VCU then acts as the domain computer and can be designed to be correspondingly powerful depending on the OEM's requirements.

However, it is not possible to integrate an unlimited number of functions in a single control unit. Thus it is always worth considering in each individual case whether the strategy provides for a higher integration per ECU or an optimized network with ECUs divided up in accordance to related functions.

Vehicle Management - Data processing to assist the driver



Generic Vehicle Control Unit – Vehicle management made easy.

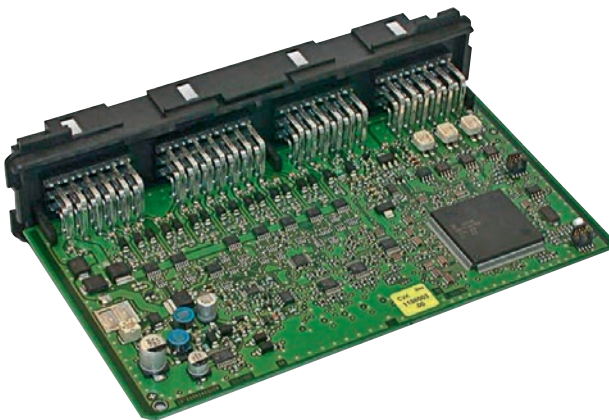
In the late 1990s vehicle management as a separate control unit above the engine controller was successfully established. In the meantime all major heavy duty truck manufacturers have implemented this structure in a specific adapted hard- and software solution.

To make the benefits of a dynamic vehicle management available to our worldwide partners in the commercial vehicle market Continental has developed a universal platform hardware with all necessary I/O features implemented. In addition, we offer a proven software development process based on MatLab®/Simulink® to ensure highest quality in safe and reliable application function programming. The programming is based on software tool chains common to the transportation industry and can also be done by the commercial vehicle manufacturers themselves.

This Model Based Development System (MBDS) is a seamless system solution to cover the whole V-Cycle of the development process. It includes the software testing to ensure the software to be completely tested on operating system level as well as with regard to developed application functionalities.

The hardware design of the control unit is automotive qualified – guaranteeing the control unit to be reliably operative. The software development process is supported via MBDS down to system simulation to ensure a completely tested operating system. Additionally Continental is providing support with basic application function libraries to simplify developing processes and support fast time to market solutions.

