Middleware is Lubricant and Glue of SDV E/E Architecture

AutoSAR is Cornerstone of Automotive Middleware

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China Software and System Development Center (CSSDC)
Moving Toward Excellence in System & Software Engineering
Middleware Transforming E/E A System Engineering
Middleware is from Thin to Thick and will be partial E/E A in the future.

E/E A System Design Top-Down

- User Cases (fixed)
- Vehicle Functions (fixed)
- E/E Architecture (fixed)
- ECU & Component (fixed)

Before

E/E A System Design Bottom-Up

- User Cases (Updatable)
- Vehicle Features (Configurable)
- Middleware
- E/E A (Flexible)
- ECU & Component (Changeable)

Today
Middleware on Ethernet In-Vehicle Enabling SOA
Ethernet is Dominating Communication in Vehicle
AutoSAR is Becoming the Foundation of Automotive Middleware

Automotive is Widely Recognized and Used by COEM and Suppliers
Control-by-Wire is Control-by-Middleware

Control-by-Wire System leads to decoupling Vehicle Body and Chassis

Skateboard Chassis

Software & Service Driven

Cockpit HPC

Hardware & Product Driven

Cockpit HPC

VIU

Vehicle HPC

PCU

ESC

VIU

ESC

Vehicle HPC

VIU

Vehicle HPC

VIU

Vehicle HPC

VIU

ADAS/AD HPC

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Performance & Computation Functions

A-Core (Performance)

R-Core (Safety & Realtime)

Real-Time & Safety Functions

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Picture Link: https://www.bmw.co.uk/content/dam/bmw/marketGB/bmw_co_uk/bmw-cars/bmw-i8-coupe/2019/i8-coupe-li-ion-drive-890x501.jpg/jcr:content/renditions/cq5dam.resized.img.585.low.time1560935953768.jpg
Middleware Standardizing Data Sharing between Vehicle and Road
Smart Infrastructure Extending SDV User Cases
Performance ECU (HPC) SW Architecture Overview

1. Real-Time & Safety Domain Functions (ADAS, Brake, Chassis, VCU, Body, BMS, Suspension)
2. Linux/QNX
3. AutoSAR CP/RTOS
4. Complex Driver & IPC
5. Middleware Scope
6. System Engineering (Solution)

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Customer & 3rd Party SW Dev. & Integration (Service)

HPC Host SW Integration (Service)

Total System Integration (Service)

Common Functions (OTA, Cybersecurity, Datalog, Customer App)

Firmware + Basic SW

Middleware

SOA Middleware

Real-Time & Safety Domain Functions (ADAS, Brake, Chassis, VCU, Body, BMS, Suspension)

Real-Time Core

Performance Core

Hardware (HPC)

Integrated Middleware

Business SW (Components)

Customer & 3rd Party SW Dev. & Integration (Service)
Middleware Enhancing SWC Reusability and Portability

Body HPC Case Overview

Body HPC(Example)

Middleware

Safety Partition
- Body & GW (Conti)
- VCU & Body $ Thermal (OEM)
- Common Services

Performance Partition
- Connectivity (OEM)
- SOA App (OEM)
- Common Services

• With Anchored Middleware
  ✓ SWCs could be reusable among different vehicle lines or models by SW adaption work
  ✓ New SWCs could be add-on easily under middleware framework
  ✓ New SWCs doesn’t need to change E/EA due to SWC decoupling from actual HW via middleware
  ✓ SoC could be further updated with better performance by middleware SW adaption
  ✓ Bring flexibility and extensibility to E/E A during car-line lifetime
Middleware Enhancing SWC Reusability and Portability

ADAS HPC Overview

With Anchored Middleware
- OEM ADAS functions is easily deployed on AD HPC
- OEM functions could be isolated from Supplier Driving Functions
- Safety Driving Functions (like AEB) portability is highly enhanced
- OEM Driving Functions could be activated or updated when vehicle is sold to final user
- Best balance between Driving Functions reusability and standardization cross project and even HW
- Time reduction of HPC application project variant by variant once middleware is anchored in pilot project
- High SW Synergy between different SoC

Safety Partition
- Safety Functions SWC
  - IPC
  - Common Services
  - AutoSAR CP
  - BL
  - MCAL
  - CDD

Performance Partition
- Performance Functions SWC
  - Common Services
  - AutoSAR AP
  - Performance OS
  - U-Boot
  - BSP

Vision Partition
- SWC
  - Common Services
  - AutoSAR AP
  - Performance OS
  - BSP

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What Makes Middleware Excellent
Middleware is NOT Only Software Development

Advanced & System Engineering
- Project Management
- Requirement Engineering
- SW Architect Engineering
- Safety & Security Engineering
- Supplier/Partner Management
- CI/CT Solution
- SW System Testing Solution
- System Integration Solution
- Software Maintenance Solution
- SAFe Team and Process Excellence
- Customer Engineering Solution

Software Engineering
- SW Requirements
- SW High-level Design
- SW Low-level design and Coding
- SW Module Test
- SW Integration Test
- SW Validation Test
- SW Release Process

System Integration Engineering
- System Integration
- System Integration Test
- Vehicle Test
- Test Data Analysis
- Test Software Development

Customer Engineering

Middleware Design

Middleware Development

Middleware Deployment

Excellence Middleware Release
What Makes Middleware Success
Middleware is Lubricant and Glue of SDV E/E Architecture

**Engineering Excellence**

**Lubricant**
- Hardware Independent
- Flexible
- Scalable
- Compatible
- Upgradable

**Glue**
- High Performance
- Safety
- Security
- Compliance
- Robustness
Takeaways

1. Unified Middleware deployed on HPC and ECU is highly increasing **portability** and **reusability** of application software module.

2. Middleware is far beyond SW module with a single solution. More importantly, middleware is an elegant engineering process of **complex software system development, integration and delivery**.

3. **Engineering Excellence** is magic code leading middleware to success.

4. **AutoSAR** framework, both CP and AP, is cornerstone of **Automotive Middleware** which is key enabler of Software Defined Vehicle.