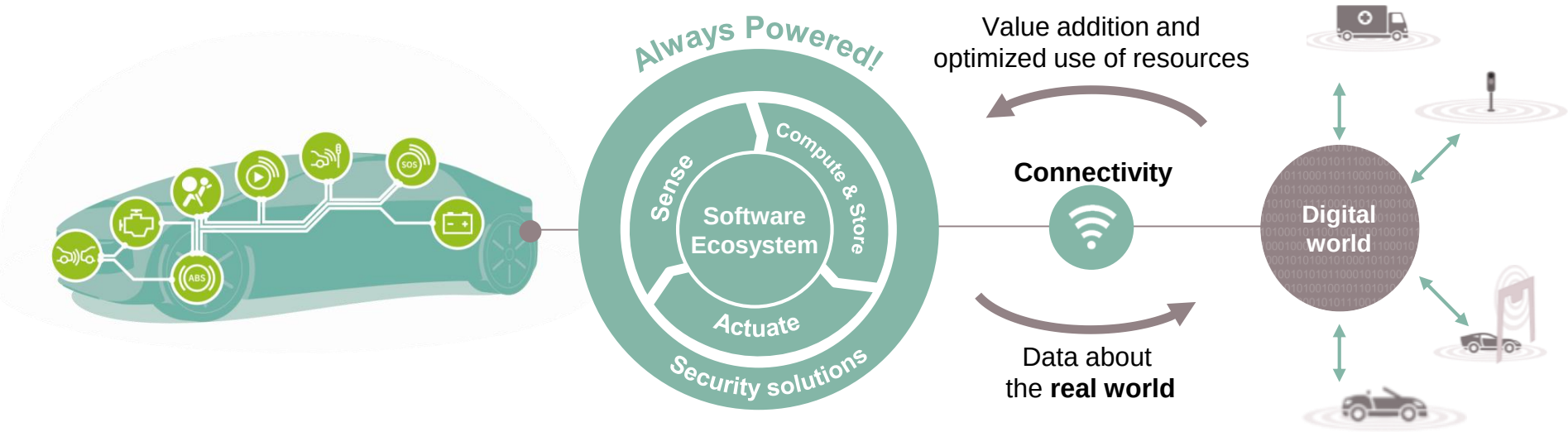
Dependable Solutions for Future Mobility and Zonal E/E Architectures

Infineon Automotive Dependability

Infineon

The future car is fully connected and always online. It requires artificial intelligence and a dependable system of electronics to drive autonomously

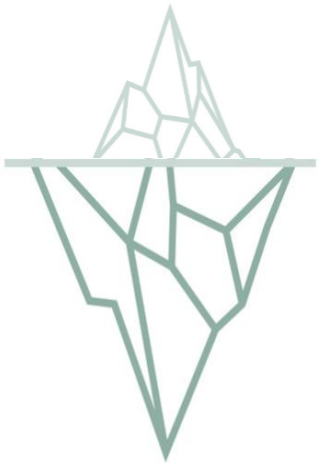
The future car links the real world with the digital world and ensures safer and more efficient roads