Generic Vehicle Control Unit

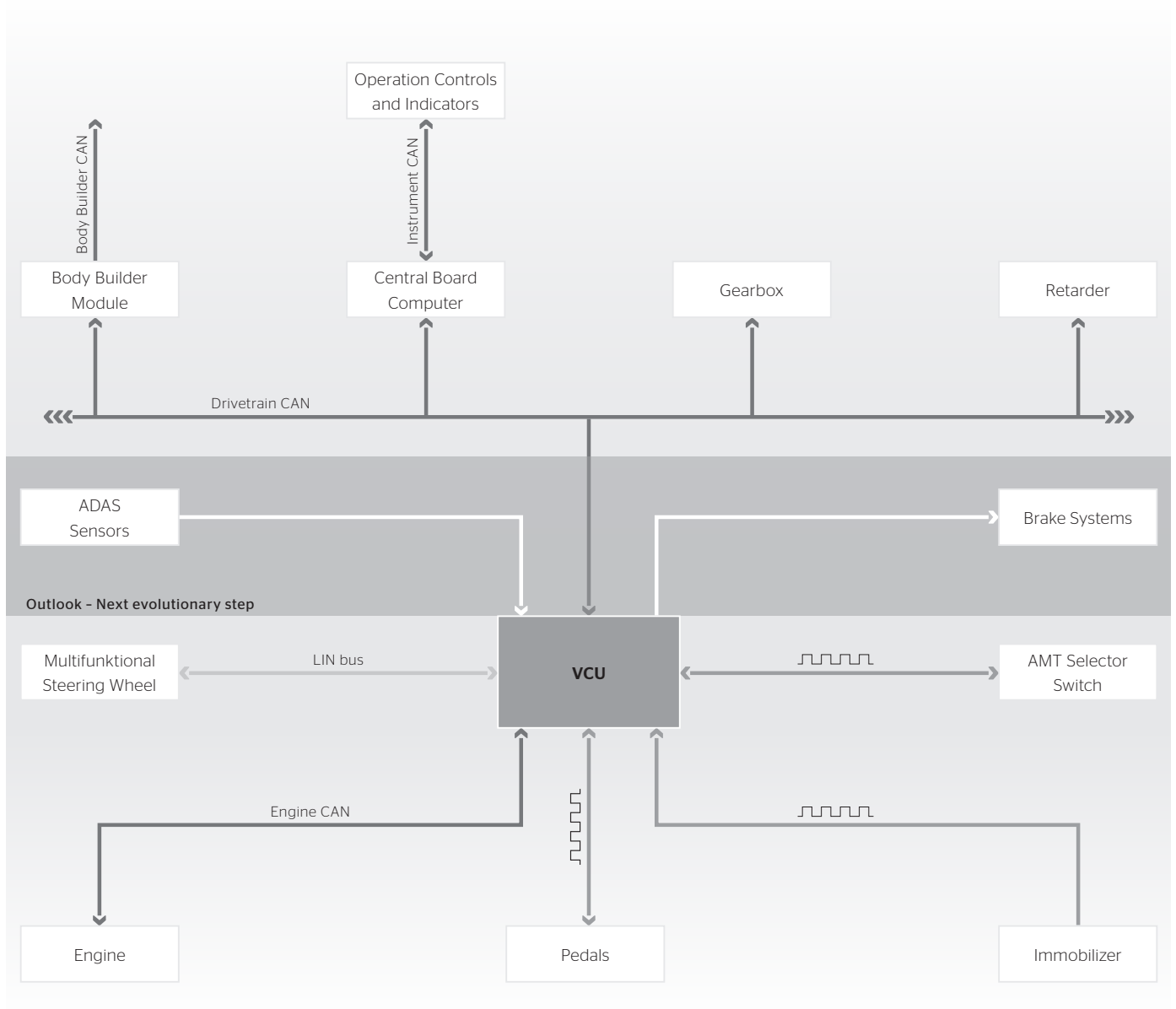


Universal platform hardware with all necessary I/O features implemented.

Advantages at a glance

- Proven software development process based on MatLab®/Simulink®
- Automotive qualified hardware design
- Software function simulation for reduced testing time and cost-efficiency
- Extensive basic function libraries to support fast time to market solutions
- Application support with basic function libraries to ensure fast time to market solutions

Generic Vehicle Control Unit – System view and outlook



The dominant VCU is responsible for the entire powertrain domain and coordinates the control tasks of the individual control units via CAN and

LIN bus. The next evolutionary step is the additional input of ADAS sensors and the advanced control of brake systems via the VCU.

eHorizon® – Knowing exactly what lies ahead.

While today's ADAS-sensors are observing the actual environment in front of and next to the vehicle, eHorizon® offers the possibility to look far ahead and even “around the corner”. This “electronic horizon” allows vehicle and driver to cast an eye on the road in front which is improving safe driving as well as opening up new possibilities regarding fuel efficiency.

“In face of” an ascending slope of the road eHorizon® will take action: In case of a manual gearbox the driver will be advised to change the gear correspondingly. With automated gearboxes and cruise control the gear change will be optimized to achieve maximum fuel efficiency.

On top eHorizon® provides functionalities to significantly improve road safety, e.g. automatically reduced speed when expecting a sharp curve, emergency braking in case of upcoming hazardous situations or danger spots and speed limit warnings based on fixed road speed limits map data. Thanks to these functionalities eHorizon® can

be of great value to reducing the number of accidents and therefore improving road safety especially in regard to the constantly rising density of traffic.

