

# ELECTRIC/ELECTRONIC ARCHITECTURE AS AN ENABLER FOR CONNECTED MOBILITY AND AUTOMATED DRIVING.

TERATEC FORUM 2019.



June 2019.  
Dr. Matthias Traub



Rolls-Royce  
Motor Cars Limited



BMW GROUP – GLIMPSE INTO THE FUTURE WITH VISION VEHICLES.

THE NEXT  
100 YEARS





# ACES – A CORE ELEMENT OF BMW'S STRATEGY NUMBER ONE > NEXT.





# THE LATEST BMW 5 SERIES. COMFORT AND SAFETY AT THE HIGHEST LEVEL.



Advanced Real-time Traffic Information

Intelligent Voice Assistant

Natural Language Understanding

3D View

Wrong Way Assistant

Top View Remote

Remote Control Parking

Gesture Control

Lane Change Assistant

Distance Information

Crossroad Assist

Wi-Fi Hotspot

Crossing Traffic Warning

Lane Keeping Assistant with  
Active Side Collision Protection

Night Vision

BMW Selective Beam

Lateral Parking Aid

Active Cruise Control with Stop&Go

On Street Parking Information

Rear Collision Prevention

Steering and Lane Control Assistant  
up to 210 km/h

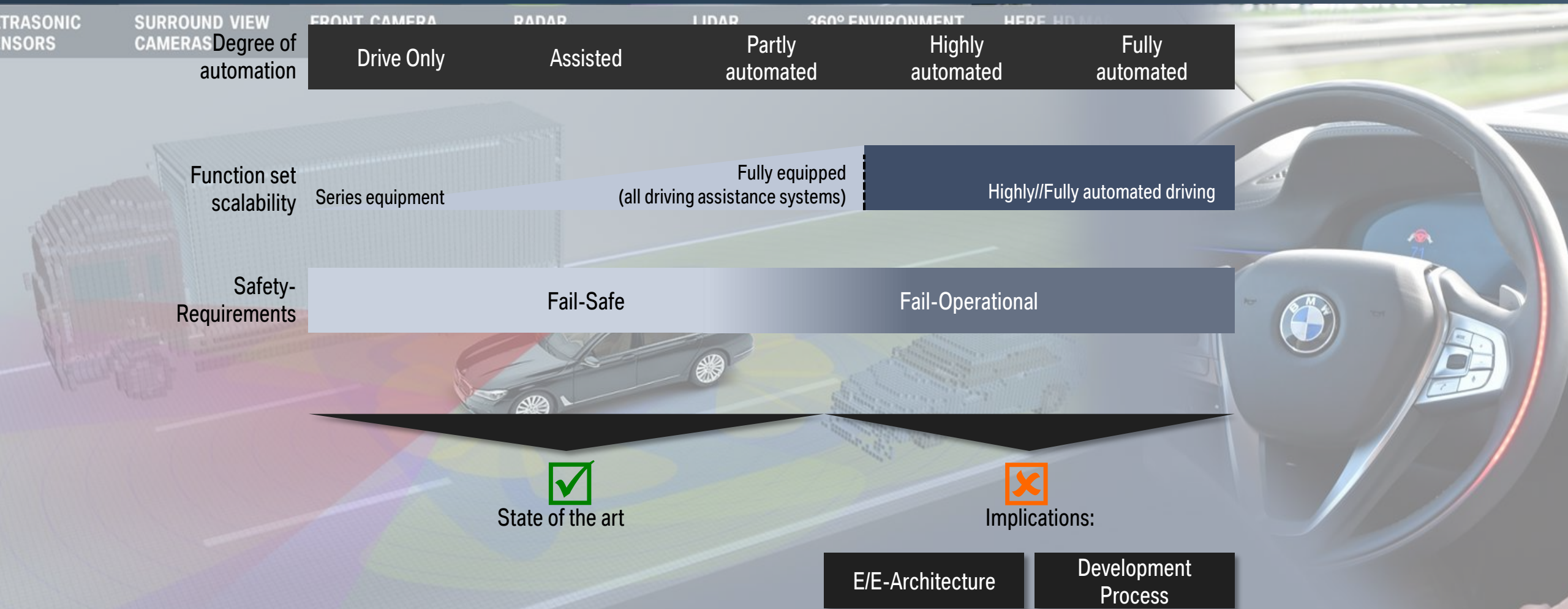
Speed Limit and No Pass Information

Lane Departure Warning





# AUTOMATED DRIVING GENERATES NEW CHALLENGES FOR THE E/E-ARCHITECTURE AND THE DEVELOPMENT PROCESS.



# THE FUTURE E/E ARCHITECTURE INCLUDING ITS DEVELOPMENT PROCESS REQUIRES SUSTAINABLE CHANGES.

Picture: Castle Neuschwanstein



Picture: BMW plant Leipzig



- Technical changes: Using more and more IT standards and establishing a homogenous system structure.
- Collaboration: Systemic thinking without borders using agile working methods.