- 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

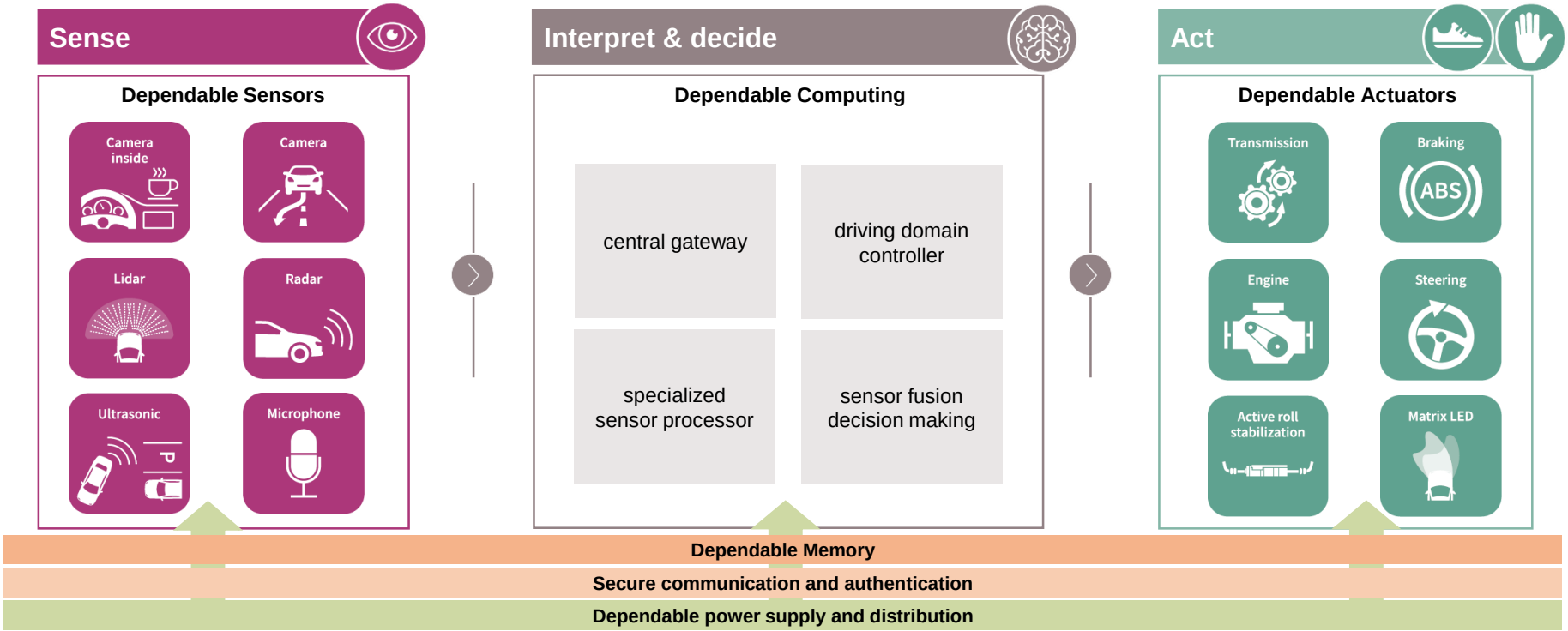
High Availability | Ensure high availability beyond critical operations; a safe and secure system, that operates in all conditions

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

	Fail-Safe	Fail-Operational	High Availability
Automation	Lower levels (ADAS, <L2)	Higher levels (AD, =L3)	Higher levels (AD, ≥L4+)
Failure	Vehicle enters safe mode	Vehicle continues safety critical tasks	High availability in all conditions for extended time
System	Reliable, robust, safe, secure	**Fail safe** + available	**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

High availability

Increasing functionalities

Dependable systems

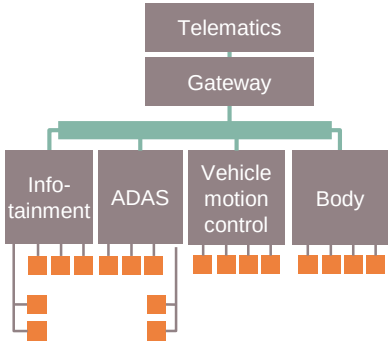
- …not only avoid and **mitigate** potentially **hazardous effects** (functional safety)
- …but also enable safe & secure autonomous **driving under all conditions** (secure high availability)