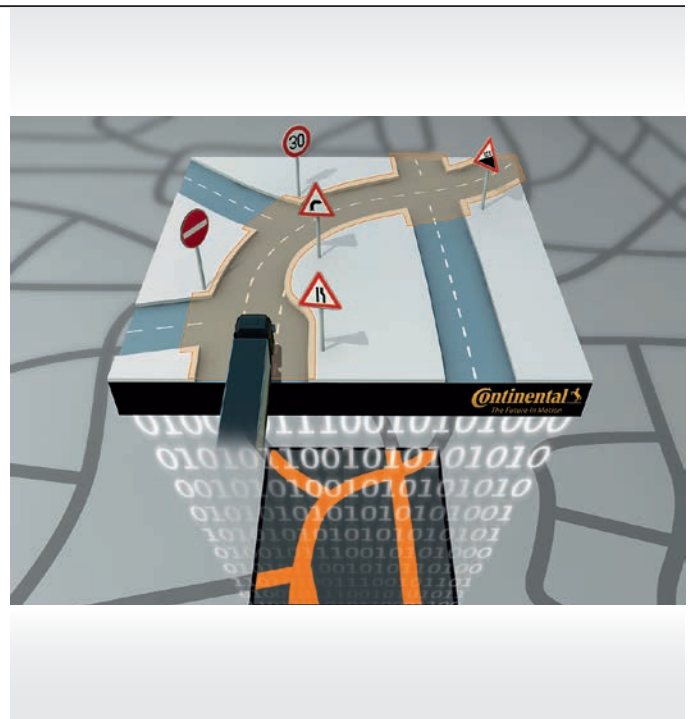
In the future the vehicle will be connected to live infrastructure-information sent by its surroundings, e.g. traffic news, red light signals, information on accidents sent by other vehicles etc. This collection of useful data will be the next step towards a safety increase in traffic and will help substantially to create a safe and clean urban environment for future generations.

eHorizon®



Advantages at a glance

- Remarkable safety improvement
- Optimized fuel-efficiency
- Effective driver assistance

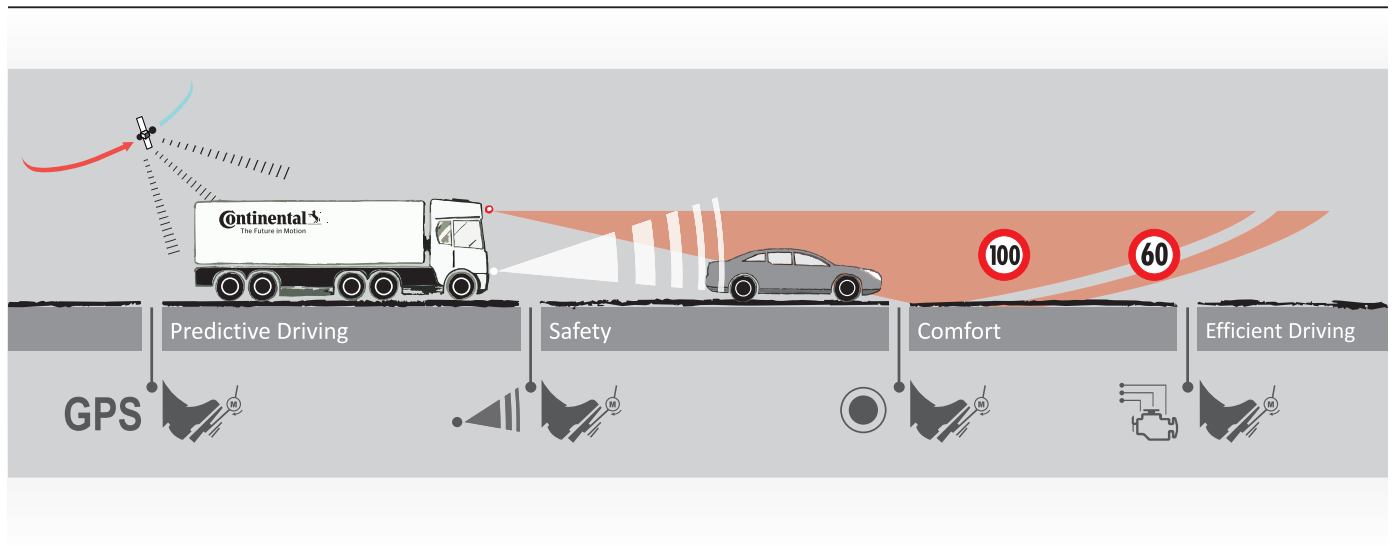


The combination of AFFP® and eHorizon® can significantly improve road safety and fuel efficiency providing the perfect overview of the actual and upcoming road and traffic conditions.

AFFP® – The direct line to the driver.

