

**IEEE COMPSAC 2011, Munich**

**Panel: Opportunities and Challenges in Software Engineering for  
the Next Generation Automotive**

**EE-Architectures of Cars will transform  
from electronics to information  
dominated systems**

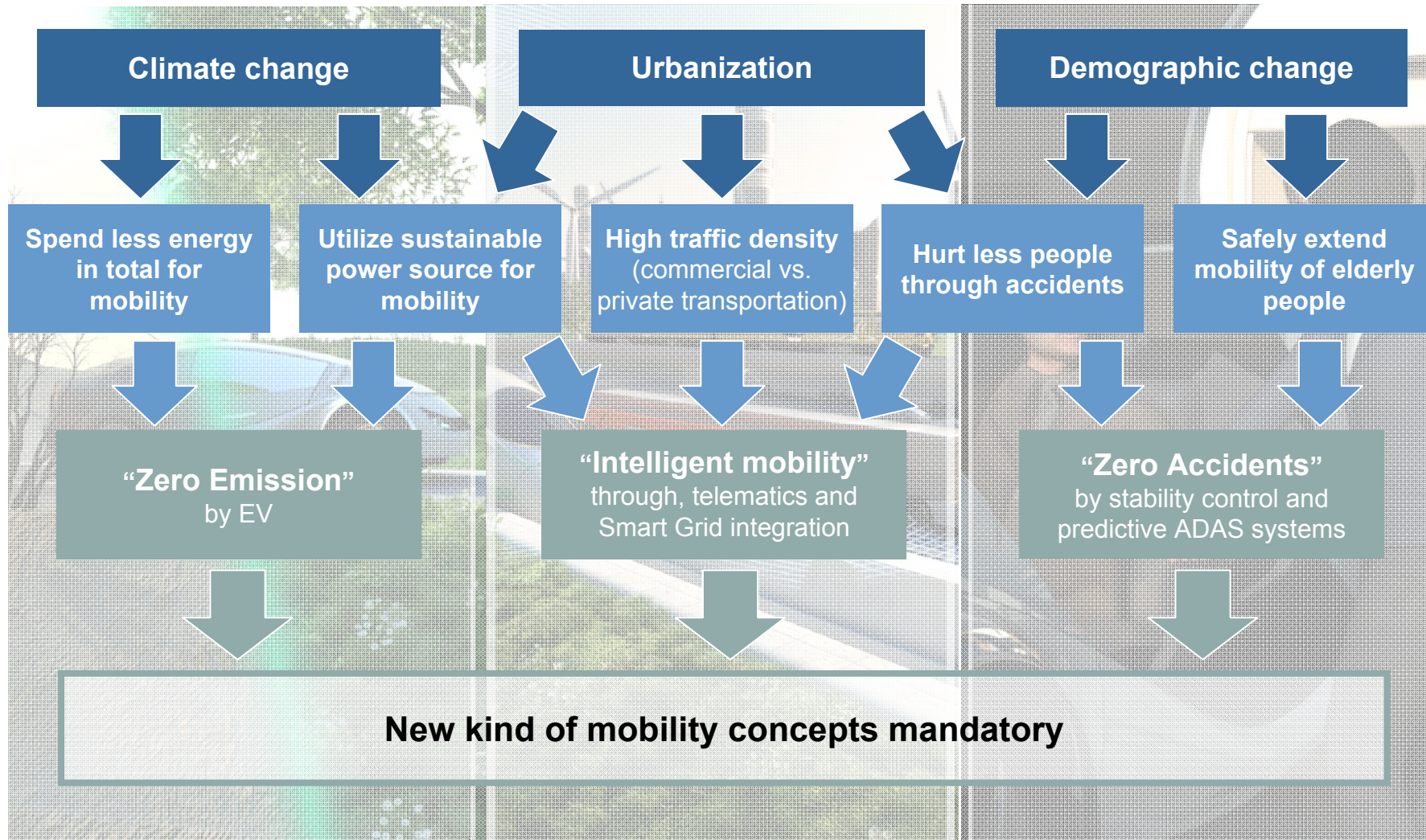
**Karl-Josef Kuhn**

Siemens Corporate Research and Technologies

July 21, 2011

# Global Megatrends strongly influence the future of mobility

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## “Zero Emission” can be achieved with electric vehicles