# THE NEXT GENERATION AND VISION OF THE E/E ARCHITECTURE ARE ALIGNED OVER THE MAIN OBJECTIVES.

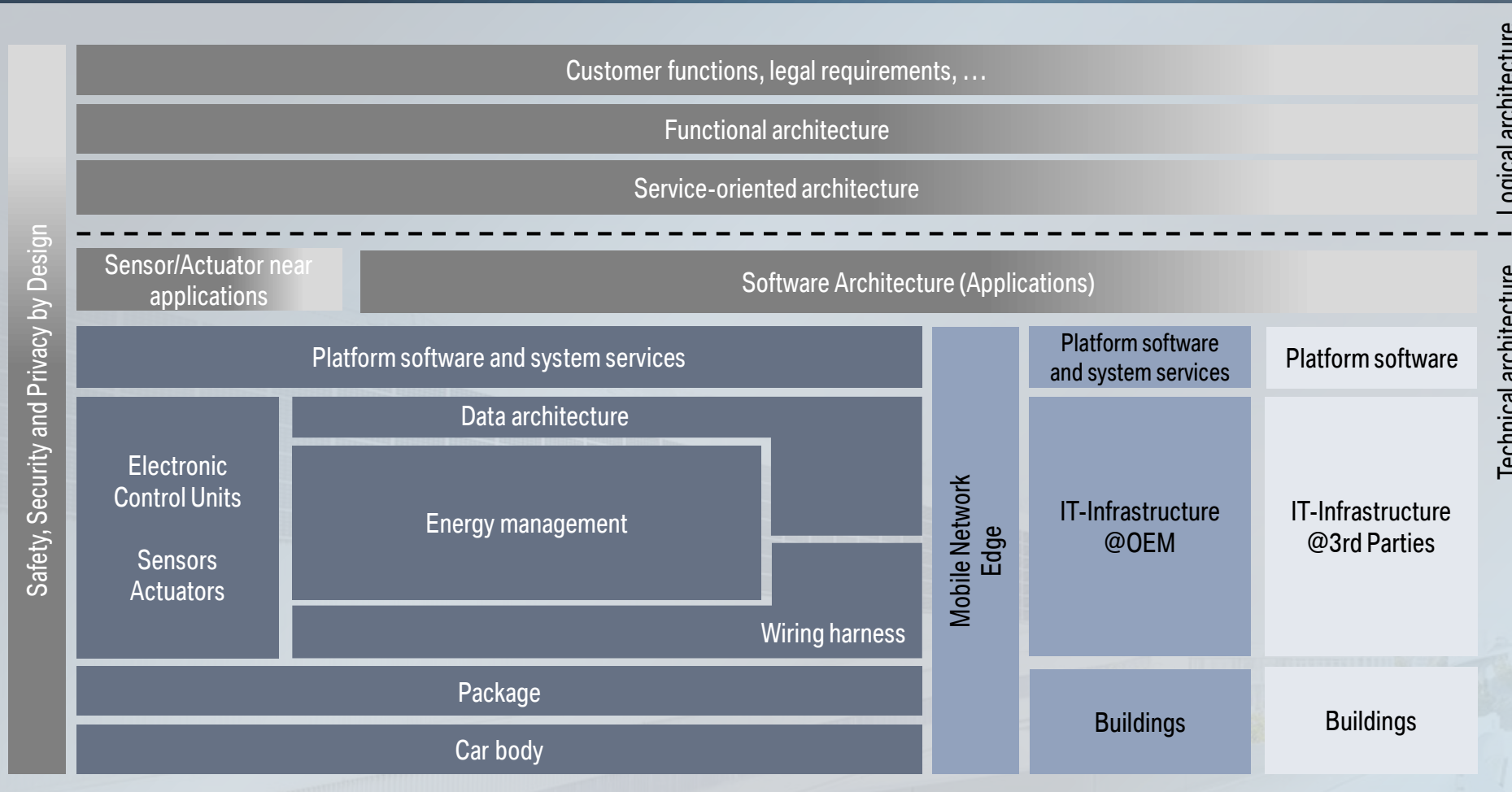
## Main objectives.



