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

TERATEC FORUM 2019.

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BMW GROUP – GLIMPSE INTO THE FUTURE WITH VISION VEHICLES.
ACES – A CORE ELEMENT OF BMW’S STRATEGY NUMBER ONE > NEXT.
THE LATEST BMW 5 SERIES.
COMFORT AND SAFETY AT THE HIGHEST LEVEL.

- Lane Departure Warning
- Active Cruise Control with Stop&Go up to 210 km/h
- Rear Collision Prevention
- Lane Departure Warning
- Lateral Parking Aid
- Night Vision
- BMW Selective Beam
- Intelligent Voice Assistant
- Natural Language Understanding
- Gesture Control
- Lane Keeping Assistant with Active Side Collision Protection
- On Street Parking Information
- Speed Limit and No Pass Information
- Crossroad Assist
- Wrong Way Assistant
- Remote Control Parking
- Wi-Fi Hotspot
- Distance Information
- 3D View
- Top View Remote
- Steering and Lane Control Assistant
- Advanced Real-time Traffic Information
- Intelligent Voice Assistant
- Natural Language Understanding
- Gesture Control
- Lane Change Assistant
- Lane Departure Warning
- Remote Control Parking
- Lane Keeping Assistant with Active Side Collision Protection
- Lane Change Assistant
- Steering and Lane Control Assistant
AUTOMATED DRIVING GENERATES NEW CHALLENGES FOR THE E/E-ARCHITECTURE AND THE DEVELOPMENT PROCESS.

Function set scalability
- Fail-Safe
- Fail-Operational

Safety-Requirements
- Fail-Safe
- Fail-Operational

Degree of automation
- Drive Only
- Assisted
- Partly automated
- Highly automated
- Fully automated

State of the art
- Fully equipped (all driving assistance systems)

Implications:
- E/E-Architecture
- Development Process
THE FUTURE E/E ARCHITECTURE INCLUDING ITS DEVELOPMENT PROCESS REQUIRES SUSTAINABLE CHANGES.

- 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.

- Dependability and Security
- Testability
- Energy-Efficient
- Common building block and Standardization
- Scalability
- Risks, change, compatibility
- Customer value
- Cost optimum
- Update- and upgradeability

The e/E architecture strategy – Three step approach.

1. The corporate strategy, legal requirements and game changers are important inputs for the e/E architecture vision.
2. Starting point is set by lessons learned based on the actual e/E architecture.
3. 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.
DERIVATION OF NECESSARY BUILDING BLOCKS FOR A SUSTAINABLE DIGITAL AUTOMOTIVE INFRASTRUCTURE.

Service-oriented and und data architecture
- Explicit and seamless APIs
- Semantic descriptions
- Change from Signal- to IP-based communication

Computing Platforms
- Update-/Upgradeability
- HW/SW codesign
- High performance processors
- Energy affective Computing

Network architecture
- Zone orientation
- Modular wiring harness
- Intelligent fuse boxes
- Optimized energy distribution

Vehicle – backend infrastructure
- Digital Twin Connectivity (5G, C2x)

Artificial Intelligence
- Learning architecture
- AI based functions
- Verifiable AI

Safety und Security by Design
- Fail operational
- Post quantum cryptography

Communication architecture
- IP based communication
- 10MBit/s Ethernet
- OFDM technology

Agile automotive Systems Engineering
- Extending model-based development
- Seamless agile development process
- Harmonized workflows

Customer functions, legal requirements, …
- Functional architecture
- Service-oriented architecture

Sensor/Actuator
- Software Architecture (Applications)

Platform software and system services
- Data architecture
- Energy management
- Wiring harness

Package
- Car body

Mobile Network Edge
- IT-Infrastructures @OEM
- IT-Infrastructures @3rd Parties

Buildings
- Buildings

Facilitator
- Communities

Deployment

Customer

Technical Product Manager

PD

Customer & Partners

System manager

Area PO

Area PO

SM

Feature Team

SM

Feature Team

SM

Feature Team

SM

Component Team

…

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

Building blocks of CP (Technology and system design)

High integration

Actual
- AD High
- AD mid
- Body
- Head Unit
- IC

Next Generation
- CP AD NF
- CP Basis
- CP I&K

Big Picture for E/E architecture
- Brake
- EC
- Intelligent Sensors/Actors

Configuration set
- CP
- ECU class
- ECU class
- Chassis control
- Powertrain control
- Number
REALIZING SUCH A COMPUTING PLATFORM (CP) THE TECHNICAL DESIGN AND THE DEVELOPMENT PROCESS HAS TO BE ENABLED.

Technical Design.

- **CP**
  - SW: Software
  - BSW: Basis Software
  - µP: Microcontroller
  - µP (Rcar-H3)
  - Hypervisor
  - MCP Mainboard
  - Safe-µC (AURIX)
  - Bus Interfaces

Agile automotive Systems and Software Engineering (aaSE).

- **Individual e/e development**
  - E/E architecture
  - Concept development
  - Product development
  - E/E integration

- **Homogenous e/e development**

**Abbreviations**:
- SW: Software
- HPC: High-Performance
- BSW: Basis Software
- µC: Microcontroller
- µP: Microprocessor
NEW WAYS FOR DERIVING THE NEXT GENERATION OF HIGH-PERFORMANCE PROCESSORS FOR AUTOMOTIVE APPLICATIONS ARE NECESSARY.

- 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.

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€

*European Processor Initiative*
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.

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

Methodical view: Systemic thinking without borders, a trustful collaboration and agile working methods.
THANK YOU FOR YOUR ATTENTION.

"WHAT IS NOW PROVED WAS ONCE ONLY IMAGINED."
LAO-TSE

"TO SEE THINGS IN THE SEED, THAT IS GENIUS."
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