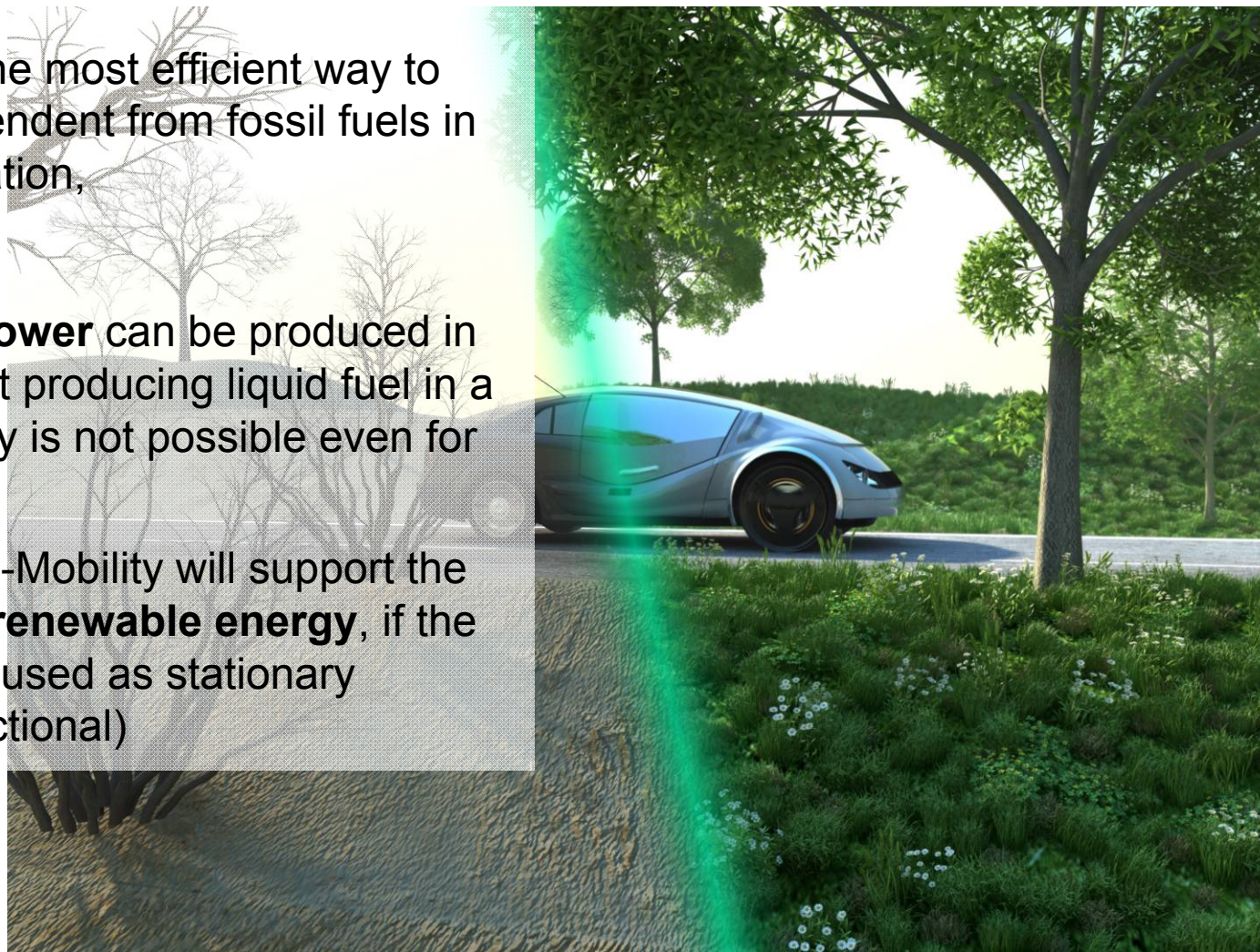
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**E-Mobility** is the most efficient way to become independent from fossil fuels in road transportation,

because

**Sustainable power** can be produced in many ways, but producing liquid fuel in a sustainable way is not possible even for today’s fleets.

Furthermore, E-Mobility will support the **expansion of renewable energy**, if the car’s battery is used as stationary storage (bidirectional)



**“Intelligent Mobility” means that the vehicle becomes a part of a greater service network**

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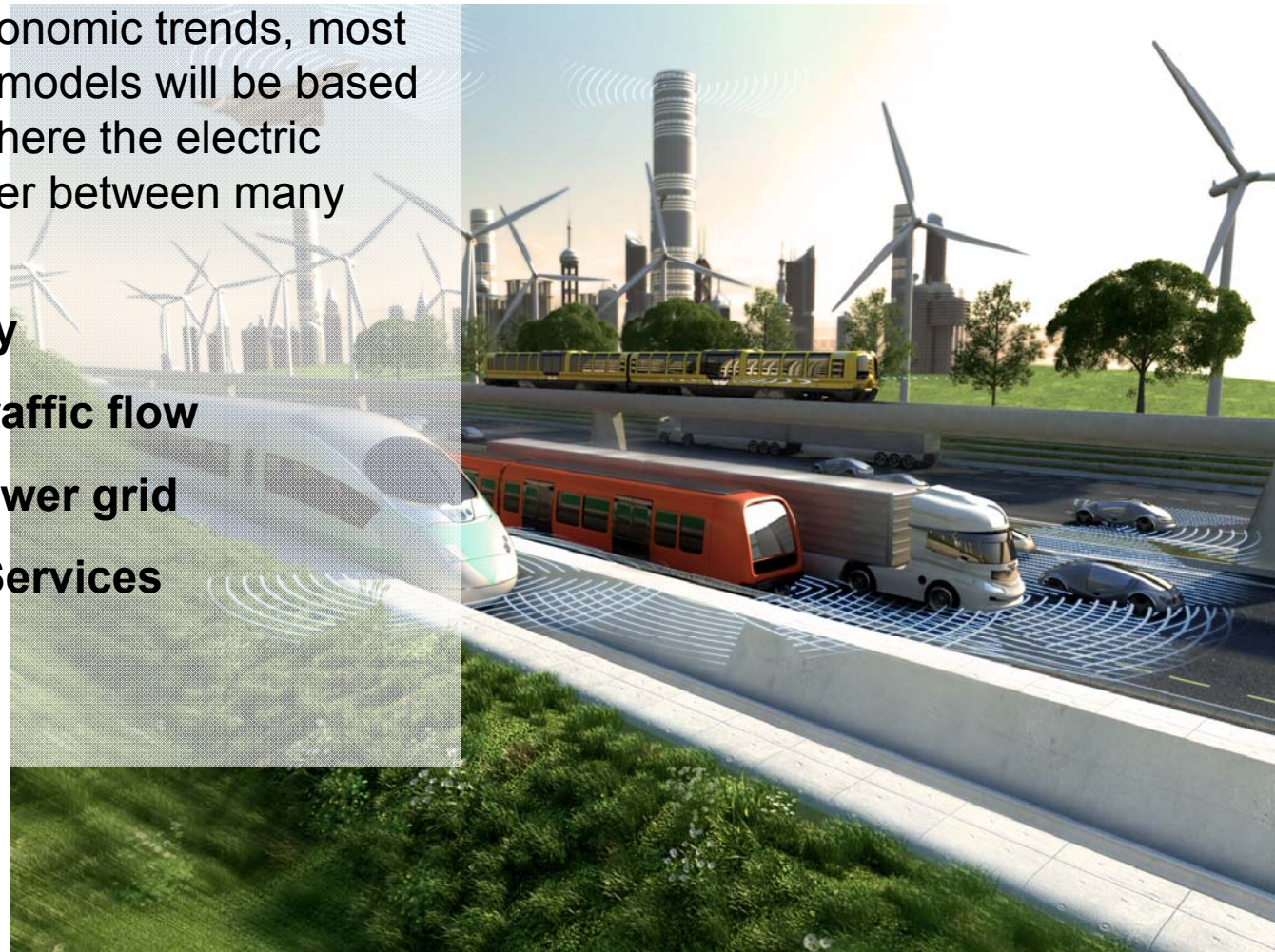
Driven by socio economic trends, most of future business models will be based on new services where the electric vehicle is one player between many others:

**Seamless Mobility**

**Optimization of traffic flow**

**Stabilizing the power grid**

**Location Based Services**



**“Zero Accidents“ becomes attractive if safety is combined with comfort**

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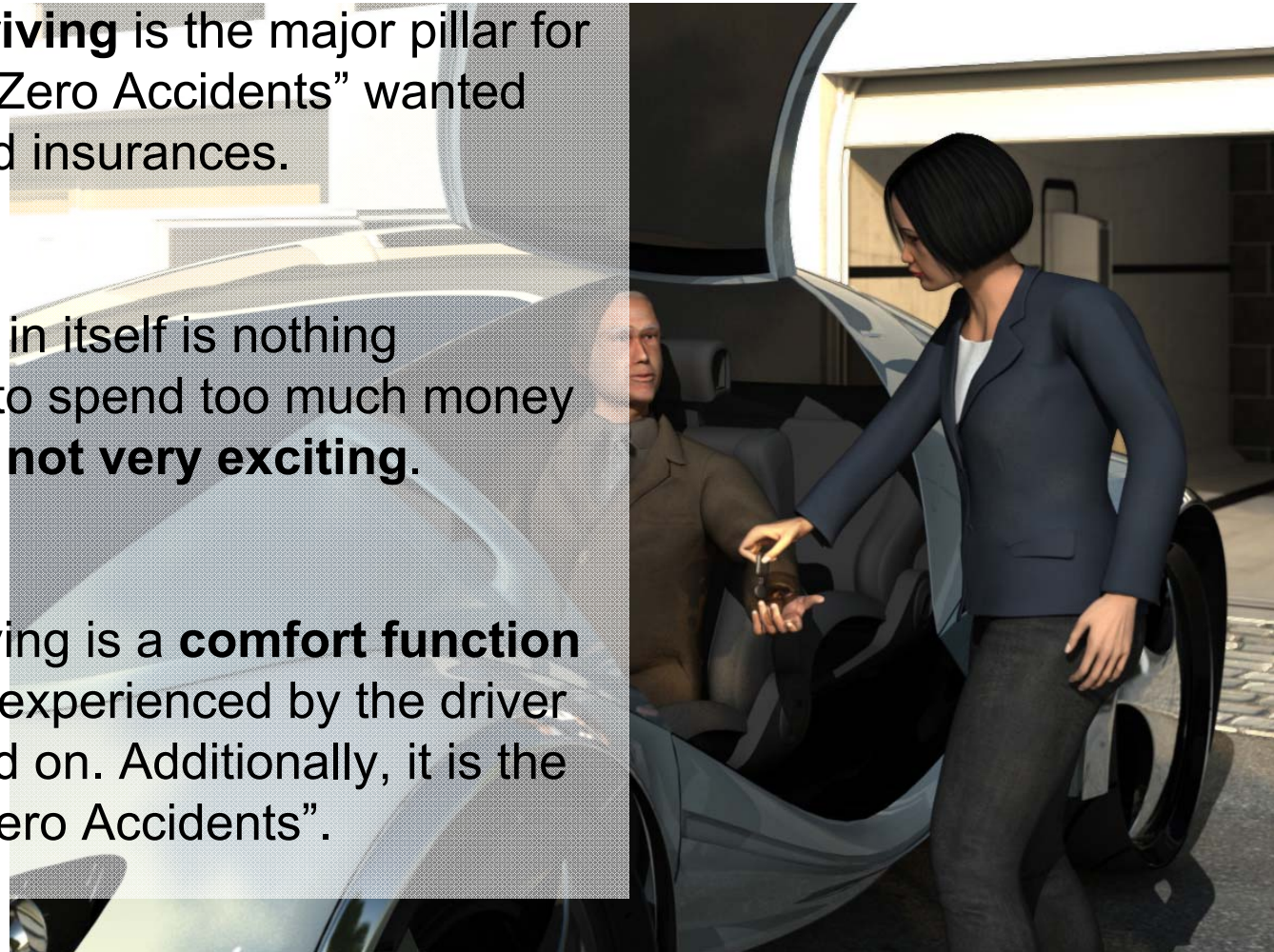
**Autonomous driving** is the major pillar for getting close to “Zero Accidents” wanted by legislators and insurances.