## The e/e architecture strategy – Three step approach.

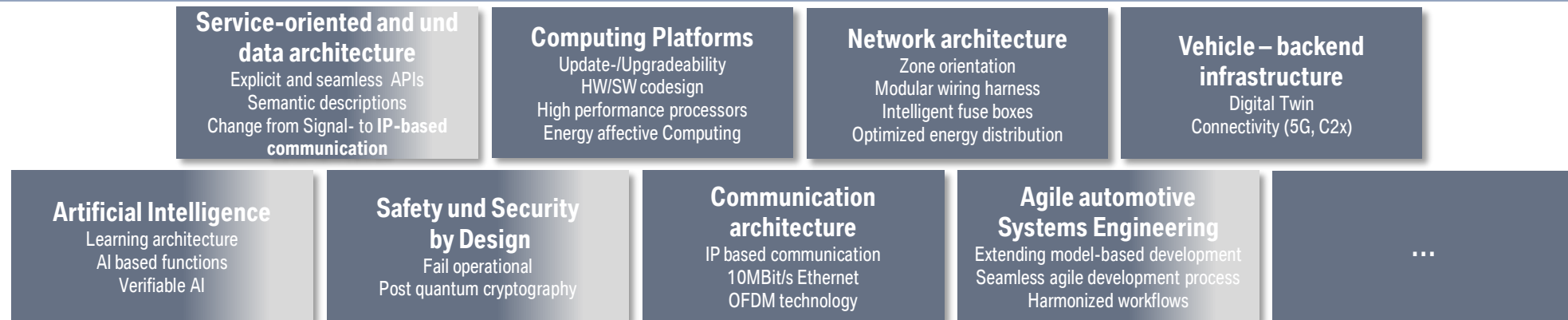
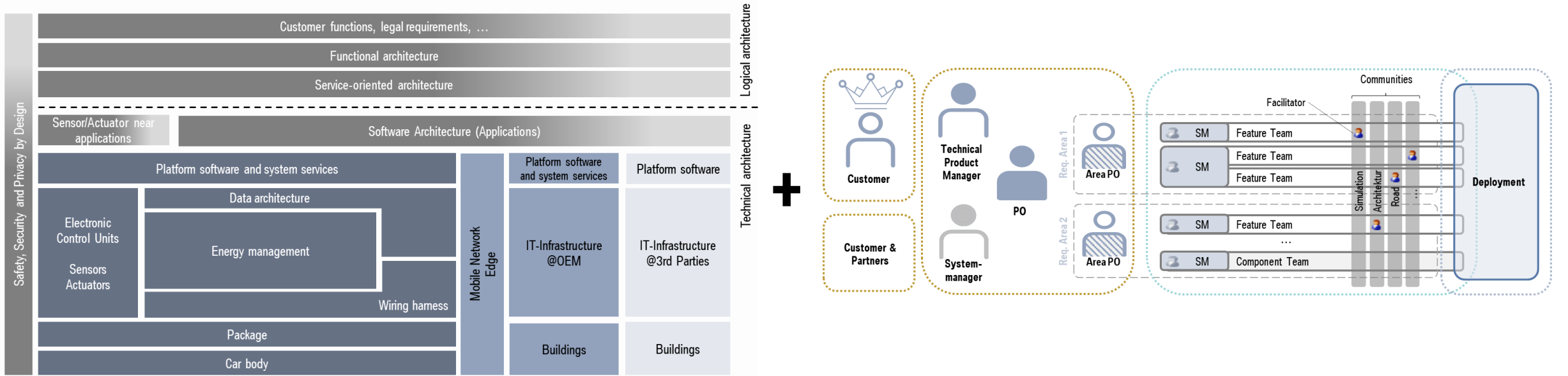
- ❶ The corporate strategy, legal requirements and game changers are important inputs for the e/e architecture vision.
- ❷ Starting point is set by lessons learned based on the actual e/e architecture
- ❸ The step size for the next generation of e/e architecture has been decided by the actual generation and the future vision.