Electronic Accelerator Pedals came up with the need to evolve from a mechanic driver interface to full electronic control of the combustion engine. This meant a large technological step on the way to realizing smooth control of vehicles decoupled from the drivers wish to control the flow of fuel by stepping onto the accelerator pedal.

Accelerator Force Feedback Pedal



Prediction & safety

When tailgating AFFP® will press against the driver's foot to guide.

Safety

Overdriving a speed limit (e.g. traffic sign) AFFP® will pulse to warn.

Comfort & efficiency

Having the wrong gear selected AFFP® will pulse to remind gear shifting.

Today the driver's wish for acceleration/deceleration is only one of many requests among others based on data derived from cruise control, eHorizon® or infrastructure information.

Following the idea of "force feedback" borrowed from the computer games industry Continental developed the Accelerator Force Feedback Pedal (AFFP®). The pedal is used as tactile interface to inform or warn the driver about dangerous situations

by pulsing his foot. This is a very fast possibility to get in touch with the driver without any distraction. The driver's reaction time is remarkably reduced compared to warning lamps or acoustic signals. Therefore the AFFP® is the ideal warning system in today's high volume of traffic that requires prompt action of the driver.

In combination with eHorizon® AFFP® can significantly improve safety and fuel efficiency.

Architecture optimization.

As more and more digital solutions replace the analog world in commercial vehicles, the freedom of the OEM grows to redefine or partition the E/E-architecture. Thanks to high performance microcontrollers (e.g. Power PC) and an increasing number of bus interfaces, the potential of the VCU domain computer can be used in an extremely wide variety of ways.

ECU integration as a simplification strategy

To reduce the number of partner control units on the powertrain, we have integrated the functions for the differential locks for all wheel driven vehicles during the further development of a current vehicle controller. In the preceding architecture, this function was still designed as a separate ECU.

The highly integrated VCU unifies control and management functions:

- for the engine
- for transmission and permanent brakes
- the traction control for several driven and steered axles
- the engine thermal management with control of additional aggregates and power take-offs
- the recording of diagnostic and service data

VCU performance requirements can be derived from the technical characteristics as follows: Designed in 32-bit technology with a mathematical coprocessor that is used for the real-time processing of complex algorithms, ready for model-based development. A multilayer PCB carries not only the multi-pin μ Processor (416-pin PBGA), but also a large number of electronic power switches for currents of up to 10 Ampere. A 150-pin connector and five CAN and four LIN interfaces are used to connect the vehicle environment.

Integration of additional functions beyond the powertrain

The VCU can also assume additional functions beyond the domain computer tasks such as:

- the high degree of freedom of networks to integrate body functions in a VCU (we have already implemented this approach for a leading commercial vehicle manufacturer)
- the direct control of safety-relevant signal lamps and the interface for additional steering wheel buttons
- as gateway between all domains, the VCU passes on a large number of messages to less safety-relevant electronic systems, e.g. to the instrument cluster, the air conditioning, the fleet management or the radio