**But**

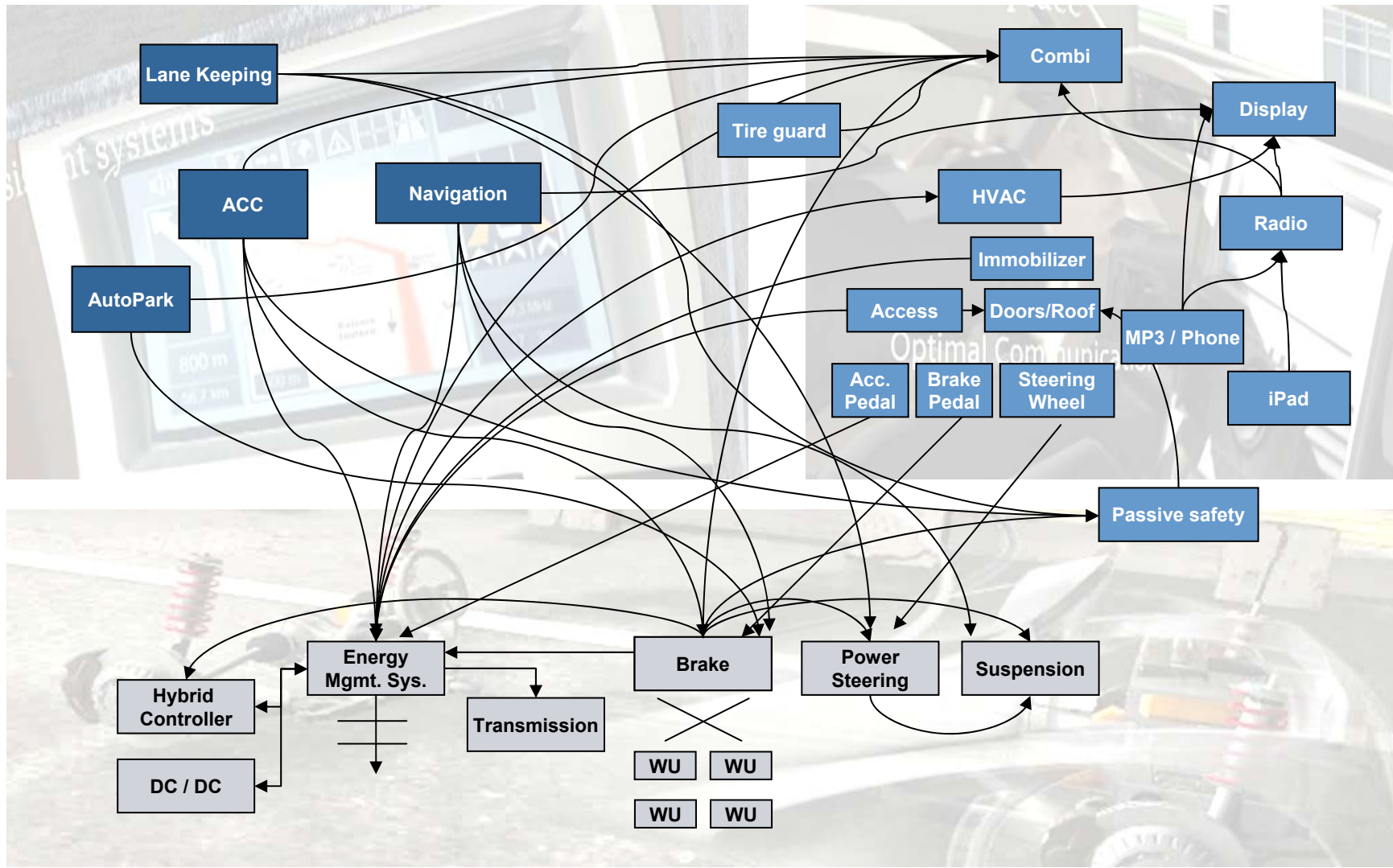
“Zero Accidents“ in itself is nothing customers want to spend too much money for, because it is **not very exciting**.

**Solution**

Autonomous driving is a **comfort function** and thus can be experienced by the driver as a valuable add on. Additionally, it is the foundation for “Zero Accidents”.