# DERIVATION OF NECESSARY BUILDING BLOCKS FOR A SUSTAINABLE DIGITAL AUTOMOTIVE INFRASTRUCTURE.

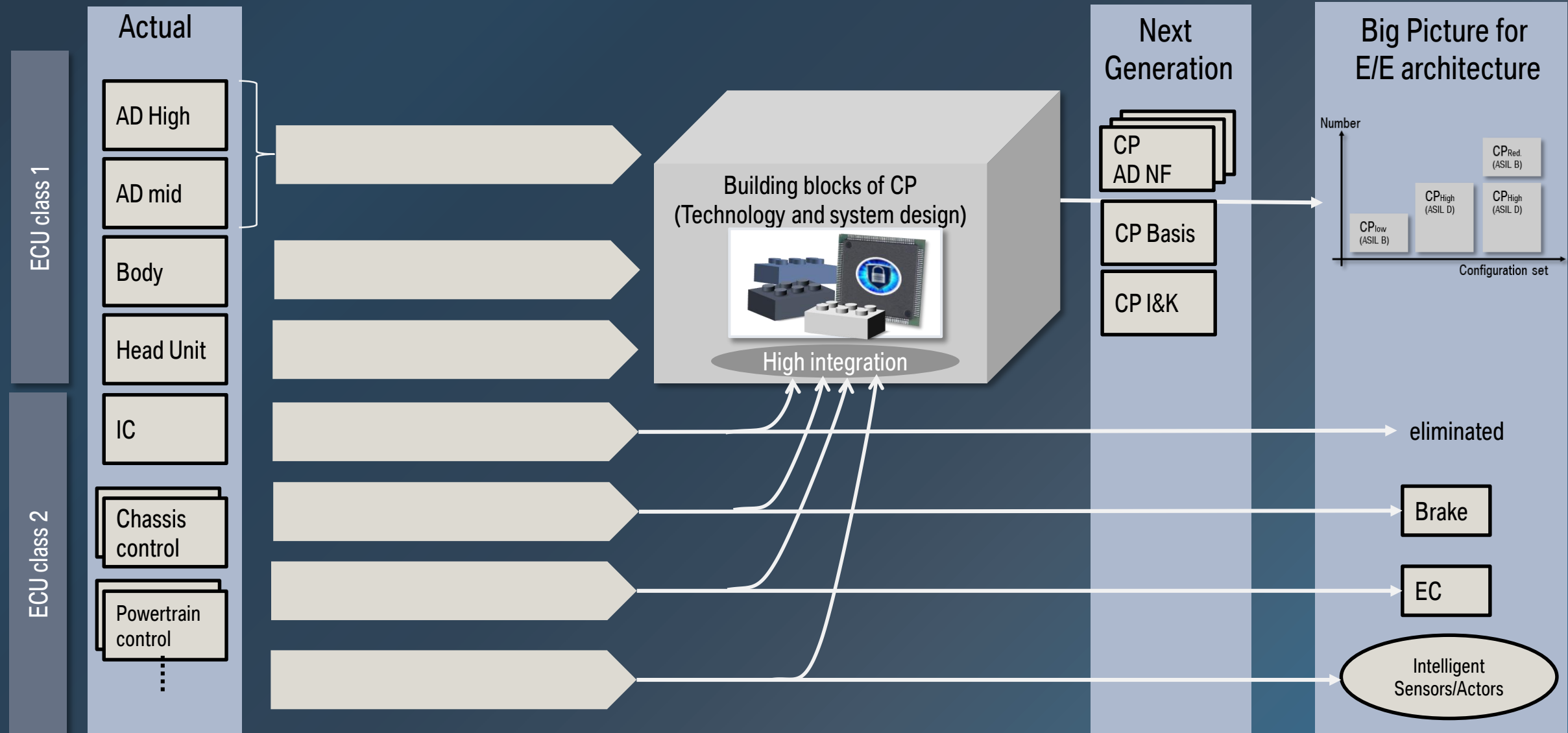




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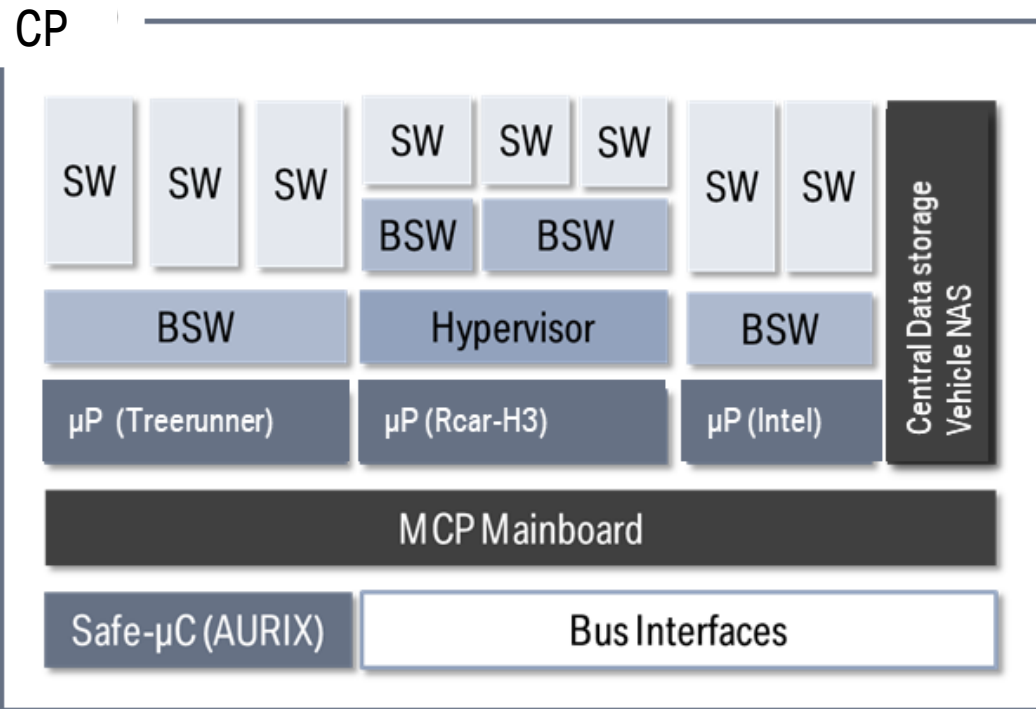
# VISION: THE COMPUTING PLATFORM (CP) CREATES SYNERGIES AND OFFERS THE POSSIBILITY FOR A HOMOGENOUS SYSTEM STRUCTURE.