Managing hybrid bus drives

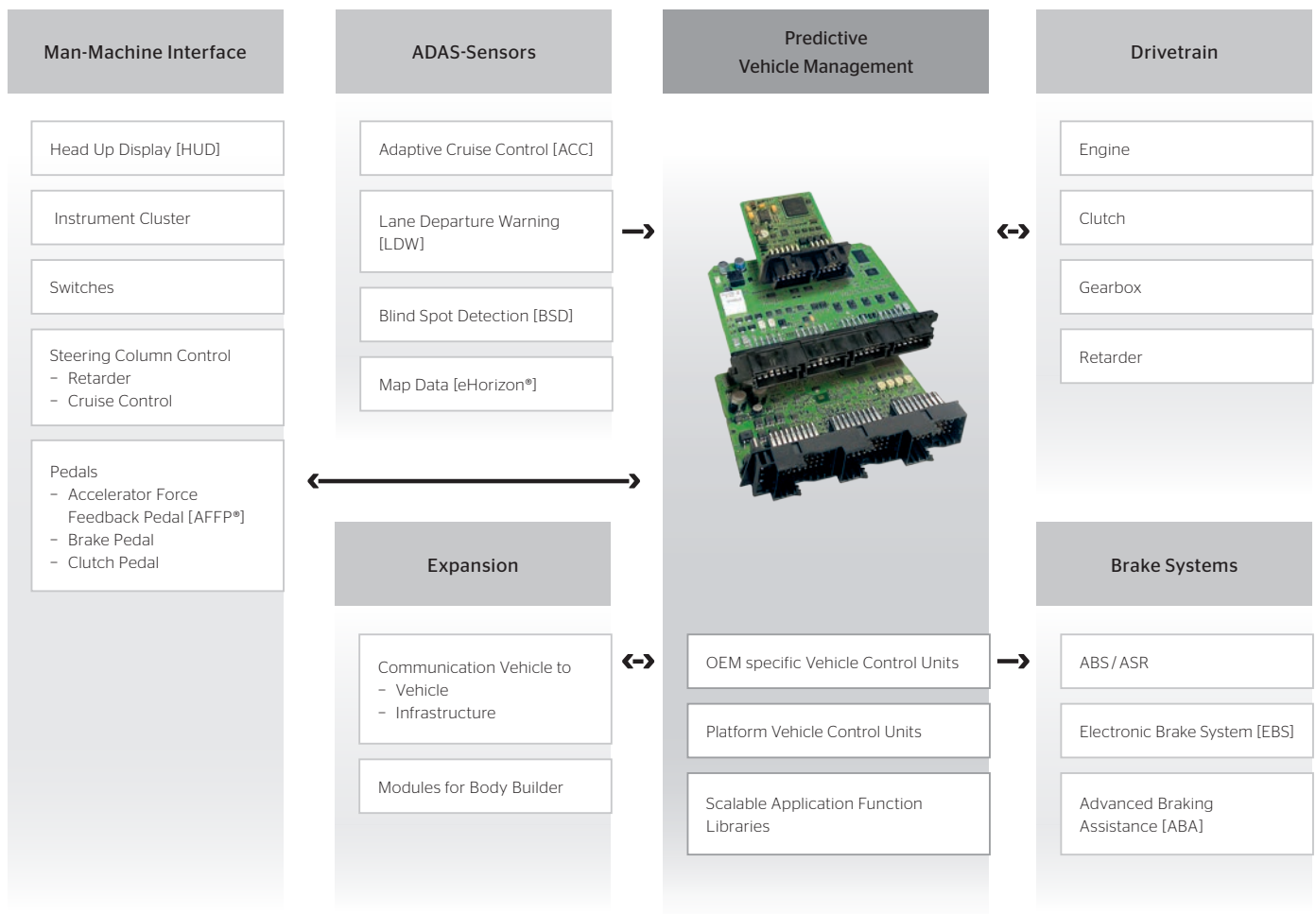
Today the "elite class" in the implementation of electronic systems is indisputably the hybrid vehicle. In city buses, for example, a high-performance coordination level is required for overall management above the two drive levels of the diesel engine and the electric motor. We have also successfully developed this type of VCU under the designation of Powertrain Control Unit (PCU). Beyond the central management of driving dynamics, the PCU also assumes safety and emergency management and the recording of diagnostic and service data.

Outlook.

In the future it must remain an unprejudiced consideration as to whether a higher integration is a better solution, or whether ECUs separated according to their functions are more suitable for a specific vehicle. Anyway, more and more digital technology is to be expected in commercial vehicles. And one day possibly even a fully networked vehicle in which switches and buttons are no longer connected with individual wires, but instead via a standard data bus. Of course, this places especially high demands on both the computing speed and on the required program and data memory. However, this reduces the total complexity and therefore the costs for the wiring harness in future vehicles, making it an advantage for the customer and its competitiveness.

The last decades in vehicle management show a clear trend towards predictive vehicle management - realizing the possibility to look far ahead and even "around the corner". Therefore new sensors like radar, cameras or "electronic horizon"-solutions are installed, reacting much faster than any well trained driver can ever do. These vehicle management solutions will produce an intelligent vehicle that is able to change the gear automatically before a hill is reached, lower the speed in good time before the road bends, warn the driver when tailgating or carry out an emergency braking in case of danger. Trendsetting driveline dynamics control is going to make future vehicles safer, more efficient, quiet and eco-friendly and thus will take vehicles a step further towards protecting our unique environment.

Predictive Vehicle Management - Next step to the assisted driver



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