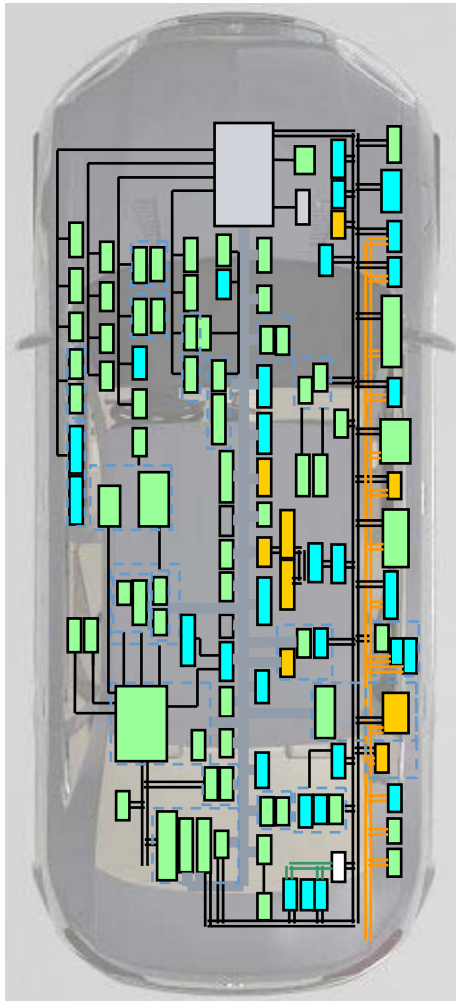


# An ever increasing inter dependability reaching the limits of integration for an affordable price



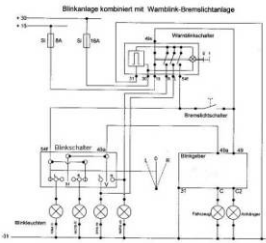
**Physical complexity, power consumption and installation space drive the integration of new functions to the limit**

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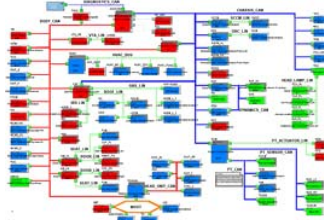
**Time for a change – it happened before**