# REALIZING SUCH A COMPUTING PLATFORM (CP) THE TECHNICAL DESIGN AND THE DEVELOPMENT PROCESS HAS TO BE ENABLED.

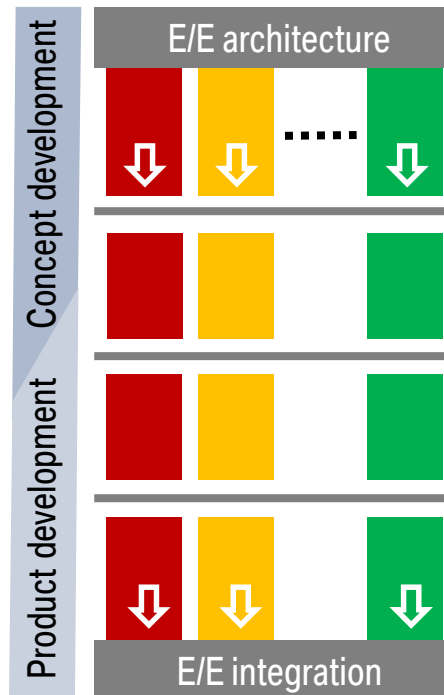
## Technical Design.



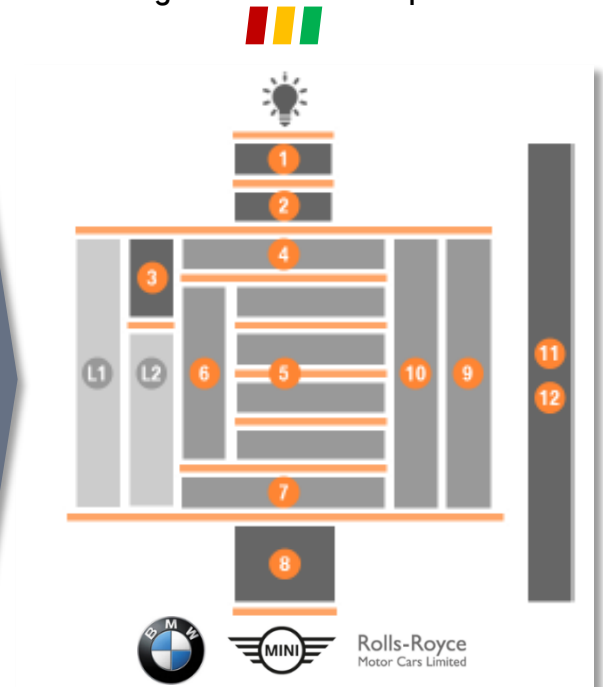
SW: Software  
HPC: High-Performance  
BSW: Basis Software  
µC: Microcontroller  
µP: Microprocessor