Dependable systems

- … **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

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

Domain Architecture

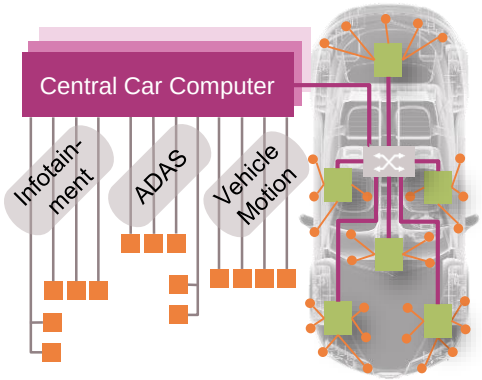


Domains: ADAS, vehicle motion…

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

Driver: Traditional application-centric approach

Mixed Domain/Zone Architecture

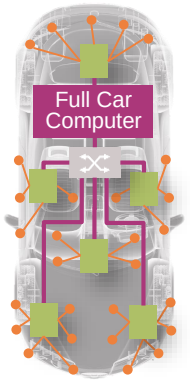


Zones: Body, some Chassis/ Powertrain/ xEV

Benefits: wire harness reduction, weight reduction

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

Zonal Architecture



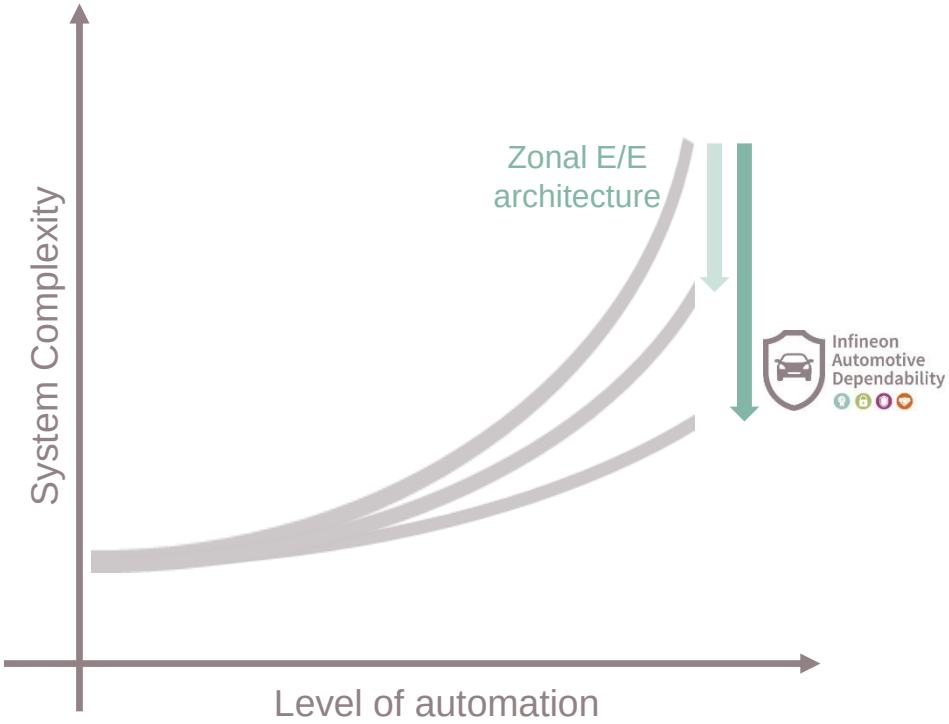
Zones: Body, some Chassis/ Powertrain/ xEV + ADAS

Benefits: mixed architecture benefits + scalability through pooled computational resources

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

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!

Dependable Actuation

Dependable Computing

Dependable Power

Dependable Sensing

Dependable Communication

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

Infineon Automotive Quality

Infineon Functional Safety

Infineon Cybersecurity

Operational Excellence

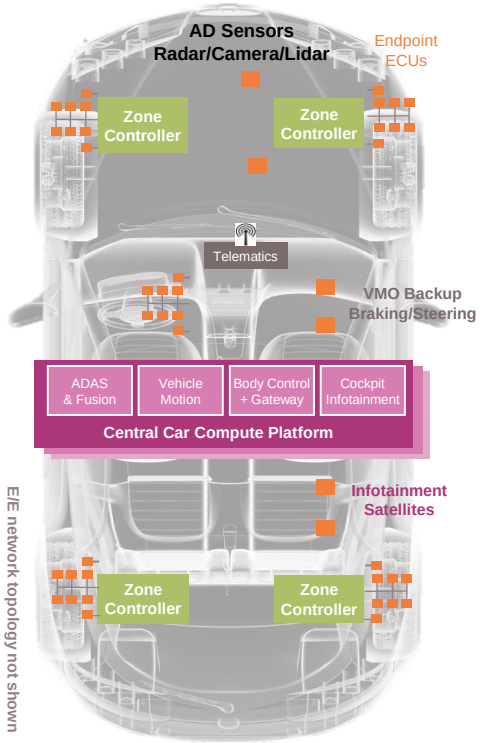
Passion for Innovation

System Understanding

Infineon Automotive Dependability

Autonomous systems push microcontrollers to be safe, secure and smart

Autonomous System Design



Autonomous System Description

- The goal is ensure secure sensor data is used to determine 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

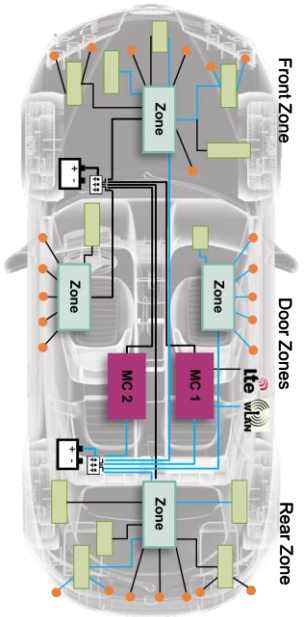
Freedom of interference Safety Architecture