————— 1987 ————— Today ————— ? —————>



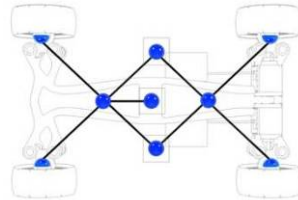
**Mechanics**

**EVOLUTION**



**Mechatronics**

**DISRUPTION**



**Information processing**

————— 1957 ————— 1977 ————— Today —————>

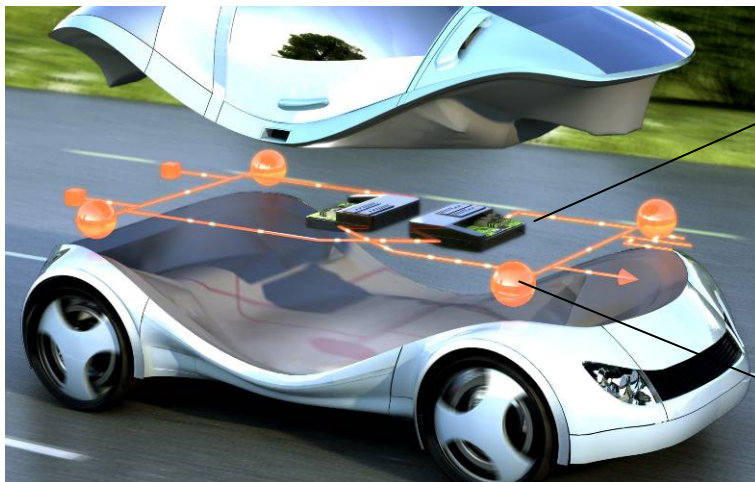
**Mechanical view**

**Information processing view**



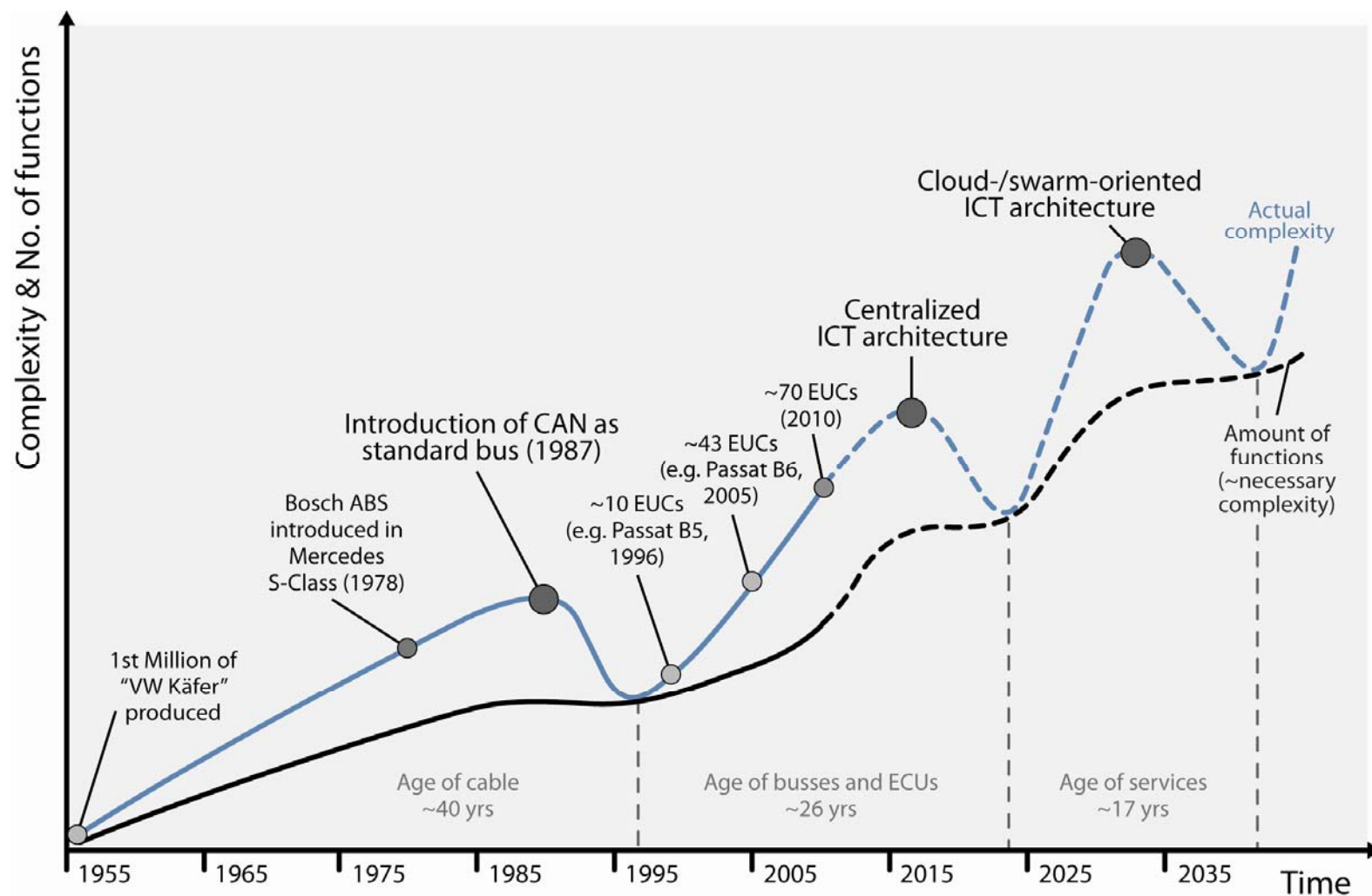
## A new technological approach is mandatory to realize the “Smart eCar”

To develop the „Smart eCar“ a new innovative technological approach is necessary. This approach must be able to recognize the demands of the new mobility in a cost effective way.



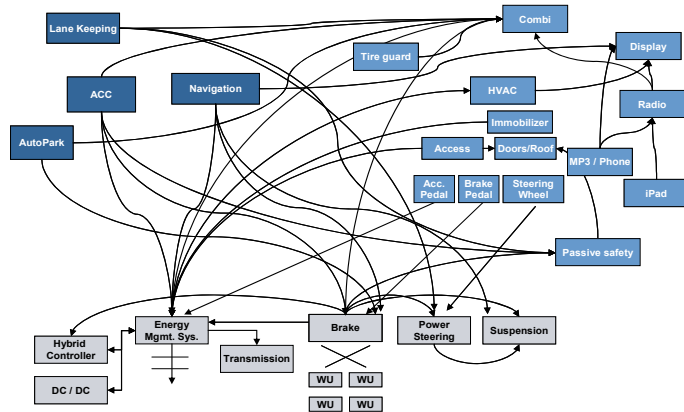
The solution is a new information and communication **system architecture** in the car!

# One major driver of today's system architecture is the Evolution of complexity

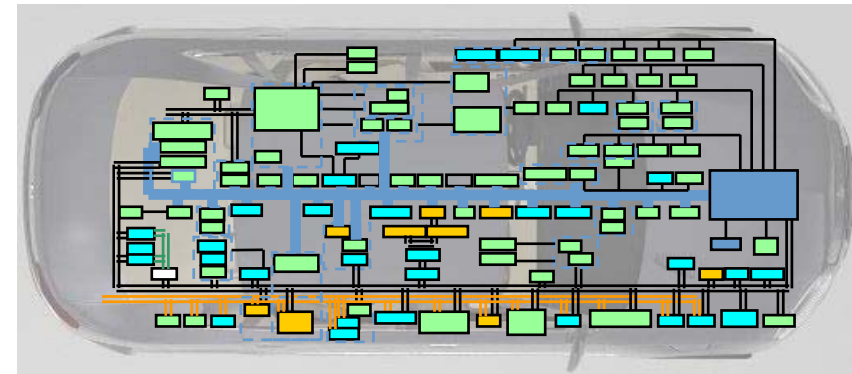


Source: "The Software Car: Information and Communication Technology as an Engine for the Electromobility of the Future", page 48

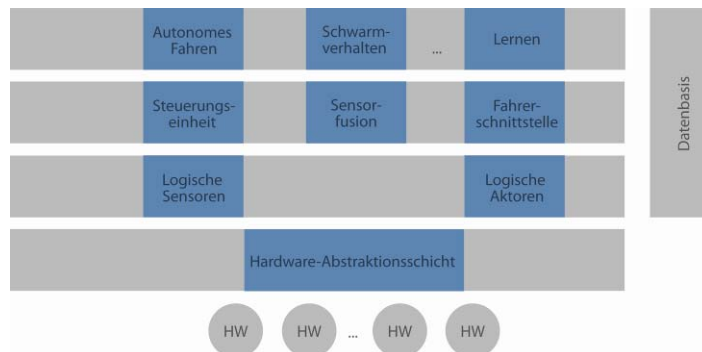
# To discover the full potential of electric vehicles a new E/E architecture is mandatory