## Agile automotive Systems and Software Engineering (aaSE).

### Individual e/e development

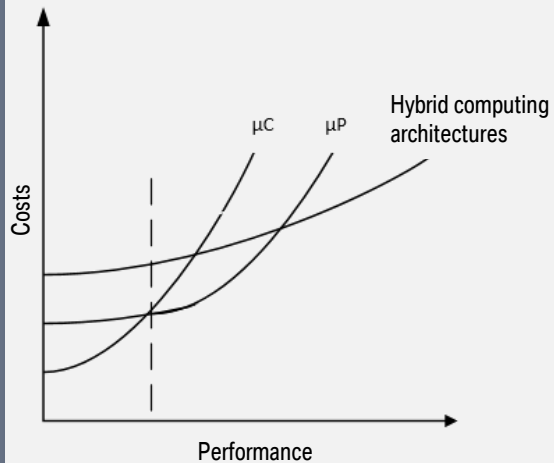


### Homogenous e/e development



# NEW WAYS FOR DERIVING THE NEXT GENERATION OF HIGH-PERFORMANCE PROCESSORS FOR AUTOMOTIVE APPLICATIONS ARE NECESSARY.

## Technology comparison

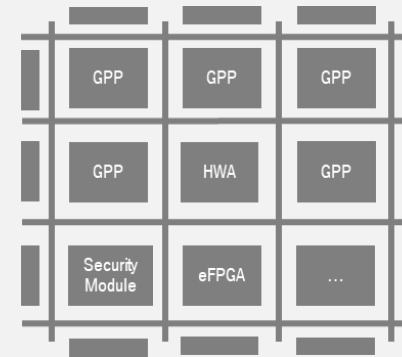


- For basic functions (e.g. brake and engine control) automotive microcontrollers (μCs) are ideal.
- A direct usage of microprocessors (μPs) of the CE-world is not constructive.
- New approaches in the form of hybrid computing architectures are necessary.

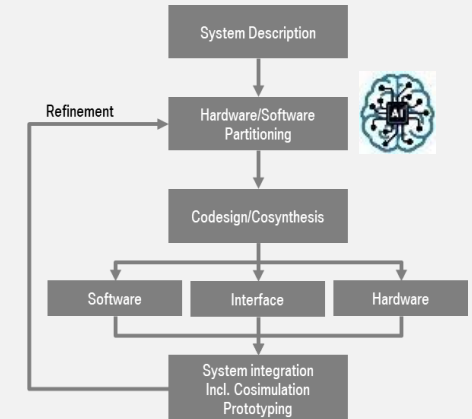
## Energy = Range



## Energy-efficient hybrid computing architectures



## Hardware/Software Codesign



- Hybrid computing architectures enable a energy-efficient allocation of the necessary performances by a optimal interaction of general purpose processors (GPP), dedicated hardware accelerators (HWA) and embedded field programmable gate arrays (eFPGA).
- A optimal composition on system level could be derived by using hardware/software codesign.

- Over the European Processor Initiative (EPI) the first steps on the way are started. For a sustainable ability there are further actions necessary.
- Enabling the automotive industry using hardware/software codesign is one of the main goals.



# EUROPEAN PROCESSOR INITIATIVE (EPI) SUPPORTS THE FURTHER ROLLOUT OF HIGH-PERFORMANCE COMPUTING (HPC) IN AUTOMOTIVE E/E SYSTEMS.

EC Horizon2020



European 10 years research program

EU FPA call (ICT-42)

## EPI European Processor Initiative



- European approach for HPC technology for exascale super computer including a scalable HPC General Purpose Processor (GPP) with special security and reconfiguration options and dedicated hardware acceleration.
- Project budget: 120 M€, 4 years, start: 12/18

