Dependable Solutions for Future Mobility and Zonal E/E Architectures
The future car is fully connected and always online. It requires artificial intelligence and a dependable system of electronics to drive autonomously.

The future car links the real world with the digital world and ensures safer and more efficient roads.

- Artificial Intelligence is needed to enable the transformation towards a fully autonomous driving experience.
- This transformation requires enormous computational horsepower as well as...
- …an interoperable dependable system of electronics including sensors, specialized processors, memory and network ICs, intelligent switches and power semiconductors.
Challenges reach far beyond AI computing and include the high availability and the implementation of all required AD* functions.

### Control loop

### Challenges

**Computational Challenges:**
- Accuracy of probability-based AI
- Data capture and availability
- Complex edge cases and scenarios
- Advanced sensor technology

**Availability & Implementation Challenges:**
- Highly integrated systems increase security vulnerability and failure risks
- Reliable, real time communication
- Software complexity of multiple components and domains
- Power distribution systems which can diagnose issues, isolate failures and enable backup supplies very quickly

An autonomous system must ensure the availability of all safety-critical functions and allow at the same time the feasibility of a physical implementation of all functions.

*AD = autonomous driving*
Autonomous driving functions require highly available systems which require dependable electronics.

High Availability | Ensure high availability beyond critical operations; a safe and secure system, that operates in all conditions.

Fail-Operational | Mitigate potentially hazardous effects by ensuring critical operations in the event of a failure.

Fail-Safe | in the event of a failure, system enters safe state.

- Lower levels (ADAS, <L2)
- Vehicle enters safe mode
- Reliable, robust, safe, secure

- Higher levels (AD, ≥L3)
- Vehicle continues safety critical tasks
- Fail safe + available
- Higher levels (AD, ≥L4+)
- High availability in all conditions for extended time
- Fail operational + highly available
High availability is required for and across all systems and functions of the vehicle.

Dependable systems require **secure** systems, which always **sense**! always **compute**! always **act**! are always **connected**! are always **powered**!
In addition to high availability, the increasing number of functionalities drive the need for dependable electronics.

Dependable systems

→ …not only avoid and **mitigate** potentially hazardous effects (functional safety)

→ …but also enable safe & secure autonomous **driving under all conditions** (secure high availability)

Increasing functionalities

→ …are also key to enable the implementation of more functionality required for automated driving

→ …and **mitigate growing physical system challenges** through enabling software and hardware scalability, more wire harness, weight, or manufacturability

A fully software-defined car

Increasing wire harness

Increasing weight

More difficult manufacturability
In the future, zonal E/E architectures will enable the implementation of more functionalities in the car.

**Domain Architecture**

- Telematics
- Gateway
- Info-tainment
- ADAS
- Vehicle motion control
- Body

**Domains:** ADAS, vehicle motion...

**Benefits:** ECUs which are optimized for their application, limited complexity per ECU

**Driver:** Traditional application-centric approach

**Mixed Domain/Zone Architecture**

- Central Car Computer
- Info-tainment
- ADAS
- Vehicle Motion

**Zones:** Body, some Chassis/Powertrain/xEV

**Benefits:** wire harness reduction, weight reduction

**Driver:** Increasing computational demand and the transition to a scalable car architecture

**Zonal Architecture**

- Full Car Computer

**Zones:** Body, some Chassis/Powertrain/xEV + ADAS

**Benefits:** mixed architecture benefits + scalability through pooled computational resources

**Driver:** The software-defined car. Easier control over complete SW stack

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Zone architecture reduces system complexity - dependable solutions enable needed system requirements resulting from zonal architectures

System complexity increases with the level of automation

System complexity drivers
› Trend towards autonomous driving
› Central computing and HW/SW decoupling
› Increasing need for high availability and intelligent power distribution
› Increasing need for security (SOTA)

Zonal E/E architecture eases complexity
› SW and HW scalability
› Reduce overall wire harness length
› Weight and manufacturability issues

Dependable systems...
› …enable the implementation of zonal architectures
› …and further reduce complexity by safeguarding system security, safety and availability
We deliver dependable electronics enabling autonomous systems and their required E/E architectures.

Secure dependable systems, which always sense, always compute, always act, are always connected, are always powered!

Robustness
Degree to which a system continues to function with invalid inputs or in stressful environments

Reliability
Probability that a system performs requested functions under stated conditions when required

Availability
Probability that the system is operating properly when a failure occurs

Safety
Ensures the absence of Unreasonable Risk

Security
Enables the protection of the system from its environment

Operational Excellence
Passion for Innovation
System Understanding

Infineon Automotive Quality
Infineon Functional Safety
Infineon Cybersecurity
Autonomous systems push microcontrollers to be safe, secure and smart

Autonomous System Design

- AD Sensors
- Radar/Camera/Lidar
- Zone Controller
- Endpoint ECUs
- Telematics
- VMO Backup Braking Steering
- ADAS & Fusion
- Vehicle Motion
- Body Control + Gateway
- Cockpit Infotainment
- Central Car Compute Platform

Autonomous System Description

- The goal is to ensure secure sensor data is used to determine and create a safe, humanlike driving experience.
- Radars, cameras, ultra-sonic sensors, Time-of-Flight (ToF), microphones and LIDAR’s data are aggregated in zone or central compute platform.
- Decision making located in vehicle computer and distributed to vehicle motion control systems.

System Objectives

- Scalability and upgradeable with common wiring
- Software flexibility
- Both high speed and real time communication
- ASIL-D
- Security architecture to address increased vulnerability

Dependable Solution

- Required key features of microcontrollers
- Real Time Performance and versatility
- Safety and Security Beyond the Standards
- Freedom of interference Safety Architecture
- Dedicated Accelerators for AI, Connectivity, and Signal Processing
Fail operational power net architectures become decentralized and require semiconductor based Intelligent Power Devices.

Decentralized power distribution

Zone E/E Architecture

- The goal is to attain reduced wire complexity and high availability – Always Powered!

PD functional architecture

- Always powered fail-operational approach with independent power distribution systems

- Dependable semiconductor based safety elements required to ensure the system availability and guarantee the freedom from interference

- Development according functional safety ISO 26262 ensuring the failure mode coverage

Dependable Solution

Required key features of safety elements

- Fast Failure Isolation < 100µs
- Wire Protection $I^2t$
- Capacitive charging 1-15mF within 100ms
- Low Power ON < 50 µA
System understanding is critical to enable these highly available systems and architectures.

**Environment**

**Safe Autonomous Vehicle**

**Dependable systems**

**Dependable subsystems**

**ECUs and Modules**

**Components**

Infineon leverages a deeply embedded system thinking.
Think Automotive Dependability. Think Infineon.

› The future car is fully connected and always online and requires artificial intelligence to drive autonomously

› Major challenges are changes in the E/E Architecture and the high availability to enable autonomous driving

› Dependable and innovative electronics and systems will mitigate complexities and enable future mobility and autonomous driving

› Infineon is a the dependable partner and supplier of dependable electronics
We deliver dependable electronics which enable systems that are the foundation for trust.
Part of your life. Part of tomorrow.