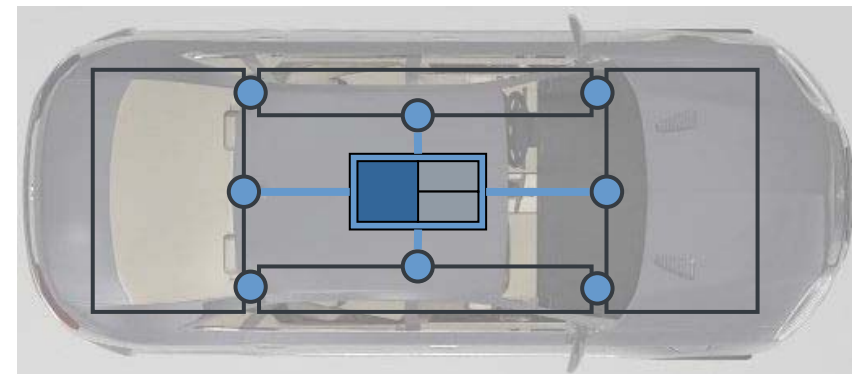
- Get rid of position oriented partitioning
- Well defined information flow
- Hierarchical decision making
- Plug & play capable



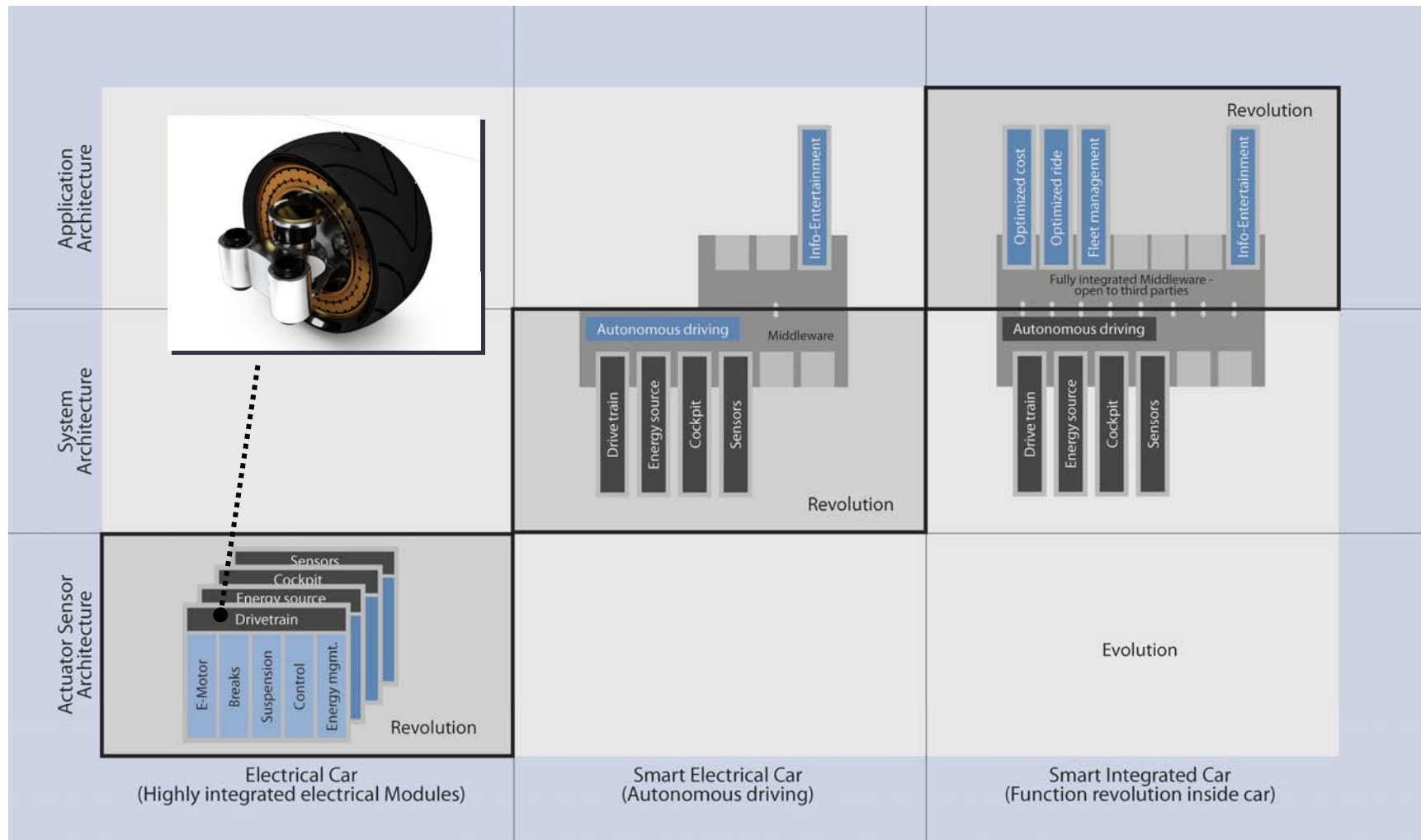
- Less controller
- Likely less copper
- Less different connectors
- Plug & play capable