Automotive stream in EPI

### A dedicated work package for automotive:

- eHPC: MCU and GPP and Accelerators for automotive
- Total budget: 20M€

eHPC: Embedded High Performance Computing  
MCU: Micro Controller Unit



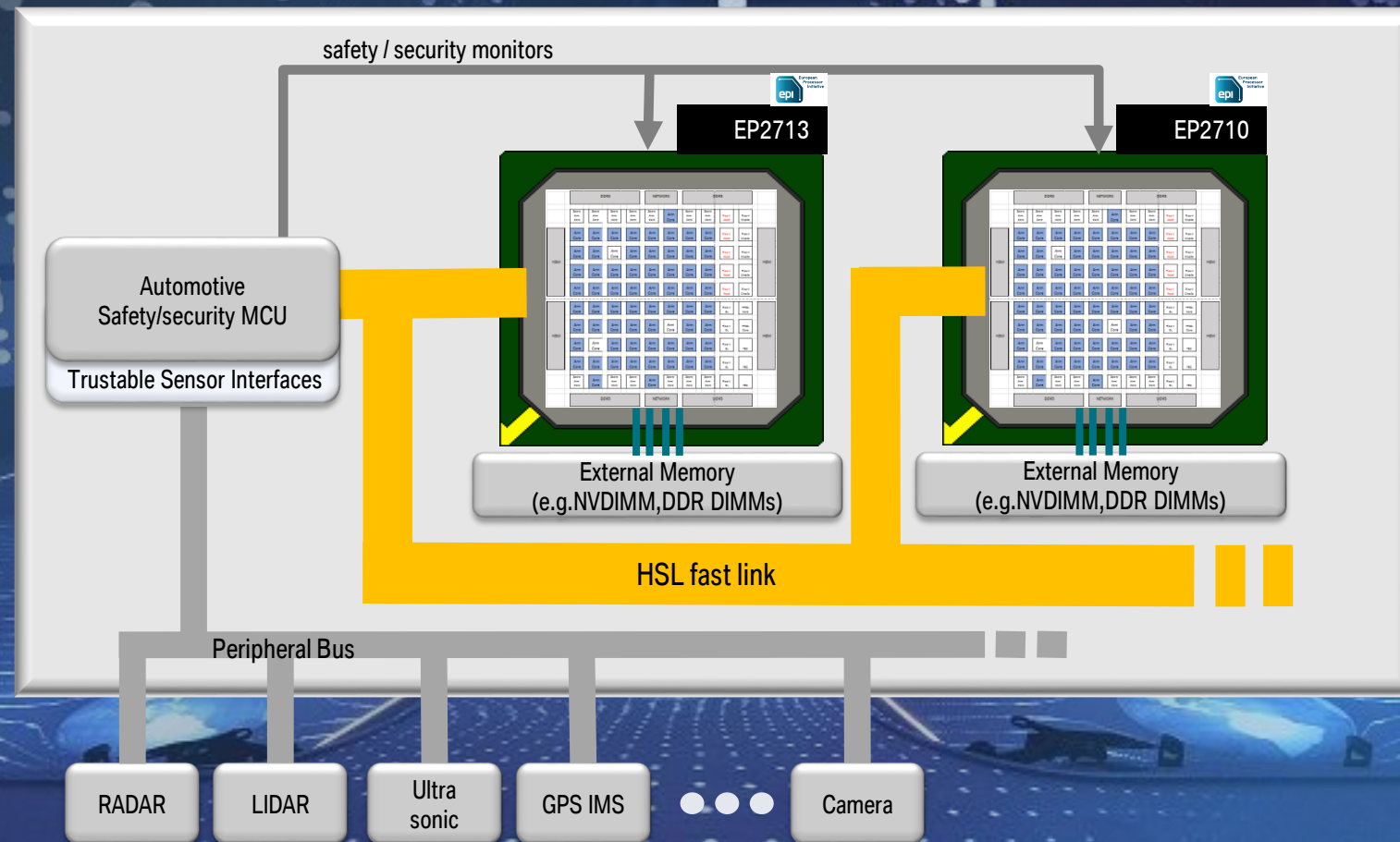
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KALRAY