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

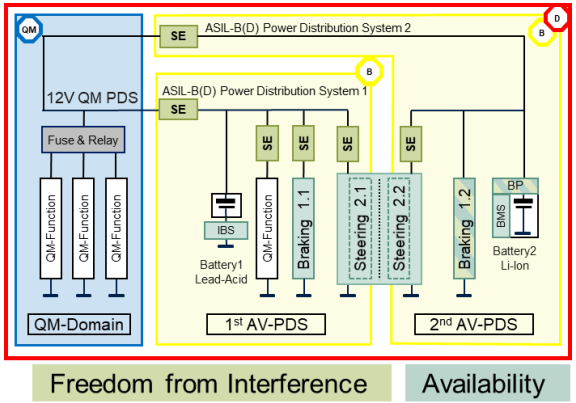
Zone E/E Architecture



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

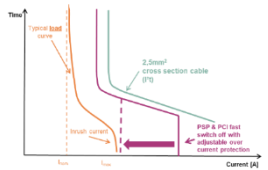


Dependable semiconductor based **safety elements** required to ensure the system availability and guarantee the freedom from interference

Dependable Solution

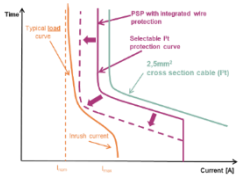
Required key features of safety elements