\*Symbolic pictures

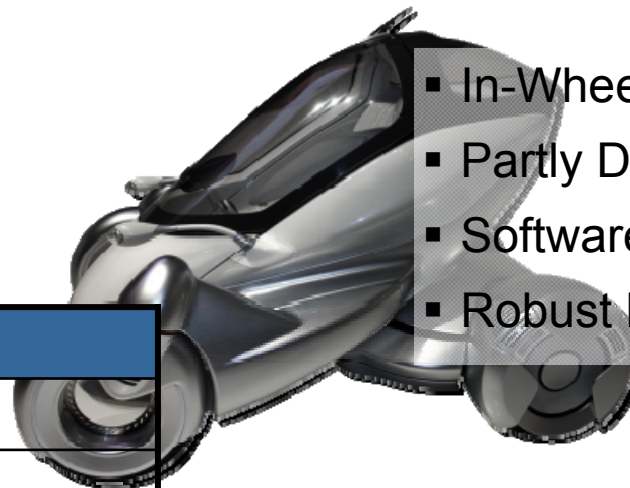
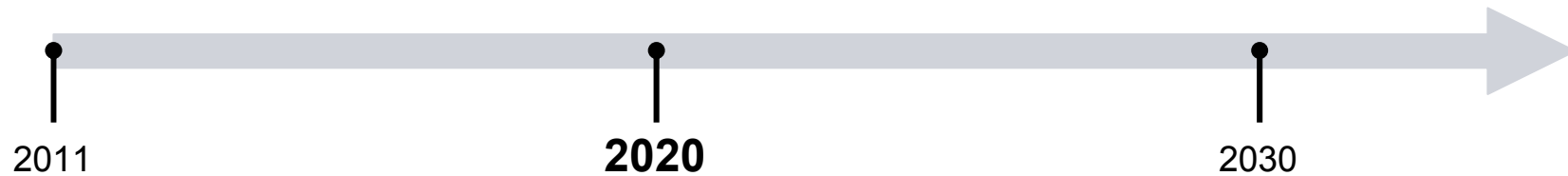


# Revolutionary steps driven by integration and new ICT system architecture



Source: "The Software Car: Information and Communication Technology as an Engine for the Electromobility of the Future", page 49

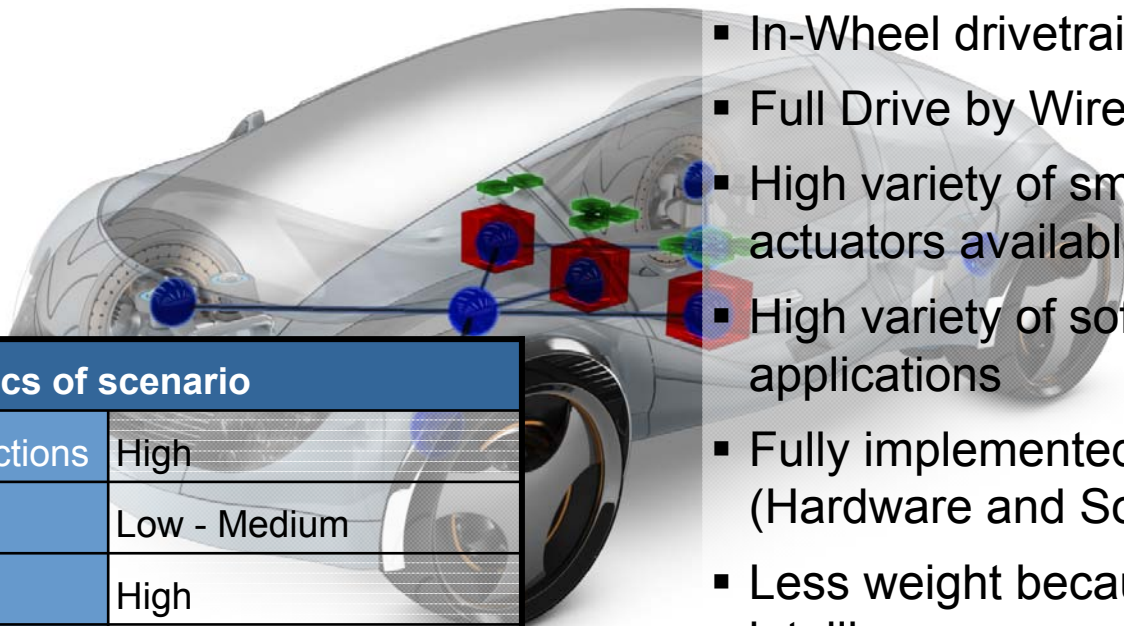
**Scenario „Low Function / Low Cost“**



- In-Wheel drivetrain
- Partly Drive by Wire
- Software partly exchangeable
- Robust but simple chassis

Characteristics of scenario	
Variety of functions	Low - Medium
Cost	Low
Extendibility	Low - Medium
Integration effort	Low
Market	Low price segment

**Scenario „High Function / Low Cost“**



- In-Wheel drivetrain
- Full Drive by Wire
- High variety of smart sensors and actuators available
- High variety of software applications
- Fully implemented plug'n play (Hardware and Software)
- Less weight because of predictive intelligence

Characteristics of scenario	
Variety of functions	High
Cost	Low - Medium
Extendibility	High
Integration effort	Low
Market	All price segments

**Conclusion of architectural goals**