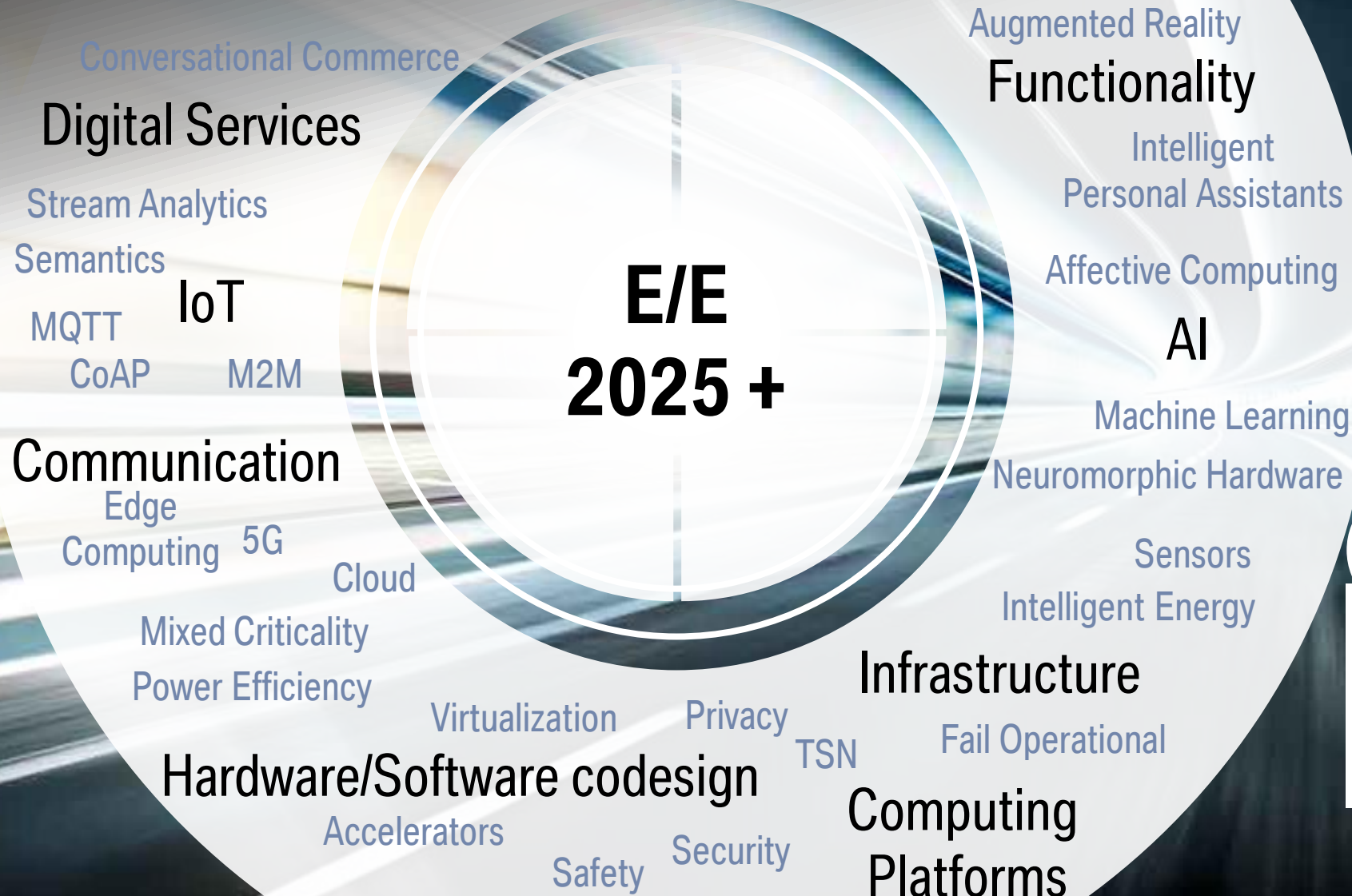
# A FIRST REFERENCE IMPLEMENTATION OF AUTOMOTIVE eHPC WILL BE REALIZED OVER THE EPI PROJECT IN 2021.





**WE HAVE TO HANDLE A LOT OF NEW TOPICS BUT TWO OF THEM ARE ESSENTIALLY.**

**E/E  
2025 +**



**1**

**Technical view:**  
Using more and more IT standards and establishing a homogenous and energy-efficient system structure.

**2**

**Methodical view:**  
Systemic thinking without borders, a trustful collaboration and agile working methods.

# THANK YOU FOR YOUR ATTENTION.

## THE NEXT 100 YEARS



„TO SEE THINGS  
IN THE SEED,  
THAT IS GENIUS.“

LAO-TSE

„WHAT IS NOW  
PROVED  
WAS ONCE ONLY  
IMAGINED.“

WILLIAM BLAKE

„THE FUTURE  
BELONGS TO  
THOSE  
BOLD ENOUGH  
TO SHAPE IT.“

BMW GROUP

„TO ACCOMPLISH  
GREAT THINGS  
WE MUST  
NOT ONLY ACT,  
BUT ALSO DREAM.“

ANATOLE FRANCE

„ALL TRUTHS ARE  
EASY TO  
UNDERSTAND  
ONCE THEY ARE  
DISCOVERED, THE  
POINT IS TO  
DISCOVER THEM.“

GALILEO GALILEI

„KNOWING IS  
NOT ENOUGH;  
WE MUST  
APPLY.  
WILLING IS  
NOT ENOUGH,  
WE MUST DO.“

JOHANN  
WOLFGANG  
VON GOETHE