Fast Failure Isolation
< 100µs

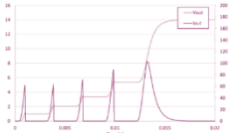


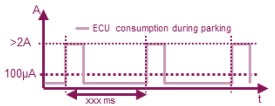
Capacitive charging
1-15mF within 100ms

Wire Protection
I²t



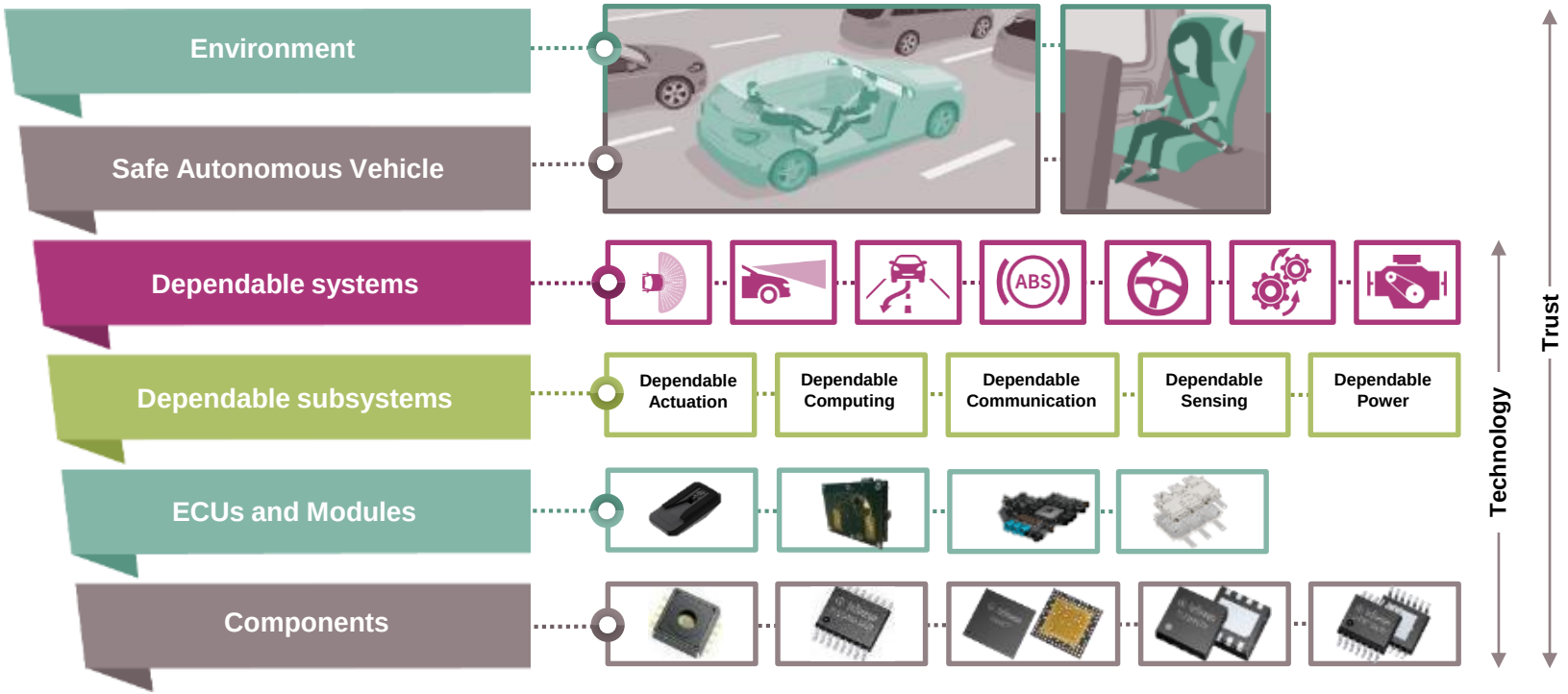
Low Power ON
< 50 µA





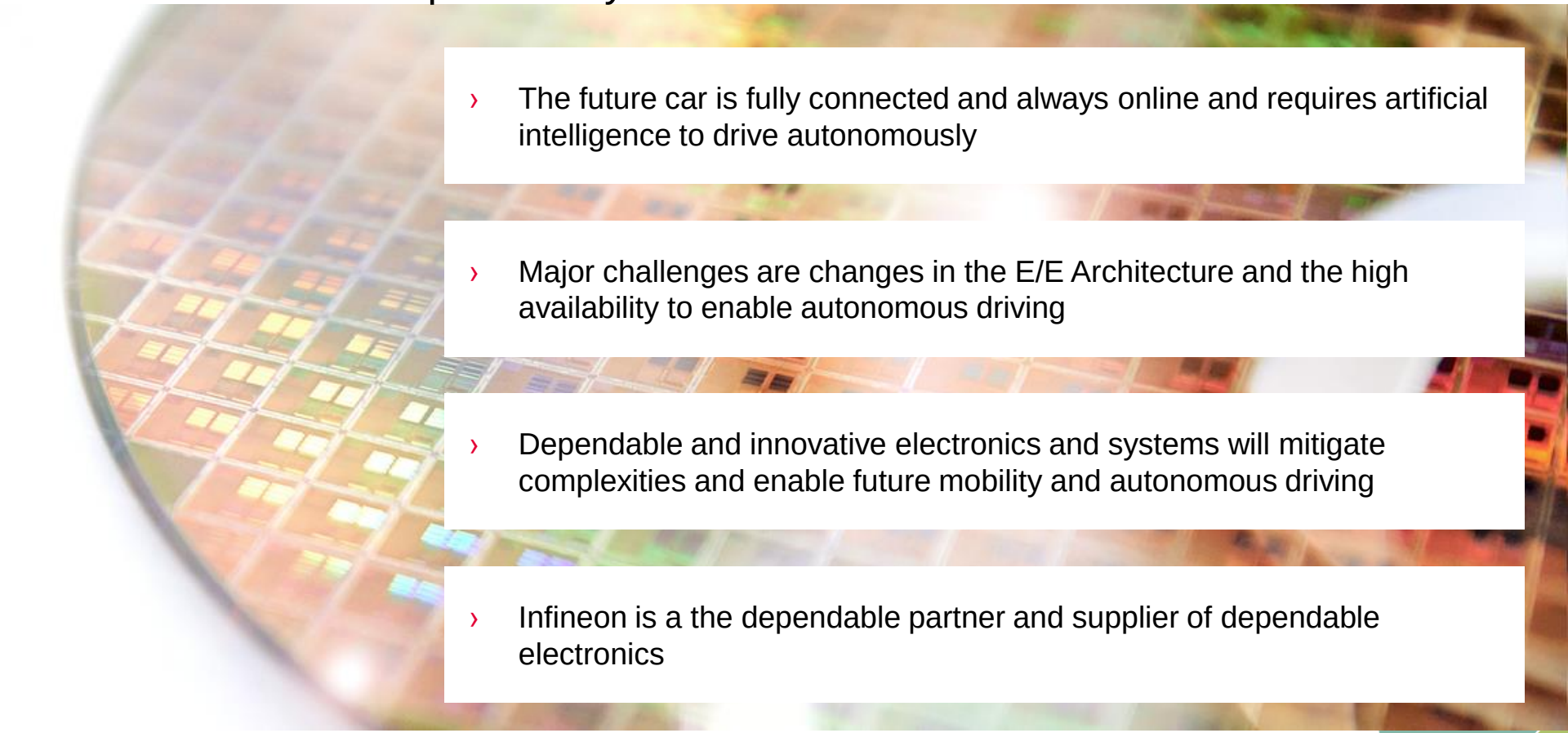
Development according functional safety ISO 26262 ensuring the failure mode coverage

System understanding is critical to enable these highly available systems and architectures



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

Summary

We deliver dependable electronics which enable systems that are the foundation for trust.

Infineon Automotive Dependability

Part of your life. Part of tomorrow.